Fourth

Fire Behavior and Fuels CONFERENCE

AT THE CROSSROADS:
Looking Toward the Future in a Changing Environment

Raleigh, North Carolina, USA
February 18 -22, 2013

Fourth Fire Behavior and Fuels CONFERENCE

Presented by:

International Association of WILDLAND FIRE

IAFSS – Fire Safety Science

In conjunction with:

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Fourth Fire Behavior and Fuels Conference

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About *the* IAWF

International Association of Wildland Fire
1418 Washburn • Missoula, Montana, USA • (01) (406) 531-8264
Toll Free from US & Canada: (888) 440-IAWF (4293)

The International Association of Wildland Fire (IAWF) is a non-profit, professional association representing members of the global wildland fire community. The purpose of the association is to facilitate communication and provide leadership for the wildland fire community.

IAWF Mission Statement

The International Association of Wildland Fire's (IAWF) mission is to foster leadership and communication for the wildland fire community.

The IAWF is uniquely positioned as an independent organization whose membership includes experts in all aspects of wildland fire management. IAWF's independence and breadth of global membership expertise allows it to offer a neutral forum for the consideration of important and at times controversial, wildland fire issues. Our unique membership base and organizational structure allow the IAWF to creatively apply a full range of wildland fire knowledge to accomplishing its stated mission.

Vision Statement

To be an acknowledged resource, from the local to global scale, of scientific and technical knowledge, education, networking and professional development that is depended on by members and partners in the international wildland fire community.

If you were not an IAWF member you will be receiving a one-year membership with the *International Association of Wildland Fire* by having registered for this conference.

WILDFIRE Magazine –

All members receive WILDFIRE magazine, official publication of the IAWF, published bi-monthly by Penton Media. Our authors submit fire articles from all corners of the world and our topical editors cover a broad array of important issues in wildland fire. We encourage you to submit articles and photographs for inclusion in the magazine. Visit our magazines' Editorial Advisory Board page on our website for more information such as Writer's Guidelines.

International Journal of Wildland Fire –

Our official fire science journal, published on our behalf by CSIRO, is dedicated to the advancement of basic and applied research covering wildland fire. IAWF members receive free online access to the eight issues of this leading scientific journal online, as a members benefit. For those members who want to receive the hard copy version of the journal, they may receive it at the IAWF discounted rate of US $220, which includes your IAWF membership and a 1-year subscription to WILDFIRE.

Checkout www.iawfonline.org or www.wildfireworld.org – your websites with all the information you need. One of the most visited pages on our website is the Wildland Fire Events Calendar – please pass along event information so it can be posted. You can participate in polls, update your address information, check your membership status and renew your membership all-online. Visit the site and join FireNet, our e-mail ListServ keeping you informed of what is happening with wildland fire around the world. It is also your place to ask and find answers to your questions!

About *the* IAFSS

International Association for Fire Safety Science
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IAFSS was founded with the primary objective of encouraging research into the science of preventing and mitigating the adverse effects of fires and of providing a forum for presenting the results of such research. The International Association for Fire Safety Science perceives its role to lie in the scientific bases for achieving progress in unsolved fire problems. It will seek cooperation with other organizations, be they concerned with application or with the sciences that are fundamental to our interests in fire. It will seek to promote high standards, to encourage and stimulate scientists to address fire problems, to provide the necessary scientific foundations and means to facilitate applications aimed at reducing life and property loss. Since its inaugural meeting, the IAFSS has grown to more than four hundred members.

Current members come from Australia, Austria, Belgium, Brazil, Canada, China, Denmark, Germany, Finland, France, Holland, Hong Kong, India, Ireland, Italy, Japan, Korea, Luxembourg, Netherlands, New Zealand, Norway, Russia, Spain, Sweden, Switzerland, Taiwan, United Kingdom and United States of America. The Association is legally established as a charitable organization in England and Wales

If you were not an IAFSS member you will be receiving a one-year membership with the International Association for Fire Safety Science by having registered for this conference, a $40 value.

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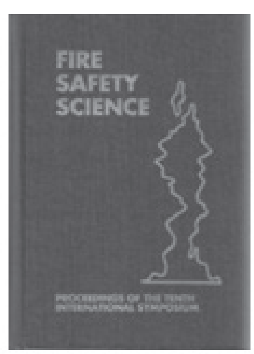

Welcome Letter *from* *the* IAWF President

Dear Participants,

Today's world is complicated. Issues, problems, crises and events from all over the globe swirl around us in a constant stream, whether in the media, on our computers, or via our smartphones. Magnitudes of information are constantly at our fingertips and in every venue of our lives. In the midst of all of this, our global problem with wildfire continues to escalate.

As members of the wildland fire community, we must be vigilant and not let this issue slip into the world's background chatter. The wildfire problem is not retreating. We must make every effort to strive for balance in today's complex world by continuing our tradition of providing extraordinary training opportunities.

Our 4th Fire Behavior and Fuels Conference maintains this unique tradition. Over the next five days, you can expect to expand unique collaborative connections and gain unlimited insights for developing and testing new knowledge. This year's theme, *At the Crossroads: Looking Toward the Future in a Changing Environment,* continues to build on our three prior conferences by highlighting knowledge gaps as well as opportunities for innovation and development.

Some of the highlights of this year's conference include: A Fire Science Quiz Bowl on Monday evening. The goal is to provide a spirited competition between students from different schools and allow both the participants and the audience to gain a better knowledge of wildland fire science's finer points. On Wednesday evening, the banquet will take place with a multi-course dinner and lively entertainment. Additionally, we have extended an open invitation to artists to display their works throughout the week, in the Fire Art Exhibit and Competition—which will celebrate a variety of mediums including textile, painting, wearable, photography, ceramics, collage, poetry, sculpture and carving. To finish out the week, we've arranged an 18 Hole Golf Scramble on Friday.

So enjoy a great learning experience, and a bit of fun in North Carolina's capital, Raleigh, where the excitement of a big city blends with the hospitality and charm of a small Southern town. With a vibrant social, sports, cultural and arts scene, multinational business and diverse recreational opportunities, Raleigh is a city of contrasts—where industry, research and wild landscapes converge. Please take the opportunity to explore this unique place.

Welcome to one of the most renowned and enlightening global conferences, powered by the International Association of Wildland Fire® (IAWF). On behalf of the Board of Directors of the IAWF, thank you for your support and we hope you'll take full advantage of the opportunity to interact with fellow participants. Have a great conference.

Dan W. Bailey

Dan W. Bailey

President and Chairman of the Board of Directors
president@iawfonline.org

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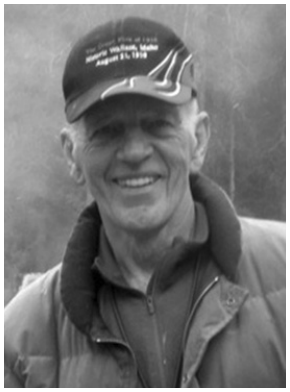


OPENING CONFERENCE KEYNOTE ADDRESS

Fire Behavior Science and Experience: Framing Successful Megafire Solutions for Policy Makers, Politicians, and the Public

Robert W. Mutch, Fire Management Applications, Darby, MT, USA

2013 marks the 25th Anniversary of the Yellowstone fires, where multiple convection columns on a daily basis motivated fire researcher Dick Rothermel to produce crown fire nomograms that were taught to a national class three years later. His crown fire work helped to fulfill the post-Yellowstone recommendation for fire research to improve fire behavior prediction systems. We have achieved remarkable progress in fire behavior prediction during the intervening years, allowing us to game different fire management alternatives.

Also, the Fourth Fire Behavior and Fuels Conference appropriately is meeting in the southeast where prescribed burning is practically a cultural requisite for sustainable resource management. Not far from here, on the Francis Marion National Forest, Dave Devet and others developed the DESCON plan to use "benign" wildfires in the 1970's to achieve resource management objectives. DESCON stood for Designated Controlled Burning and any fire starting that met prescriptive conditions was allowed to burn.

The year 2012 marked another anniversary: the 40th Anniversary of allowing free-burning fires to burn in the Selway-Bitterroot Wilderness. Perhaps this program is a DESCON West, producing large numbers of free-burning fires, prescribed natural fires, over the years. A celebratory overflight on July 2, 2012, to view four decades of complex fire perimeter patterns on the landscape, caused Steve Pyne to opine in a later essay that "if Americans had a National Register of Historic Places for fire, the Selway-Bitterroot region would rank among the early entries." Experience over decades taught that new fires were being regulated in size and intensity by earlier fires, to the extent that risk to firefighters and suppression costs were greatly reduced. Results from a University of Montana study lend numerical credence to these observations.

The IAWF's President's Desk last fall carried the headline that "It's Time to Make Wildland Fire Policies Work", or see the status quo "continue to result in larger, more deadly, and more costly wildfires. In that same 2012 issue of Wildfire an article made the case to "frame" our fire story in a way that improves public understanding of the issues; and offered examples on how to do that. The case will be made that two other audiences need to be on the receiving end of enlightened understanding of fire behavior imperatives: policy makers and politicians. They need to understand the compelling evidence that more of the same old policies will not suffice in de-fusing the Megafire holocaust. Regressing back to a 10 a.m. fire exclusion policy, as the Forest Service essentially did in a May 25, 2012, letter to all Regions, is not sustainable in fire dependent ecosystems. Among the talking points accompanying the Fire Ban was one that admitted this emergency approach will produce catastrophic fire for communities in the long run.

The irony of the Fire Ban is that it increased firefighter risk and increased suppression costs in those wildernesses where fires are self-regulating. A case in point: the 2500 acre Chrandal Fire on the Bitterroot National Forest in 2012 cost $8.2 million to suppress in a remote, steep, beetle-killed forest while the 2500 acre Salamander Fire in the Selway-Bitterroot Wilderness cost $1000 to monitor under its "point protection" strategy.

Suggestions will be offered on ways to motivate policy makers, politicians, and the public to propose and fund sustainable fire policies and practices in the future; solutions that are in sync with fire-adapted ecosystems. Fire managers and researchers must play key roles in framing the motivational story.

Bio: Bob is retired from a 38-year career in forest fire research and fire management with the U.S. Forest Service in 1994. His areas of special interest include forest fuel management, fire ecology, fire behavior prediction, wildland fire training, public and firefighter safety, wildland fire suppression, prescribed fire in wilderness management, fire safe strategies for the interface, and international assistance. He was the co-leader of a Forest Service pilot project in the 1970's that developed procedures and approval for allowing lightning fires to burn to sustain fire-adapted natural ecosystems in Wilderness.

Since 1994 he has served as a fire management consultant with assignments in Brazil, Bulgaria, Ethiopia, India, Italy, and Mongolia for the United Nations and the World Bank, as well as domestic projects in the United States.

PLENARY PRESENTATION

A Century of Fire Ecology and Management: Lessons for an Uncertain Future

Norman L. Christensen, PhD, Duke University, Durham, North Carolina, USA

A century ago, ecology was a nascent discipline wed to notions disturbance, succession and climax communities that were linear and highly deterministic. Ecologists and land managers of that era viewed fire as unnatural, unnecessary and undesirable. Then, the phrase "fire ecology" would have seemed oxymoronic. Over the succeeding five decades, ecologists and managers came to understand that fire is a natural process in many ecosystems, that successional change often influences the likelihood and behavior of fire, and that all this has significant consequences for the biological diversity and functioning of ecosystems. By the 1960s, several prominent ecologists identified themselves as fire ecologists, and land managers were purposefully setting fires as well as extinguishing them. The discipline of fire ecology has not only grown and matured during the last fifty years, its connections and relevance to land management have become stronger and more explicit. The following are important among the lessons of from era. 1) Fire can only be fully understood and effectively managed in the context of the entire "cycle" of ecosystem change, bu t these cycles are neither simple nor do they repeat themselves exactly. 2) Beware of sweeping generalizations; fire and the absence of fire have vastly different consequences, even in apparently similar ecosystems. 3) Fire is a landscape process; spatial and temporal scale and context are critical both to ecological understanding and effectively management. 4) Ecosystem biodiversity is often dependent on fire, and fire regimes are also influenced by biodiversity. 5) Current and future change will likely produce surprises. Climate change, invasive species and changing patterns of land use are creating conditions that have no historical precedents. Fire management that mimics the historic range of variation may therefore produce unexpected and undesirable change. Fire ecology should work to identify thresholds of change that are likely to produce significant shifts in fire behavior and trajectories of ecosystem change. The relationship between fire ecology and fire management has changed considerably over this past century, sometimes isolated, sometimes disputative and sometimes collaborative. Over the past several decades, synergistic interactions have prevailed. Such synergism is essential if we are to meet the challenges of the future.

Bio: Norm Christensen is Research Professor of Ecology and Founding Dean of Duke University's Nicholas School of the Environment. Norm's research deals with patterns of disturbance (including fire and human land use) and the nature and mechanisms of change deriving from disturbance. He has served on numerous advisory committees, including the Interagency Taskforce on the Ecological Effects of the 1988 Yellowstone Fires (chair), The National Research Council's Committee on Environmental Issues in Pacific Northwest Forest Management (chair), the Ecological Society of America's Committee on the Scientific Basis for Ecosystem Management (chair), the California Spotted Owl Federal Advisory Committee (co-chair), the Sierra Nevada Ecosystem Project Team, and the National Commission on Science for Sustainable Forestry. In 1997, he was appointed by then President Bill Clinton to the Nuclear Waste Technical Review Board, and he served as ecologist on that board through 2004. He was President of the Ecological Society of America from 2006-2009, and he is a Fellow in the American Association for the Advancement of Science. Norm is author of the environmental science textbook, "The Environment and You", published by Pearson Education.

PLENARY PRESENTATION

Burning in Their Backyards and Having Them Say "Thank You"

Steven R. "Torch" Miller,
Chief, Bureau of Land Management,
St. Johns River Water Management District Florida, USA

Planning and executing any prescribed burn can be considered a complex process. The complexities can grow exponentially, both in size and in number, if the burn is in the wildland urban interface (WUI). One of the variables that make burning in the WUI so challenging, is the neighbors themselves. Rightfully or not, the neighbors are nervous about fire managers lighting fires in what they consider to be "their backyard". The St. Johns River Water Management District (SJRWMD) has been burning in their neighbors backyards to restore ecosystems and reduce hazardous fuel loads since 1992. Along the way the staff from the SJRWMD have developed effective tools for communicating with their neighbors, and garnering their support. Since the inception of the District's fire program, I have had the pleasure of serving as the leader of the program. SJRWMD manages approximately 400,000 acres, much of it interspersed with high-end homes and condominiums; we typically burn approximately 30,000 acres each year. I will share some of the lessons we have learned and the strategies and techniques used by District staff to get our neighbors in the WUI to say "thank you" for burning their backyard.

Bio: Steve graduated from the University of Wisconsin Stevens Point with a degree in Forest Administration in 1985. He has since worked for a private forestry consultant, the USDA Forest Service, Texas Forest Service, and Florida Division of Forestry and is currently the Chief of the Bureau of Land Management for the St. Johns River Water Management District. In his present capacity, Steve is responsible for directing a multiple use land management program on over 600,000 acres, including a fire program whose goal is to prescribed burn 65,000 acres/year. Steve has experience in both prescribed fire and fire suppression and is currently qualified as a Type I Burn Boss and a Type II Operations Section Chief. He serves as Operations Chief on the Florida Red Overhead Team. He is married and the father of two college students; one of whom aspires to be a second-generation forester and fire manager.

PLENARY PRESENTATION

Public Response to Fire and Fuels Management: Understanding Current Dynamics to Improve Future Decisions

Sarah McCaffrey, PhD., USDA Forest Service,
Northern Research Station, Evanston, Illinois, USA

Decades of research on natural hazards has identified different adaptation stages in a society's response to a natural hazard. When impacts are minimal, societies tend to focus on distributing the costs through mechanisms such as insurance. As impacts increase, the focus shifts to a technological effort to modify the environment to either prevent or decrease the extent and degree of a hazard's impacts. While these efforts often initially minimize impacts, over time the actions often simply raise the threshold: decreasing the frequency of moderate events but ensuring that when conditions overwhelm the technological solution the impacts are broader and more extreme. When technological fixes turn out to be insufficient to reduce negative impacts, societies then turn to modifying both the environment AND human behavior to reduce overall vulnerability.

With wildfire, suppression can be seen as a traditional technological attempt to modify the environment. For many decades the approach has minimized societal impacts, but it has also effectively raised the threshold and recent years have begun to see an increase in wildfires that overwhelm suppression abilities that burn more acreage and have increasing social impacts. Although fuels treatments are a newer approach to modifying the environment, natural hazards theory would suggest that in the future a primary focus on improving suppression response and changing fuels will not be sufficient to minimize negative outcomes. Instead, a focus on modifying human behavior, at both the public and the organizational levels, will be necessary. Given this, accurately understanding different social factors that can influence fire outcomes will be integral towards minimizing the future negative impacts of wildfires.

This presentation will focus on relevant social science research findings in relation to public dynamics and wildfire management and how this knowledge can be used to inform future wildfire management. Findings indicate that many of the current views of public dynamics are inaccurate and suggest that improving future outcomes will require a shift in thinking by managers of both their role and that of the public in shaping future outcomes.

Bio: Sarah M. McCaffrey, Ph.D. is a Research Social Scientist for the USDA Forest Service, Northern Research Station. Her research focuses on the social aspects of fire management. This has included National Fire Plan and Joint Fire Science sponsored projects examining the social acceptability of prescribed fire, thinning, and defensible space and characteristics of effective communication programs. More recently she has begun work on the social issues that occur during fires including alternatives to evacuation and community-agency interactions during fires. She received her PhD in Wildland Resource Science from the University of California at Berkeley where her research examined Incline Village, Nevada homeowner views and actions in relation to defensible space and fuels management.

PLENARY PRESENTATION

Can Risk Assessment Disentangle Us from Our Wildfire Paradox?

Dave Calkin, Ph.D.,
Economic Aspects of Forest Management on
Public Lands Rocky Mountain Research Station
Missoula, Montana, USA

Over the last decade considerable advances have been made in the field of wildfire risk assessment. Innovative research has led to improved capacity to quantify wildfire risk and evaluate the effectiveness of mitigation efforts that can reduce risk throughout the wildfire management planning cycle. A significant aspect associated with many of these advances is the coalescence around an actuarial definition of wildfire risk as put forward by Finney (2005). This definition is consistent with the economic framework of optimal wildfire investment defined by Sparhawk over 80 years ago - the optimal investment in wildfire management is that which minimizes the cost of management plus expected net value change (E(NVC)) due to wildfire. Advances in wildfire simulation models, improved spatial data on the location of natural and developed resources, and increased computing capacity have created the ability to develop probabilistic models of wildfire potential (probability and intensity) that may be interacted with the location of and potential impacts to highly valued resources. Using this approach we have the ability to quantify the E(NVC) due to wildfire across a range of resources and at multiple planning scales.

Federal agencies with wildfire management responsibilities are strongly promoting the use of risk management principles across the full range of wildfire management activities. However, a number of challenges must be overcome to realize the full potential of quantitative risk assessment in helping us manage increasingly complex and damaging wildfires (see Calkin et al. 2011). In this talk I will discuss the evolution of wildfire risk assessment, introduce some specific barriers that will need to be overcome, and attempt to outline a future for the application of risk sciences to wildfire management. Specifically, I will focus on the following efforts:

1) Risk sharing among property owners, local, state and federal managers. Efficient risk management requires that mitigation efforts should occur where it can be most cost effectively done. Further, it is important to recognize who primarily benefits from specific mitigation activities and who pays.
2) Managing expectations. Increasingly, extensive suppression efforts have had limited impact on changing the course of the largest most damaging wildfires. Under extreme conditions the appropriate suppression response may involve a smaller more concentrated response that focuses efforts when and where they are most likely to reduce loss. Further, in many locations it is unrealistic to expect fuel treatments to be at the scale necessary to substantially modify wildfire spread under these extreme conditions. An approach that focuses on reducing the impact to HVRs once fire occurs may be most appropriate.
3) Knowledge, incentives, and biases. The application of risk management will require managers and the public to acquire new skills and knowledge. Several aspects of the existing incentive structure for both federal managers and private individuals are not consistent with efficient risk management and will need to be addressed. Finally, there are a number of common decision making biases that currently lead to inefficient management that may be addressed within existing decision support environments to improve programmatic outcomes.

Bio: Dr. Dave Calkin is a research forester with the USDA Forest Service Rocky Mountain Research Station's Human Dimensions Program. Dave is the lead for the wildfire economics team of the National Fire Decision Support Center and is stationed in Missoula, MT. Dave and his team conduct research on wildfire risk assessment at a variety of scales from project level planning to national level allocation, evaluate the costs and returns from various wildfire mitigation programs, develop decision support tools, and explore the impact of fire management policy, managerial incentives and risk preferences on wildfire decision making. Dave holds a PhD in economics from Oregon State University's College of Forestry, a MS in resource conservation from the University of Montana, and a BS in applied mathematics from the University of Virginia.

A Decade of Coordinated Fire Research in Australia – Hits, Misses and New Opportunities

Richard Thornton, PhD, Bushfire Cooperative Research Centre
Melbourne, Victoria, Australia

This talk will outline the issues leading up to the formation of the Australian Bushfire Co-operative Research Centre, its research outcomes and successes, gaps where further work still needs to be undertaken, and the role that the international community can play in meeting some of the skills and capability gaps through collaboration.

2001 and 2002 saw bushfires impact upon the suburbs in and around Sydney with the central business district shrouded by thick smoke over the Christmas period. Images of the fires went round the world, and the impact was felt at political levels in Australia. At that point, fire research was fragmented across the country, the research community was ageing and there was no effective recruitment of young researchers. The levels of funding into fire science had been dropping and Australia was losing its world-leading status.

The fire agencies across Australia had been seeking to form a co-operative research centre over the previous three years, unsuccessfully. The Sydney Fires were the catalyst for success, with strong support of the Federal Minister of Science. The Bushfire Co-operative Research Centre (CRC) was formed in 2003 with a seven-year funding horizon, which was extended in 2009 for another three years following the catastrophic fires in Victoria in February of that year. The Bushfire CRC was set up to be a multi-disciplinary research organisation covering physical, biological and social sciences. It was funded by the Federal Government, all fire and land management agencies, and research institutions across Australia and New Zealand.

So what has changed in the last ten years of co-ordinated national research; are we in a better position? The answer is clearly yes - the changes since 2003 have seen increased emphasis on early warning, focus on protection of human life over fighting the fires, the need for shared responsibility for bushfire safety and the use of personal bushfire survival planning and protection areas around the home. The 'Prepare, Stay and Defend or Leave Early' mantra has been replaced by the 'Prepare. Act. Survive' message, underpinned by the breadth of Bushfire CRC research on community safety and preparedness. There is now a stronger focus that the safest place to be during a bushfire is somewhere else. This change in the way that bushfires, and indeed other hazards, are managed has been strengthened by the extensive and concerted research efforts of the Bushfire CRC's researchers and others, as well as the determination of the fire agencies to use the outputs.

As a result of the longer-term investment in research on the rate of fire spread, flame height, intensity and spotting, and smoke, fire managers are now able to make better decisions about fire suppression and firefighter safety armed with a better understanding of the interaction between fire, fuel, weather and topography.
It is notable that various enquiries into fires in the last ten years have all called for a reliable ongoing research capability for Australia. However, the funding for fire research finishes in July this year and uncertainty is once again driving young researchers away from this important field.

Even with the successes of the last ten years, there is still more to do to address the underpinning issues still outstanding in the management of bushfires in Australia. Many of these are focussed on land management, demographic change and climate. The debate still rages around prescribed burning; health and safety of communities and firefighters; the use of large aircraft; prevention of fires through better understanding of arson and powerline failures, and community acceptance of risk.

Given extent of bushfires throughout the country in the past few years, the Australian community will still need a national body to coordinate the response to these types of events. It is vital to ensure lessons are learnt and policies and practices are changed, based on sound, scientific research, to safeguard the community. There is still a lot more to do.

Bio: Dr. Richard Thornton is the Deputy CEO and Research Director of the Bushfire CRC a role he has held for six years. His responsibilities have included leadership and oversight of the research program for the research centre, ensuring research quality, research relevance, and up-take. Richard was the project director for the extensive research - data collection task-force project undertaken following the 7 February 2009 bushfires in Victoria. Prior to this Richard was Research Strategy manager for a major telecommunications company in Australia and has a PhD in Physics from RMIT University. Richard is chair of the Editorial Advisory Committee of *IAWF's International Journal of Wildland Fire.*

CLOSING PRESENTATION:

A Changing Fire Environment: 40 years of Forest Service Experience

Tom Tidwell, Chief
US Forest Service
Washington, DC, USA

Tom Tidwell has spent 33 years in the Forest Service. He has served in a variety of positions at all levels of the agency, including as district ranger, forest supervisor, and legislative affairs specialist in the Washington Office. As deputy regional forester for the Pacific Southwest Region, Tom facilitated collaborative approaches to wildland fire management, roadless area management, and other issues. As regional forester for the Northern Region, Tom strongly supported community-based collaboration in the region, finding solutions based on mutual goals and thereby reducing the number of appeals and lawsuits.

In 2009, after being named Chief, Tom set about implementing the Secretary's vision for America's forests. Under his leadership, the Forest Service is restoring healthy, resilient forest and grassland ecosystems—ecosystems that can sustain all the benefits that Americans get from their wildlands, including plentiful supplies of clean water, abundant habitat for wildlife and fish, renewable supplies of wood and energy, and more.

Such benefits are at risk from the effects of climate change, and Tom has led the way in forging a national response. Under Tom's leadership, the Forest Service has charted a national roadmap for addressing climate change through adaptation and mitigation. The Forest Service is taking steps to help ecosystems adapt to the effects of a changing climate while also taking action to mitigate climate change, partly by reducing greenhouse gas emissions.

Tom has facilitated an all-lands approach to addressing the challenges facing America's forests and grasslands, including the overarching challenge of climate change. Such challenges cross borders and boundaries; no single entity can meet them alone. Under Tom's leadership, the Forest Service is working with states, Tribes, private landowners, and other partners for landscape-scale conservation—to restore ecosystems on a landscape scale.

Tom is married to Kim, and they have one daughter, MacKenzie.

PANEL SESSION:

Changes in the Fire Environment: Policy, Demographics, Climate and Technology

Tom Zimmerman, US Forest Service, retired
Miranda Mockrin, Research Scientist, Rocky Mountain Research Station, USDA Forest Service
Bob Keane, Research Ecologist, Rocky Mountain Research Station, Missoula Fire Sciences Laboratory, USDA Forest Service
Tim Sexton, Program Manager, Wildland Fire Management RD&A, USDA Forest Service
Panel Moderator: **Diane Rau,** Fire Technology Transfer Specialist, Wildland Fire Management Research, Development, and Applications

This panel was designed around the theme of the conference, "At The Crossroads: Looking Toward the Future in a Changing Environment". It looks at the changing fire environment in four dimensions, with subject matter experts to focus on changes in the policy environment (Tom Zimmerman), demographics including the changing wildland urban interface (Miranda Mockrin), climate (Bob Keane), and technology (Tim Sexton). Panelists will discuss the changes recently observed in these aspects of the fire environment, as well as projected changes in coming decades. They will consider the impacts of these changes on fire management and emerging fire research needs that will allow managers to respond to these changes.

Miranda Mockrin

Miranda is a research scientist with the Rocky Mountain Research Station, USDA Forest Service, based in Fort Collins, CO, in the Human Dimensions Program. Her research includes mapping growth of the wildland urban interface over time; examining rebuilding in the WUI after fire; studying housing development and its ecological and social effects; and exploring alternative forms of development such as conservation developments. She also researches changing patterns of wildlife-associated recreation, and the results and implications of the 2010 Census for ecologists and resource managers. She received her PhD in Ecology from Columbia University in 2008 and started her Forest Service career in the Presidential Management Fellows Program.

Robert E. Keane

Bob is a Research Ecologist with the USDA Forest Service at the Missoula Fire Sciences Laboratory His most recent research includes 1) developing ecological computer simulation models for the exploring landscape, fire, and climate dynamics, 2) conducting field research on the sampling, describing, modeling, and mapping of fuel characteristics, and 3) investigating the ecology and restoration of whitebark pine.

Tim Sexton

Tim is currently the Program Manager for the Wildland Fire Research Development & Applications Program. His responsibilities include management of the Wildland Fire Decision Support System as well as facilitating technology transfer of new science associated with wildland fire to the field. He previously served as a Type I Incident Commander on Great Basin IMT 1 and as a Type II IC on Rocky Mountain IMT #2. He remains active in large fire management, serving on Area Command and the Command and General Staff of Type I IMTs. Tim has a Bachelor's Degree in History from Boise State University and a Master's Degree in Fire Ecology from Oregon State University.
Tim started his fire career as an engine and fuels crewmember on the Shasta-Trinity NF at Weaverville Ranger District.
His work experience includes:

- Suppression and fuels on the Gifford Pinchot and Umpqua National Forests
- Fire Operations Specialist for the BLM at the National Interagency Fire Center
- Hotshot Superintendent at Redmond, Oregon (Deschutes NF)
- District Fire Management Officer for 11 years on the Winema National Forest
- Deputy Regional Fire Management Officer for the Intermountain Region of the National Park Service in Denver, Colorado
- National Fire Ecologist for the National Park Service
- Fire Use Program Manager for the US Forest Service
- District Ranger, LaCroix RD, Superior NF

Tim enjoys snow skiing, canoeing, woodworking, photography, fishing, and hunting.

Thomas Zimmerman

Tom retired in 2011 after 32½ years of federal service with multiple federal wildland fire management agencies. In these assignments, Tom was involved in training, program management, policy development, technology transfer, use of wildland fire, prescribed fire, wildfire and emergency incident management, fire ecology, fire behavior, long-term risk assessment, decision support, change management, and other field operational activities. He is a member of the Society of American Foresters (SAF), the Association for Fire Ecology (AFE), and the International Association of Wildland Fire (IAWF). Since his retirement in 2011, Tom has stayed active in wildland fire management through training, conference presentations, consulting, and is currently serving on the Board of Directors of the IAWF.

MODERATED DISCUSSION

Wildfire Management Dynamics: Balancing knowledge, experience, opportunities, and limitations with objectives to develop direction

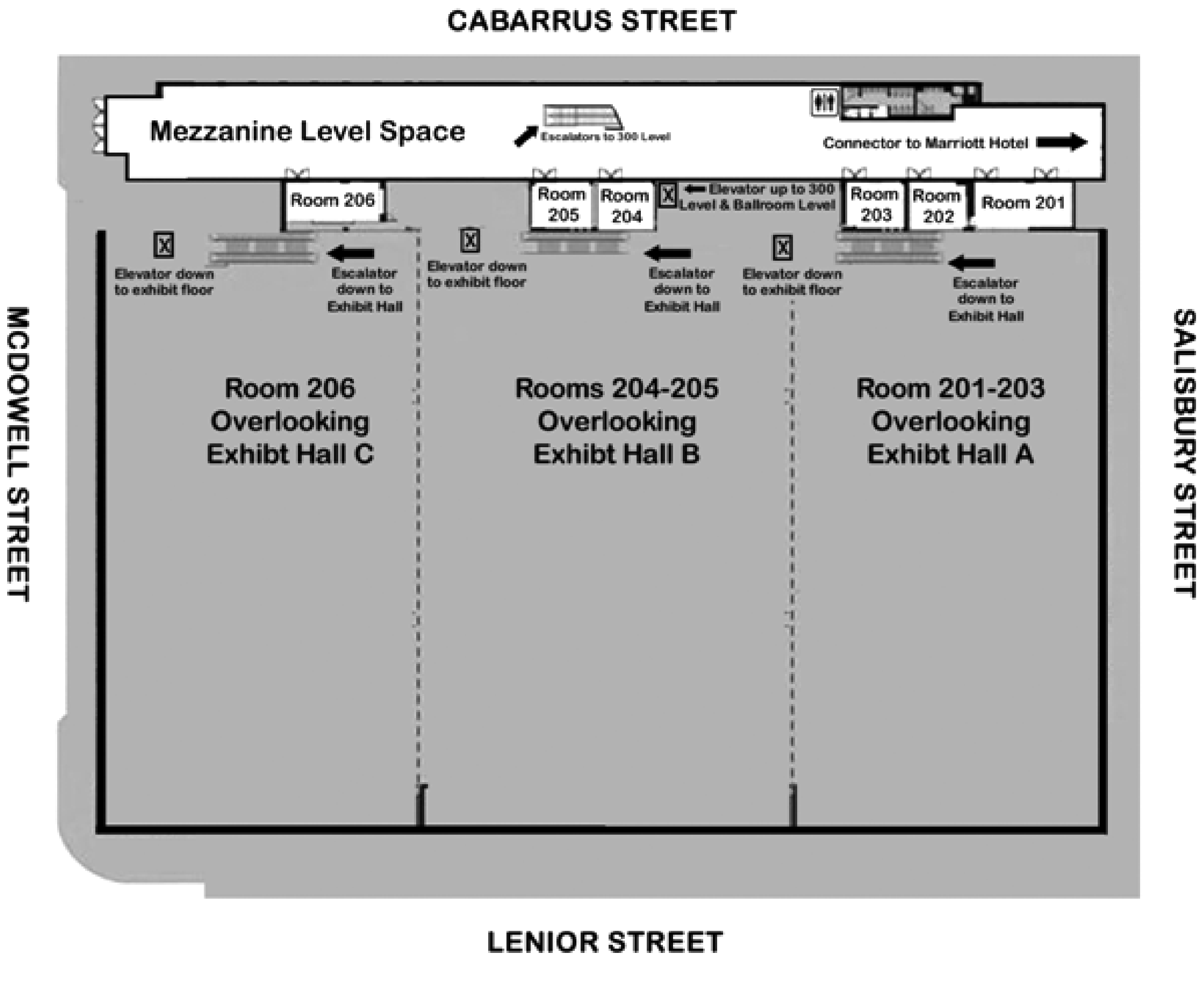
Tom Harbour, Director of Fire and Aviation Management, US Forest Service
Bob Mutch, Fire Management Applications
Jacque Buchanan, Forest Supervisor, Bridger-Teton National Forest Headquarters

Moderated by **Tom Zimmerman,** US Forest Service (retired)

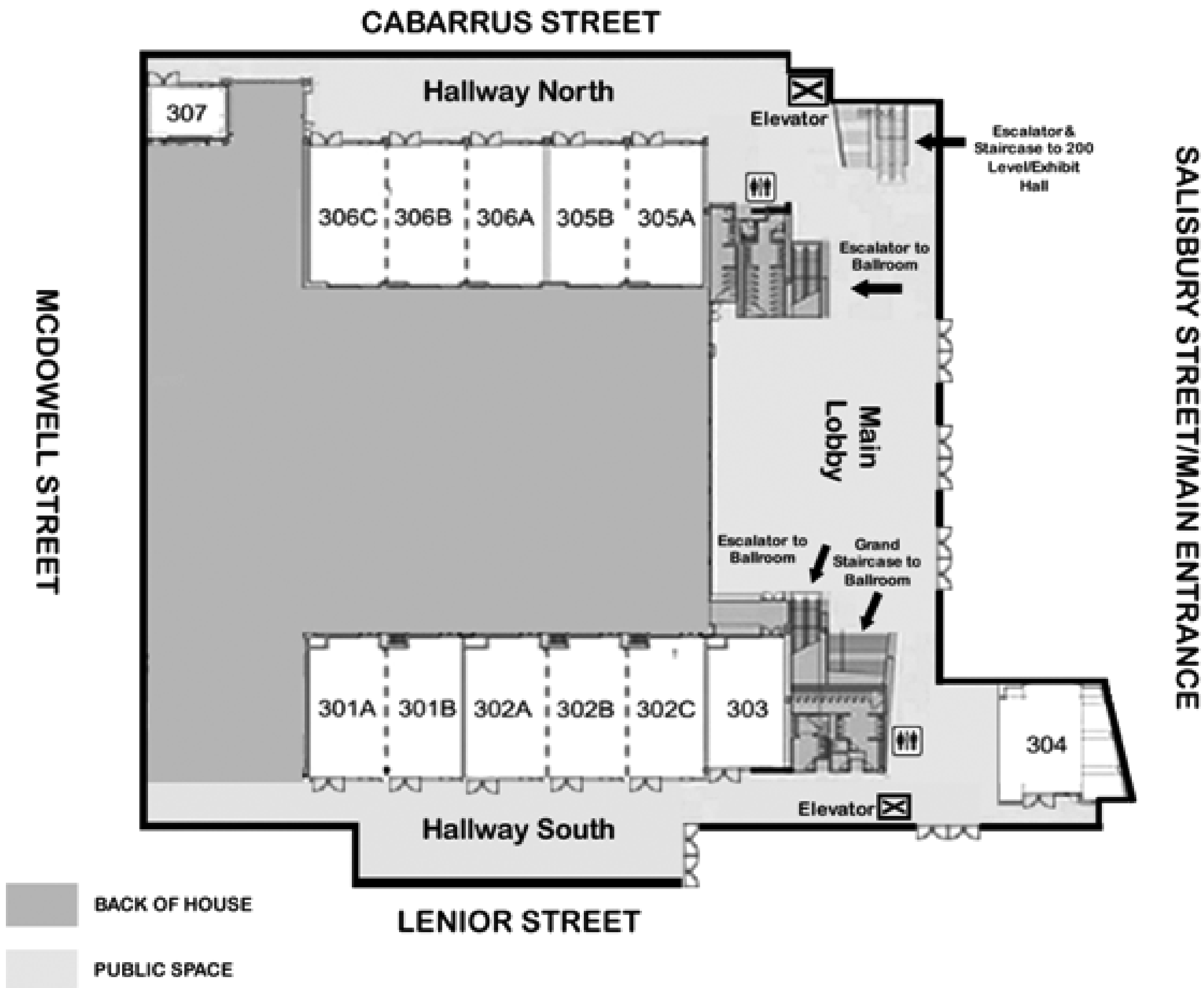
This panel is a discussion of ecological motivations, social, political and economic constraints, and managerial considerations that alter our ability to manage wildfires to achieve objectives. Discussants will provide perspectives on historical, recent, and current wildfire management direction, including the Forest Service 2012 and 2013 direction.

Convention Center *Maps*

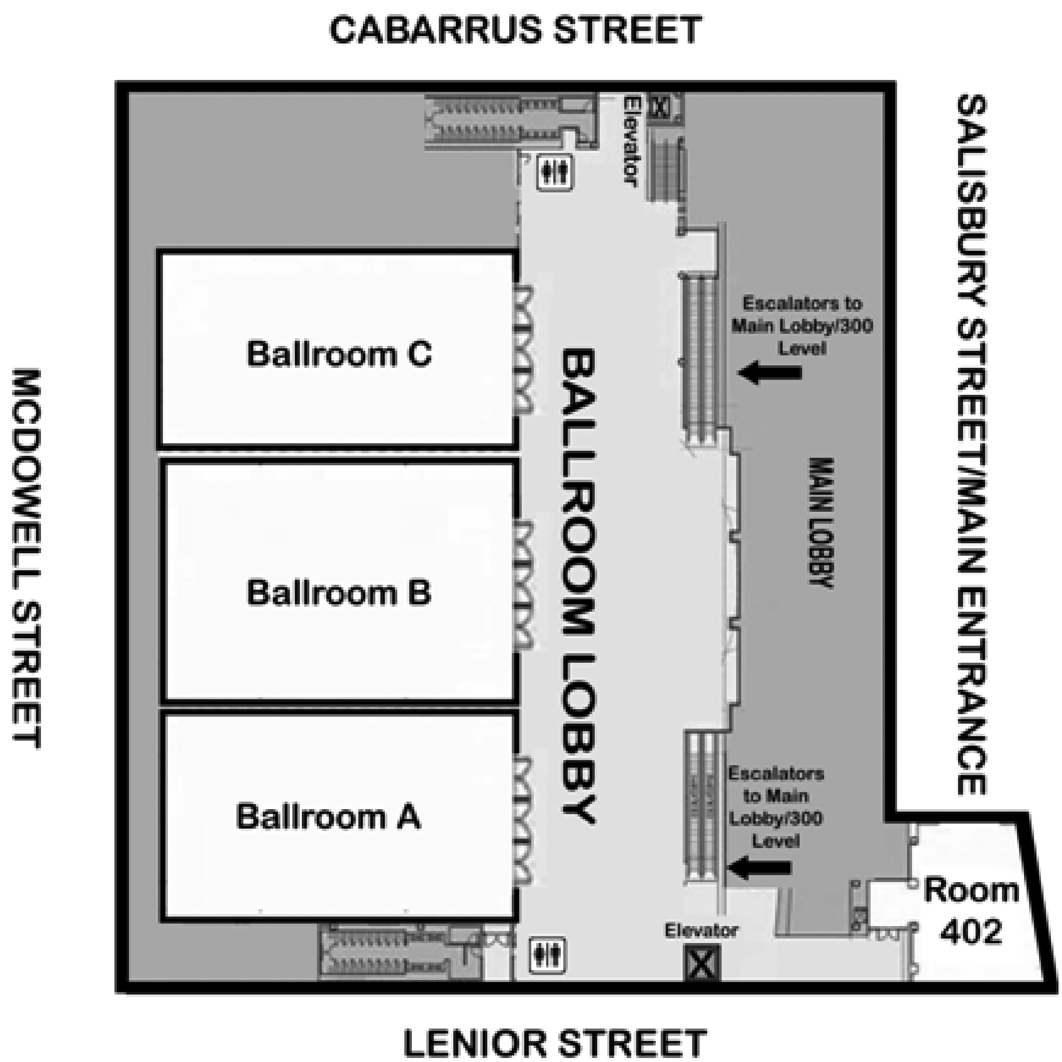
200 LEVEL/Mezzanine Level



300 LEVEL-Street Entrance



BALLROOM LEVEL-Level 4



Program *Schedule*

INTERNATIONAL ASSOCIATION OF WILDLAND FIRE

4th Fire Behavior and Fuels Conference

At The Crossroads: Looking Toward the Future in a Changing Environment

Raleigh Convention Center, North Carolina, USA • February 18-22, 2013

MONDAY, FEBRUARY 18, 2013

7:00AM - 8:00 PM	Registration Desk Open (Reception Area)	
Time	Location	**Educational and Training Workshops**
8:00 - 5:00	306 A	RX 310 - Introduction to Fire Effects
8:00 - 5:00	306 B	Introduction to Interagency Fuels Treatment Decision Support System (IFT-DSS)
8:00 - 5:00	306 C	Wildfire Analyst: Fire Behavior Analysis & Simulation Tools for Operational Decision Making
8:00 - 5:00	302 B	Fire Practitioner Tools for Assessing Wildland Smoke
8:00 - 3:00	302 C	Assessing Residential Wildfire Hazards
8:00 - 3:00	303	Crown Fire Behavior in Conifer Forests
8:00 - 12:00	305 A	Introduction to Fuel Treatment Planning and Fire Behavior Modeling with ArcFuels10
8:00 - 12:00	206	Wildland Fire Assessment Tool (WFAT): A Spatial Model for Wildland Fire Behavior and Fire Effects
10:00 - 12:00	205	Fire Culture: Using the Humanities to Revive the Ancient Link of People and Fire in Southeastern North America … and Around the World
1:00 - 3:00	205	International Journal of Wildland Fire Information and Feedback Session
1:00 - 3:00	206	Fire Monitoring and the Application of Adaptive Management for Public Lands Management
1:00 - 5:00	305 A	Fire Regime Condition Class: Concepts, Applications, and Mapping Tool
1:00 - 5:00	305 B	Advanced Fire Behavior Analysis Through Lessons Learned,
3:00 - 5:00	303	Fire, Fuels, and Climate: Science Resources to Keep Pace with a Changing World
4:00-8:00 PM		**Exhibitor Move In** (Ballroom B/C)
5:00-6:30 PM	**No host social reception (5:00 - 5:30)** (Reception Area) **Cohesive Strategy Meeting (5:30 - 6:30)** (Room 305 A)	
6:00 PM	**Fire Science Quiz Bowl** (306A)	

TUESDAY, FEBRUARY 19, 2013

6:30-7:30 AM	**Group Led Exercise Session** (204)
7:00-8:30 AM	**Continental Breakfast** (Ballroom B/C)
7:00 AM	**Registration Desk Opens** (Reception Area)
8:30-9:00	**Opening Remarks and Welcome** (Ballroom A) *Dan Bailey, IAWF President and Chairman of the Board &* *Greg Pate, State Forester, North Carolina Forest Service*
9:00 - 10:00	**Keynote Presentation: Fire Behavior Science and Experience:** **Framing Successful Megafire Solutions for Policy Makers, Politicians, and the Public** *Bob Mutch, Fire Management Applications, Darby, Montana, USA*
10:00 - 10:30	**BREAK with Exhibitors** (Ballroom B/C)
10:30-11:30	**Panel Session: Changes in the Fire Environment: Policy, Demographics, Climate and Technology** (Ballroom A) *Panelist: Tom Zimmerman, Miranda Mockrin, Bob Keane and Tim Sexton, Panel Moderator: Diane Rau*
11:30-12:30	***Poster Session*** (Ballroom B/C)

POSTER PRESENTATIONS

P1. The standardized fuel bed: a tool for capturing variation in fire weather among experimental low intensity fires. *Dexter Strother*	P6. Simulation of low-temperature dehydration of peat *Alexander Filkov*	P11. Simulating Prescribed Burn Events in the New Jersey Pine Barrens using ARPS-CANOPY *Michael Kiefer*	P15. Background, methods and call for feedback on fuel and fire behavior data collection on active wildland fires *Alicia Reiner*	P19. The use of IR-diagnostics for registration of high-temperature objects screened by the layer of flame formed during combustion of plant fuels and pecularities of the flame temperature measurement in the study of wildland fires *Egor Loboda*
P2. Validation of the WRF-Fire model using observation data from a prescribed burn experiment *Xindi Bian*	P7. The Twitter social media platform: the Southern Fire Exchange experience in fire science communication *David Godwin*	P12. The Advantages and Disadvantages of the Pre-Formed Type III Fire Suppression Team *Patrick Withen*	P16. Maps for the Masses: Improving Upon Printed Map *Justin Shedd*	P20. Development of an ArcGIS fire frequency, fuel accumulation, seasonality and prioritization tool to facilitate prescribed fire decision making on the Talladega National Forest, Alabama *Jonathan Stober*
P3. Assessing Canopy Fuels Across Heterogeneous Landscapes Using LiDAR *Kenneth Clark*	P8. Relative comparison of fuel load estimates *Scott Goodrick*	P13. Facilitating Knowledge Exchange About Wildland Fire Science *Alan Long*	P17. A coupled approach to evaluating the dynamic linkage between fuel treatment effects on fuel matrices and effectiveness at reducing wildfire intensity and spread rate. *Nicholas Skowronski*	P21. Synthesizing Knowledge on Crown Fire Behavior in Conifer Forests: We Could Use Your Help! *Marty Alexander*
P4. Ground Zero Daily Smoke Production Values for NC Coastal Plain Organic Soil Fire - Pains Bay May / June 2011 *Gary Curcio*	P9. Fire-Atmosphere Interactions During Low-Intensity Prescribed Fires in the New Jersey Pine Barrens *Warren Heilman*	P14. First results in characterizing the smouldering processes under the influence of heterogeneous moisture content *Nuria Prat*	P18. Smoke management in Australia and New Zealand, application of the BlueSky Modelling Framework *Tara Strand*	P22. The Fire and Fuels Application (FFA): a suite of fire management tools *Susan Prichard*
P5. Real-Time Analysis of Fire Weather Prediction Accuracy: Year 2 Progress *Stacy Drury*	P10. BlueSky Playground: A Web-Based Smoke Modeling Decision Support Tool *Sean Raffuse*			

12:30-1:30 PM	**LUNCH** (Ballroom B/C)

CONCURRENT SESSIONS

	Room 305 A	Room 305 B	Room 306 A	Room 306 B	Room 306 C
	SPECIAL SESSION Behavior and Ecological Consequences of Smoldering Fires *Moderator: Jesse Kreye*	**SPECIAL SESSION Fire Culture: Using the Humanities to Revive the Ancient Link of People and Prescribed Fire** *Moderator: Johnny Stowe*	**Smoke** *Moderator: Chuck Bushey*	**Prescribed Fire** *Moderator: Tom Zimmerman*	**Fire Modeling** *Moderator: Gene Rogers*
1:30-1:40	Announcements & Introductions	Announcements & Introductions	Announcements & Introductions	Announcements & Introductions	Announcements & Introductions
1:40-2:00	SS1.1 Ecological consequences of smoldering fires in long-unburned longleaf pine forests *Morgan Varner*	SS2.1 Fire-Ties: Ritual and Ceremony as Ways to Link People and Conserve Fire Landscapes *Johnny Stowe*	1. JFSP's Smoke Line of Work under the Smoke Science Plan *Douglas Fox*	7. Investigating coupled fire/atmosphere behavior of prescribed fire: influence of Ignition patterns and vegetation structure *Rodman Linn*	13. Quantifying parametric uncertainty in the Rothermel model with randomized quasi-Monte Carlo sampling *Yaning Liu*
2:00-2:20	SS1.2 Kalimantan Peat Fires: Field and Laboratory Observations *Kevin Ryan*	SS2.2 Is a Picture Worth a Thousand Fires? *Philip Juras*	2. First Look at Smoke Emissions from Prescribed Burns in Long-unburned Longleaf Pine Forests *Timothy Johnson*	8. The conundrum of controlled burning, forest productivity, and fuel loading *Michael Gavazzi*	14. Validation of the Consume and FOFEM fuel consumption models in pine and hardwood forests of the eastern United *States* *Susan Prichard*
2:20-2:40	SS1.3 Linking smouldering experiments with simple cellular automata models of smouldering combustion *Jon Yearsley*	SS2.3 Lightning Fire, Anthropogenic Fire, and Other Factors Maintain Southern Grasslands *Reed Noss*	3. Modeling Smoke for Incident Support: The 2012 Wildfire Season *Miriam Rorig*	9. Does prescribed fire reduce wildfire in the Southern US? A region-wide survey of public and private land manager perspectives *Leda Kobziar*	15. Capturing complexity in fuels for fire behaviour modelling *Phillip Zylstra*
2:40-3:00	SS1.4 Modeling Smoldering Combustion of Forest Duff *Christopher Dugaw*	SS2.4 Fire in the Longleaf Ecosystem - Using the Popular Media for Opposing Outcomes *Rhett Johnson*	4. Fire environment effects on PM2.5 emission factors in southeastern U.S. pine-grassland communities *Kevin Robertson*	10. Water Management to Facilitate Prescribe Fire in Coastal North Carolina *Ed Christopher*	16. The Level Set Method as a Tool for Modeling Wildland Fire Spread *Anthony Bova*
3:00-3:20	SS1.5 Linking Smoldering Duff Temperatures to Surface Thermal Infrared Images *Jing Cao*	SS2.5 By the light of the fire: The history of humans and fire in the Canadian Rockies *Jane Park*	5. Using Fire-Atmosphere Coupling to Initialize a Smoke Model *Gary Achtemeier*	11. Influence of homogenously applied ecosystem-based fire prescriptions on landscape heterogeneity *Marcus Lashley*	17. Fireline dynamics and geometry *Jesse Canfield*
3:20-3:40	SS1.6 Moisture Limits of organic soil ground fires in North Carolina pocosin and pond pine fuel types *James Reardon*	Q&A, Discussion	6. Airborne-Based Carbon Aerosol Observations from Prescribed Burning *Amy Sullivan*	12. Vegetation response following canopy reduction and repeated prescribed fire in mixed upland hardwoods *Emma Willcox*	18. Simulating Fire Spread in Chamise Chaparral Fuel Beds *Ruddy Mell*
3:40-4:10	**BREAK with Exhibitors** (Ballroom B/C) sponsored by ESRI				
4:10-4:55	PLENARY SESSION (Ballroom A) **A Century of Fire Ecology and Management: Lessons for an Uncertain Future** *Norman L. Christensen, Ph.D., Research Professor and Founding Dean of the Nicholas School Environmental Sciences & Policy, Durham, North Carolina, USA*				
5:00-7:00	***Social Reception*** (Ballroom B/C) sponsored by FireIce, A GelTech Solution				

WEDNESDAY, FEBRUARY 20, 2013

6:30-7:30 AM	**Group Led Exercise Session** (204)
7:30-8:30 AM	**Continental Breakfast** (Ballroom B/C)
7:00 AM	**Registration Desk Opens** (Reception Area)
8:30-8:45	**Welcome Back and Daily Announcements** (Ballroom A) *Gene Rogers, IAWF Board of Directors and Conference Chair*
8:45-9:30	PLENARY SESSION **Burning in Their Backyards and Having Them Say "Thank You"** *Steven R. "Torch" Miller, Chief, Bureau of Land Management, St. Johns River Water Management District, Florida, USA*
9:30-10:15	PLENARY SESSION **Public Response to Fire and Fuels Management: Understanding Current Dynamics to Improve Future Decisions** *Sarah McCaffrey, Ph.D., Research Social Scientist, USDA Forest Service, Northern Research Station, Evanston, Illinois, USA*
10:15-10:45	**BREAK with Exhibitors** (Ballroom B/C)
10:45-11:30	PLENARY SESSION (Ballroom A) **Can Risk Assessment Disentangle us from our Wildfire Paradox?** *Dave Calkin, Ph.D., Research Forester, Economic Aspects of Forest Management on Public Lands Rocky Mountain Research Station, Missoula, Montana, USA*
11:30-12:15	***Poster Session*** (Ballroom B/C)

POSTER PRESENTATIONS

P23. The Interagency Fuels Treatment Decision Support System (IFTDSS): Current Software Tools and Data Available Online for Fuels Treatment Planning *Stacy Drury*	P28. Whitebark pine regeneration following a prescribed fire in west central Alberta *David Finn*	P33.Development and Evaluation of the Physics-based WIldland-Urban Interface Fire Dynamics Simulator *Anthony Bova*	P38. Predicting litter and live herb fuel consumption during prescribed fires in native and old-field upland pine savannas of the southeastern United States *Angie Reid*	P43. ArcFuels10: An ArcGIS 10 toolbar used for fuel management planning and wildfire risk assessments *Nicole Vaillant*
P24. An Integrated Research Approach to Improving the Balance of Protection and Comfort of Wildland Firefighter Clothing" *Roger Barker*	P29. Semi-empirical Fire Spread Simulator for Utah Juniper and Chamise Shrubs *Tom Fletcher*	P34. Development of an empirical model to predict fire movement across an ecotonal gradient *Michael Just*	P39. Moisture dynamics and probability of sustained flaming of masticated fuelbeds in the Canadian boreal *forests* *Tom Schiks*	P44. Making the invisible physical: effectively communicating fire weather in the third dimension *Darren Clabo*
P25. From Sweating Plates to Manikins: Evaluating the Role of Clothing Materials in Reducing the Risk of Heat Stress in Wildland Firefighting *Marika Walker*	*P30. Providing science to managers: The Francis Marion-Sumter National Forest Prescribe Fire Prioritization Model: A Logistical and Ecological Approach to Management* *Reginald Goolsby*	P35. An Investigation of the Sensitivity of Wind and Temperature in the Lower Atmosphere to Canopy and Fire Properties *Michael Kiefer*	P40. Dry slots and large fire growth in the United States: A case for better utilization of satellite water vapor imagery *Fred Schoeffler*	P45. Turbulence and energy fluxes during prescribed fires in the New Jersey Pine Barrens *Kenneth Clark*
P26. From RPP to RadMan: the Role of Clothing Materials in Protecting against Radiant Heat Exposures in Wildland Forest Fires *Kyle Watson*	P31. Fuels or microclimate? Biological and physical controls over fire feedbacks at tropical savanna-forest boundaries. *William Hoffman*	P36. LANDFIRE Fuels Mapping: Overview of Status and Methods *Donald Long*	P41. LiDAR Applications at Mammoth Cave National Park; Constructing a 3-D Fire Fuel Database *Justin Shedd*	P46. Atmospheric stability's influence on rate of spread and plume rise *Kara Yedinak*
P27. Moisture Management: Evaluating Sweat Absorption in Wildland Firefighter Protective Clothing Materials and Effects on Wear Comfort *Julisha Joyner*	P32. Improving Upon the Wildland Fire Portion of the National Emissions Inventory *ShihMing Huang*	P37. The National Wildfire Coordinating Group (NWCG) Smoke Committee (SmoC) *Pete Lahm*	P42. Structure-level fuel load assessment and analysis in the wildland-urban interface: A demonstration of LiDAR and spectral remote sensing methodologies. *Nicholas Skowronski*	P47. Fire Severity Assessment in the Allegheny Highlands of Virginia *Nikole Swaney*

12:15-1:15	***LUNCH (Ballroom B/C)*** (Ballroom B/C)

CONCURRENT SESSIONS

	Room 305 A	Room 305 B	Room 306 A	Room 306 B	Room 306 C
	SPECIAL SESSION Standing on the Shoulders of A Giant: A Tribute to George M. Byram (1909-1996) - Pioneering Scientist in Forest Fire Research *Moderator: Marty Alexander*	**SPECIAL SESSION A data set for fire and smoke model development and evaluation--the RxCADRE project** *Moderator: Roger Ottmar/John Hiers*	**Fire Weather** *Moderator: Ron Steffens*	**Management Implications** *Moderator: Kris Johnson*	**Fire Effects, History, and Monitoring** *Moderator: Dave Moore*
1:15-1:20	Announcements & Introductions	Announcements & Introductions	Announcements & Introductions	Announcements & Introductions	Announcements & Introductions
1:20-1:40	SS3.1 Honoring Those That Have Come Before Us: Introductory Remarks to the Special Session *Marty Alexander*	SS4.1 Prescribed fire Combustion and Atmospheric Dynamics Research Experiments Overview *John Hiers*	19. Decoupling seasonal changes in water content and dry weight to predict live conifer foliar moisture content *Matt Jolly*	26. Providing science to managers: The Francis Marion-Sumter National Forest Prescribe Fire Prioritization Model: A Logistical and Ecological Approach to Management *Reginald Goolsby*	33. Forty-Years of Fire Suppression Alters Soil CO2 Efflux Rates at the Stoddard Fire Plots in North Florida *David Godwin*
1:40-2:00	SS3.2 George Byram - Father of Wildland Fire Sciene Dale D. Wade	SS4.2 Data management of the Prescribed Fire Combustion and Atmospheric Dynamics Research Experiment (Rx-CADRE) *Bryce Nordgren*	20. Comparison of Remote Automated Weather Station (RAWS) Location Information 2009 and 2012 *Charles McHugh*	27. Fire behaviour prediction tools for fire managers - lessons learned from tools development in New Zealand *H. Grant Pearce*	34. Refining the oak-fire hypothesis for management of oak-dominated forests in the eastern US *Mary Arthur*
2:00-2:20	SS3.3 George Emerges from the Smoke -- The Early Years of G.M. Byram *Darold E. Ward*	SS4.3 Ground Measurments of Fuel and Fuel Consumption from Experimental and Operational Prescribed Fires at Eglin Air Force Base, Florida *Roger Ottmar*	21. Micrometeorology of Fire Front Passage observed in Complex Terrain *Jon Contezac*	28. Fire Use in the R11 Forest Management Unit *David Finn*	35. Structure is the Key to Predicting Function during Restoration of Southern Appalachian Forests *Tom Waldrop*
2:20-2:50	**BREAK with Exhibitors** (Ballroom B/C)				
2:50-3:10	SS3.4 George M. Byram -- A Forest Fire Research Pioneer: Perspectives of a Colleague *Ralph M. Nelson, Jr.*	SS4.4 Ground LiDAR fuel measurements of the Prescribed Fire Combustion and Atmospheric Dynamics Research Experiment *Carl Seielstad*	22. LES techniques for the modeling of flow through vegetation with applications to wildland fires *Eric Mueller*	29. Response of wildland fires to aerially applied fire retardant *Philip Riggan*	36. Background, methods, and call for feedback on fuel and fire behavior data collection of active wildland fires *Alicia Reiner*
3:10-3:30	SS3.1 Learning from Those Who Came Before Us: Closing Remarks to the Special Session Martin E. Alexander	SS4.5 Relationships between pre-fire fuels, fire radiative energy, and post-fire ash *Andrew Hudak*	23. Observations of fire behavior on a grass slope during a wind reversal *Dianne Hall*	30. Autonomous Wildfire Detection and Reporting *Darell Engelhaupt*	37. Relating fire behavior and fire effects in Scots pine forests of central Siberia *Susan Conard*
3:30-3:50	Q&A, Discussion	SS4.6 Meteorological measurements during the Prescribed Fire Combustion and Atmospheric Dynamics Research Experiment (Rx-CADRE) *Craig Clements*	24. The diagnosis of mixed-layer depth above an eastern U.S. wildfire using a mesoscale numerical weather prediction model *Joseph Charney*	31. Best Practices in Risk and Crisis Communication: Implications for Wildfire Management *Toddi Steelman*	38. Balancing Early- and Late-Successional Forest Conditions in Fire-Prone Forest Types *John Bailey*
3:50-4:10		SS4.7Integrating ground, airborne, and satellite measurements on prescribed fires *Matthew Dickinson*	25. Coupled Weather-Wildland Fire Modeling of the 2012 High Park Fire *Janice Coen*	32. Forecasting the wildfire suppression expenditures of federal land management agencies *Charlotte Ham*	39. Effect of season of burn on surface fuel dynamics in mesic longleaf pine flatwoods of northwest Florida *James Cronan*
4:10-4:15	**Transition to Plenary Session** (Ballroom A)				
4:15-5:00	PLENARY SESSION **A Decade of Coordinated Fire Research in Australia – Hits, Misses and New Opportunities** (Ballroom A) *Richard Thornton, PhD, Bushfire Cooperative Research Centre, Melbourne, Victoria, Australia*				
5:30-6:00	**IAWF Annual Membership Meeting**				
5:00-6:30	**Networking and Social Hour** (Foyer outside Ballroom 306)				
6:30	**Banquet,** Entertainment by Old Habits (Ballroom 306)				

THURSDAY, FEBRUARY 21, 2013

6:30-7:30 AM	**Group Led Exercise Session** (204)
7:00-8:30 AM	**Continental Breakfast** (Ballroom B/C)
7:30 AM	**Registration Desk Opens** (Ballroom A)
8:15-8:30	**Welcome Back and Daily Announcements** (Ballroom A) *Kris Johnson, IAWF Vice President and Deputy Conference Chair*
8:30-9:15	MODERATED DISCUSSION **Wildfire Management Dynamics: Balancing knowledge, experience, opportunities, and limitations with objectives to develop direction** *Tom Harbour, Robert Mutch and Jacque Buchanan (Moderated by Tom Zimmerman)*
9:15-9:30	**Transistion to Concurrent Sessions**

CONCURRENT SESSIONS

	Room 305 A	Room 305 B	Room 306 A	Room 306 B	Room 306 C
	Fuels and Fire Behavior in Mountain Pine Beetle Affected Forests *Moderator: Marty Alexander*	**SPECIAL SESSION A data set for fire and smoke model development and evaluation--the RxCADRE project** *Moderator: Roger Ottmar*	**Fuel Classification** *Moderator: Moderator: Lemmi Briedis*	**Fuels Treatment** *Moderator: Moderator: Adam Gossell*	**Fire Modeling** *Moderator: Moderator: Dave Moore*
9:30-9:40	Announcements & Introductions	Announcements & Introductions	Announcements & Introductions	Announcements & Introductions	Announcements & Introductions
9:40-10:00	40. Looking beyond red crowns: Canopy and surface fuels in lodgepole pine forests following mountain pine beetle epidemics in south-central Oregon *Travis Woolley*	SS4.8 Ground Based Measurements of Energy Release and Air Flow in Experimental and Operational Prescribed Fires in Grass and Long Leaf Pine Woodlands *Bret Butler*	43. Australian Fuel Classification - Overview and framework *James Gould*	46. Fuel Life Cycle and Long Term Fire Behavior Responses to Fuel Treatment in Southeastern US Pine Ecosystems *Ben Hornsby*	49. Data assimilation for fuel moisture in WRF fire model *Martin Vejmelka*
10:00-10:20	41. Potential fire behavior in post-MPB lodgepole pine forests in south-central Oregon: Comparisons and lessons among BehavePlus, FCCS, and FlamMap *LaWen Hollingsworth*	SS4.9 RxCADRE: Fine scale spatially explicit fire measurements *Joseph O'Brien*	44. Local Enhancement of LANDFIRE Data: Evaluation of Options *Wendel Han*	47. The effectiveness and longevity of fuel treatments in coniferous forests across California *Erin Noonan-Wright*	50. Using terrestrial LiDAR to describe fuel elements in a diffuse-form shrub for fire behavior modeling *Theodore Adams*
10:20-10:40	42. Fire in the Crown? Comparing different sources of spatial data to monitor fire behavior in Montana's Southwestern Crown of the Continent *LaWen Hollingsworth*	SS4.10 Merging Unmanned Aircraft Collected Aerial Imagery to Map the 2012 Rx-CADRE Prescribed Burn Plots *Gregory Walker*	45. Application of L systems to geometrical construction of chamise and juniper shrubs *Tom Fletcher*	48. Effects of Mechanical Thinning on Fuel Consumption and Emissions from Prescribed Burning in Coastal NC *Karsten Baumann*	51. Analysis of inventory data derived fuel characteristics and fire behavior under various environmental conditions. *Anne Andreu*
10:40-11:00	**BREAK** (Ballroom B/C)				

POSTER PRESENTATIONS

11:00-12:00	***Poster Session*** (Ballroom B/C)			
P48. Numerical experiments to provide functional relationships that describe differential heating around a tree bole *Anthony Bova*	P52. Assessing conditions that lead to night time smoke problems *Scott Goodrick*	P56. Effects of mastication on fire behavior and post-fire tree mortality in pine flatwoods ecosystems *Jesse Kreye*	P60. Development of Wildfire Ignition Risk Prediction Model from Transportation Corridors using Fluid Mechanics Analogy *Ravi Sadasivuni*	P64. Comparing the RAWS and RTMA Datasets to Help Analyze Surface Characteristics *Alan Srock*
P49. Fuel Element Combustion Properties for Live Wildland Utah Shrubs *Tom Fletcher*	P53. The Oak Woodlands and Forests Fire Consortium *Keith Grabner*	P57. Using crib fires to predict flame residence time *Sara McAllister*	P61. Local variability in understory microclimate is explained by LiDAR-derived measures of canopy structure *Michael Gallagher*	P65. A Synopsis of the 2012 National Prescribed Fire Use Survey Report *Pete Lahm*
P50. Achieving Economic Efficiencies and Sustainability of Wildland Fire Programs in the National Park Service: An Analytical Approach to Investment Priorities and Workforce Management *Jesse Duhnrack*	P54. Characterization of fuel structure and estimations of biomass using 3D terrestrial laser scanning *John Hom*	P58. Fire Intensity and Regime on Vegetation Dynamic in Climate Change Context in West African Savanna *Aya Brigit N'Dri*	P62. Wildland fire suppression modeling using Wildfire Analyst *Nicole Simons*	P66. Using Landsat imagery to monitor post-fire forest dynamics in upland oak forests on the Cumberland Plateau, Kentucky *Mary Arthur*
P51. Ramifications of (In)Accurate Corporate Geospatial Databases *Justin Shedd*	P55. The Southwest Fire Science Consortium: An opportunity in fire science and management *Barbara Satink- Wolfson*	P59. Fuel treatment effectiveness over 10 years in California forests *Alicia Reiner*	P63. LANDFIRE Processes, Products and Applications: Data and Tools for Managers *Jim Smith*	P67. Fire Induced Tree Mortality following Lightning Ignition in the Ouachita Mountains, AR *Virginia McDaniel*

12:00-1:00	***LUNCH (Ballroom B/C)*** (Ballroom B/C)

CONCURRENT SESSIONS

	Room 305 A	**Room 305 B**	**Room 306 A**	**Room 306 B**	**Room 306 C**
	SPECIAL SESSION: Behavior and Ecological Consequences of Smoldering Fires *Moderator: Adam Watts*	**SPECIAL SESSION: A data set for fire and smoke model development and evaluation--the RxCADRE project** *Moderator: Roger Ottmar*	**Decision Support Information** *Moderator: Kris Johnson*	**Fuels Treatment** *Moderator: Adam Gossell*	**Smoke** *Moderator: Chuck Bushey*
1:00-1:10	Announcements & Introductions	Announcements & Introductions	Announcements & Introductions	Announcements & Introductions	Announcements & Introductions
1:10-1:30	SS1.7 Pile Age and Fire Effects *Clint Wright*	SS4.11 Supporting RxCADRE Fire Measurements with Unmanned Aircraft Systems *Thomas Zajkowski*	52. National Weather Service Smoke Management Decision Support Tools in the Carolinas and Georgia *John Tomko*	57. Fuel Treatment Effectiveness Monitoring and Lessons Learned *Bradley Washa*	62. Pains Bay Fire Assessment *Robert Mickler*
1:30-1:50	SS1.8 Determinants of smoldering in cypress swamps: landscape factors and implications for carbon release *Adam Watts*	SS4.12 New scientific investments and approaches to fire behavior modeling *William (Ruddy) Mell*	53. Development and Use of a New Forecast Tool to Improve Super Fog Forecasts *Josh Weiss*	58. Evaluating models for low intensity wildland burning using comprehensive observations from four prescribed fires *Tara Strand*	63. Detection and simulation of smoke feedbacks to atmospheric boundary layer for a prescribed burn *Yongqiang Liu*
1:50-2:10	SS1.9 The role of pine cones as a vector for duff ignition *Jesse Kreye*	SS4.13 The RxCADRE project: Ground-based emission and plume dynamics measurements *Brian Potter*	54. Incident Management Team utilizes two National Weather Service Products: Fire Weather Point Matrix and Super Fog Smart Tool to successfully implement smoke mitigation plan to address smoke hazards to transportation corridors *Gary Curcio*	59. Fuel accumulation rates following hazardous fuel reduction treatments throughout California *Nicole Vaillant*	64. Using optical flow techniques to examine smoke plume dynamics *Scott Goodrick*
2:10-2:30	SS1.10 An approach to bridge the gap between combustion and geoscience: emissions and dynamics from smoldering fires *Rory Hadden*	SS4.14 Aerial and Ground Measurements of Emissions from Prescribed and Laboratory Forest Burn *Brian Gullett*	*55. SmartFire 2: A Flexible Framework for Merging Fire Information* *Sean Raffuse*	60. Creating an Efficient and Effective Conservation Plan: Finding the Right Mix of Fire and Non-Fire Treatments Based Upon Costs and Benefits *Jim Smith*	65. A Superfog Index Based on Historical Data *Gary Achtemeier*
2:30-2:50	Q&A, Discussion	SS4.15 Airborne measurements of smoke chemical composition, plume rise, and smoke dispersion from operational prescribed fires in Florida *Shawn Urbanski*	56. Fire managment objective considerations *Grant Steelman*	61. Wood to Energy in the Southeastern US *Dan Len*	66. Identification of Necessary Conditions for Arctic Transport of Smoke from Fires in CONUS and Russia. *Sim Larkin*

2:50-3:10	**BREAK** (North Hallway outside Ballrooms 305/306)				
	Fire Effects and Monitoring *Moderator: Richard Thornton*	**Emerging Fire Situations** *Moderator: Gene Rogers*	**Decision Support Information** *Moderator: Kris Johnson*	**Fuels Treatment** *Moderator: Adam Gossell*	**Smoke** *Moderator: Chuck Bushey*
3:10-3:30	67. Effects of Fire on Wading Bird Foraging Habitat and Resources *Louise Venne*	70. Future trends in mega-fire and fuel in the United States under a changing environment *Yongqiang Liu*	73. An accuracy assessment of surface fuel classification systems and maps, and why fuel variability and spatial scaling matters *Robert Keane*	76. Hazardous Fuels Treatments and Wood Utilization in the Colorado Front Range *Dan Len*	79. Linking Visual Range, PM2.5 Concentrations and the Air Quality Index - What do we tell the Public in Smoke-Filled Wildfire Situations? *Susan O'Neill*
3:30-3:50	68. Fire effects monitoring is a valuable tool in managers' toolbox *Beth Buchanan*	71. The Waldo Canyon Fire and Front Range Fires of Colorado *Rich Harvey*	74. Estimation of Fireline Construction Rate for Large Wildland Fire Using Geospatial Perimeter Data *Hari Katuwal*	77. Woody Biomass for Thermal Energy in the Northeast and Midwest *Lew McCreery*	80. Where the Wind Doesn't Blow: A Climatology of Air Stagnation Events in the United States *Alan Srock*
3:50-4:10	69. Alteration of presettlement fuels and fire regimes of the Custer-Little Bighorn landscape in Montana *Cecil Frost*	*72. Determining and Evaluating Variables Contributing to the Spread of Fire in Alaska* *Marsha Henderson*	75. An Enhanced Spatial and Predictive Fire Danger Rating System for New Jersey *John Hom*	78. The technical and financial feasibility of using distributed scale thermochemical conversion to produce biochar from forest and range treatment residues *Nathaniel Anderson*	81. Air pollution forecasting by coupled atmosphere-fire model WRF and SFIRE with WRF-Chem *Adam Kochanski*
4:10-4:20	**Transition to Closing Session** (Ballroom A)				
4:20-4:55	CLOSING PRESENTATION **A Changing Fire Environment: Forty Years of Forest Service Experience** (Ballroom A) - *Tom Tidwell, Chief, US Forest Service*				
4:55	**Conference Adjournment -** *Dan Bailey, IAWF President*				

FRIDAY, FEBRUARY 22, 2013

8 AM-5 PM	POST CONFERENCE TOURS AND FIELD TRIPS
11 AM-5 PM	GOLF SCRAMBLE

Special *Events*

BANQUET, WEDNESDAY, FEBRUARY 20TH

Tickets are $42 and include dinner and entertainment

If you are interested in attending but did not sign up in advance,
please check at the registration desk to see if there is still space available.

Entertainment by Old Habits

Picking around Raleigh since 2003, Old Habits blends bluegrass, rock & country into music for all people. They sound like Bill Monroe playing John Prine songs with The Band. These guys have developed a classic sound and put on a fun show that will keep you dancing all night.

The band members are Chad Johnson on Acoustic Guitar; Craig Thompson on Upright Bass, Harmonica; and Lin Peterson on Banjo, Telecaster.

Expressions *of the* Beauty *and* Danger *of* Fire

AN ART EXHIBIT, COMPETITION AND SILENT AUCTION

Purpose: Exhibit artwork with a fire theme

We encouraged people to enter any form of **art including textile, painting, wearable, photography, ceramics, collage, poetry, sculpture, carving etc.**

Visit the exhibit in Ballroom B/C during meals and networking breaks.

Awards will be given in several categories – best: in show, photography, oil, water color, acrylic, textile, ceramic, written, and people's choice. Awards will be announced at the banquet Wednesday, February 20, for all categories after closing of people's choice voting.

People's Choice Voting
Look for the voting form in your registration packet. Complete and return to the registration area. Voting must be completed by 5:00 pm on Wednesday.

Some of the work will be donated to a silent auction to raise funds for support of the National Fallen Firefighter Foundation and the International Fire Relief Mission. The **Silent Auction** will begin Tuesday morning and end Wednesday Evening after the banquet.

The Fire Science Quiz Bowl

A Quiz Bowl will be conducted on Monday Evening, February 18, 2013 - 6:00 PM

The goal is to provide a spirited competition between students from different schools and allowing both the participants and the audience to gain a better knowledge of Wildland Fire Science's finer points.

1. Each school may only have one team with a maximum of four student members currently enrolled at the school. Teams consisting of less than four members will be allowed to participate. Graduate and undergraduate students from the school may participate as members of the team.
2. Schools who wish to participate must register. We will accept registration at any time leading up to one hour before the start of the Quiz Bowl. Earlier registrations will insure your team a place in the Quiz Bowl bracket. The registration form is attached.
3. Only a limited number of teams will be allowed to compete due to time constraints. If more teams register than time allows for the competition, a testing procedure will be implemented to select the most qualified teams.
4. Questions for the Quiz Bowl come for all areas associated with Wildland Fire Science and Management. Questions wills be solicited from schools with a Fire Science program, state fire chiefs, and fire scientists. A complete list of categories is included in item 15.
5. Questions will be phrased in an open-ended manner. There will not be any true/false questions. Questions will be asked in a way that the answer is clear.
6. The competition will be single elimination. Teams will be arranged in a random order without regard to type of school. The field will be narrowed to two teams, which will compete in the final round.
7. Each match will last for a predetermined amount of time.
8. The moderator will announce the category of the question before the question is read. The moderators can be student members of the host student chapter. The organizing committee will select volunteers to serve as judges.
9. Each team will have an equal chance to answer the question within 10 seconds using an electronic buzzer provided. Teams will need to "buzz in" when they know the answer to the question asked by the moderator. If neither team signals within the time constraint, the moderator will announce that time has run out and will move on to the next question. The team that signals first will be allowed 20 seconds to answer the question. The team captain must report the answer within the allotted time. If the team's answer is correct, they will earn 2 points. If the answer is incorrect, the team will lose 2 points, and the second team will be given the chance to answer the question. The second team will have the option to hear the question again, and will be given 5 seconds to signal after the question is read and 10 seconds to answer. If the second team answers correctly, they will gain 2 points; however, if they answer incorrectly, they will be penalized 2 points. Should the first team signal in before the question has been completed, the moderator will not complete the question, and the team must answer within 20 seconds. Should the team answer incorrectly, the entire question will be repeated for the second team; they will be given 10 seconds to signal after the question has been read, and 20 seconds to answer.
10. Discussion is allowed between team members only after they have initially signaled. Deliberation between team members is not permitted before "buzzing in". No discussion between different teams or their advisors will be allowed. The moderators and judges will help keep background and audience noise to a minimum during each round.
11. The team captain is the speaker for the team and must address the moderator within the time limit or the team will lose 2 points. Each team must designate a team captain before the competition begins.
12. At the end of the time period, the team with the most points will be the winner of the match and will move on to the next round. The winner of the final match wins the Quiz Bowl Competition.
13. In the event of a tie for any match, the teams will enter a rapid-fire session, which will last no more than 2 minutes. In this session, the signaling time is reduced to 5 seconds, and the answering time is reduced to 10 seconds. (If the signal interrupts the moderator when asking the question, the moderator will discontinue asking the question.) Only the first team to signal after each question is read will be allowed to answer in the rapid-fire session. Point values are the same as for the regular round. Additional 2 minute long rapid-fire sessions will be held until there is a winner.
14. Should there be an odd number of schools registered a bye will be awarded to one school using the following procedure: a card with a number between 1 and N (N being the number of schools registered) will be put face down on a table and numbers between 1 and N will be drawn from a hat. The school that draws the same number as on the face down card on the table will get a bye in the first round. The order of schools will be determined by the number they drew. The team receiving the bye will advance to the next round. The final format for the competition will be available the day of the competition (Early registration of the teams is encouraged. This will reduce the problem of rearranging the competition format for late registering teams.)
15. The categories are as follows: Fire Behavior; Wildfire; Models, Fuels; Fire, people and history; Incident Command; Acronyms; Weather; Prescribed Fire; JSFP; Fire Policy; Fire Effects; Smoke Management; Fire tools and Fire disasters
16. The winning team will be awarded the right to brag that their school is the best in Fire Science in 2013. All other teams must bow in their presences.

Field Trips

1) Marine Corps Base, Camp Lejeune

Date: Friday, February 22
Time: 7:30 am - 6:00 pm
Trip departs and returns to the Raleigh Convention Center
Space is limited, open to 50 people on a first come, first serve basis.
Cost: $65/person, includes lunch and refreshments

Itinerary:
The first stop will be an organic soil discussion led by Jim Reardon. This stop is at the site of a successful prescribed burn of pocosin fuels on organic soil. This burn resulted in high surface fuel consumption with no significant soil consumption or residual smoldering. Fire management of sites with organic soils is a serious challenge due to the effects on flora and fauna habitat and to the emissions that can affect public health and serve as a contributing factor for super-fog events in smoke sensitive areas miles downwind . Our onsite discussion will focus on current research to develop and field test a model to estimate smoldering potential and the use of new remote site monitoring tools.

The second stop of the field trip will be weather dependent with a stop at a prescribed burn being conducted by Danny Becker's staff. We will hear about fire management on Lejune from Danny and Gary Achtemeier will discuss smoke management and new smoke tools. Option 2 - In the event it is too wet to conduct a prescribed fire, Susan Cohen (Research coordinator for Lejune) and Danny will have another location where we will hear about fire management on Lejune.

The third stop of the field trip will be the fuel mastication site. Norm Christensen and Karsten Baumann will talk about longleaf ecosystem restoration and smoke. We also hope to have a couple of individuals at this stop to discuss the Rabbit Rules for smoke and super fog, and the tools they use on Eglin AFB where they burn over 100,000 acres/year.

2) NCSU Textile Protection and Comfort Center T-PACC!

This field trip will take you to the North Carolina State University College of Textiles, T-PACC to examine the equipment and methodology involved in the development and testing of PPE. You will see firsthand the infrastructure, equipment and personnel that investigates all aspects of protection and comfort of clothing. T-PACC has unique scientific abilities that permit evaluations of comfort and protection from fabric swatch level all the way to full ensemble systems.

T-PACC, is a world leader in development of laboratory based instrumented systems, has facilities devoted to analysis of heat and flame protection, chemical resistance, and comfort performance. You will see demonstrated PyroMan™ - a fully instrumented, life-sized manikin used to evaluate the performance of thermally protective clothing, housed in a large fire test chamber. Also, you will see comfort performance testing using "Sweatman", and other textile performance tools, that test complex interactions between fabric and garment design, climate, physiological, and psychological variables that define comfort and performance, the two most important qualities influencing product acceptance by the end user.

Dates: Monday, February 18 and Friday, February 22, 2013

Trips depart and return to the Raleigh Convention Center.

Monday, February 18
Trip 1: 9:00 - 11:00 a.m.
Trip 2: 1:00 -3:00 p.m.

Friday, February 22
Trip 3: 9:00 - 11:00 a.m.
Trip 4: 1:00 - 3:00 p.m.

Capacity: 15 seats available for each trip on first come, first serve basis

Cost: $5/person to help pay for the transportation

General *Information*

Conference Proceedings

For publication in the Joint Conference Proceedings for the International Association of Wildland Fire (IAWF) 4th Fire Behavior and Fuels Conference in both Raleigh, North Carolina and St. Petersburg, Russia all presenters, both oral and poster, are encouraged to submit one of the following:

1. Abstract - Authors will have the opportunity to edit the abstract that was submitted for the program.
2. Extended Abstract - The extended abstract is a longer version of your original abstract and is generally about 2 pages in length. For the extended abstract you should include references (see below).
3. Full Paper - For full papers the author must clear all third party intellectual property rights and obtain formal permission from their respective institutions, where necessary. Authors must also warrant that their work:
    - Has not been published before
    - Is not presently being considered for publication elsewhere
    - Does not violate any intellectual property right of any person or entity
    - Does not contain any subject matter that contravenes any laws (including defamatory material and misleading and deceptive material) and
    - Meets ethical research standards.

The technical editor will review, edit and send back to the author for approval.

Deadline for Raleigh conference submissions is March 30, 2013.

Visit the conference webpage for more information; including guidelines and template.

Dining

Breakfast, lunch, morning and afternoon refreshments will be provided Tuesday, Wednesday and Thursday. All meals and breaks will be located in the exhibit hall, Ballroom B/C.
A list of local restaurants may be obtained from the registration/information desk in the reception area. Check with staff and/or volunteers manning the table for specials some local restaurants are offering the conference attendees.

Exhibitors

The exhibitors will be set up on Tuesday and Wednesday in the exhibit hall located in Ballroom B/C. We encourage you to visit our sponsors and exhibitors during breakfast, lunch and breaks.

Green Initiative

The International Association of Wildland Fire (IAWF) is committed to minimizing the environmental impact of its conferences and meeting through:

- Reducing the amount of solid waste produced by the event;
- Reducing energy and water consumption at the event;
- Minimizing or off-setting harmful emissions resulting from vehicular transportation and energy consumption associated with the event;
- Disposing of solid and liquid waste in an environmentally responsible manner;
- Selecting facilities who have developed a sustainability policy;
- Buying environmentally aware products; and
- Educating participants and exhibitors.

We invite our conference participants and vendors to join us in this goal of incorporating environmentally responsible procedures and practices and in the use of environmentally responsible products while participating in this conference. Working together, we can make this a successful 'Green' event. Please remind yourself and help others to remember to reduce, reuse, and recycle!
The Raleigh Convention Center is committed to having the most environmentally efficient Convention Center in the nation. Their recent LEED Silver Certification shows that from safe cleaning products to optimized HVAC systems to water-use reduction, going green is critical to being a responsible member of a community, and we're all members of the global community, after all.

Mobile App

To download the 4th Fire Behavior and Fuels Conference mobile app:

- iPhone and iPad users--search "IAWF 2013" on the Apple App Store.
- Android users--search "IAWF 2013" on the Google Play Store.
- Blackberry and Windows users--go to this address on your smart phones: https://iawf.gatherdigital.com

Thanks! We hope you enjoy the mobile app!

Parking (See parking map on next page)

Public Parking garages on Lenoir Street between Salisbury and McDowell Street; one on McDowell Street between Cabarrus and Davie Street; One on Salisbury Street between Cabarrus and Davie Street.
Charge: $7.00
Accessible Parking: 1st level of each garage

Posters

Poster will be displayed on panels in Ballroom B/C. There are three formal poster presentations at the following times:
Tuesday, 11:30-12:30 pm
Wednesday, 11:30-12:15
Thursday, 11:00-12:00
Please see the detailed program for the list of posters that will be presented on each day. All posters will be left up the entire three days, however will be manned by the authors during the formal presentation times listed above.

Poster presenters may place their posters anytime between 4:00 pm on Monday – Tuesday at 11:30 am. All posters must be removed before 2:00 pm on Thursday, February 21st

Presenters

All presenters are required to turn in their power point presentations the day prior to their scheduled session. Please confirm schedule at the registration desk. This will ensure presentations can be opened and loaded onto the conference computer. All final adjustments can be made at this time.
Presenters should be in their presentation room at least 10 minutes prior to the commencement of the session in which they will be presenting to meet with the Session Moderator.

A Speaker Ready Room is available for all conference presenters to preview their material prior to presentation. The Speaker Ready Room is Room 307.

Questions and Information

If you have any questions or need any assistance please visit the registration desk which will be located in the reception area outside of the main ballroom. Raleigh area information has been provided by the Raleigh Convention and Visitors Bureau; please visit the registration area for more information.

Wellness

Take care of yourself at the Fire Behavior and Fuels Conference. We all know that our health and wellness should take top priority, but sometime we need a reminder. Take advantage of the group led physical activity session that we will be providing each morning before the conference. The sessions will be in Room 204 on Tuesday, Wednesday and Thursday morning from 6:30-7:30 am.

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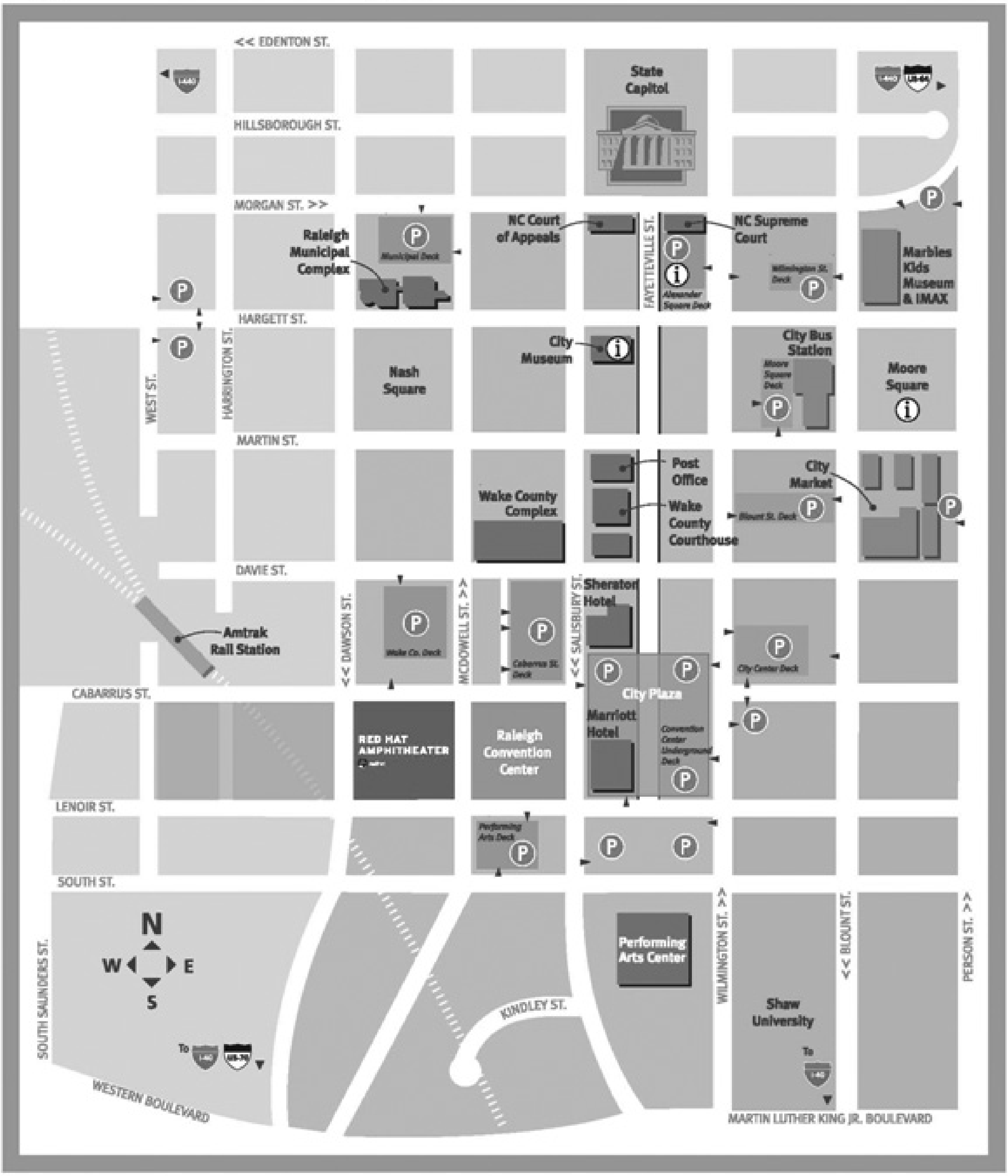

Exhibitors/ *Sponsors*

Bushfire CRC www.bushfirecrc.com
The Bushfire Cooperative Research Centre is conducting research into the social, environmental and economic impacts of bushfires. After an initial grant through the Australian Government's CRC program in 2003 combined with substantial partner resources, the Bushfire CRC is now funded to 2013 to address key issues raised by recent major fires. The Bushfire CRC is made up of all the fire and land management agencies in Australia and New Zealand, CSIRO, the Bureau of Meteorology, the Attorney General's Department and several other fire related organisations. A small executive office is in East Melbourne.

EnvironX Solutions www.environxsolutions.com
EnvironX Solutions formulates and manufactures organically based, environmentally beneficial fire suppressant and retardant solutions that control all (above and below) ground fires. The result: minimal property damage, no health hazards and increased firefighter safety. Our journey began with a focus on the safety and health of firefighters. Alarmed by the health issues many fire fighting professionals experienced when employing toxic fire retardants, our engineers set out to develop a completely safe, organic, and sustainably produced fire suppressant. Our first product – now called Fire TechX™ – proved not only safe enough to eat, but the most innovative and effective fire retardant in the industry.

Esri www.esri.com
GIS software from ESRI enables you to capture and create an integrated picture of information in the form of interactive maps and reports on the desktop, laptop, handheld, or in the emergency vehicle. GIS will help you unlock the spatial component of your valuable data and see your organization's information from a new perspective.

Fecon, Inc. www.fecon.com
Fecon, Inc. was established in 1992 to meet the growing needs of the Organic Resource Recovery Industry in North America. Today, Fecon serves as an international supplier of vegetation management equipment and wood to energy equipment. Fecon serves thousands in R.O.W., land clearing, firebreaks, pasture restoration, invasive species and wildlife restoration markets. Fecon's product line includes Bull Hog® Mulchers, FTX Track Carriers, Bio-Harvesting Equipment, Tree Shears, Grapples and Stump Grinders. In 2004, Fecon expanded into a new state of the art 56,000 sq. ft. manufacturing facility in Lebanon, Ohio. An additional expansion of 55,000 sq. ft. was achieved in fall of 2008.

FireIce www.FireIce.com

GelTech Solutions is committed to creating effective solutions to common problems. We created the FireIce® line of products to fight fires efficiently and effectively, all while doing so safely and without harming the environment. FireIce has dramatically improved the ability of both professional firefighters with fire suppression systems and homeowners with home fire protection to successfully fight and prevent fires. FireIce takes the world's most precious resource, water, and increases its firefighting ability. While water has the natural ability to slow fire, only FireIce has the ability to stop it. Firefighters, first responders and military personnel have seen FireIce stop fire in its tracks before it can destroy property or claim lives. With our FireIce Home Defense Unit, we've also put the power to protect property in homeowners' hands. The GelTech Solutions family is committed to environmental preservation. Our FireIce products are non-toxic to wildlife and aquatic species, as well as children and pets, and it breaks down harmlessly over time in the soil.

FireWatch America www.firewatchamerica.com

FireWatch, the 2012 winner of the Space Foundation's Hall of Fame Award for technology has partnered with FireWatch America, LLC to distribute early wildfire smoke detection technology here in North America. This state-of-the-art, patented technology uses both an on-sight computer along with transmitted data to a control center as a two-step detection and analytic process. Moving in 10 degree increments, the sensor completes a 360 degree rotation every 8 to 12 minutes, during which it takes images, analyzes, and transmits those images back to the central secondary analysis. If possible fire events are detected, the system alerts fire authorities. Any suspected fire event creates a forensic digital record.

Geo-Marine, Inc. www.geo-marine.com

With more than 40 years of corporate growth and success, GMI provides engineering design, construction management, environmental planning and programming, and other A-E services in support of a wide range of government, industry, and commercial clients. Based from seven US offices, GMI's full-time staff of 102 engineers, scientists, and program managers executes projects on a worldwide basis. Current project locations range from Guam, Okinawa, and mainland Japan in the Pacific, to Scotland and the Mediterranean in Europe, as well as more than 30 US states. GMI is committed to a simple principle: Great service creates satisfied customers. Many of our client relationships exceed 20 years, evidence of the focus we put on customizing our services to meet the needs of each individual client. Each of our scientists, engineers, and program managers has a thorough understanding of engineering standards, regulatory requirements, logistical challenges, and funding constraints, enabling us to provide you with timely, innovative, and cost-effective solutions.

International Fire Relief Mission www.ifrm2007.com

The International Fire Relief Mission is a 501(c)(3) nonprofit corporation that provides humanitarian aid to fire and EMS first responders in developing countries by recycling serviceable fire fighting and EMS equipment. IFRM dispatches teams to the receiving countries to demonstrate and provide the necessary information to safely and effectively use the donated gear. Founded by retired firefighters and medics in 2007, IFRM is propelled by monetary, equipment and in-kind donations from corporate partners and individuals; its field staff is all-volunteer. IFRM maximizes its donors' gifts by operating with a 98% efficiency rating, as measured by the Charity Navigators and the Better Business Bureau. The International Fire Relief Mission is firefighters helping firefighters.

Joint Fire Science Program www.firescience.gov

Our Mission is to provide credible research tailored to the needs of fire and fuel managers. Engage and listen to clients and then develop focused, strategic lines of new research responsive to those needs. Solicit proposals from scientists who compete for funding through a rigorous peer-review process designed to ensure the best projects are funded. Focus on science delivery when research is completed with a suite of communication tools to ensure that managers are aware of, understand, and can use the information to make sound decisions and implement projects. Our program is uniquely positioned to tailor wildland fire research in response to the emerging needs of policymakers and fire managers. An annual cycle of proposal solicitation, review, and funding ensures timely response to evolving conditions. Research projects complement and build on other federal research programs, such as those in the Forest Service Forest and Rangeland Research Stations, U.S. Geological Survey, and National Fire Plan. Synthesis of research findings and targeted delivery to managers are essential components of the Program.

National Fallen Firefighter Foundation www.firehero.org

Congress created the National Fallen Firefighters Foundation to lead a nationwide effort to honor America's fallen firefighters. Our mission is to honor and remember America's fallen fire heroes and to provide resources to assist their survivors in rebuilding their lives.

NFPA – Firewise Communities® www.firewise.org

Firewise Communities® is a national interagency program that plays a critical role in the wildland/urban interface encouraging personal responsibility by engaging residents and others. The program's concern for safety of fire fighters working in interfaces is illustrated by programs such as Firefighter Safety in the W/UI and Using Water Effectively.

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North Carolina State University - College of Textiles

www.tx.ncsu.edu/tpacc/

Located in the North Carolina State UniversityCollege of Textiles, T-PACC incorporates a comprehensive infrastructure of equipment and personnel to address the need for integrated investigations on all aspects of the protection and comfort of clothing. T-PACC is a broad base facility with unique scientific abilities that permit scientific evaluations of comfort and protection from fabric swatch level all the way to full ensemble systems. T-PACC, a world leader in laboratory based instrumented systems, has facilities devoted to analysis of heat and flame protection, chemical resistance, and comfort performance. Comparative testing is routinely conducted on materials and clothing systems using procedures found in various standard test methods. Additionally, non-standard test protocols are utilized with appropriate procedures and instrumentation while new methods and instrumentation are developed to address the evaluation needs for specific end use or wear scenarios. T-PACC is comprised of highly skilled professional and technical personnel with a proven performance record in fundamental research, method and instrument development, and in providing testing services to both industry and government clients. The acquired knowledge of T-PACC personnel spans various areas of textile materials science and engineering required for the measurement and analysis of textile comfort and protection. T-PACC personnel participate in ASTM and ISO committees involved in the development of standards for measurement of textile comfort properties and protective performance. Additionally, The Manikin Men assist with meeting project goals and are an important component of the T-PACC core team!

North Carolina State University – GIS www.gis.ncsu.edu

Geospatial Information Science and Technology is the study of the theory and practice of spatial analysis and Geographic Information Systems. NC State provides an outstanding opportunity for scholarship and training in GIS&T through its multidisciplinary Graduate GIS faculty, its extensive ties to industry and government, and its traditional university strengths in computational technology and analytics.

Phos-Chek® www.phos-chek.com

Phos-Chek® long-term fire retardants, Class A foams, and water enhancing gel are the world's leading chemical solutions for managing wild land, industrial and municipal fires. In 1962, the Phos-Chek name was born and an era of innovation and partnership began. For several years before and for four decades since, we have worked side-by-side with fire management agencies in North America and across the world to provide safe and effective firefighting chemicals to meet the needs and desires of fire management personnel. Phos-Chek Class A Foam M makes water more effective. Phos-Chek Flash 21 is a fuel gelling agent for ground and heli-torches. Phos-Chek AquaGel-K and Insul-8 Gel are thickened water products that are ideal for structure protection, exposure protection and other specialty applications. Long-Term Retardants, both in dry powder form or as liquid concentrates, for aerial or ground application are designed to meet the full range of fire management needs.

Southern Fire Exchange www.southernfireexchange.org

The Southern Fire Exchange (SFE) is a regional fire science delivery program, representing the southeastern United States. The SFE is a member of the national network of knowledge exchange consortia, funded by the Joint Fire Science Program. The Joint Fire Science Program funds scientific research on wildland fires and distributes results to help policymakers, fire managers, and practitioners make sound decisions. The regional consortia were established to accelerate the awareness, understanding, and adoption of fire science information within ecologically similar regions. The SFE is end-user driven, so please provide feedback about your fire-related information needs and opportunities.

USFS Pacific Northwest Research Station www.fs.fed.us/pnw/pwfsl

The Pacific Wildland Fire Sciences Laboratory (PWFSL) is one of seven research facilities of the U.S. Forest Service's Pacific Northwest Research Station and one of only three Forest Service fire science laboratories in the Nation. Fire research conducted at the Pacific Wildland Fire Sciences Laboratory examines the effects of weather and climate on fire, the effects of fire on ecosystems, and the impacts of smoke on human health. The laboratory houses about 40 employees and research collaborators.

Wildland Fire Management Research, Development, and Application (WFM RD&A) Program http://www.wfmrda.nwcg.gov/

The Wildland Fire Management Research, Development, and Application (WFM RD&A) Program will sponsor and guide the development and application of wildland scientific knowledge; develop decision support tools and hazardous fuels planning applications; and provide science application services to the interagency wildland fire community. The WFM RDA Program will manage the National Fire Decision Support Center and serve as a primary point of contact for communication between scientists and participating field managers, and as an advisor to program administrators at local, regional, and national levels. With integrity, professionalism, safety, and mutual respect as our core values, we serve as leaders, role models and mentors within our resource management agency.

Monday, February 18, 2013

RX 310 - Introduction to Fire Effects
8:00 am – 5:00 pm and several evenings during week
Instructors: Linda Wadleigh, US Forest Service, Region 3

RX 310 will provide students with the knowledge and skills necessary to recognize and communicate the relationships between basic fire regimes and first order fire effects, the effects of fire treatments on first order fire effects, and to manipulate fire treatments to achieve desired first order fire effects." (NWCG PMS 901-1) The course will meet the 32-38 hour requirement of NWCG through unit instruction, pre-work, conference attendance and post-workshop homework. Students will attend an 8-hour seminar on Monday, February 18th to receive introductory instruction in fire ecology, fire effects, and ecosystem dynamics. Students will have already completed pre-work concerning basic fire ecology as well as examining how fire ecology and fire effects are incorporated into resource management on their home units. As the week and Conference proceeds, students will participate fully in the conference, armed with a series of questions and discussion topics to be addressed during plenary sessions. They will also have two evening sessions when they will meet with assigned cadre members and selected Conference presenters to address questions and discussion topics, helping them to more fully understand class and conference information. Their week will end with a class session/close-out and assignment of a follow-up project at their home unit which will require them to meet and discuss fire effects on an ongoing project with an agency resource professional outside the fire management arena.

Introduction to Interagency Fuels Treatment Decision Support System (IFT-DSS)
8:00 am – 5:00 pm
Instructor: Stacy Drury & Erin Banwell, Sonoma Technology

The web-based Interagency Fuels Treatment Decision Support System (IFTDSS) was designed to provide fire and fuels managers with a single software solution to manage the many data types, software applications, and tools available for fuels treatment planning. IFTDSS provides a user-friendly platform that addresses the proliferation of software tools and systems in the fire and fuels treatment domain. This workshop will provide an introduction to IFTDSS and will discuss the workflow scenarios that have been developed to address common goals and objectives in fuels treatment planning. Workshop participants will be introduced to the functionality currently implemented for prescribed burn planning, hazard analysis and risk assessment via live online demonstrations of the IFTDSS system and classroom exercises. Workshop participants are encouraged to bring their own laptop computers to get hands on experience using IFTDSS as well as project ideas and project data from their home units to investigate the full potential of IFTDSS.

Wildfire Analyst: Fire Behavior Analysis & Simulation Tools for Operational Decision Making
8:00 am – 5:00 pm
Instructors: Joaquin Ramirez, DTS Wildfire; Santiago Monedero, Technosylva; and David Buckley, DTS Wildfire

Wildfire Analyst (WFA) is the next generation of wildfire simulators, that provides for use of traditional and new innovative fire behavior analysis and spread simulation models to support real time decision making. Attendees will receive an evaluation copy of the software and learn how to prepare scenarios, derive fire behavior outputs and simulate wildfires in a couple of minutes using a seamless GIS environment. Advanced capabilities will include automatic adjustment of wildfire rate of spread factors based on field observations; integration of active and forecasted weather from web sources; simulation of prescribed fires for daily burn operations; and innovative new simulation modes for calculating evacuation timesheds, full frontal propagation, MTT fire paths. Both desktop and web tools will be used. The primary goal is that participants be able to use WFA in real fire incident operations with adjustments for the simulations automatically based on the on-scene observed fire behavior. Any participant who brings their own laptop with an active license of ArcGIS 9.3 or 10 will be able to install and run a 90 day full evaluation of the complete suite of Wildfire Analyst, that will be provided in advance along with test data scenario.

Fire Practitioner Tools for Assessing Wildland Smoke
8:00 am – 5:00 pm
Instructors: Miriam Rorig, US Forest Service PNW Research Station; Gary Curcio, PFAFES; and Bill Jackson, US Forest Service, Southern Region

This workshop will present simple and complex tools that can be used by fire practitioners to assess how smoke will disperse, and give participants practical experience using these tools. Presently there is information available in the NWS Weather grid that if requested, acquired and evaluated, can project for the day and night how atmospheric conditions will affect smoke dispersal and potential for Super-Fog events. Southern and western fires and simulated fires (created with NWS PFW's and other tools) will be used as examples to demonstrate how to use tools such as: already deployed Air Monitoring Stations (EBAMS, ESAMPLERS, and Javelins with CO Dosimeters), WFDSS, WFDSS_AQ Portal, Blue-Sky Playground, Smoke Dispersion Matrix Table, Determining Smoke Management Burnout Window, Creating NWS Fire Weather Point Matrix (PFW) with a Smoke format, and Models utilized for wildland smoke projections: FEPS, CONSUME, VSMOKE, and PC-HYSPLIT. Workshop participants will be required to bring their own PC with WIRELESS capability. Instructions will be sent to participants to have already installed and functioning software, user id and password to key programs such as WFDSS, BLUESKY, and HYSPLIT, etc. There will be a file of required pre-workshop reading material for attendees to complete to facilitate the speed of this workshop.

Advanced Fire Behavior Analysis Through Lessons Learned
1:00 pm – 5:00 pm
Coordinators: Dan Mindar, National Park Service, Erin Noonan-Wright, US Forest Service, Tami Parkinson, USFS, and Laurie Kurth, USFS, RMRS
Instructors: Chuck McHugh, Robert Ziel, and Marsha Henderson

This course will develop skills to critically assess fire behavior inputs and results, calibrate fire behavior analyses and achieve confidence in the results. Each workshop will focus on two principal components of fire behavior analyses and interpretation, such as weather inputs or probabilistic outcomes. Case studies will be developed from wildland fire incidents where modifications to analyses were necessary in order to achieve results that simulated actual fire movement. Participants will review an unedited analysis, compare the analysis to fire growth/behavior, discuss inputs that may provide better results, make changes, run fire behavior, compare results, and discuss the modifications and results that were done on that incident. Focus will be on fires where thinking beyond standard fire behavior rules was required. Additionally time will be included to discuss questions, issues, or modifications that participants have faced while conducting fire behavior analyses. Participants should bring a laptop

Assessing Residential Wildfire Hazards
8:00 am – 3:00 pm
Instructor: Pat Durland, Stone Creek Fire LLC and National Fire Protection Association

When adequately prepared, a home or structure and the surrounding vegetation can survive a wildland fire without the intervention of the fire service. In fact, homes and communities can exist compatibly with nature and effectively resist wildfire ignitions. This is an interactive workshop which provides individuals the knowledge and skills to conduct comprehensive wildfire assessments and identify and prioritize mitigation efforts that reduce the risks of wildfire losses. Participants will: 1) Increase their understanding and competency in wildland/urban fire mitigation; 2) Be enabled to assist wildfire mitigation and prevention professionals in assessing risks to individual homes in areas at risk of wildfire losses; and 3) Be able to encourage and engage residents and homeowners in preparing their homes before a wildfire event.

Crown Fire Behavior in Conifer Forests
8:00 am – 3:00 pm
Instructors: Marty Alexander, University of Alberta, Miguel Cruz, CSIRO Australia, Nicole Vaillant, USFS, PNW Research Station

The current state-of-knowledge with respect to crown fire initiation and propagation in relation to fuel complex characteristics and surface weather conditions will be described with time for questions and discussion. Workshop participants will also have the opportunity to share their experiences and observations regarding crown fires, including thoughts on future research needs and knowledge gaps. Participants will be asked to submit a color photo of a crown fire to be projected during the workshop and be prepared to orally provide a short description of the image. The instructors will elicit input on fuels and fire behavior characteristics that are unique to the southern United States in regards to crown fire behavior in conifer forests.

Introduction to Fuel Treatment Planning and Fire Behavior Modeling with ArcFuels10
8:00 am – 12:00 pm
Instructor: Nicole Vaillant, US Forest Service, Pacific Northwest Research Station

ArcFuels10 is a streamlined fuel management planning and wildfire risk assessment system which creates a trans-scale (stand to large landscape) interface to apply various forest growth (FVS, FFE-FVS) and fire behavior models (FlamMap5, Behave Plus, etc.) within an ArcGIS platform to design and test fuel treatment alternatives. The workshop will introduce the attendees to the capabilities of the system through a presentation of case study examples followed by instructor lead hands on exercises. Each attendee (or group of attendees) will need to supply a laptop with ArcGIS 10 with the Spatial Analysis extension to follow along during the exercises. The required ArcFuels ESRI AddIn file, documentation, demonstration data, and extra programs will be supplied at the beginning of the workshop.

Wildland Fire Assessment Tool (WFAT): – A Spatial Model for Wildland Fire Behavior and Fire Effects
8:00 am – 12:00 pm
Instructors: Wendell Hann, US Forest Service; Josh Hyde, University Idaho

WFAT provides an interface between ArcMap, FlamMap5, and the First Order Fire Effects Model (FOFEM), combining their strengths into a spatial fire behavior and fire effects analysis tool in GIS. WFAT allows managers to compare management alternatives and saves the time and effort of converting data between multiple formats. The workshop will begin with a presentation describing the WFAT tool, followed by live demonstrations of the tools, and examples of applications. We will demonstrate how downloadable LANDFIRE layers (landfire.gov) can be used as input GIS data. Time will be allotted for students to engage in hands on exercises using WFAT to assess fire behavior and fire effects. Participants will learn how to use WFAT to locate potential fuel treatment units and to evaluate the effects of a prescribed burn on soil exposure, emissions, and mortality. Computers are provided. Software, tutorials, and data examples will be provided in advance for those who register for the workshop.

Fire Culture: Using the Humanities to Revive the Ancient Link of People and Fire in Southeastern North America … and Around the World
10:00 am – 12:00 pm
Instructors: Johnny Stowe, Rhett Johnson, Jane Park

The use of fire is unique to humans, and stretches back well over a million years. People have used fire to shape landscapes and lifeways, and conversely, fire has shaped us. This inextricable link continues today, although it is often taken for granted, unrecognized, ignored, or even denied. Certain elements of the human dimensions of landscape fire (e.g. surveys of perceptions, information exchange) have grown considerably in the last few decades. But despite these advances, we have largely missed something in our human dimensions efforts, especially in the role of the humanities in wildland fire. The global wildland fire community needs to increase its efforts to make people aware of the ways in which people and fire are inextricably-linked through art, literature, philosophy, and history. This workshop will focus on people as part of the fire-landscapes of Southeastern North America -- but we believe that our proposed workshop will be timely, relevant and appealing to the IAWF's diverse, global audience. By highlighting existing and emerging artwork, literature, history and concepts, we will provide a fascinating workshop revealing the wonders of fire and people in southeastern North America, and hopefully, we will inspire the global wildland fire community to further revive the "humanities of fire" that are unique to their own landscapes.

International Journal of Wildland Fire Information and Feedback Session
1:00-3:00 pm
Instructor: Susan G. Conard, Co-Editor in Chief, International Journal of Wildland Fire

The workshop is intended to provide information about the International Journal of Wildland Fire to those who either might be interested in submitting papers in the future, or have submitted or published papers in IJWF in the past. We will discuss manuscript submission, data on past submissions (including turnaround time, manuscript handling, early online publishing, impact factor, etc.), and recent changes in Journal procedures. An important objective of the workshop is also to obtain feedback from the fire science community on the Journal practices, content or other issues.

Fire Regime Condition Class: Concepts, Applications, and Mapping Tool
1:00 am – 5:00 pm
Instructors: Steve Barrett & Josh Hyde, University Idaho

Fire Regime Condition Class (FRCC) assessments have been widely used for evaluating ecosystem status in many facets of natural resource planning across the U.S. State-and-transition modeling provides a basis for reference information related to landscape fire frequency, severity, and vegetation seral stage proportions. Quantitative methods based on similarity indexing serve to compare historical versus current vegetation and fire regimes. This technique allows field and GIS users to consistently assess FRCC for fire management plans and related planning efforts. Current applications of FRCC data include project design, risk assessments, treatment prioritization, fire use decisions, and evaluation of ecosystem sustainability. Although FRCC does not represent a stand-alone risk or allocation tool, such assessments provide a consistent landscape metric that can complement other measures of ecological health and fire regime departure. The workshop instructors will present an overview of the Fire Regime Condition Class concepts and methods, engage students in hands on exercises, and illustrate FRCC with the most recent version of the FRCC Mapping Tool.

Fire, Fuels, and Climate: Science Resources to Keep Pace with a Changing World
3:00 – 5:00 pm
Instructor: Lisa Jennings, North Carolina State University; Emrys Treasure, USFS, Eastern Forest Environmental Threat Assessment Center

In this interactive workshop, participants will explore the effects of climate change on fire and fuel management using the Template for Assessing Climate Change Impacts and Management Options (TACCIMO), a web-based tool that puts current and concise climate change science at the fingertips of forest planners and managers. A collaborative product of the USDA Forest Service Research Stations and the National Forest System, TACCIMO integrates peer-reviewed research with management and planning options through search and reporting tools that connect land managers with information they can trust. There is an ever-increasing volume of useful scientific knowledge about climate change effects and management options for natural ecosystems. However, the combined volume of existing information and rate of development of new information, lack of climate change specialists, and limited technology transfer mechanisms make efficient access and use difficult. TACCIMO highlights elements from the wealth of climate change science with attention to what natural resource planners and managers need through a searchable repository of over 4,000 effects of climate change and close to 1,000 adaptive management options, all excerpted from a growing body of peer-reviewed scientific literature. A geospatial mapping application provides downscaled climate data for the nation and other spatially explicit models relevant to evaluating climate change impacts on forests. Report generators assist users in capturing outputs specific to a given location and resource area in a consistent and organized manner. Overall, TACCIMO provides a fast, concise, and creditable starting point to guide critical thinking, additional analysis, and expert consultation to support all aspects of natural resource management decision making. Case-studies will focus on the effects of climate change on fire and fuel management in the southern US. Get started exploring TACCIMO at www.forestthreats.org/taccimotool/ and bring your laptop to the workshop.

Fire Monitoring and the Application of Adaptive Management for Public Lands Management
1:00 pm – 3:00 pm
Instructors: Jesse Burton & Caroline Noble, National Park Service

The workshop will provide students with information on how to determine and initiate a monitoring program, in accordance with interagency prescribed fire planning. Students will learn basic fire effects monitoring protocols, references and tools as well as how to utilize collected data for feedback to managers and fire management decisions. The workshop will provide an interactive environment where particular challenges faced by class participants can be discussed in an audience with broad backgrounds. The ultimate goal of fire monitoring for fuels, vegetation, or any other outcomes is to apply changes to programs through the adaptive management process.

Oral Abstracts

1. JFSP's Smoke Line of Work under the Smoke Science Plan

Author(s): Douglas Fox, Colorado State University
Allen Riebau, Nine Points South Technical
Cindy Huber, Nine Points South Technical
John Cissel, Joint Fire Science Program
Tim Swedberg, Joint Fire Science Program
Nancy Thomas, Nine Points South Technical

From its inception in 1998 the Joint Fire Science Program (JFSP) has funded smoke research. In 2009 JFSP developed a Smoke Science Plan (SSP) to insure that the line of work remains responsive to management needs and complimentary to other JFSP research. This presentation will review the SSP, specifically its four themes and 21 currently active funded projects: Emissions Inventory (6 projects), Model Validation (7), Populations and Smoke (5) and Climate Change (3). The objectives of the Emissions Inventory Theme are to develop the missing science and knowledge needed to improve national wildland fire emissions inventories and define best practices for developing future inventories and inventory systems for air quality management. Funded projects are characterizing organic aerosol emissions and their smoke impacts on regional particulate and ozone pollution, and evaluating the quality of current inventory tools. The objective of the Model Validation Theme is to develop techniques and interagency partnerships needed to objectively validate smoke and fire models. Funded projects are developing methodologies to archive, organize, present and apply field data for model validation, and initiating comprehensive validation dataset collection. Additionally, we are hosting an interagency workshop to develop a consensus approach to field studies for collection of smoke model validation data sets. The objectives of the Populations and Smoke Theme are to quantify the impact of wildland fire smoke on people including fire fighters and improve smoke warning systems. Funded projects are elucidating mechanisms of public smoke acceptance, identifying impacts of megafire smoke on large urban centers and linking visual and air quality impacts. The objective of the Climate Change Theme is to understand implications of wildland fire smoke to and from climate change using UN IPCC scenarios. Funded projects are reviewing simulation tools to assess regional climate change impacts on fuels, fire regimes, black carbon emissions and smoke. To ensure that SSP products are effectively delivered to users nationwide the JFSP has recently released a Smoke Communications Plan which will be implemented through JFSP Regional Consortia, the interagency smoke committee (SMoC) of the National Wildfire Coordination Group (NWCG), and fire and air quality managers.

Bio: Doug has been involved with smoke management research for over 40 years. He has worked on smoke management, air pollution and climate change research with the National Center for Atmospheric Research, NOAA, EPA, USDA Forest Service, the Cooperative Instituite for Research in the Atmosphere at Colorado State University and currently with Nine Points South Technical Pty, Ltd. He has authored or coauthored well over 100 research papers. He was educated in Engineering at the Cooper Union and holds a Ph.D. from Prinvceton University.

2. First Look at Smoke Emissions from Prescribed Burns in Long-unburned Longleaf Pine Forests

Author(s): Timothy Johnson, Pacific Northwest National Laboratory
Sheryl Akagi, University of Montana
Robert Yokelson, University of Montana
Ian Burling, University of Montana
David R. Weise, USDA Forest Service
James Reardon, USDA Forest Service
Shawn Urbanski, USDA Forest Service

While fire has long played a role in the longleaf pine ecosystem, there are still some stands in the southeastern United States where fire has not been reintroduced and fuels have accumulated for 50 years or more. As part

of a larger study examining fuel loading and smoke emissions on Department of Defense installations in the South, we measured fuels and trace emissions on three prescribed burns totaling 126 ha at Ft. Jackson Army Base near Columbia, South Carolina in November 2011. Last known fires on the three burn sites occurred in 1957, 1956, and 2003. Due to access constraints because of active training, we typically sampled fuels the day of the burn. Smoke emissions were measured on the ground and from an aircraft by scientists from the University of Montana, Colorado State University, the Forest Service Rocky Mountain Research Station, the Environmental Protection Agency, and the Pacific Northwest National Laboratory. Concentrations of twenty-two gas species were measured using an airborne FTIR instrument and seventy-six gas species were measured off-line by whole-air sampling. Selected emissions data will be compared with similar emissions data collected from prescribed burns sampled in coastal North Carolina in 2010 in younger fuels beds in loblolly/longleaf stands at or near Camp Lejeune.

Bio: Dr. Johnson is a m ember of a team involved in building the Northwest Infrared Database, a vapor-phase infrared spectral library used for a multitude of purposes, including environmental monitoring, fence-line monitoring, hazardous material response, and general scientific research. Dr. Johnson is part of an EMSL-based team for collaborations involving fundamental spectroscopy, both infrared and Raman, and is also working to develop infrared sensors, both FTIR-based and laser-based systems for atmospheric chemical sensing.

3. Modeling Smoke for Incident Support: The 2012 Wildfire Season

Author(s): Miriam Rorig, USDA Forest Service, AirFire Team
Narasimhan K. Larkin, USDA Forest Service, AirFire Team
Robert Solomon, USDA Forest Service, AirFire Team
Susan M. O'Neill, USDA Forest Service, AirFire Team
Pete Lahm, USDA Forest Service, F&AM

Numerous large wildfire complexes burned throughout the western United States during the summer of 2012, including fires in Colorado, Wyoming, Idaho, California, and Washington. These and other fires caused significant smoke impacts in many areas. Customized smoke modeling was done in support of various incidents during 2012, and efforts were made to incorporate this and other air quality information into the Incident and Area commands through the deployment dedicated Air Resource Advisors; this work built off of efforts undertaken for the 2011 Southwest fires in Arizona and New Mexico. As such 2012 represented the first large scale deployment of a new collaborative arrangement between smoke modeling expertise (here drawn from US Forest Service Research) and on-the-ground operational firefighting teams and other state and local agencies working to mitigate the smoke impacts from the fire and relay information to the public. Lesson learned from this experience for both smoke modeling and information transfer will be presented.

Bio: Miriam Rorig has been a meteorologist with the Pacific Northwest Research Station since 1994, working in the field of fire weather meteorology and smoke dispersion modeling. She has worked on the development and evaluation of the BlueSky Smoke Modeling Framework. She is actively involved in tech transfer by teaching smoke dispersion modeling and working collaboratively with land managers to use tools developed for smoke management by the AirFire Team.
Accept as Oral Presentation

4. Fire environment effects on PM2.5 emission factors in southeastern U.S. pine-grassland communities

Author(s): Kevin Robertson, Tall Timbers Research Station
Yuch Ping Hsieh, Florida A&M University
Glynnis Bugna, Florida A&M University

Accurate estimation of emission of particulate matter smaller than 2.5 microns (PM2.5) from wildland fire is essential for development of reliable emissions inventories and development of sound air quality and fire management policies. Emissions estimates depend heavily on emission factors (EFs), which predict the amount of pollutant produced per unit biomass consumed. PM2.5 EF has been shown to correlate strongly with modified combustion efficiency (MCE), which is derived from the ratio of CO_2 to CO emitted, provding a reatively convenient means to estimate PM2.5 EF. Although PM emissions typically have been calculated from fixed EFs for whole ecosystems or regions, PM2.5 EF can be strongly influenced by factors including dominant combustion phase (flaming versus smoldering), fuel moisture, fuel particle size, fuel bulk density, fuel composition, and weather conditions influencing fire behavior, which in turn reflect plant community type, season of burn, and time since last fire. The purpose of this study was to investigate the effects of fire environment conditions and ecological variables on esimates of PM2.5 EF, compare our estimates of PM2.5 EF with those from previous studies, and compare the relationship between PM2.5 EF and MCE between this and other studies. PM2.5 EF was estimated by collecting PM2.5, CO2, and CO immediately above flames and smoldering fuels during prescribed fires at different times of the year and different times since previous fire (1-4 years) in frequently burned pine-grassland communities in northern Florida and southern Georgia while measuring a suite of fuel, fire behavior, and weather variables. PM2.5 EF was also estimated in a controlled environment to test the accuracy of field methods of estimation. PM2.5 EF was strongly related to fuel moisture, which reflected the ratio of live to dead fine fuel associated with with season of burn and time since last fire. Overall, our estimates of PM2.5 EF and ratios of PM2.5 EF to MCE were higher than previously reported, possibly because measurements were made near the ground and incorporated a higher proportion of emissions from smoldering combustion. Results suggest that PM emission models should consider the effects of season of burn and changes in fuel conditions associated with time since fire in order to improve accuarcy of emissions estimates.

Bio: Kevin Robertson received his BS in Botany from Louisiana State University where he conducted fire ecology research in pine communities of Everglades National Park, southern Georgia, and Louisiana. He received his Ph.D. in Plant Biology at the University of Illinois where he studied the effects of river migration on floodplain forest succession along rivers of the southeastern U.S. He is currently the Fire Ecology Research Scientist at Tall Timbers Research Station. There he studies the plant community ecology of southeastern U.S. pine ecosystems, the natural history of the Gulf Coastal Plain, remote sensing of fire, fire regime effects on plant communities, soils, and fire behavior, and prescribed fire effects on air quality. He also provides extension and education regarding the use of prescribed burning in fire-dependent ecosystems of the southeastern U.S.

5. Using Fire-Atmosphere Coupling to Initialize a Smoke Model

Author(s): Gary Achtemeier, USDA Forest Service

Fire-atmosphere (F-A) coupling in the fire model Rabbit Rules generates small pressure anomalies in response to heat released by fire spread over the landscape. These pressure anomalies are hypothesized to identify roots of updraft cores that define the smoke plume. The magnitudes are related to aerial coverage and strength of heat convergence into the anomaly centers and thus can be used to calculate data needed to initialize the smoke model Daysmoke. A pressure anomaly identification scheme is tested on two aerial ignition prescribed burns done as part of the 2011 RxCadre project. The plumes could be characterized as wind-dominated (Block 608A) and plume-dominated (Block 703C). Both burns produced comparable numbers of updraft cores with the updraft core numbers related to the lengths of the fire lines. Updraft core fluxes for the plume-dominated burn were 3-10 times larger than those for the wind-dominated burn. Initial updraft core vertical velocities and plume diameters were typically twice as large. Prevailing weather conditions and human factors (segmenting fire lines and setting fire line spacing) explain differences in updraft core numbers and intensities between the two burns.

Bio: Gary L. Achtemeier has been a research meteorologist with the USDA Forest Service since 1990. His research interests are in fire modeling, smoke plume modeling, nocturnal smoke transport, superfog, and long-range transport of air-borne biota.

6. Airborne-Based Carbon Aerosol Observations from Prescribed Burning

Author(s): Amy Sullivan, Colorado State University
Taehyoung Lee, Colorado State University
Gavin R. McMeeking, Colorado State University
Jeffrey L. Collett, Jr., Colorado State University
Robert J. Yokelson, University of Montana
Sonia M. Kreidenweis, Colorado State University

One of the main sources of carbon aerosols (water-soluble organic carbon (WSOC), organic carbon/organic matter (OC/OM), and black carbon (BC)) is biomass burning. Therefore, it is important to understand the properties of these different types of carbon to better understand the contribution of biomass burning to carbon aerosols as well as the impact of biomass burning on air quality. To that end, a suite of aerosol instruments were flown aboard a Twin Otter aircraft as it flew through smoke from prescribed burning activities taking place in South Carolina in November 2011. The instruments included a single particle soot photometer (SP2) to measure BC, an Aerodyne Time-of-Flight Aerosol Mass Spectrometer (ToF AMS) to measure OM, and a Particle-into-Liquid Sampler (PILS) coupled with a Total Organic Carbon analyzer for real-time measurement of WSOC and a fraction collector to obtain off-line samples for smoke marker analysis by high-performance anion-exchange chromatography with pulsed amperometric detection. Airborne results from these instruments will be presented. How parameters such as fuel type and aging might play a role on these various carbon emissions will be discussed.

Bio: Amy P. Sullivan is a Research Scientist at Colorado State University. Her research has focused on the composition of organic aerosols, especially those from biomass burning.

7. Investigating coupled fire/atmosphere behavior of prescribed fire: influence of Ignition patterns and vegetation structure

Author(s): Rodman Linn, Los Alamos National Laboratory
Judith Winterkamp, Los Alamos National Laboratory
James Furman, Eglin Air Force Base
Brett Williams, Eglin Air Force Base
J. Kevin Hiers, Eglin Air Force Base
Jesse Canfield, Los Alamos National Laboratory
Jeremy Sauer, Los Alamos National Laboratory

In the southeastern United States, prescribed fire is widely used to maintain the health of the ecosystems and manage the risk of catastrophic wildfires. In some locations such as Eglin Air Force Base, large-scale (1000-2000 ha) prescribed fire operations are essential to achieving fuels management goals. Such prescribed fire operations utilize a variety of ignition techniques such as distributed multiple ignition sources with the intended effect that interaction between resulting fires will produce a landscape scale burn of desired intensity. Experience-based expertise has allowed professionals to become quite adept at using the coupled interaction between multiple fire, fuels and surrounding atmosphere to harness the influence that multiple fires have on one another. In order to support this expertise, and provide additional explanations of these influences, a coupled fire/atmosphere model, FIRETEC, has been used to simulate realistic spot (aerial) and strip ignition patterns under fuels and wind conditions representative of those present during prescribed fires in the southeastern United States.

These FIRETEC simulations illustrate the dynamic balances between ambient winds, fire-induced indrafts and updrafts, and vegetation drag, that determine fire behavior response to ignition patterns in particular fuel-bed and wind conditions. For example, a reduction in the ambient wind or increased vegetation density leading to decreased ventilation in the interior of a spot ignition region. Reduction of ventilation increases the interaction between the separate fires and accelerates the coalescence of the fires. Increasing the ignition density also influences the ventilation to any single fire. However, this limits the potential fireline depth resulting from any single fire, affecting the local intensity. Fuel moistures and the vertical and horizontal distribution of fuel also influence this complex coupling. These preliminary simulations suggest that the use of coupled fire/atmosphere modeling tools can provide explanations of complex observed fire behavior as well as provide new hypotheses that should be tested through field experiments as well as close observation of operational burns.

Bio: Dr. Linn is a team leader is a Team Leader in the Earth and Environmental Sciences Division in Los Alamos National Laboratory and has a PhD from New Mexico State University in Mechanical Engineering. Rodman began his career in theoretical turbulence modeling at LANL in 1990 working with Francis Harlow. This work provided the foundations for Dr. Linn's research in the area of forest fire modeling, which began in 1995. He was the principle investigator/developer for a physic's-based wildfire model utilizing computational fluid dynamics techniques, FIRETEC, Rodman has focused much of his attention on studying coupled atmosphere/fire behavior.

8. The conundrum of controlled burning, forest productivity, and fuel loading

Author(s): Michael Gavazzi, USDA FS, SRS, EFETAC
Steve McNulty, USDA FS, SRS, EFETAC

Prescribed fire is an important management tool in southern US forests, with more acres burned in the South than any other region in the US. Despite its use to reduce fuel loads, prescribed fire and forest fuels research in the South has generally lagged behind western states, especially in hardwood ecosystems. Studies have shown there are many factors that influence burning effectiveness and rapid regrowth of understory species can be a hindrance to maintaining reduced fuel loads. Therefore, we designed an experiment to determine how quickly wildfire fuel loads could be reduced and stabilized following repeated 1- 5 year control burns. In 2004 and 2005 we measured fuel loads (coarse and fine woody material, shrub, herbaceous, litter and duff biomass) on sites in North Carolinas Croatan National Forest (CNF) and Uwharrie National Forest (UNF) prior to and following prescribed burns. We continued measuring fuel loads annually at the UNF sites through the next prescribed burn. The CNF sites included two loblolly/longleaf pine stands, one burned annually and the other on a 3 year cycle. The UNF sites included one loblolly pine stand and one oak/hickory stand, both managed with prescribed fire on 3 - 5 year cycles. Prescribed fire management had the most significant effect on litter and both live and dead shrub biomass across all sites except for the annually burned site where there were no significant changes in fuel loads following prescribed fire. On the other sites litter and live shrub biomass decreasing while dead shrub biomass increased following the burns. Litter loss recovered within one to two years on the UNF sites following prescribed fire. Fine woody fuel loads responded differently to prescribed, with increases and decrease in smaller sized classes on some sites and decreases in larger size classes on others. Coarse woody material was unaffected by prescribed fire. Results indicate that prescribed fire can be an effective tool to reduce litter and live shrub fuel loads, especially on sites with high understory biomass, but the increase in dead shrub biomass may contribute to future fire intensity.

Bio: Michael Gavazzi is a biological scientist with the USDA Forest Service, Southern Research Stations' Eastern Forest Environmental Threat Assessment Center. He received his Masters Degree from Virginia Tech in 1998. His research includes a small scale assessment of National Fire Danger Rating System fuel load estimates in North Carolinas piedmont and coastal plain, and the impact of prescribed fire on forest productivity.

9. Does prescribed fire reduce wildfire in the Southern US? A region-wide survey of public and private land manager perspectives

Author(s): Leda N. Kobziar, Associate Professor, University of Florida
Adam C. Watts, Post-doctoral Researcher, University of Florida
Leland Taylor, Research Assistant, University of Florida School of Forest Resources and Conservation

The Southern region of the United States is widely recognized for its successful prescribed burning programs, with estimates of over 5 million acres treated each year. Prescribed fire is considered an integral component to conserved, preserved, and even private lands management. When compared to other regions, both institutional and public support for prescribed burning programs is relatively high. Given the widespread use of prescribed fire as an ecosystem maintenance, restorative, site preparatory, and fuels reduction tool, it is surprising to find that region-wide assessments of the tool's effectiveness are few. On both public and private lands, reduction of wildfire hazard is frequently credited as the impetus for prescribed burning, but whether fire users witness this benefit is poorly understood. Through the Southern FIre Exchange, we conducted an on-line survey of over 500 participants to help address questions about prescribed fire's effectiveness in reducing wildfire potential, behavior, and suppression expenditures in the Southern region. The longevity of effectiveness was highly sensitive to ecosystem type and prescribed fire return interval. Trends in prescribed fire use, and impressions of its effectiveness, differed among land owner type, state, and across ecosystem types. This survey represents the largest survey ever conducted to address this topic, and captures viewpoints from 11 states in the Southern region.

Bio: Leda Kobziar is the Associate Professor of Fire Science and Forest Conservation at the University of Florida in Gainesville, Florida. After completing her PhD at the University of California at Berkeley in 2006, she established long term research sites in Florida to track the effectivenss of prescribed fire and mechanical fuels treatments in flatwoods forests. Her work addresses fuel treatment effectiveness, plant community and soil response to fire, and the application of dendrochronology methods in the South. She helps lead the Southern Fire Exchange, serves on the Board of the Association for Fire Ecology, and mentors a plethora of graduate students.

10. Water Management to Facilitate Prescribe Fire in Coastal North Carolina

Author(s): Ed Christopher, U.S. Fish and Wildlife Service

Fire Management decisions on Pocosin Lakes National Wildlife Refuge are influenced by duff moisture content on the surface as well as the moisture content of the organic sapric muck soil layer (peat soil). Prescribing fire within narrow burn windows has shown mixed results of success. Prescribe fire conversions to wildfire designation have occurred in the past when surface duff moisture, influenced by recent rains, was thought to prevent ground fire occurrence. However, discovered is that although the surface duff layer was moist, the sapric muck layer was dry. It is the dry sapric muck layer when ignited has a topography changing effect. Manipulating the sapric muck layer to high moisture content levels is a goal to reduce the risk of fire consuming the limited peat soil resource. Further, the high water levels will also reduce the potential for the duff layer to sustain ignition into the peat.

Research has shown organic duff layer moisture content <170% sustains combustion while the sapric muck soil layer sustain combustion at <240% moisture content (NCFS Tech Note, 2009 & G. Curcio personal communication 2012). Data samples on the Refuge have shown that within the last six months average duff layer moisture content at the northern end of Allen Rd., where water is stored as high as possible, are greater than on the southern end of Allen Rd. Along the southern end of Allen Rd., where water is released to generate lower water tables for private landowners, duff layer moisture content is averaging 200%, which was helped by frequent spring rainfalls. However, the organic peat's sapric muck moisture levels at the northern end of Allen Rd. hover around 400% while the southern end of Allen Rd. average moisture level is 180%, where the frequent rain events were not realized beyond the duff layer.

The results show water management on northern end of Allen Rd. is buffering against organic soil loss from wildfire or prescribe fire while organic soil along the southern area of Allen Rd. may lose over two feet of peat soil if ignited. The water table is held higher along north Allen Rd. (average water depth in the past three months is 8" below the surface) while south Allen Rd. shows an average water table depth in the past three months around 2.5' below the surface.

Bio: Ed Christopher is the Fire Management Officer for Pocosin Lakes National Wildlife Refuge located within the coastal plain of North Carolina. Prior to his tenure at Pocosin Lakes, Ed worked for the North Carolina Forest Service as a District Forester, Assistant District Forester, and Service Forester. Ed received his Master of Science degree and Bachelor of Science degree in Forestry from Virginia Tech. Ed is a Registered Forester in North Carolina as well as the USFW representative on the Southern Area Fire Environment Working Team. Ed enjoys spending time with his wife Samantha and adventurous sons Patrick and Jac.

11. Influence of homogenously applied ecosystem-based fire prescriptions on landscape heterogeneity

Author(s): Marcus Lashley, North Carolina State University
Christopher E. Moorman, North Carolina State University
M. Colter Chitwood, North Carolina State University
Christopher S. DePerno, North Carolina State University

Land managers often use fire prescriptions to mimic intensity, season, completeness, and return interval of historical fire regimes. However, fire prescriptions based on average historical fire regimes do not consider natural stochastic variability. Applying prescribed fire based on averages coupled with consistent firing techniques could result in a homogeneous landscape, with little variation in relative abundance of important plant species and stand structure. We evaluated the abundance and distribution of oak (Quercus sp.) and persimmon (Diospyros virginiana) stems and mast after 22 years of a homogeneously applied, historical-based growing-season fire prescription in the longleaf pine(Pinus palustris) – wiregrass (Aristida beyrichiana) complex . In upland longleaf stands, this fire regime killed young hardwood trees, thereby decreasing compositional and structural heterogeneity within the upland pine forest type. Often, this result is viewed as a success because hardwood encroachment is considered degrading to the structural requirements of the endangered red-cockaded woodpecker (Picoides borealis), which is a focal wildlife species in the longleaf pine ecosystem. Thus, management activities often are focused on eliminating occurrence of overstory hardwoods in longleaf stands, despite empirical data indicating their presence under historical fire regimes. Further, many wildlife species native to this ecosystem are dependent on mast production and hardwood structure for survival. Therefore, dispersion of some overstory hardwoods across the landscape is necessary for proper ecosystem function. Our data indicate local management activities must mimic spatial distribution, frequency, and intensity of historical disturbances to maximize structural heterogeneity and conserve key ecosystem functionality. We recommend a multi-tiered management approach focusing on maintaining heterogeneity at the stand-, landscape-, and ecosystem-scales.

Bio: Marcus Lashley developed a passion for wildlife at a young age and never looked back. In 2006, he earned a B.S. degree in Forestry/Wildlife Management from Mississippi State University. In 2009, he earned a M.S. degree at the University of Tennessee under Dr. Craig Harper, evaluating fire effects on nutritional carrying capacity for deer in the southern Appalachians. He is currently pursuing his Ph.D. with Drs. Chris Moorman and Chris DePerno at North Carolina State University, evaluating the effects of growing-season fire on wildlife food abundance and distribution in the Sandhills longleaf pine-wiregrass ecosystem.

12. Vegetation response following canopy reduction and repeated prescribed fire in mixed upland hardwoods

Author(s): Emma Willcox, University of Tennessee, Department of Forestry, Wildlife, & Fisheries

Prescribed fire is being used increasingly in mixed upland hardwood forests in the eastern US. Objectives range from ecological restoration, improved cover and food resources for wildlife, and fuels reduction to help prevent wildfire. Effects of prescribed fire in hardwood forests are not fully understood and long-term data are needed to understand dynamics in the vegetation community. In particular, effects of multiple fires need to be evaluated over time. We monitored vegetation response to 6 treatments (i.e., control, prescribed fire only, canopy reduction only, canopy reduction with herbicide, canopy reduction with prescribed fire, and canopy reduction with prescribed fire and herbicide) over 10 years in 4 mixed upland hardwood stands in the Ridge and Valley province of northeast Tennessee. Canopy reduction was implemented in 2001 as an improvement cut in mature stands that reduced basal area from 100-120 square feet per acre to approximately 70 square feet per acre. Prescribed fire was implemented through low-intensity backing and strip-heading fires during the early growing season (i.e., April) of 2005, 2007, 2009, and 2011. Vegetation data were collected each growing season from 2001 through 2011. Groundcover increased following canopy reduction with fire (84%), canopy reduction with herbicide (70%), and canopy reduction with fire and herbicide (77%), as compared to control (61%). Woody species represented 39 – 64% of the groundcover in all treatments, compared to 33% in control. Repeated low-intensity fire during the early growing season did not influence vegetation composition. Although fuels were reduced following early growing season fire, our data suggest fire intensity or timing must be altered in mixed hardwood stands to influence vegetation composition.

Bio: Emma V. Willcox is an Assistant Professor in the Department of Forestry, Wildlife, and Fisheries at the University of Tennessee in Knoxville. Her research focuses on the use of prescribed fire and mechanical treatments as tools for wildlife habitat management and restoration.

13. Quantifying parametric uncertainty in the Rothermel model with randomized quasi-Monte Carlo sampling

Author(s): Yaning Liu, Florida State University
Edwin Jimenez, California Institute of Technology
M. Yousuff Hussaini, Florida State University
Giray Okten, Florida State University

Wildland fire management involves using mathematical models to predict fire behaviors. The Rothermel wildland surface fire spread model, as one of the most widely used models in the North America, has been incorporated in many software systems such as FARSITE. Rothermel's model consists of a system of highly nonlinear algebraic equations with as many as 24 fire environment parameters. Uncertainty in these parameters is inevitable, which renders uncertainty quantification and sensitivity analysis necessary. We implement global sensitivity analysis for the Rothermel model to identify significant parameters and freeze insignificant ones. Uncertainty quantification using the randomized quasi-Monte Carlo method is then performed for the resulting reduced model. The accuracy of the estimates is further improved by an optimized version of sensitivity derivative enhanced sampling. We consider a coniferous fuel type in the Malcantone valley in Switzerland in our numerical results, and find that our proposed sampling method improves the standard Monte Carlo method by up to three orders of magnitude.

Bio: Yaning Liu is a PhD candidate at the Department of Mathematics at Florida State University. His main research interests are uncertainty quantification and sensitivity analysis.

14. Validation of the Consume and FOFEM fuel consumption models in pine and hardwood forests of the eastern United States

Author(s): Susan Prichard, University of Washington
Eva Karau, Fire Modeling Institute
Roger Ottmar, US Forest Service
Robert Keane, US Forest Service
James Cronan, University of Washington
Clinton Wright, US Forest Service

Reliable predictions of fuel consumption are critical in the eastern U.S. where prescribed burning is broadly used and air quality is an increasing concern. Consume and the First Order Fire effects Model (FOFEM) were developed to provide an efficient means to predict fuel consumption and emissions in wildland fires throughout the U.S. Consume's consumption equations are empirically based while FOFEM uses a combination of empirical equations and the physically-based BURNUP model. In this study, we collected a dataset of 54 operational prescribed fires to help determine each models uncertainties and application limits in eastern U.S. forests. Most sites were burned in southern pine forests, but 11 sites were mixed hardwood forests. Preburn surface fuel loading in pine sites was dominated by shrubs, woody fuels, and litter and ranged from 4.5 to 23.7 Mg/ha. Mixed hardwood fuels were dominated by large wood, litter and duff layers and had substantially higher preburn loading than pine sites, ranging from 20.0 to 73.0 Mg/ha. Despite substantial differences in preburn loads, total fuel consumption was similar between pine and mixed hardwood sites, ranging from 1.3 to 10.9 Mg/ha. Comparisons between model predictions and measured fuel consumption indicate that shrub, herbaceous, and 1-hr fuel consumption can be predicted reasonably well by Consume and FOFEM. Both models performed poorly in all other woody fuel categories in pine sites, but FOFEM's predictions were reasonable in mixed hardwood sites. FOFEM's assumption of 100% litter consumption offered more accurate predictions than Consume's empirical equations. Both models underestimated duff consumption. Results suggest that Consume and FOFEM can be improved in their predictive capability for woody fuel, litter, and duff consumption for the eastern U.S. Additional work is needed to improve the validation data set by targeting sites with litter and duff accumulations and expanding the number of mixed hardwood sites.

Bio: I am a forest ecologist with a specialty in fire ecology. My main interests are in the effects of fire and other disturbances on forest dynamics, climatic change on forest ecosystems, and fuel treatment options to mitigate wildfire effects.

15. Capturing complexity in fuels for fire behaviour modelling

Author(s): Philip Zylstra, University of Wollongong

Fuel load is a parameter commonly used in fire behaviour modelling, however the weight of fuels that will actually burn at any given time is a product of factors other than simple presence or moisture content, and these factors may produce significant changes in behaviour that are not captured by broad trends. Fuel load is also a difficult parameter to measure directly by remote sensing. Live fuels are by nature discontinuous, so fire must first cross the discontinuities before fuels can become available. This produces an iterative IF, THEN process of fire spread, whereby the availability of fuel to burn in a fire cannot be pre-determined without first knowing whether fire will spread across the spaces between leaves, branches, plants and strata. In effect, while we may want to know the fuel load to model the fire behaviour, we must first know the fire behaviour before we know the fuel load. The Forest Flammability Model (FFM) was developed to address this dilemma using a complex systems approach. Fuel inputs are defined using dimensions rather than weight, rendering them measurable via remote sensing and thereby greatly reducing the labour requirement for fuel data collection. The inclusion of multiple physical parameters enables detailed, process-based modelling of factors influencing landscape flammability such as fuel treatment effectiveness or the influence of specific disturbances, altered rainfall or temperature patterns, species change or even changes in leaf dimensions or moisture. Operational and research software is currently under development alongside a program of intensive model validation and development of systems for broad-scale integration with existing technologies. As a process-based model, the FFM can be utilised across vegetation types.

Bio: Dr. Philip Zylstra is a Research Fellow with the University of Wollongong Centre for Environmental Risk Management of Bushfires, and developed his perspectives and approach to fire behaviour while working as a fire manager and remote area fire fighter in the Snowy Mountains of south eastern Australia.

16. The Level Set Method as a Tool for Modeling Wildland Fire Spread

Author(s): Anthony Bova, Colorado State University - Dept. of Forest & Rangeland Stewardship
William Mell, U.S. Forest Service - Pacific Wildland Fire Sciences Lab
Randall McDermott, NIST - Fire Research Division
Ronald Rehm, NIST - Fire Research Division

The "level set" method of modeling the propagation of curvilinear fronts has been applied to diverse problems ranging from robotic navigation to reproducing the shape of a human organ from computer tomography. In this method, an evolving, two-dimensional front is conceptualized as the intersection of a plane and the surface of a three-dimensional object passing through it over time. A key advantage of the level set method is that, unlike so-called "marker" or "buoy" methods of front propagation, it handles the crossing and merging of separate fronts naturally, without the need for complex algorithms to untangle them. As applied to simulating fire spread, an additional advantage is that any model of heading, flanking and backing rates of spread (ROS) may be used with this method, allowing different ROS models to be compared within the same simulation framework. We will discuss the ongoing development and application of a level set model implemented within NIST's Wildland-Urban Interface Fire Dynamics Simulator (WFDS) model suite. Level set fire front simulations, using different ROS models, will be compared with the results of other empirical models, full-physics WFDS simulations and experimental data from grassland fires.

Bio: Anthony Bova is a research associate at The Colorado State University Department of Forest & Rangeland Stewardship. He earned an M.S. in Environmental Engineering from the Ohio State University, where he received a NASA Fellowship, and has over ten years of experience as a modeler and experimentalist in the fields of wildland fire, fire effects and atmospheric dispersion.

17. Fireline dynamics and geometry

Author(s): Jesse Canfield, Los Alamos National Laboratory
Rod Linn, Los Alamos National Laboratory

Fireline curvature is the result of a competition between the head fire and the flanks of the fire. The current study focuses on fireline dynamics and resultant geometry. A number of complex physical features (i.e. buoyancy and wind field divergence to name for example) arise in and around a fire that give the fireline a defined shape and spreading pattern. These features are dissected using a numerical atmospheric dynamics model HIGRAD, and wildfire combustion physics model FIRETEC. HIGRAD/FIRETEC was designed to investigate wildfires and their interactions with the environment. In the current study, this model was used to simulate grass fires that were initiated with a finite length, straight ignition line in homogeneous fuels. The dynamic evolutions of these firelines are analyzed to understand the individual events that evolve a wildfire. By understanding each individual process and how it interacts with other processes, information can be extracted to develop a theory about the mechanisms that combine to produce the chaotic wildfire phenomenon. Wind speed and direction is primary in driving wildfire spread rate and intensity. In the current study, the wind field in the region of the fire developed consistent features for all cases simulated. These features were driven by buoyancy, which in turn set up a preferential in-draft direction along the fireline. These in-drafts allow for air to penetrate into the fireline in a periodic way that influence the intensity of burning. This periodicity in the wind field and fire intensity resulted in a succession of streaks left in the fuel bed where there were strips of near-complete fuel depletion. These strips were interspersed with regions of lightly burned fuel. It is demonstrated that increased ignition line length leads to increased rate of spread (ROS). However, the ROS tends toward a finite value.

Bio: Jesse Canfield is a graduate research assistant at Los Alamos National Laboratory. He is nearing completion of his Ph.D. at the Geophysical Fluid Dynamics Institute at Florida State University. Jesse has been researching wildfire behavior numerically for the past 8 years.

18. Simulating Fire Spread in Chamise Chaparral Fuel Beds

Author(s): William Mell, USDA Forest Service
Xiangyang Zhou, FM Global
Shankar Mahalingam, University of Alabama in Huntsville
David Weise, USDA Forest Service

The ability of the Wildland-urban Interface Fire Dynamics Simulator (WFDS, version 5.5.3) to simulate fire spread in fuel beds composed of living plant material < 0.63 cm diameter was evaluated using laboratory fires. Homogenous fuel beds composed of chamise (Adenostoma fasciculatum), a common chaparral plant species, were burned under various wind velocity and slope angle configurations. Fire spread successfully in 70 of 113 experimental fuel beds. Two different thermal degradation models were used in the WFDS simulations: a linear thermal degradation model with no char combustion and an Arrhenius-based thermal degradation model with char combustion. The linear degradation model only produced successful fire spread in one of the 113 simulations. Using char combustion with the linear model did not improve simulation success. Simulations using the Arrhenius-based degradation model produced successful spread in 24 of the 113 simulations. As expected, the simulated gas phase temperatures in the fuel beds were much higher when the Arrhenius-based model was used. Qualitative and quantitative comparisons of the different simulations will be presented.

Bio: Dr. Mell has been involved in the development and validation of NIST's Fire Dynamics Simulator (FDS) and the Wildland-Urban Interface extension (WFDS). He is currently focussed on laboratory and field experiments to further develop and validate WFDS

19. Decoupling seasonal changes in water content and dry weight to predict live conifer foliar moisture content

Author(s): Matt Jolly, US Forest Service, Rocky Mountain Research Station

Live foliar moisture content (LFMC) has been shown to significantly influence the ignition and spread of wildland fires. However, characterizing seasonal changes in LFMC is difficult because both foliar water content and dry matter can change throughout the season. Here we present the results of a study aimed at quantifying the seasonal changes in both plant water status and dry matter partitioning. We collected new and old foliar samples from Pinus contorta for two growing seasons and we quantified their foliar moisture content, relative water content and dry matter chemical partitioning. We found that the amount of starches, sugars and crude fats in the foliage explained more of the seasonal variations in LFMC than relative water content. We show that a combination of relative water content, non-structural carbohydrates, crude fat and ash content can explain 92% of the variation in live foliar moisture content throughout the entire study period. These results suggest that models attempting to characterize seasonal variations in LFMC must separately consider seasonal changes in actual water content and dry matter partitioning. We suggest that a physiological modeling approach to assessing live foliar moisture content dynamics is needed over approaches that simply attempt to correlate LFMC to indicators of drought stress alone.

Bio: Dr. W. Matt Jolly is a Research Ecologist in the Fire, Fuel and Smoke Science Program of the US Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory in Missoula, MT. He attended the University of Virginia where he received a BA with high distinction in Environmental Science in 2000. He later moved to Missoula, MT where he earned a PhD in Forestry from the University of Montana in 2004. His research focuses on linking plant physical and chemical characteristics to their flammability and better understanding how this information can be utilized to support fire management.

20. Comparison of Remote Automated Weather Station (RAWS) Location Information 2009 and 2012

Author(s): Charles McHugh, USFS, RMRS, Fire Sciences Lab
Larry S. Bradshaw, USFS, RMRS, Fire Sciences Lab

Remote Automated Weather Stations (RAWS) are critical components of fire management in the United States. Currently, station metadata for RAWS are recorded in two separate systems; the US Forest Service's Weather Information Management System (WIMS) and the Bureau of Land Management's Wildland Fire Management Information (WFMI). (WFMI was formerly the Automated Sorting, Conversions, and Distribution System, or ASCADS.) As use of spatially explicit data has increased over the past decade, questions concerning the accuracy and precision of these metadata, particularly regarding station location have arisen (Zachariassen et al. 2003; Brown et al. 2011). Incorrect location information can have adverse impacts on National Weather Service forecasts, Fire Weather Spot Weather Forecasts, National Digital Forecast Data validations, and selection of appropriate weather stations by fire management personnel and within other systems, such as ROMAN and the Wildland Fire Decision Support System (WFDSS).

In a previous analysis (McHugh et al. 2009) found that the maximum global distance location difference between the two systems was as great as 232 miles. More problematic was that a zero distance difference did not always indicate correct location information. In some instances we found that neither system reflected the actual physical position of the station.

In response, in 2009 the Fire Weather and Fire Danger Subcommittees of the National Wildfire Coordinating Group (NWCG) Fire Environment Committee sent out requests and procedures for Station Managers to verify the location of stations both on the ground and in WFMI and WIMS, with the intent that in 2013 WFMI would become the official system of record for RAWS metadata. Here we update the previous analysis using summer 2012 metadata from WIMS and WFMI to compare 1,782 stations common to both systems and summarize that information by Geographic Area Coordination Centers (GACC).

We found that only 23.7% of the stations in 2012 indicated changes to their station location data from 2009. Inconsistent precision for latitude and longitude remains in both systems. Based on the 2012 analysis, maximum distance difference varied by GACC and ranged from a low of 8.7 miles to as high as 447.2 miles. Additionally, we found occasions where the same NESDIS ID's are assigned to different stations in WIMS and in WFMI, where incorrect State IDs were part of the WIMS Station ID; and stations in WIMS which had not actively collected data for over 10 years but were classified as active Fire Danger Stations rather than historical.

There is multi-system dependency on correct location information recorded for these stations. The RAWS network is an excellent system that is only limited by its management. If the stations are not properly maintained and their associated metadata is not kept up to date users will lose confidence in it.

Bio: Charles has worked for the US Forest Service since 1981. He has worked in the Fire Fuels and Smoke program with the Rocky Mountain Research Station since 2002.

21. Micrometeorology of Fire Front Passage observed in Complex Terrain

Author(s): Jon Contezac, San Jose State University

Micrometeorology of Fire Front Passage observed in Complex Terrain   Jon Contezac, Daisuke Seto, Braniff Davis, Dianne Hall, Bill O'shaunessy and Craig Clements
The micrometeorology of two experimental head fires in complex terrain was observed using an array of in situ meteorological instrumentation to study the fire-atmosphere interactions. Two field experiments were conducted on 20-26 degree slopes with uniform grass fuels. The array of instrumentation included a suite of sonic anemometers, heat flux radiometers, and fine-wire thermocouples mounted on three 10 m towers aligned along the slope. In addition, a micronet array, consisted of a grid of sensors that measured temperature and barometric pressure at 3 m AGL was located at the base of the slope.

Preliminary results show that during ignition, a decrease and recovery in the pressure was observed. It is hypothesized that this decrease in pressure is associated with the development of the fire plume and fire-induced circulations.

Bio: Received a bachlor of science in meteorology from St. Cloud State University in 2009. Currently pursuing a master of science in meteorology at San Jose State University. Specializes in micrometeorological measurements and dynamics surrounding wildfires.

22. LES techniques for the modeling of flow through vegetation with applications to wildland fires

Author(s): Eric Mueller, WPI
William Mell, USFS
Albert Simeoni, WPI

One of the most important driving factors in the dynamics of wildland fires is the influence of wind. At the small scale, wind will impact convective heat transfer by governing whether unburnt vegetation is exposed to either hot combustion products or cool ambient air. Additionally, wind can impact radiative heat transfer by causing flame lean and adjusting view factors. At the large scale, wind will drive the plume dynamics and thus impact the transport of emissions and embers. Therefore, in order to suggest the use of LES CFD models in helping to understand wildland fire dynamics, it is first necessary to evaluate the ability of such models to simulate wind flow through vegetation. This study focuses on the application of one specific model, the Wildland-urban interface Fire Dynamics Simulator (WFDS), to two different scales. The first scale is that of a full canopy. This scenario has been tested for several other LES models, and the intent here is to confirm that the specific model is able to replicate previous results. The second scale is that of individual trees. The flow characteristics through and around individual trees have been far less studied to date. However, this scale is important if such models are to be applied for evaluation of the Wildland-Urban Interface (WUI), which cannot be adequately characterized by a homogeneous canopy layer. This study finds that WFDS is able to generate profiles of mean flow and turbulent statistics which demonstrate its ability to simulate fully developed canopy flow. At the scale of an individual tree, however, the inherent complexity of the structure (composed of elements which span in size from the trunk to the individual needles) and its potential for elastic behavior proves to reach the limits of the model's current capabilities. This study demonstrates just one example of how more work, both experimental and numerical, is required to help improve these types of models to the next level where they can be utilized for the simulation of WUI fires.

Bio: Eric Mueller is a PhD candidate in the Fire Protection Engineering Department at Worcester Polytechnic Institute.

23. Observations of fire behavior on a grass slope during a wind reversal

Author(s): Dianne Hall, San Jose State University
Allison Charland, San Jose State University
Craig Clements, San Jose State University
Daisuke Seto, San Jose State University
Jon Contezac, San Jose State University
Braniff Davis, San Jose State University

On June 19-21, 2012, two experimental grass fires were conducted at Fort Hunter Liggett in central California. These burn plots were on slopes with angles between 20-26° with uniform grass fuels. A suite of instruments including a Doppler lidar, a microwave profiling radiometer, in situ micrometeorological towers, ground and aerial based video, time-lapse and infrared cameras, recorded the environment before, during and after the fires. Both fires had slight cross slope winds which altered the direction of spread of the fires from directly upslope. The first burn experienced a nearly 180° wind shift which occurred first above the ridge crest and later at the slope bottom, which further influenced the direction and rate of spread of the fire. This paper presents preliminary results related to the observed fire behavior and fire-atmospheric interactions during the wind shift.

Bio: Dianne is a Masters student in the Department of Meteorology and Climate Science at San Jose State University. Her current area of research is to measure and document the interaction between fire and the atmosphere in complex terrain through a series of head fire experiments on slopes. Dianne has worked multiple seasons as a firefighter in California and has been a volunteer fire fighter in her community for more than 12 years.

24. The diagnosis of mixed-layer depth above an eastern U.S. wildfire using a mesoscale numerical weather prediction model

Author(s): Joseph Charney, USDA Forest Service
Daniel Keyser, University at Albany

Diagnosing the spatial and temporal variability of meteorological variables in the planetary boundary layer (PBL) is necessary for understanding and predicting how the atmosphere can influence fire behavior. When the PBL is well mixed, the vertical distribution of wind, temperature, and relative humidity above a wildland fire can profoundly affect its evolution and behavior, such that the depth over which momentum, heat, and moisture can be mixed vertically within the PBL is an important parameter for understanding and predicting when the atmosphere can influence a wildland fire. Since above-ground measurements of wind, temperature, and relative humidity are not commonly available in close proximity to most wildland fires, the ability to simulate the evolution of the well-mixed PBL, hereafter referred to as the mixed layer, in mesoscale numerical weather prediction (NWP) models is an important element of fire-weather forecasting and research. The evolution of the mixed layer within a mesoscale NWP model can depend strongly upon the choices of model parameterization and grid configuration, and the effects of these choices on the evolution of the mixed layer during wildland fire events are not well understood.

The WRF (Weather Research and Forecasting) model will be used to simulate the meteorological conditions associated with an eastern U.S. wildfire event. A parameterization-independent formulation of the mixed-layer depth, defined as that depth over which near-surface eddies rise freely, will be applied to the WRF simulations of this event and compared with the PBL depths predicted by selected PBL parameterizations available within the WRF model. The WRF simulations will be used to investigate the dependence of the diagnosed mixed-layer depth on the PBL parameterization, the representation of land-surface processes, and the formulation of entrainment, as well as on the horizontal resolution of the model and the distribution of model levels. The sensitivity of various fire-behavior and smoke-dispersion diagnostics, such as the Ventilation Index, the Haines Index, and downdraft convective available potential energy, to differences between the diagnosed mixed-layer depth and the model-predicted PBL depth also will be examined. The implications of the results of these analyses will be discussed in the context of applications of mesoscale NWP models to fire-weather forecasting and research.

Bio: I am a research meteorologist with the USDA Forest Service, Northern Research Station in East Lansing, MI. I study fire weather and employ meteorological models and analyses to attempt to better understand when weather conditions have the potential to contribute to erratic or unexpected fire behavior. My research has both research and operational applications, in that the results can help researchers choose optimal model configurations for their studies and can help fire weather forecasters and fire managers anticipate when weather conditions could promote potentially dangerous fire behavior.

25. Coupled Weather- Wildland Fire Modeling of the 2012 High Park Fire

Author(s): Janice Coen, National Center for Atmospheric Research

Beyond estimating the direction and rate at which a fire's leading edge spreads, modeling aims to reproduce and explain wildland fire phenomena and why events unfolded as they did. My approach couples numerical weather prediction models with extensions that model wildland fire behavior. The atmospheric models are designed to simulate synoptic to microscale atmospheric flows in complex terrain. The wildland fire component, with new developments, is based upon semi-empirical relationships for surface fire rate of spread, fuel consumption rate, and crown fire representation that allow the shape to unfold naturally. The two are coupled such that near-surface atmospheric winds, terrain, and fuel properties drive fire growth, which in turn releases sensible heat, latent heat, and smoke fluxes into the atmosphere, notably creating fire winds. In contrast to commonly-used kinematic (BehavePlus, FARSITE) models or fine-scaled models with detailed parameterization of combustion (WFDS, FireTec), these modeling systems (the Coupled Atmosphere-Wildland Fire Environment (CAWFE) model and the Weather Research and Forecasting (WRF) Model with the wildland fire behavior module WRF-Fire) are suited to address the combination of weather, complex terrain, and fire dynamics that contribute to the individual character of each fire event, yet may be configured to run at computational speeds faster than real-time. Here, I will present case studies applying these coupled models to the High Park wildfire and other fire events in different environments including chaparral and forested ecosystems, with observational data where available. I evaluate their strengths and weaknesses in capturing the character of each event and provide insight on the mechanisms responsible.

Bio: Dr. Janice Coen is a Project Scientist at the National Center for Atmospheric Research in Boulder, Colorado. She studies fire behavior and its interaction with weather using coupled weather-fire computer simulation models and by analyzing infrared imagery of wildfires and prescribed fires. She received a B.S. in Engineering Physics from Grove City College and an M.S. and Ph.D. from the Department of Geophysical Sciences at the University of Chicago. She has been a member of the Board of Directors of the International Association of Wildland Fire and is currently an Associate Editor for the International Journal of Wildland Fire.

26. Providing science to managers: The Francis Marion-Sumter National Forest Prescribe Fire Prioritization Model: A Logistical and Ecological Approach to Management

Author(s): Reginald Goolsby, US Forest Service

As targets increase, so do the demands on fire management officers (FMOs) to prioritize treatment areas. Prescribed fires accomplish multiple objectives including reducing hazardous fuels, improving wildlife habitat, aiding listed species and increasing resource access. Researchers have provided guidance to help FMOs reintroduce fire into the landscape most appropriately; yet dialogue between scientists and managers is still not what it should be. FMOs need knowledge in a format understood by the "boots on the ground" rather than the scientific community. At the request of its FMOs, The Francis Marion and Sumter National Forest developed a fire prioritization model founded on fire science and understood by management to answer the questions of "when to burn, where to burn, how to burn, and why to burn."

The burn prioritization model ranks treatment areas on ecological and logistical scores and allows users to set optimal burning constraints such as days since rain, KDBI, relative humidity, temperature, and season of burn to achieved desired resource goals. The goal of many burns is ecological restoration therefore some criteria such as percent of fire-dependent vegetation, departure from desired condition, and presence of listed species were factored in. Some logistical score criteria factored in were ignition patterns, fireline construction and holding, road closures, smoke management and personnel requirements.

The model allows managers to enter day of burn environmental conditions which the model provides the user with the optimum location to burn to achieve desired management results.

The advantages of this model over others is that it closes the gap that has divided researchers and science from the on the ground technicians actually managing the land. Researchers now have an interactive way to descriptively describe the best optimal way to achieve resource objectives in a format that easy to understand by the managers applying the tool.

Bio: Reginald Goolsby is a fire ecologist trainee on the Francis Marion and Sumter National Forest in South Carolina. He received his B.A. in communications from Furman University and his Masters in Forestry Resources from Clemson University.

27. Fire behaviour prediction tools for fire managers - lessons learned from tools development in New Zealand

Author(s): H. Grant Pearce, Scion, Rural Fire Research group, Christchurch, New Zealand
Veronica R. Clifford, Scion, Rural Fire Research Group, Christchurch, New Zealand

Much of the focus of rural fire research in New Zealand in recent years has centred on the development of tools for fire managers that allow prediction of fire behaviour in local fuel types. This has resulted in the development of a series of tools, progressively moving from look-up tables to calculator software to GIS-based fire growth simulation models. These tools have been produced using fire behaviour prediction models developed from data collected at experimental burns and wildfires in a range of New Zealand vegetation types over a period of 20 years. Without doubt, these tools have led to a greater appreciation of fire behaviour by fire managers, and to improved rural fire management outcomes as a result of their use. However, as individual tools have been produced, demand has increased for increasingly more complex tools that require greater technical skills and understanding on the part of fire managers, and increased technology transfer and training input from fire researchers. This presentation will describe the progression of fire behaviour tools development in New Zealand, and highlight some of the lessons learned during this process.

Bio: Grant Pearce has been a Fire Scientist with NZ's rural fire research group since its establishment in 1992. Fire weather, fire behaviour prediction and fire danger rating provide the main focus for his research. Grant has led development of NZ's fire danger rating system, including the experimental burning and wildfire documentation to produce fire behaviour models for NZ fuel types and associated tools. He has also participated in several international projects including the Australasian Bushfire CRC's shrubland fire behaviour research and "Black Saturday" bushfires Research Review Taskforce, and served as a Fire Behaviour Analyst at wildfires in NZ and Australia.

28. Fire Use in the R11 Forest Management Unit

Author(s): David Finn, Alberta Gov't, ESRD

The R11 Forest Management Unit (FMU) in west central Alberta is a 1.3 million acre mountainous forest landbase managed with prescribed fire and fire use as the primary disturbance tools. The R11 FMU is extensively used by a variety of recreational users and is closely monitored by environmental groups. The R11 FMU is administered through the R11 Forest Management Plan, which was collaboratively created with government and stakeholder input using a novel Charette process. This presentation outlines the process used to create the R11 Forest Management Plan and lessons learned from the application of prescribed fire on a large landbase as a disturbance tool in the midst of extensive recreational public use. A number of social issues have arisen since the implementation of the plan that affect the planning and execution of planned prescribed fire and fire use within the area. The R11 unit and the planning process used to bring together diverse and often conflicting public stakeholders is a model of land management and a positive step forward in bringing fire back to a fire-excluded landbase. The results of the last five years of implementing this plan have shown positive results with the public and with the re-introduction of fire on the landscape as a management tool.

Bio: David Finn, Wildfire Technologist, Clearwater Area, Alberta Department of Environment and Sustainable Resource Development.
David Finn is an employee of the Department of Alberta Environment and Sustainable Resource Development with twenty five years of service. He currently oversees prescribed fire and fire use in the 1.3 million acre R11 Forest Management Unit in west central Alberta. David also serves on national type one incident management teams as a Fire Behaviour Analyst and a Planning Section Chief. He resides in the community of Rocky Mountain House, Alberta. His hobbies include guitar and banjo, wood and metal working and anything involving time in the mountains.

29. Response of wildland fires to aerially applied fire retardant

Author(s): Philip Riggan, USDA Forest Service, PSW Research Station
John Litton, USDA Forest Service, Pacific Southwest Region

The Forest Service, Pacific Southwest Research Station, has begun applying its FireMapper remote-sensing system as part of a national study of Aerial Firefighting Use and Effectiveness. Incorporating the FireMapper thermal-imaging radiometer, the airborne system provides the means to not only track the aerial delivery of retardant along fire lines but to ultimately determine the effects of that retardant on fire intensity and spread, and to improve the effectiveness of retardant applications. In 2012 the FireMapper was flown over active wildfires in Montana, Idaho, and California and recorded retardant applications from Single Engine Air Tankers; P2 and S2 aircraft; Military Aerial Fire-Fighting System (MAFFS) C130 aircraft; and Tanker 910, a DC-10 Very Large Air Tanker (VLAT). Results demonstrate the ability of the FireMapper to document the location, contiguity, and apparent density of retardant applications as well as the response of adjacent fire lines.

The FireMapper radiometer measures upwelling radiation at thermal-infrared wavelengths of 8 to 12.5 micrometers and includes both a full broadband channel and narrow-band channels centered at 8.5 and 11.9 micrometers to provide unsaturated, high-resolution measurements of fire radiance. Recently applied fire retardant, which is up to 10° C cooler than unburned surroundings, can be differentiated in the broadband thermal imagery by its shape, recency of appearance, and persistence in time sequences of images.

Bio: Philip J. Riggan is a Research Ecologist with the USDA Forest Service, Pacific Southwest Research Station. He holds a Bachelor of Science degree in chemistry from San Diego State University and a Doctor of Philosophy degree from the College of Forest Resources, University of Washington. Dr. Riggan has conducted research on remote measurement of wildfire properties, the development and fire ecology of Mediterranean ecosystems in California, and the global consequences of burning in tropical ecosystems. He has led development of the FireMapper thermal-imaging radiometer and its application to measurement of large wildland fires for research and fire operations.

30. Autonomous Wildfire Detection and Reporting

Author(s): Darell Engelhaupt, University of Alabama in Huntsville

Autonomous Wildfire Detection and Reporting Wildfires in open and remote areas require early detection and reporting in order to provide rapid response and adequate resources in order to avoid rapid spreading and devastating damage including loss of property and resources, wildlife and most importantly loss of life. Methods of detection and reporting vary from random observers reporting by telephone to very sophisticated space-borne satellites such as provided by NASA, government sponsored aerial patrols, dedicated ranger towers, continuously monitored cameras and electronic/optical sensors with independent transmitting and receiving communications and the option of aerial platforms. This discussion will address each with emphasis on the future implementation of electro-optical sensors and autonomous radio frequency reporting to the appropriate resources in real-time. Flames produce energy ranging from sound (low frequency) to infra-red, through visible and into ultraviolet energy bands. This energy is dissimilar to the energy from the sun only at the very lowest and highest frequencies but has very different modulation characteristics within the IR and visible range. Therefore a wide variety of autonomous viable sensors are available and under consideration and limited use. The time for detection and reporting will be reviewed. Presented by Darell Engelhaupt Senior Research Scientist University of Alabama in Huntsville (retired) Member IAWF

Bio: Presented by Darell Engelhaupt Senior Research Scientist University of Alabama in Huntsville (retired) Member IAWF Darell Engelhaupt has more than 35 years experience as research and development engineer/scientist working with Defense, Industry, Energy, and Academic entities. He is principal or participating investigator on 15 scientific patents, including scientific instrumentation and methods and additionally, opto-electronic fire sensing and reporting. He is a member of IAWF.

31. Best Practices in Risk and Crisis Communication: Implications for Wildfire Management

Author(s): Toddi Steelman, University of Saskatchewan
Sarah McCaffrey, USFS Northern Research Station

As societies evolve often the most appropriate response to wildfire must also evolve. However, such shifts in appropriate response to wildfire, whether at the individual or at the societal level, are rarely straightforward: closing the gap between desired practice and current practice requires effective communication. Although there is a significant literature on how to encourage adaptation before an event and how to communicate during an event, there is less work tying the two together or on how to communicate shifts in larger scale societal response to a natural hazard, such as a wildfire. In this presentation, we bring together the best practices and theoretical literature from risk communication and crisis communication and empirical literature on wildfire communication to derive the key characteristics associated with best communication practices. We then use this framework on three case studies of wildfires in California, Montana, and Wyoming, each of which used a different strategy for managing the fire, to understand whether approaching communication more holistically can lead to more desired natural hazard management outcomes. Our working hypothesis was: effective communication before and during a fire would be associated with acceptance of more flexible fire management strategies. The findings indicate how a type of desired management change (more flexible fire management) is associated with more effective communication practices before and during the event.

Bio: Toddi Steelman is Executive Director for the School of Environment and Sustainability at the University of Saskatchewan. Dr. Steelman has a more than 10 year history of wildfire research and has conducted research on community aspects of wildfire management in Arizona, Colorado, New Mexico, California, Montana, Wyoming, and Idaho. Her research agenda has focused on understanding community responses to wildfire and how communities and agencies interact for more effective wildfire management.

32. Forecasting the wildfire suppression expenditures of federal land management agencies

Author(s): Charlotte Ham, North Carolina State University and USDA Forest Service
Karen Abt, USDA Forest Service, Southern Research Station, Forest Economics and Policy Research Unit
Jeff Prestemon, USDA Forest Service, Southern Research Station, Forest Economics and Policy Research Unit

In response to requests from the agencies and to fulfill the requirements of the FLAME act, we develop forecasts for annual and monthly (fire season) suppression expenditures. These forecasts are used to help determine whether additional funds are needed to suppress wildfires (from fire-borrowing or from congressional allocation) and to help determine the suppression approach used by land managers as available funds dwindle through the season. We develop a complex set of models using current or forecasted acres, drought, and climate variables. These models are developed at various times during the year, and for various months and years ahead, resulting in a total of 20 forecast models each year. We use OLS and SUR estimation, and validate the models using out-of-sample forecasts. When forecasted variables are themselves used in the cost forecasts, we use out-of-sample drought and acre forecasts to improve the cost forecasts. We present preliminary forecasts for FY13 for USDA Forest Service regions and for the DOI; and compare our FY12 forecasts to actual expenditures.

Bio: Charlotte Ham is a Postdoctoral Scholar/Economist with the Department of Forestry and Environmental Resources at North Carolina State University. She is collaborating with the USDA Forest Service Forest Economics and Policy Research Unit at the Southern Research Station to improve wildland fire suppression cost forecasts for the USDA Forest Service and the Department of the Interior. Her doctorate is from Colorado State University's Graduate Degree Program in Ecology through an interdisciplinary program in Resource Economics. Her dissertation is a geospatial exploration of how people value properties in close proximity to different land uses for consideration in planning and policy analysis.

33. Forty-Years of Fire Suppression Alters Soil CO2 Efflux Rates at the Stoddard Fire Plots in North Florida

Author(s): David Godwin, University of Florida
Kevin Robertson, Tall Timbers Research Station
Leda Kobziar, University of Florida

Soil CO2 efflux (R s) is a significant flux of carbon dioxide from ecosystem soils to the greater atmosphere and is a critical component in determining total ecosystem carbon budgets. Much of the land in the 'Red Hills' region of North Florida and South Georgia is dominated by loblolly pine - shortleaf pine old-field forests that are managed using frequent prescribed fire to promote Northern Bobwhite quail populations. As many of these forests also provide critical habitat for threatened and endangered species such as the Red-cockaded Woodpecker, future alternative revenue streams for carbon sequestration services may provide incentives for landowners to maintain their properties in conserved states. This study sought to understand the influence of long-term frequent prescribed fire and fire suppression on soil CO2 efflux, soil temperature, and soil moisture content in old-field forests. The study took place within the Stoddard Fire Plots at the Tall Timbers Research Station in Florida, USA, approximately 30 km from the town of Tallahassee. The study consisted of nine measurement plots representing three treatments: annual dormant season prescribed fire, biennial dormant season prescribed fire, and total fire exclusion. Treatment plots represented the environmental and vegetative conditions following over 60-years of continuous management of the respective fire regimes. Study period data were assessed after sampling monthly for a period of twenty-one months (2009-2011). Results indicated that prolonged fire exclusion significantly elevated Rs rates relative to the frequently burned treatments. Similar to previous research in the southern USA, results found that Rs rates in all treatments were strongly correlated with soil and ambient temperatures, but weakly correlated with soil moisture content.

Bio: David R. Godwin is currently finishing his PhD in Forest Resources and Conservation at the University of Florida.

He also has a MS in Forest Resources and Conservation from the University of Florida and a BS in Geography from Florida State University. He was a 2012 Presidential Management Fellows Finalist and a 2010 JFSP Graduate Research Innovation (GRIN) award winner. His research interests include forest and fire management influences on carbon dynamics as well as fire effects mapping using remote sensing.

34. Refining the oak-fire hypothesis for management of oak-dominated forests in the eastern US

Author(s): Mary Arthur, University of Kentucky
Heather D. Alexander, University of Texas, Brownsville
Daniel C. Dey, USDA Forest Service Northern Research Station
Callie J. Schweitzer, USDA Forest Service Southern Research Station
David L. Loftis, USDA Forest Service Southern Research Station

Prescribed fires are being implemented with increasing frequency in eastern deciduous forests to accomplish a variety of goals. One frequently stated goal is to manage for the perpetuation of oak-dominated (Quercus spp.) forests. Many oak forests have limited oak regeneration, due at least in part to increased density of shade-tolerant tree species in the understory and midstory. The results of fire management to accomplish this goal have met with somewhat inconsistent results across the region. Thus, despite increased management with prescribed fire, our understanding of the mechanisms by which fire can improve oak regeneration is still emerging. For prescribed fires to effectively increase oak regeneration, they must positively influence one or more critical life stages: pollination, flowering, seed set, germination, seedling establishment and development, and release into the canopy. We posit that a simplistic view of the relationship between fire and oak forests has led to a departure from an ecologically-based management approach using prescribed fire. We will present evidence, or lack thereof, for ways that fire may improve the success of oak regeneration, with the goal to improve the match between management tools and objectives. For each life history stage, we provide guidelines for applying an ecological understanding to guide decisions about when and where to apply fire on the landscape to sustain oak-dominated forests.

Bio: Mary Arthur is Professor of Forest Ecology in the University of Kentucky, Department of Forestry. Her research program addresses three primary focal areas, the ecological effects of prescribed fire in upland oak ecosystems in the central Appalachians, the role of forest change and species composition on ecosystem processes, and the impacts of invasive plants on the alteration of ecosystem dynamics. She has published over 65 refereed journal articles, and has been funded by the USDA-NRI, NSF, and USDA-USDI Joint Fire Science Program.

35. Structure is the Key to Predicting Function during Restoration of Southern Appalachian Forests

Author(s): Thomas A. Waldrop, Southern Research Station

Four fuel reduction/restoration treatments were applied to forests of the Southern Appalachian Mountains in 2002 and 2003 as a component of the National Fire and Fire Surrogate Study. Each treatment impacted forest structure differently after an initial entry, after repeated treatments, and over time. Compared to the untreated controls, the burn only treatment reduced overstory density and either increased or decreased understory cover depending on the time since treatment; the mechanical-only treatment increased overstory density and reduced understory cover; the combined mechanical and burn treatment greatly decreased overstory density and either increased or decreased understory cover depending on the time since treatment. Each treatment produces significantly different canopy openness as measured by analysis of hemispherical photographs. The amount of sunlight reaching the forest floor impacts many variables including bird habitat, insect abundance, predicted wildfire intensity, vegetation abundance, vegetative composition, and others. Repeated treatments (burning 2006, 2012 and mechanical 2012) either push forests toward the goal of open woodlands or push them farther away. This presentation will discuss multiple benefits from using fuel reduction treatments for restoration objectives.

Bio: Tom Waldrop is Supervisory Research Forester and Team Leader for Fire Science within the Southern Research Station's Center for Forest Disturbance Science. His research includes fire ecology, fire implementation, and fuels management in the southern Appalachian Mountains. Tom has been with the Southern Research Station and located at Clemson, SC for over 25 years. He was recognized in 2012 by the Forest Service with the National Distinguished Scientist Award.

36. Background, methods and call for feedback on fuel and fire behavior data collection on active wildland fires

Author(s): Alicia Reiner, USDA Forest Service, Adaptive Management Services Enterprise Team
Carol Ewell, USDA Forest Service, Adaptive Management Services Enterprise Team
Scott Dailey, USDA Forest Service, Adaptive Management Services Enterprise Team
JoAnn Fites-Kaufman, USDA FS Region 5
Nicole Vaillant, Western Wildland Environmental Threat Assessment Center

Fire behavior measurements collected during active wildfires are paramount to fire behavior research. A USDA Forest Service Enterprise Team, Adaptive Management Services, (AMSET), has a module focused on collection of fire behavior data on wildland fire incidents, called the Fire Behavior Assessment Team (FBAT). The purpose of this talk is to outline the current methods and data variables collected in order to obtain feedback and to discern practical uses of this data with input from fire managers and the scientific community. Clearly identified uses for FBAT fire behavior and fuels data will allow for streamlining or enhancing FBAT data collection methods.

FBAT can be ordered by a (U.S.) fire incident through the National Interagency Resource Ordering and Status System (ROSS), just as other fire crews and overhead are. The FBAT crew assimilates into incidents well due to their high level of wildland fire experience of the FBAT members, and the rapport the crew has with some Incident Management Teams. Plots are placed opportunistically ahead of the fire based on access, likely fire spread and behavior as well as fire management tactics. Pre- and post-fire data are collected for overstory, surface and ground fuels and vegetation. At each site, sensors and a digital video camera(s) enclosed in a fire safe box are set up to gather information about weather and fire behavior including 5-foot windspeed, flame height, rate of spread, and temperature profile through time .

With the help of peer-reviewers and collaborators, the data collected by FBAT could be utilized more effectively and methods could be improved. To date, FBAT fire behavior data has been used in case studies of fuel treatment effects on wildfire behavior and severity. A project assessing the effects of fire on Carbon emissions is utilizing FBAT fuels consumption data in California. Other potential applications of FBAT fuels and fire behavior data include smoke modeling and calibration of fire behavior applications. The FBAT program would like to continue into the future, only with the most useful of methods and with improvement feedback from the scientific and management communities on realistic applications of the data.

Bio: Ali Reiner works for the USDA Forest Service Enterprise Team called Adaptive Management Services, "AMSET" as a fire ecologist. She has completed several fuel characterization, treatment effectiveness and fire severity studies since starting with AMSET in 2006. Prior to working with AMSET, Ali worked as a firefighter on an engine and hotshot crews. Ali uses her experience in fire management along with her academic and ecological background to create strong science useful for land and fire management.

37. Relating fire behavior and fire effects in Scots pine forests of central Siberia

Author(s): Susan Conard, USFS, International Journal of Wildland Fire, George Mason University
Douglas J. McRae, Natural Resources Canada, Canadian Forest Service
Galina A. Ivanova, Sukachev Institute of Forest, Krasnoyarsk, Russia

Scots pine is a widespread forest type in central Siberia as well as areas of Europe and European Russia. Scots pine forests have a natural fire regime dominated by relatively frequent surface fires. The extent of these forests, and the importance of fire in them, underlines the need to understand the range of fire behavior and fire effects, as well as the effects of key environmental factors on seasonal fire patterns. This paper summarizes major results from a series of 20 experimental fires conducted in Scots pine (Pinus sylvestris) and mixed conifer forests in the Krasnoyarsk Region of central Siberia. Our objective was to characterize fire behavior, emissions, and fire effects on ecosystem components (including carbon) over a range of burning conditions. We also provide a brief overview of the role of large-scale circulation patterns in determining occurrence of severe fire outbreaks. Further, we present a new index of fire severity for Scots pine systems and illustrate its application to evaluating and understanding responses of individual ecosystem components and of overall fire emissions. These results provide a basis for projecting the potential impact of fires in Scots pine on overall carbon balance, atmospheric greenhouse gas forcing, and ecosystem responses under changing climate.

Bio: Susan G. Conard, retired from the USFS in 2008 after 25 years in Forest Service research, both in the field and the Washington office. Experience includes fire research in California and in Russia, as well as extensive knowledge of fire research programs in the USFS and around the world. Currently emeritus Ecologist at Rocky Mountain Research Station's fire science laboratory in Missoula, also affiliate faculty member at George Mason University in Virginia, and Co-editor of the International Journal of Wildland Fire. Ph.D. in Plant Ecology, University of California, Davis (1980). Living in coastal Maine, still have ongoing fire research program in Russia.

38. Balancing Early- and Late-Successional Forest Conditions in Fire-Prone Forest Types

Author(s): John Bailey, Oregon State University

Too much of our current debate about wildlife habitat, fire risk and fuels management takes place at insignificant temporal and spatial scales: individual stand conditions as they are now. In fact, temporal patterns are often completely ignored even though they are equally important to spatial ones given predictable rates of fuel accumulation and structural change. Because fire risk changes over time, the optimal spatial allocation of fuels treatment in one year depends on temporal change in that risk. But, given budget and workforce constraints, agencies allocate fuels/silvicultural prescriptions to a limited number of stands each year, over relatively small areas. Additional constraints associated with "protection" of late-successional habitat further complicate the allocation problem. It is unrealistic to assume that managers could truly account for all the issues and how they change in time and space; however, there are some basic patterns and realities for which we should all account in our land management. Four basic rules can form the foundation for our approach: 1) wildland fire is a growing reality and cannot be excluded from ecosystems any more than humans or exotic species; 2) fire behavior is imminently predictable at the smallest scales but unpredictable at the largest – and we manage landscapes in between these two extremes; 3) given a lack of predictability and control, we must relax our expectations and conservatively build spatial resistance and resilience into ecosystems that provides for a mix of early- and late-successional habitat; and 4) wildland fire can actually be a partner in that process.

Bio: Associate Professor of Silviculture and Fire Management at Oregon State University's College of Forestry, where I've been for over six years. Prior to that was nine years at Northern Arizona University. PhD from OSU in 1997; MF and BS from Virginia Tech in 1985 and 1983. Other work experience includes: fire fighting, private industry research, and federal research on acid rain and climate change.

39. Effect of season of burn on surface fuel dynamics in mesic longleaf pine flatwoods of northwest Florida

Author(s): James Cronan, University of Washington

In the southeastern United States large public landholders have well established prescribed fire programs that replicate the natural fire rotation of fire-dependent ecosystems. Most acreage is burned during the winter when weather conditions are more amenable, however it is widely accepted that most acreage historically burned during the growing season. As a response to this departure from the natural fire regime, season of burn has been the frequent subject of research aimed primarily at measures of community ecology. To date, no studies have examined the impact season of burn has on the fuel life cycle in pine savannas. This research was proposed to address this question. Our objectives were to test for the effect that season of burn (dormant vs. growing season) has on the surface fuelbed and associated potential fire behavior for the period of a natural fire cycle (3 years) in a common pine savanna type (mesic flatwoods). A total of 16 sites were split between dormant and growing season burns at two locations in northwestern Florida. A suite of prefire, in situ fire, and postfire measurements were collected to assess fire behavior, weather and fuel dynamics. Sites were sampled at one year intervals over the course of the fire rotation to record fuelbed development. ANOVA tests are used to test for effects of season and location. Multivariate statistical methods are used to determine patterns among sites and relationships with environmental variables that may influence fuel dynamics.

Bio: I am a PhD student at the University of Washington and my research interests are focused on plant-disturbance reactions in fire-adapted environments. Prior to beginning my dissertation work I investigated the relationship between stand development and fire behavior in boreal forests of interior Alaska and developed a spatially explicit landscape fire model to examine patterns of fire regimes in the Cascade Mountains of the Pacific Northwest. My dissertation work is being supported by the Pacific Wildland Fire Sciences Lab in Seattle, WA.

Additionally, I am interested in the effectiveness of restoration projects at smaller scales in urban and suburban environments.

40. Looking beyond red crowns: Canopy and surface fuels in lodgepole pine forests following mountain pine beetle epidemics in south-central Oregon

Author(s): Travis Woolley, Oregon State University
Dave Shaw, Oregon State University
Stephen Fitzgerald, Oregon State University
LaWen Hollingsworth, Rocky Mountain Research Station - Missoula Fire Sciences Laboratory

Mountain pine beetle (Dendroctonus ponderosae:MPB), a bark beetle native to the western U.S., has caused extensive lodgepole pine mortality in south-central Oregon, peaking at over 1,000,000 acres of mortality in 1986 and over 500,000 cumulative acres in the past decade (USFS-FHP Aerial Detection Survey data). This widespread mortality has raised concerns over the potential for extreme fire behavior across large landscapes as forest structure is altered following these MPB epidemics. However, previous research has provided equivocal evidence concerning temporal and spatial changes of post-MPB fuels. In addition, lodgepole pine forests in south-central Oregon are ecologically unique (e.g., low cone serotiny, primarily climax lodgepole pine communities) compared to the remaining extent of the species' range. Using a chronosequence approach, we sampled fuels and forest structure in 215 plots to understand how fuel profiles (ground, surface, ladder and crown fuels) in these lodgepole pine forests change over time in response to MPB epidemics. Using multivariate cluster analysis we delineated post-MPB environments based on fuel complexes. Using this technique we are able to elucidate and quantify changes in fuels over time for managers, rather than illustrating changes in fuels over time using ad-hoc/arbitrary groupings of fuel complexes. Previous research has focused primarily on the beginning phases of MPB epidemics (the red phase) and less attention has been given to the decades following MPB epidemics when fuels and forest structure can change dramatically. The changes in fuels associations over a 30 year time frame, comparisons to the standard fire behavior fuel models and use in fire behavior modeling will be described.

Bio: Travis Woolley is a Faculty Research Assistant at Oregon State University. His research focuses on disturbance and forest health related issues such as insect, pathogen, and fire interactions.

41. Potential fire behavior in post-MPB lodgepole pine forests in south-central Oregon: Comparisons and lessons among BehavePlus, FCCS, and FlamMap

Author(s): LaWen Hollingsworth, Rocky Mountain Research Station - Missoula Fire Sciences Laboratory
Travis Woolley, Oregon State University
Dave Shaw, Oregon State University
Stephen Fitzgerald, Oregon State University

Mountain pine beetle (Dendroctonus ponderosae:MPB), a bark beetle native to the western U.S., has caused extensive lodgepole pine mortality in south-central Oregon, peaking at over 1,000,000 acres of mortality in 1986 and approximately 500,000 cumulative acres in the past decade. This widespread mortality has raised concerns related to potential fire behavior, effective fire management strategies, and firefighter safety as forest structure is altered following MPB epidemics. These concerns are magnified as previous research has provided equivocal evidence concerning post-MPB fire behavior and the uncertainty of applying currently available research and observational data as the lodgepole pine forests in south-central Oregon are topographically and ecologically unique (e.g., low cone serotiny, primarily climax lodgepole pine communities) compared to the remaining extent of the species' range. Using post-MPB fuels associations developed from a chronosequence sampling approach, we analyzed fire behavior using two point fire behavior systems: BehavePlus and the Fuel Characteristic Classification System. Additionally, we used a recently (2-10 years post-MPB) disturbed landscape to analyze geospatial fire behavior using FlamMap. The results from these efforts shall directly aid managers on both the Deschutes and Fremont-Winema National Forests by framing potential fire behavior in these post-disturbance environments. Thus, providing a basis to compare future observed fire behavior with predicted fire behavior as well as the uses, limitations, and assumptions associated with predicting fire behavior using the current suite of operational models.

Bio: LaWen Hollingsworth is a Fire Behavior Specialist for the Fire Modeling Institute at the Rocky Mountain Research Station in Missoula, Montana. Professional interests include observing and analyzing fire behavior and fire effects, data preparation and calibration, and designing and analyzing projects to meet ecological objectives. Most of her federal career has been spent in the field working as a Fire Ecologist, firefighter, and conducting long-term vegetation monitoring in upland and riparian systems. She has a M.S. from the University of Montana in Forestry/Fire Ecology and a B.S. from the University of Idaho in Forest Resources.

42. Fire in the Crown? Comparing different sources of spatial data to monitor fire behavior in Montana's Southwestern Crown of the Continent

Author(s): LaWen Hollingsworth, USDA Forest Service

The Southwestern Crown of the Continent (SWCC) straddles the southern boundary of the Bob Marshall Wilderness Complex and includes a diverse array of ecosystems ranging from broad river valleys to upper timberline. The 600,000 hectare SWCC is centered within several large contiguous roadless areas that link the Canadian Rockies with the Selway-Bitterroot Wilderness and Greater Yellowstone Ecosystem. Fire management operations run the spectrum from full suppression within the wildland-urban interface to flexible zone/point protection or monitoring strategies within wilderness areas. As part of the Collaborative Forest Landscape Restoration Program, a landscape restoration strategy has been developed for the SWCC including a range of proposed activities such as prescribed fire and managed natural ignitions designed to reestablish natural fire regimes and reduce the potential for uncharacteristic fire.

Landscape-scale fire behavior analyses are important to inform decisions on resource management projects that meet land management objectives and protect values from adverse consequences of fire. SWCC monitoring objectives include quantification of pre- and post-treatment fire behavior metrics to determine if project and landscape objectives have been satisfied and report on the degree of change towards desired conditions. This study evaluates geospatial fire behavior analyses for the SWCC in western Montana using two different data sources: LANDFIRE and a local dataset built from regional remote sensing data and plot data. Rulesets were developed to account for disturbances across the landscape, such as wildfires and mortality due to insect activity. Performance of the data sources was evaluated by comparing modeled fire growth to actual fire growth. The best-fit dataset provides information at multiple scales for project-level analyses and landscape analyses and proves to be a dynamic dataset updated annually to report on the required metrics.

Bio: LaWen Hollingsworth is a Fire Behavior Specialist for the Fire Modeling Institute at the Rocky Mountain Research Station in Missoula, Montana. Professional interests include observing and analyzing fire behavior and fire effects, data preparation and calibration, and designing and analyzing projects to meet ecological objectives. Most of her federal career has been spent in the field working as a Fire Ecologist, firefighter, and conducting long-term vegetation monitoring in upland and riparian systems. She has a M.S. from the University of Montana in Forestry/Fire Ecology and a B.S. from the University of Idaho in Forest Resources.

43. Australian Fuel Classification - Overview and framework

Author(s): James Gould, CSIRO Ecosystem Sciences & Bushfire CRC
Miguel Cruz, CSIRO Ecosystem Sciences
Jennifer Hollis, University of New South Wales

Quantifying fire prone vegetation is a challenge for wildland managers who need explicit fuel data to manage fire hazard, predict fire behaviour, understanding suppression difficulty and evaluate fire impact to human and ecosystem values. The Australasian Fire and Emergency Services Authorities Council (AFAC) and the Forest Fire Management Group (FFMG) recognised the need for a national fuel classification to ensure a nationally appropriate method of characterising and quantifying fuels.

As a key feature the Australian Fuel Classification should enable the categorisation and organisation of fuel complexes in order to capture spatial diversity as well as dynamic and structure complexity in a way that accommodates existing models for fire behaviour and assists development the next-generation of fire management Decision Support Systems.

This paper presents the results of a collaborative interagency effort to develop a nationally consistent and locally relevant fuel classification for fire management in Australia. Here we introduce the concept and framework for the Australian Fuel Classification (AFC), provide a general overview of the proposed AFC and highlight the interdependency on multiple data sources and applications. Finally, we discuss the need for a cohesive interagency effort to initiate and implement the AFC.

Bio: Jim Gould is Principal Reseach Scientist for CSIRO Ecosystem Sciences. Jim has been working with CSIRO for over 30 years with his first project in evaluation of air tankers and a cost-benefit study of aerial suppression of bushfires. Completion of this study, Jim concentrated his research into fire behaviour and fuel management of various vegetation types throughout Australia. The results of this research has been a revision of grassland fire behaviour models, prescribed burning guidelines for regrowth forest in SE New South Wales fire behaviour model for eucalypt forest and shrublands. He has published a number of scientific papers on fire behaviour science in national and international journals.

44. Local Enhancement of LANDFIRE Data: Evaluation of Options

Author(s): Wendel Hann, US Forest Service Retired
Chris Winne, Systems for Environmental Management

We investigated options for enhancement of LANDFIRE data for a Subbasin watershed near Silver City in Southwestern New Mexico. Objectives were to test enhancement options for applications of fire behavior, effects, and regime modeling typically used in watershed scale fire and fuels planning. LANDFIRE vegetation type, cover, height, and biophysical setting layers were inputs for mapping LANDFIRE fuels and fire regime layers. We developed a process for refinement of LANDFIRE 2001 vegetation type, cover, and height layers through analysis of the LANDSAT 2001 imagery. LANDFIRE vegetation type, cover, and height 2008 layers were then enhanced using 2008 LANDSAT image analysis. A second method for enhancement of the 2008 layers involved application of transition rules to the 2001 layers plus use of 2008 image analysis. Results from the two 2008 enhancement options were compared to the LANDFIRE 2008 layers. Differences between the fuel and fire regime input layers of the three different 2008 data sets vary depending on the layer and its sensitivity to vegetation type. Fire behavior, effects, and regime models were processed for comparison of the three different data sets. Differences in fire behavior, effects and regime modeling outcomes of the three related data sets were evaluated.

Bio: Wendel is an accomplished professional in landscape fire ecology, with over 40 years of experience. Wendel retired from the U.S. Forest Service in 2009 with more than 30 years experience ranging from early years fighting fires, packing mules, and clearing trails to later work in land management and prescribed fire to work in landscape ecology research to his last assignment as National Landscape Fire Ecologist. Wendel has a PhD from the University of Idaho, and MS and BS from Washington State University.

45. Application of L Systems to Geometrical Construction of Chamise and Juniper Shrubs

Author(s): Tom Fletcher, Brigham Young University
Marianne E. Fletcher, Brigham Young University

Improved models of fire spread and fire characteristics are desired for live shrub fuels, since more research efforts have been focused in the past on beds of dead fuels or crown fires in trees. Detailed studies of individual leaf combustion have been performed, and these results have been incorporated into a shrub combustion model for broadleaf species. However, this approach was not applicable to non-broadleaf shrubs, such as where the fuel elements are small needles along the stems. In such shrubs, the stem geometry influences the combustion characteristics. Methods were therefore developed to simulate the branching structure of chamise (Adenostoma fasciculatum) and Utah juniper (Juniperus osteosperma). The plant structure was based on a form of fractal theory called Lindenmayer systems (i.e., L-systems). The structure model was tuned to specifically match the characteristics of each species, such as the angle of primary and secondary branches, the number of stems coming from the ground, and the fuel element length. Correlations to predict the number of branches based on the input crown diameter were made based on data from the literature so that the modeled shrubs have the same bulk density as live shrubs. This method can be used to generate shrub geometries for detailed shrub combustion models or for realistic artistic renditions.

Bio: Dr. Thomas H. Fletcher is a Professor in the Department of Chemical Engineering at Brigham Young University. He received a PhD in Chemical Engineering from BYU in 1983. He worked for seven years at the Combustion Research Facility at Sandia National Laboratories in Livermore, California. He has been on the faculty at BYU for the last 21 years, and is currently serving as Associate Chair. He has been working on fire spread in live wildland shrubs for over ten years. His research interests include pyrolysis of low grade fuels and biomass.

46. Fuel Life Cycle and Long Term Fire Behavior Responses to Fuel Treatment in Southeastern US Pine Ecosystems

Author(s): Benjamin Hornsby, US Forest Service
Robert Mitchell, Joseph W. Jones Ecological Research Center
Kevin Hiers, US Department of Defense
Joseph O'Brien, US Forest Service
Bret Butler, US Forest Service
Dan Jimenez, US Forest Service

Long-term effectiveness of fuel treatments in forests of the Southeastern US is not well understood. Although structural legacies from common midstory reduction treatments can be observed by managers, the resulting effects of these legacies on fire behavior have not been quantified. This study utilized a long term study at Eglin Air Force Base (EAFB) to compare the effects of midstory reduction treatments including herbicide, growing-season fire, and mechanical clearing, on fire behavior 15 years post treatment. In situ fire behavior measurements were collected in 3 replicates of each treatment type (and 3 desired future condition reference sites) using high resolution (80 square millimeter pixels) infrared thermography in 9 operational prescribed burns at EAFB in February and April of 2011. Infrared and visual images were collected in 4x4m plots at nadir (7.1m above) at 1 Hz. Point intercept vegetation data was also collected in the 4x4 m plots at a 0.25 square meters resolution as well as fuel loadings in surrounding vegetation (10, 0.25 square meter clip plots). Fuel loadings were found to be significantly different at alpha=0.05 among treatments and within treatments, with the exception of within loadings of the burn treatment (P=0.889). Total radiant energy released within the 4x4m plot ranged from 197 to 1100 kJ with 675 kJ being the average. Preliminary data analyses suggested that there were not large differences in total energy released among fuel treatments with respect to plot level measurements. Although plot level differences among treatments were not obvious, the data indicated that fire intensity varied within and among plots primarily due to the heterogeneity of fuels at the sub meter scale and variance associated with plot level wind turbulence.

Bio: Benjamin Hornsby is a Forester for the Southern Research Station Center for Forest Disturbance Science (CFDS). Benjamin has six years of experience in operational fire management and coordinates fire behavior research and analysis using infrared thermography for the CFDS Fire Science Team. He holds a Master of Science degree in Forest Resources from the University of Georgia's Warnell School of Forest Resources.

47. The effectiveness and longevity of fuel treatments in coniferous forests across California

Author(s): Erin Noonan-Wright, WFM RDA, U.S. Forest Service

A better understanding of the longevity of fuel treatement effectiveness is needed to aid managers in fuel treatment prescription development and planning. As part of the U.S. Forest Service Region 5 Fuel Treatment Effectiveness and Effects Monitoring Program, 88 pre-treatment plots were established in 14 National Forests in California dominated by mixed conifer, Jeffrey and ponderosa pine, and red fir overstory types. From 2001 to 2012, fuel loading, overstory ,and understory composition were monitored before and up to 10 years post treatment at 1-yr, 2-yr, 5-yr, 8-yr and 10 yr intervals. Fuel treatments included prescribed fire, mastication, and thinning with a surface fuel reduction. Empirical surface and canopy fuel loads were used to create custom fuel models for each plot. Wildland fire behavior was simulated with a non-spatial fire behavior modeling system, using wind, fuel moisture, and weather derived from historical large fire events that occurred in the vicinity of the plot locations. Pre- and post-predicted fire type (surface , passive or active), rate of spread, and flame length were used to evalute fuel treatment effectivness and longevity. At this time, preliminary results for a subset of the data, suggests that by 8 years post-treatment, many of the prescribed burn plots are no longer successful at mitigating passive crown fire behavior. Furthermore, predicted flame lengths were similar to pre-treatment flame lengths

8 years-post treatment, reflecting the accumulation of surface fuels nearing pre-treatment levels. Similar results regarding mastication and thinning with a surface fuel reduction treatment will be reported.

Bio: Erin Noonan-Wright graduated with a degree in Forestry from UC Berkeley and a masters degree in Environmental Resource Sciences from the University of Nevada, Reno. She worked for Point Reyes National Seashore as a Fire/GIS specialist and the U.S. Forest Service Adaptive Management Services Enterprise Team (AMSET) analyzing fire and fuels data. In 2006, she moved to Missoula, Montana and worked as a consultant with Systems for Environmental Management (SEM) in conjunction with the Fire Science Laboratory. She is currently employed as a fire application specialist working for Wildland Fire Management Research, Development and Application (WFM RDA).

48. Effects of Mechanical Thinning on Fuel Consumption and Emissions from Prescribed Burning in Coastal NC

Author(s): Karsten Baumann, ARA, Inc.
J. Mike Fort, ARA, Inc.
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Camp Lejeune near Jacksonville, NC served as platform for field experiments that allow linking fuel condition and consumption with emissions of gaseous and fine particulate (PM2.5) pollutants from prescribed burning (PB), comparing undisturbed (control) fuels with fuels that had received mechanical thinning via hydro-axe the winter before. PB of hydro-axed fuels is believed to effectively help accelerate the restoration of long-leaf pine savannas in fire-dependent forest ecosystems of the South-East. As part of the DoD-sponsored Defense Coastal-Estuarine Research Program (https://dcerp.rti.org), in situ measurements of PB emissions from control and hydro-axed fuels were conducted in conjunction with detailed before/after fuel inventory surveys. Fuel consumption measurements captured the moisture gradient from semi-mesic loblolly pine forest to pond pine pocosin. In general, hydro-axe treatment yielded greater availability and consumption of fuels, especially woody material regardless of fuel moisture. Measured PB emissions included various reactive gases and particle phase organic compounds, water-soluble ionic species, organic and elemental carbon, and total PM2.5 mass, as well as metallic and mineral PM2.5 constituents. Applying the carbon mass balance, emission factors (EF) were calculated for the suite of aerosol species measured. Our results indicate that site vegetation variation is not driving the observed EF differences, which are therefore not confounded by either soil characteristics or vegetation differences, allowing direct comparison of fuel treatment effects on emissions. Gaseous EF averages from the two fuel types are similar, and EF variability is highest for acidic gases and isoprene. However, PM2.5 mass and most PM2.5 species EF from hydro-axed fuels are significantly lower than those from untreated control fuels. Therefore, removing a certain targeted amount of fuel by employing hydro-axing prior to PB, bares significant air quality benefits due to lower total PM2.5 emissions. Organic carbon (OC) is the dominant PM2.5 constituent in emissions from both fuel types, followed by elemental carbon, nitrate, potassium and chloride. More volatile OC compounds are being emitted from either fuel type under less efficient (smoldering) combustion conditions, which also promote higher emissions of inorganic constituents, i.e. major ions (chloride, nitrate, sulfate), major metal oxides, and non-sulfate sulfur.

Bio: Dr. Baumann joined ARA in 2007. He first designed, built and staffed a top-class laboratory for the chemical analysis of discrete aerosol samples. ARA operates the most comprehensive and largest research oriented air quality monitoring network in the world, the South-Eastern Aerosol Research and Characterization SEARCH network. Since joining ARA, Dr. Baumann also managed several projects sponsored by the U.S. EPA, DoD, and private organisations. Previous employments were with RTI International and Georgia Tech, where he helping develop research programs in air quality management, receptor modeling, exposure and emissions measurements, sensor development, testing, and quality control.

49. Data assimilation for fuel moisture in WRF fire model

Author(s): Martin Vejmelka, University of Colorado Denver
Jonathan D. Beezley, Meteo France
Jan Mandel, University of Colorado Denver
Adam K. Kochanski, University of Utah

Fuel moisture is a major factor affecting the rate of spread of wildland fires and the he fluxes they emit into the atmosphere. Thus, a correct representation of fuel moisture is important for fire behavior models. In the SFIRE model, coupled with WRF, moisture levels are modelled using a time-lag dynamical model with hysteresis, which is switching between several different regimes depending on environmental conditions. The moisture model runs for separate fuel components on a coarse grid, and the moisture contents is interpolated into a finer, fuel map resolution weighted by the relative contents of the components in the fuel. We analyze the problem of the assimilation of spatially and temporally sparse data into the fuel moisture model. We present several data assimilation schemes based on the Extended Kalman Filter, the Unscented Kalman Filter, and Universal Kriging. We discuss the advantages and disadvantages of the assimilation schemes and investigate their behavior using a moisture simulation with assimilation of station-based observed moisture data.

Bio: Martin Vejmelka has received his PhD in the field Biocybernetics and Artificial Intelligence from the Faculty of electrical engineering of the Czech Technical University. He has conducted research in miltidimensional time series analysis with applications in biological signal processing. He is currently visiting with the wildfire modeling project at the University of Colorado Denver and his work involves research into methods of data assimilation.

50. Using terrestrial LiDAR to describe fuel elements in a diffuse-form shrub for fire behavior modeling

Author(s): Theodore Adams, University of Montana
Carl A. Seielstad, University of Montana

Fire behavior models have recently been developed to simulate fire propagation through individual shrubs. To date, shrubs have been represented in such modeling by distributing leaves randomly within volumes and attributing them using probability density functions developed from single leaf measurements and leaf combustion experiments. In this research, we use a terrestrial laser scanner to measure characteristics of chamise, a chaparral species (Adenostoma fasciculatum Hook. & Arn.) and then describe the location and composition of combustible fuel elements. Individual fuel elements are scanned so that point density and intensity metrics can be related to fuel properties. We then scan shrub structures from three angles at close range (4-6 m) with fine point spacing (1.0 mm) to generate point clouds of the targets. These point clouds are partitioned into many small volumes in order to describe the spatial distribution of fuel elements in three dimensions. Lastly, we attempt to attribute fuel elements using relationships between laser metrics and fuel properties. The resulting descriptions of fuel volumes are used to provide fire behavior models with spatially explicit inputs. The quality of these inputs will be examined by predicting fire behavior from our spatially explicit descriptions and from random descriptions of shrub characteristics, which will then be compared to actual fire behavior observations from shrub combustion in a controlled setting.

Bio: Ted grew up in the rural Montana community of Ronan and graduated in 2004. He started an undergrad degree at Eastern Washington University and finished at the University of Idaho with a B.S.in Environmental Science and a U.A.C. in Fire Ecology and Management in 2010. He began fighting fire in 2006 and has worked for the BLM in Buffalo, WY and Caliente, NV. He currently holds a position with the Payette National Forest in Council, ID and is in pursuit of a M.S. in Forestry from the University of Montana.

51. Analysis of inventory data derived fuel characteristics and fire behavior under various environmental conditions.

Author(s): Anne Andreu, University of Washington
William Crolly, USFS
Bernard Parresol, USFS

Detailed characterization of surface fuels allows for accurate determinations of the contributions of those fuels to surface fire behavior (SFB). The objective of this study was to develop fuelbeds representing the range of current surface fuel loads based on inventory data from 1680 plots on Savannah River Site (SRS), South Carolina and compare fire behavior at 97th, 93rd, and 75th percentile moisture scenarios. For the driest scenario, mid-flame wind speed was raised to 10 mph based on weather observations recorded during past on-site fires. We used plot data to construct fuelbeds in the Fuel Characteristic Classification System (FCCS) and calculated rate of spread and flame length under environmental scenarios representing low, moderate and high moisture and wind conditions. Woody fuels and litter comprised most of the surface fuel loading in the majority of the forest types. Litter contributed most to reaction intensity (RI) in fuelbeds that fell within the lower range of SFB (based on flame length), while shrubs contributed most to RI in fuelbeds at the higher range of SFB. Overall, SRS has relatively low fire hazard potential, however, at the 97th percentile moisture scenario and 10 mph wind speed, over 46% of plot fuelbeds were predicted to reach extreme surface fire behavior (flame lengths greater than 8 ft). Our findings suggest that active management has minimized fire risk, however, forest types with the potential for extreme SFB under the driest environmental conditions should be addressed in future fuel management treatments.

Bio: Anne Andreu is a research scientist with the University of Washington who works collaboratively with the Fire and Environmental Research Applications team at the Pacific Wildland Fire Sciences Laboratory on fuelbed development projects for the Fuel Characteristic Classification System.

52. National Weather Service Smoke Management Decision Support Tools in the Carolinas and Georgia

Author(s) John Tomko, National Weather Service
Gary Curcio, IPAFES, LLC
Joshua Weiss, National Weather Service

Wildland smoke's ground level movement and associated particulate matter can create safety hazards for transportation corridors as well as a health concerns for fire suppression personnel and populated areas. When smoke's concentrations are high or persist as nuisance smoke environmental conditions need to be thoroughly evaluated, smoke plume drift modeled and concentrations monitored. In June 2012 the Dad Fire in eastern North Carolina on the Croatan National Forest was generating heavy persistent smoke from consumption of surface and ground fuels. This generated concern for the managing Incident Management Team (IMT). Utilizing the National Weather Service (NWS) "Fire Weather Point Matrix (PFW") transportation corridor apprehensions were addressed. This new operational product was a key source of daily intelligence to the incident's Air Resource Advisor (ARA) and Meteorologist (IMET). A Super-Fog event was projected for June 24th 2012. The PFW pointed out this possibility as early as June 22nd. Alerted to favorable parameters and indices, they were monitored for the next 40 hours. IMT smoke action plan was engaged and appropriate agencies and public notified. The predicted fog event did occur during the projected optimal time of occurrence. Road visibility was reduced to 500 ft. This projected event was also corroborated by NWS smoke management tool, "Super-Fog Smart Tool". These two tools are available for NWS customers by requesting them under the NWS Fire Weather Program. PFW and Smart Tool provide key information in advance on how smoke is projected to disperse and the potential for Super-fog events.

Bio: John Tomko has been the Fire Program Leader at the National Weather Service in Greenville-Spartanburg, SC since 1995.

53. Development and Use of a New Forecast Tool to Improve Super Fog Forecasts

Author(s): Josh Weiss, National Weather Service

Many smoke management tools developed in the past decade have increased the ability to anticipate dense smoke near smoldering burns, including the atmospheric dispersion index (ADI), low visibility occurrence risk index (LVORI), and the point fire weather matrix (PFW). Still, dense smoke events cause significant public impact in the form of traffic accidents, which on average kill or injure tens of people every year in the United States. The cause of many of these accidents is not just dense smoke, but superfog, a combination of smoke and fog which reduces visibility to 1 meter or less. Although superfog poses a significant threat to public safety, it remains a somewhat poorly forecasted and understood phenomenon.

The National Weather Service (NWS) in Wilmington, NC has developed a tool in the Graphical Forecast Editor (GFE) to provide forecasters an easy method to diagnose superfog potential. The tool creates a binary mask which highlights regions where favorable parameters from the superfog matrix combine to produce conditions conducive to superfog. This mask heightens the awareness of forecasters to superfog potential near an ongoing fire, who will then delve further into the threat, and alert the local FBAN/SBAN working the fire to the superfog danger. This tool proved beneficial during the "Dad" fire of June, 2012 which burned more than 21,000 acres in the Croatan National Forest of North Carolina. Using this tool, the National Weather Service forecasters at the neighboring Morehead City, NC forecast office alerted foresters to possible superfog one night before visibilities became extremely reduced in the vicinity of the fire. This tool will not only help decrease missed dense smoke and superfog events, but increase awareness and, most importantly, enhance public safety.

Bio: Josh Weiss graduated with a Bachelor's degree in Atmospheric Science from the University of Massachusetts Lowell in 2008. He got his start in the National Weather Service working at the New Braunfels, TX Weather Forecast Office as a NOAA Hollings Scholar. He obtained his first meteorologist position at the Wilmington, NC office in August, 2009, and earned a promotion to general forecaster at the same office in January, 2012. He currently serves as the Fire Weather Program Manager and the CoCoRaHS regional coordinator.

54. June 2012, Dad Fire - Incident Management Team utilizes two National Weather Service Products: Fire Weather Point Matrix and Super Fog Smart Tool to successfully implement smoke mitigation plan to address smoke hazards to transportation corridors

Author(s): Gary Curcio, IPAFES, LLC
John Tomko, National Weather Service
Joshua Weiss, National Weather Service

Wildland smoke's ground level movement and associated particulate matter can create safety hazards for transportation corridors as well as a health concerns for fire suppression personnel and populated areas. When smoke's concentrations are high or persist as nuisance smoke environmental conditions need to be thoroughly evaluated, smoke plume drift modeled and concentrations monitored. In June 2012 the Dad Fire in eastern North Carolina on the Croatan National Forest was generating heavy persistent smoke from consumption of surface and ground fuels. This generated concern for the managing Incident Management Team (IMT). Utilizing the National Weather Service (NWS) "Fire Weather Point Matrix (PFW") transportation corridor apprehensions were addressed. This new operational product was a key source of daily intelligence to the incident's Air Resource Advisor (ARA) and Meteorologist (IMET). A Super-Fog event was projected for June 24th 2012. The PFW pointed out this possibility as early as June 22nd. Alerted to favorable parameters and indices, they were monitored for the next 40 hours. IMT smoke action plan was engaged and appropriate agencies and public notified. The predicted fog event did occur during the projected optimal time of occurrence. Road visibility was reduced to 500 ft. This projected event was also corroborated by NWS smoke management tool, "Super-Fog Smart Tool". These two tools are available for NWS customers by requesting them under the NWS Fire Weather Program. PFW and Smart Tool provide key information in advance on how smoke is projected to disperse and the potential for Super-fog events.

Bio: GARY M. CURCIO – is Lead Forester for IPA Fire Environment Specialists earning B.S. Degree from Albright College and M.F. Degree from Duke University. Former NC Forest Service Fire Environment Branch Head served on several national interagency committees: Air-tanker Board, Single Engine Air-tanker, and Amphibious Air-tanker Task Groups, Fire Danger Sub-committee, Fire Environment Observations Unit and Smoke Committee. Currently co-investigator for research concerning organic soils: their availability to ignite and impact emission inventories and under contract with the US Forest Service Air-fire Group for Smoke Mentoring, Modeling and Training. Also, deploys as an incident Fire Behavior Analyst or Air Resource Advisor.

55. SmartFire 2: A Flexible Framework for Merging Fire Information

Author(s): Sean Raffuse, Sonoma Technology, Inc.
Thom Dedecko, Sonoma Technology, Inc.
Narasimhan Larkin, USFS
ShihMing Huang, Sonoma Technology, Inc.

Emissions from wildland fires represent a large fraction of the total mass of particulate matter emitted in the United States. Recent research suggests that fire activity (the existence, size, and types of fire present on the landscape) is one of the largest sources of uncertainty in the estimation of emissions from wildland fires. Production of accurate and comprehensive assessments of fire activity requires the use of multiple input data sets, including official reporting databases and remote sensing. We present the concepts and algorithms of SmartFire 2 (SF2). Although SF2 shares some features with the original SMARTFIRE system, SF2 has been comprehensively redesigned to be more flexible, expandable, and accurate. SF2 is a modular framework that can combine an indefinite number of fire information data sets (ground reports, satellite-based detection, helicopter perimeters, etc.) into a best estimate of fire activity. Each fire information data set has specific strengths; SF2 allows the user to specify "trust metrics" for the information elements (such as final size, location, and type) in each data set and then uses the most trusted available data sources to produce merged results. Here we present an overview of SF2, explain the methods used in producing emissions inventories, and discuss outstanding issues and recommendations for future development.

Bio: Sean, with STI since 2003, conducts and coordinates STI's research and development at the intersection of wildland fires and air quality. He develops tools and techniques for evaluating how smoke impacts the environment and how those impacts can be reduced. He applies his knowledge of satellite remote sensing to interesting problems and enjoys finding the connections between disparate lines of research. Sean's love of play drives him to seek out new ideas, challenges, and opportunities both personally and professionally. Outside of STI, he enjoys music, games, sports, cooking, and his family.

56. Fire managment objective considerations

Author(s): Grant Steelman, Seminole Tribe of Florida

Wildland fire has been the primary land management tool of ranchers, farmers, and sportsmen in the Southeastern United States since early native American inhabitation. Florida fire management objectives once centered on habitat management through two variables: fire return interval and depth to water table. Since intensive canalization beginning in the 1920's, south Florida ecosystems are shifting to drier systems than previously recorded. Original surveyor notes from the late 1800's, 1940's aerial photos, and current aerial photography evaluations give land managers insight as to what landscape level changes have occurred due to water level manipulation and other factors. These same landscape level changes offer insight into obtainable management objectives. Land manager's objectives in these heavily impacted habitats can be defined better by analysis of historic and current habitats on the landscape and ability to utilize wildland fire for habitat improvement. Emphasis on pre-Columbian habitat objectives may no longer be obtainable or economically realistic in heavily impacted landscapes. This presentation looks at some objectives used by land managers in South Florida to evaluate current habitat types and land management by comparing the functionality of the landscape common to the southeastern United States.

Bio: Grant Steelman, Forester, Seminole Tribe of Florida 2010-current.
Wildlife Biologist/Land Manager, Florida Fish & Wildlife Conservation Commission, Fisheating Creek Wildlife Management Area.
1996 M.S. Range and Wildlife Management, Texas A&M University-Kingsville, Ceasar Kleberg Wildlife Research Center
1994 B.S. Wildlife Conservation, N.C. State University

57. Fuel Treatment Effectiveness Monitoring and Lesson Learned

Author(s): J. Bradley Washa, Bureau of Land Management
Jim Menakis, USFS

The effectiveness of the hazardous fuels treatment program in reducing wildfire impacts have not been sufficiently demonstrated to Congress, OMB, and the public. Demonstration and evaluations of fuels treatment effectiveness is needed to improve the hazardous fuels reduction program and to maintain current and future funding levels. In this presentation, hazardous fuel treatments will be evaluated based on mostly two key management questions: 1) Did the hazardous fuel treatment, as designed in the treatment objectives, change the wildfire fire behavior characteristics; and 2) Was the hazardous fuel treatment used in helping with the suppression of the wildfire. The presentation will focus mostly on the 2011 and 2012 wildfire season and will highlight: 1) the Fuel Treatment Effectiveness Monitoring (FTEM) system now being used by the USDA Forest Service and US Department of Interior Bureaus; 2) the importance of monitoring fuel treatment effectiveness; 3) the effectiveness of past wildfires that were managed for resource benefits on new wildfires; and 4) some of the lessons learned both in monitoring and effectiveness of hazardous fuel treatments. Examples of fuel treatment effectiveness success stories and the key elements that lead to success will be discussed. Some fuel treatments that did not meet their objectives and some of the reasons why will also be discussed.

Bio: Brad Washa's initial interest in fire management began as a seasonal on the Mesa Verde National Park helitack crew in 1989. After three years at Mesa Verde, he moved to the Arapaho-Roosevelt National Forest for another three years as an engine foreman and as an acting zone assistant fire management officer. This was followed with a short 20 month sentence to Long Island, New York as a fire management specialist with The Nature Conservancy. Brad returned to the Forest Service in 1996 on the Magdalena Ranger District of the Cibola National Forest working in various fire related positions for another three years, the last of which was developing and serving as the primary assistant and a field coordinator for the Southwest Fire Use Training Academy in Albuquerque, New Mexico. In March of 1999, Brad started as a Fire and Fuels Management Specialist with the Bureau of Land Management on the Grants Pass Resource Area of the Medford District and became the fire and fuels program lead in March of 2001. In April 2004, Brad became the Utah BLM State Fuels Specialist. His current job includes program and budget oversight of hazardous fuels, prescribed fire, fire ecology, smoke management, and wildland fire for resource benefit for BLM Lands in the State of Utah. Brad has completed several national level details to the National Interagency Fire Center as one of the BLM's National Fuels Specialists in 2009 and as the National Fuels Coordinator for the Department of Interior's Office of Wildland Fire Coordination in Washington, DC in 2010.

58. Evaluating models for low intensity wildland burning using comprehensive observations from four prescribed fires.

Author(s): Tara Strand, NZ Forest Research Institute
Robert Mickler, Alion Science and Technology
Craig Clements, San Jose State University
Miriam Rorig, USFS
Harold Thistle, USFS
Narasimhan (Sim) Larkin, USFS
Brian Lamb, Washington State University

Small low intensity burns can dominate fire emissions in woodland, agricultural, and rangeland regions of the world, including the woodlands of southeastern United States. These smaller (typically < 100ha) lower intensity fires are prescription burns set to meet land management and ecosystem-health objectives. While each fire produces less smoke than larger wildfires, the number of these fires and the relatively low-height to which smoke is sometimes lofted can contribute to large scale smoke impacts at the ground, including air quality exceedences and low visibility in transportation corridors. Smoke modelling for smaller, low-intensity fires has lagged behind model development efforts aimed at larger wildfires. To improve our understanding of low intensity smoke emissions and to recommend and/or develop a low-intensity smoke emissions modelling pathway through the BlueSky Modeling Framework (BlueSky Framework) detailed observations were collected at four low-intensity burns in The Nature Conservancy's (TNC) Calloway Forest/Sandhills Preserve, North Carolina USA. Data were collected for a wide range of variables, allowing for comparisons to be made at each modelling step (fuels, consumption, emissions, plume rise, dispersion) required in smoke modelling. Smoke emissions and concentration observations were done for PM2.5, CO, CO_2, and other trace gases associated with biomass burning. The BlueSky Framework and its incorporated models were examined to find the pathway that best represented these collected observations following the Smoke Emissions Model Intercomparison Project (SEMIP) case study methodology. Results indicate that observed emissions are less or greater than modelled emissions depending on model-pathway choice and on emission species. Evaluation results demonstrate the complexity of computing PM2.5 emissions as results vary more for PM2.5 compared to other emitted gases. Work is underway to develop a recommendation guide that assists with selection of smoke modelling pathway is for low-intensity burns.

Bio: Tara Strand, PhD, Scion, NZ Forest Research Institute

59. Fuel accumulation rates following hazardous fuel reduction treatments throughout California

Author(s): Nicole Vaillant, PNW Research Station - WWETAC
Alicia Reiner, AMSET
Carol Ewell, AMSET
Scott Dailey, AMSET
Erin Noonan-Wright, Wildland Fire Management RDA

Quantifying the longevity of effectiveness for fuel treatments to reduce potential fire behavior is of great interest to land mangers. To date the majority of research surrounding the effectiveness of fuel treatments only considers the time immediately after treatment. Little is known about how long these treatments last, or how often they will need to be re-treated to maintain desired levels of reduced fire behavior and effects. The duration of treatment effectiveness is likely to vary between forest types and between treatment types such as prescribed fire and mechanical treatments. Quantifying changes in fuel loading over time is necessary to predict potential fire behavior. As part of a long-term fuel treatment effects monitoring project data was collected at 88 permanent plots representing 28 fuel treatment projects on 14 national forests in California from 2001 to 2012. Data to quantify canopy, ladder, surface, and ground fuels was collected before treatments were applied and up to 10 years after treatment (1, 2, 5, 8, and 10 year post treatment intervals) for each plot. Fuel treatments ranged from prescribed fire only, thinning only, mechanical understory treatments such as mastication, and a combination of thinning plus understory fuel reduction treatments. We will present our findings on fuel accumulation rates for dominant forest and fuel treatment types.

Bio: Nicole Vaillant is a fire ecologist at the Western Wildland Environmental Threat Assessment Center which is part of the Forest Service Pacific Northwest Research Station.

60. Creating an Efficient and Effective Conservation Plan: Finding the Right Mix of Fire and Non-Fire Treatments Based Upon Costs and Benefits

Author(s): Jim Smith, The Nature Conservancy
Kori Blankenship, The Nature Conservancy
Randy Swaty, The Nature Conservancy
Sarah Hagen, The Nature Conservancy
Jeannie Patton, The Nature Conservancy

Conservation and restoration are often resource limited-needs almost always exceed funds. It is therefore important to create the greatest benefit from every dollar spent. This is a challenging task in a real landscape with multiple targets, multiple management options, varying costs, and unknown impacts. Relatively low cost controlled burning is typically one of the options being considered, but demonstrating that it creates the desired benefits in the long term in comparison to other management options such as thinning, fencing, etc. can be problematic. We present an implementable methodology that can help fire and resource planners compare the costs and benefits of combinations of treatments at a landscape scale. The methodology can also be used in a collaborative way, and can incorporate important issues such as invasive species and climate change.

Bio: Jim is currently the TNC Project Lead for LANDFIRE. Jim earned a B.S in Timber Management and M.S. Forest Biometrics from the University of Georgia, and a Ph.D. in Forest Biometrics and Remote Sensing from Virginia Tech. Jim spent the next 13 years on the Forestry faculty at Virginia Tech, achieving the rank of Associate Professor. Jim has also worked in the commercial sector, and was the Director of Forest Information Systems development for Champion International Paper Company and International Paper Company.

61. Wood to Energy in the Southeastern US

Author(s): Dan Len, USDA Forest Service R8

The Southeastern US is highly productive forest land and considered the "wood basket" of America. Over the past 5 to 10 years the traditional forest products industry in the Southeast has experienced a decline and timber harvest levels have also been reduced. The reduced demand for timber due to lack of housing market has contributed to the need for forest restoration and hazardous fuels treatment activities.

One market opportunity that has greatly improved in the past 5 years is the "Wood to Energy" market. This market is for wood to produce a variety of types of renewable energy. This "wood to energy" market predominantly includes the use of wood chips to generate electricity and produce wood pellets. The wood pellet industry has expanded beyond the US residential market into the European market. Last year the US Southeast surpassed Canadian wood pellet export production. An increased demand for renewable energy has resulted in an increased number of coal fired electric generation facilities converting to wood or co-firing wood with coal. There has also been an increase in the number of new wood fired electric generation facilities constructed in the Southeastern US.

The next emerging technology includes the use of wood to produce bio-fuels and chemicals. This technology is not fully developed but the goal of energy independence and security will speed the commercialization.

This situation presents opportunities to offset forest management or fuel treatment costs with the economic value of various forest products. Examples of wood to energy projects will be presented.

With the continued need to restore forests, treat hazardous fuels and produce renewable energy the USDA Forest Service is emphasizing "Building a forest restoration economy thru forest restoration and hazardous fuels treatments to accomplish wood to energy". Examples of collaboration with State, other Federal and private partners will be presented.

Wood to Energy Conversion Methods include Wood to Thermal, Wood to Electric, Wood to Combined Heat & Power, Wood to Pellets, Wood to Biofuels & Chemicals, and others (torrefaction (Biochar)). Examples of the various wood to energy facilities will be presented.

Bio: As Regional Woody Biomass Coordinator, USDA Forest Service Southern Region, responsibilities include coordination of USFS efforts to integrate of wood utilization with landscape restoration, renewable energy on National Forests and State & Private lands. Dan is a 33 year veteran with USFS. He spent six years as the Vegetation Management Program Manager on the Arapaho and Roosevelt National Forests, developing the Rocky Mountain Region's Long Term Stewardship Contract and served as USFS National Office's Small Wood or Woody Biomass Coordinator for National Forests and their partners. Dan holds degrees in Industrial Management, Auburn University and Forest Products, University of Idaho.

62. Pains Bay Fire Assessment

Author(s): Robert Mickler, Alion Science and Technology
David Welch, Alion Science and Technology
Andrew Bailey, NC DFR
Miriam Rorig, USDA Forest Service

Temperate zone (30 –50° latitude) peatlands store a large proportion of the world's terrestrial carbon (C) and are subject to high-intensity, stand-replacing wildfires characterized by flaming stage combustion of above-ground vegetation and long-duration smoldering stage combustion of organic soils. While severity, duration, and extent of peatland wildfires drives overall emissions, methods for assessing pre- and post-burn and above- and below-ground biomass, and accurately estimating C emissions have been poorly tested. Coastal peatlands are a unique region where long duration wildfire soil combustion is responsible for the majority of total emissions. We tested a method to estimate above- and below-ground C emissions from the 2011 Pains Bay peatland wildfire by combining burn intensity model output, field surveys, and remotely-sensed information. The approach to estimate belowground C emissions employed pre-fire LIDAR-derived elevation coupled with post-fire survey-grade GPS elevation measurements. Above-ground C emission calculations were characterized for litter, shrub, and tree foliage fractions in different vegetation classes thereby providing detailed emissions sources. The estimate of wildland fire C emissions considered factors contributing to peatland emissions such as hydrologic regime, land management history, and remotely sensed estimates of vegetation damage. Particulate matter data was collected from monitors surronding the fire and smoke trajectory and emission concentrations were analyzed in the BlueSky modeling framework.

Bio: Robert Mickler is a wildland fire resercher with Alion Science and Technology. He is a co-investigator on severl Joint Fire Science Program projects. His fire researchinterests are in carbon budgets of organic sol fires in the coastal plain of North Carolina. Bob is a NWCG Engine Boss and Ignition BOss, and a member of the NOrth Carolina Prescribed Fire Council.

63. Detection and simulation of smoke feedbacks to atmospheric boundary layer for a prescribed burn

Author(s): Yongqiang Liu, USDA Forest Service
Nicholas Skowronski, USDA Forest Service
Michael Gallagher, USDA Forest Service
Matthew Patterson, USDA Forest Service
Warren Heilman, USDA Forest Service
Xindi Bian, USDA Forest Service
John Hom, USDA Forest Service
Kenneth Clark, USDA Forest Service

The turbulent and convective processes in the atmospheric boundary layer (ABL) are important factors for smoke properties such as plume height. Smoke, in turn, can feed back to the ABL through modifying thermal processes on the ground and in the ABL. This study detects and simulates the feedback for a prescribed burn conducted in the New Jersey Pine Barrens near the Silas Little Experimental Forest on 6 March 2012. Emissions of smoke particles were calculated and evaluated using fuel and burn information and field measurements. ABL heights were measured using a ceilometer. Simulations were conducted using the Community Multi-scale Air Quality (CMAQ) model with coupled meteorology and chemistry. The CMAQ simulation and experimental data collected during the prescribed burn indicate two major mechanisms with opposite smoke impacts on ABL heights. On one hand, smoke particles reflect and absorb solar radiation, reducing radiative and sensible heat fluxes at the ground. The reduced heat transfer from the ground to the atmosphere results in slower ABL height growth. On the other hand, the absorption of solar radiation by black carbon, which is a component of smoke particles in the ABL, heats the atmosphere, resulting in faster ABL growth. The first mechanism is found to play a more important role than the second mechanism for the simulated prescribed burn case. Results from this study suggest that smoke from prescribed fires may tend to reduce ABL heights.

Bio: Dr. Yongqiang Liu is a Research Meteorologist and Leader of the Atmospheric Science Team, Center for Forest Distturbance Science, USDA Forest Service. His research areas include wildland fires, smoke dynamcs and air quality impacts, climate change impacts, and soil-vegetation-atmosphere interactions.

64. Using optical flow techniques to examine smoke plume dynamics

Author(s): Scott Goodrick, USDA Forest Service

Optical flow is a technique for assessing changes between a series of images. By adding constraints to optical flow problem meant to mimic those of fluid dynamics, such as conservation of mass, it is possible derive a flow field within the image. The technique has been used successfully with satelite data to generate wind fields from the motion of clouds. Application of the technique to examine smoke plume dynamics is examined using the video and data from the FireFlux experiment. The goal of the project is to develop a system capable of real-time plume analysis capable of detecting changes in plume behavior that may be precursors to dangerous changes in surface fire behavior such as down bursts and the surfacing of strong winds aloft.

Bio: Scott Goodrick is a research meteorologist with the USDA Forest Service Southern Research Station. Research is focused on the areas of smoke management, fire-atmosphere interactions and wind-related forest disturbance.

65. A Superfog Index Based on Historical Data

Author(s): Gary Achtemeier, USDA Forest Service

A superfog screening model was used to predict superfog lasting for at least one hour for sixteen combinations of fuel temperature and relative humidity linked with ambient weather. Results were normalized to a 10-point scale with zero being no fog and ten being superfog for all sixteen fuel conditions. The superfog index (SFI) shows

a strong dependency on low ambient temperature such that fog chances decline with warmer night-time lows. The SFI was applied to proximity ambient weather data for the 09 Jan 2009 I-4 and 29 Jan 2012 I-75 disasters in Florida. The SFI was high in all cases suggesting potential for superfog. Superfog plus extenuating circumstances led to the I-4 and I-75 disasters.

Bio: Gary L. Achtemeier has been a research meteorologist with the USDA Forest Service since 1990. His research interests are in fire modeling, smoke plume modeling, nocturnal smoke transport, superfog, and long-range transport of air-borne biota.

66. Identification of Necessary Conditions for Arctic Transport of Smoke from Fires in CONUS and Russia.

Author(s): Narasimhan K. Larkin, U.S. Forest Service
Jennifer DeWinter, Sonoma Technology, Inc.
Sean Raffuse, Sonoma Technology, Inc.
Tara Strand, Scion Research
Steve G. Brown, Sonoma Technology, Inc.
Jonathan Callahan, Mazama Science
Kenneth J. Craig, Sonoma Technology, Inc.
Hilary R. Hafner, Sonoma Technology, Inc.
Robert Solomon, U.S. Forest Service

The deposition of black carbon (BC), is a significant contributor to observed warming trends in the Arctic. Biomass burning outside of the Arctic, including wildland prescribed fires, is a major potential source of Arctic BC. Therefore, limiting or eliminating spring prescribed burning has been suggested as a BC reduction technique. However, there are large uncertainties in the current estimates of the sources, source regions, and transport and transformation pathways of BC transported to the Arctic region.

This study is the first comprehensive examination of the meteorological conditions required for emissions to be transported to Arctic. Using a simple trajectory modeling technique, we characterize the potential for transport of emissions from fires to reach the Arctic and Greenland over a 30 year period (1980-2009) for various source locations, times of year, and plume injection heights. Emissions sources in CONUS and in Russia are examined in parallel studies. This study identifies both Under what meteorological transport conditions can CONUS emissions potentially impact the Arctic? And the corollary: Under what meteorological transport conditions will CONUS emissions not impact the Arctic? This knowledge allows for both more targeted future studies and more precise mitigation strategies that do not focus on areas and times where Arctic impact is unlikely. Both the 30-year climatology and a daily prediction tool are presented.

Bio: Narasimhan K. ('Sim') Larkin is a senior scientist and Team Leader with the U.S. Forest Service AirFire Team. He has led numerous projects involving fire emissions and smoke modeling, including the BlueSky Framework and the Smoke and Emissions Model Intercomparison Project.

67. Effects of Fire on Wading Bird Foraging Habitat and Resources

Author(s): Louise Venne, University of Florida
Joel C. Trexler, Department of Biological Sciences, Florida International University
Todd Z. Osborne, Department of Soil and Water Science, University of Florida
Peter C. Frederick, Dept. of Wildlife Ecology and Conservation, University of Florida

Prescribed fire is commonly used to manage upland habitat for the benefit of wildlife; however, how fire effects in wetlands translate to impacts on wetland-dependent species is poorly understood. Preliminary studies in cattail-dominated marshes suggest that long-legged wading birds (i.e., herons, egrets, ibises, storks, spoonbills, order Ciconiiformes) are attracted to recently burned areas. This may be due to shallower water, increased prey density, or availability of prey. To further explore this issue, we conducted a number of studies to quantify fire effects on primary producers and consumers, determine whether wading birds prefer burned areas, and establish reasons why wading birds may prefer these areas. Immediately after a burn, primary producers increase in biomass, while fish respond temporarily in abundance. Immediately after the fire, wading birds were found in greater numbers in burned areas than in the adjacent sloughs, but this changed as water levels dropped and prey moved to the sloughs. Thus, the open habitat created by fire over shallow water probably enhances availability of fish to wading birds, resulting in an increased number of wading birds in burned areas immediately after the fire.

Bio: Louise Venne received her PhD from the Department of Wildlife Ecology and Conservation at the University of Florida in August 2012.

68. Fire effects monitoring is a valuable tool in managers' toolbox

Author(s): Beth Buchanan, USDA Forest Service
Tederell J Boyer, USDA Forest Service
Lindsey A Curtin, USDA Forest Service
Reggie J Goolsby, USDA Forest Service
James H Patterson, USDA Forest Service

The use of prescribed fire has increased dramatically over the last several decades, particularly in the fire-adapted southern United States. Corresponding research on the effects of fire, including on vegetation, has not kept pace. To fill the information void, some agencies (e.g., National Park Service) established a national fire effects monitoring program to be carried out by dedicated crews. Other agencies, such as USDA Forest Service, opted not to approach monitoring in such a top-down fashion. However, in the 13-state Southern Region, in which the majority of the prescribed burning takes place, forest-level fire management officers pushed for guidance on collecting local data to support prescribed fire being used, at first mainly to reduce fuels, but increasingly also to restore habitat. Since the early 1990s, forests have been required to collect data on fuels and vegetation in permanent plots. We discuss the results of this endeavor, including recommendations for other agencies opting to use this approach. In general, data collected in such a manner can be used at least to document trends, which can be used to support the more- rigorous research efforts which now are becoming more commonplace. Fire effects monitoring completed internally by firefighters and other employees offer multiple benefits to the local unit, the region, and the fire community as a whole.

Bio: Beth Buchanan is a fire ecologist in the Southern Region of the USDA Forest Service. She focuses on their fire effects monitoring program and increasing information exchange between managers and scientists.

69. Alteration of presettlement fuels and fire regimes of the Custer-Little Bighorn landscape in Montana

Author(s): Cecil Frost, NC Plant Conservation Program (ret)

Mapping original fire regimes is a realistic goal for any site and various ways exist for anyone having in-depth understanding of the local landscape. At the Custer Battlefield in Montana I reconstructed fire regimes in 1876 using evidence in the field along with an extraordinary collection of over 2000 photos, the most available resource here. Dating to as early as 1877, before european settlement, the images are windows in time for this part of the original landscape of the Crow Nation. I mapped the whole surrounding region since most fires here result from fire flow into the park rather than local ignitions. The site occupied a partially fire sheltered position in a frequent fire landscape with a lightning-driven fire regime, supplemented by Indians. The Little Bighorn River constituted a firebreak, protecting pockets of cottonwoods, juniper and big sagebrush, all fire-refugial species, while the prairies experienced fire intervals of 2-7 years on the fire exposed southwest side of the river and up to 50 years on the downwind side. Beginning in 1877, photos document a 136-year cascade of changes that included saturation of the land with domestic livestock, cessation of the natural fire regime around 1901, increase in cottonwoods, juniper and sagebrush, and invasion by six exotic plant species, leading to increased fuel connectivity, increased spatial coverage of fire and elimination of big sagebrush from all but its most fire sheltered habitats.

Bio: CECIL FROST is a consulting Landscape Fire Ecologist and former coordinator of the North Carolina Plant Conservation Program. His specialty is making maps of pre-European fire regimes and historical vegetation for purposes of restoration with prescribed fire, having mapped some 2.9 million acres to date.

70. Future trends in mega-fire and fuel in the United States under a changing environment

Author(s): Yongqiang Liu, USDA Forest Service
Bo Tao, Auburn University
Jia Yang, Auburn University
Hanqin Tian, Auburn University
Scott Goodrick, USDA Forest Service
John Stanturf, USDA Forest Service

A mega-fire is a wildfire that usually comes up with big size and intensity, big impact, and big effort for damage control. Mega-fires likely become more frequent and intense in this century in response to the projected climate change. A research project supported by the U.S. Joint Fire Science Program (JFSP) has been conducted to investigate mega-fires and their air quality impacts in the United States with a focus on the future trends under changing climate. A comprehensive approach of data analysis, algorithm development, and numerical modeling is used, including calculations of present and future fire potential indices using dynamical downscaling of regional climate change, analyses of mega-fire breakout using atmospheric patterns and properties as thresholds, simulations and projections of fuel and fire properties using a dynamic global vegetation model , and simulations of smoke transport and the air quality impacts using a smoke trajectory model.. Satellite remote sensing products are processed to provide fire and smoke information for modeling evaluation. This presentation describes this JFSP mega-fire project and research results.

Bio: Dr. Yongqiang Liu is a Research Meteorologist and Leader of the Atmospheric Science Team, Center for Forest Distturbance Science, USDA Forest Service. His research areas include wildland fires, smoke dynamcs and air quality impacts, climate change impacts, and soil-vegetation-atmosphere interactions.

71. The Waldo Canyon Fire and Front Range Fires of Colorado

Author(s): Rich Harvey, Nevada Division of Forestry

Wildfires are a common occurrence on the Colorado Front Range, but in 2012 the Front Range saw fire like never before. On June 26th historic fuel conditions combined with extreme weather conditions, and topography produced the most destructive wildfire in Colorado history, the Waldo Canyon fire. Rich Harvey, the Incident Commander with Great Basin Incident Management Team 2, was IC for the Waldo Canyon fire and several others on the Front Range in 2012, and will discuss the fuels, the fires, and the lessons learned on the Front Range in 2012. Rich will share his observations on fire behavior, the effectiveness of fuel treatments, and the best defense for home survivability. Rich provides an up close look at the climate and fuels that drove the Waldo Canyon fire and a unique perspective on the Front Range fires of 2012.

Bio: Rich stared his career with the US Forest Service in 1979 as a seasonal firefighter on the Plumas National Forest. Graduting from Humboldt State University with a Bachelors Degree in Forest Management, Rich joined the Nevada Division of Forestry as a Crew Supervisor and has worked in progressively challenging wildland fire, and natural resource management positions with the Division for the past 24 years currently serveing as Deputy State Forester.
Rich has over 30 years experience on Incident Management Teams, most recently as a Type I Incident Commander for several major wildland fires in Colorado and Idaho.

72. Determining and Evaluating Variables Contributing to the Spread of Fire in Alaska

Author(s): Marsha Henderson, State of Alaska

An interagency process was developed in 1983 for Alaska to determine fire suppression levels regardless of ownership. These levels are based primarily on the values at risk and the likelihood of a fire igniting and reaching them and are reviewed annually. Typically during the month of July, Alaska determines on a statewide basis to allow more fires in the full suppression level to burn with limited suppression efforts. Finally, for each fire ignition, decision-makers determine whether to follow the predetermined suppression level or to take a nonstandard approach. These three time scales for fire management decision-making in Alaska all require some basic understanding of the values potentially at risk, the likelihood of a fire igniting, and the variables that contribute to the spread of fire. Alaska has shortcomings in data needs in historic weather, weather forecasting, identification of values, and fuels. The development of a sensitivity analysis model for FSPro to model fire spread provides an understanding of the data needs which include elevation, aspect, slope, ERC, and wind speed. The data limitations have been identified along with the need of further education in the use of fire models and decision-making thought processes. This education has been developed to include a "FSPro User's Guide for Alaska" which includes recommendations for the use of LANDFIRE data, weather analysis, and model use. The decision-making education has included discussions with land managers on the development of strategic and incident objectives and courses of action. Finally, a new approach to collaborative decision-making between land managers and suppression person has been developed and implemented in Alaska which provides a streamlined process for fire decisions.

Bio: Marsha Henderson - A Strategic Planner for the State of Alaska. Marsha worked for the National Park Service for 17 years and then moved to the State of Alaska in 2006. She completed a Master's Degree at the University of Alaska, Fairbanks in 2012 with a thesis in fire behavior modeling.

73. An accuracy assessment of surface fuel classification systems and maps, and why fuel variability and spatial scaling matters

Author(s): Robert Keane, US Forest Service
Chris Toney, FIA, US Forest Service
Jason Herynk, Systems for Environmental Management

Wildland fuels are important to fire managers because they can be manipulated to achieve management goals, such as restoring ecosystems, decreasing fire intensity, minimizing plant mortality, and reducing erosion. However, it is difficult to accurately measure, describe, and map wildland fuels because of the great variability of wildland fuelbed properties over space and time. The LANDFIRE produced two map products that describe fuel loadings: the Fuel Loading Model (FLM) layer and the Fuel Characteristics Classification System (FCCS) layer. These layers are commonly used in fire management to compute smoke emissions, calculate fuel consumption, estimate fire severity, and quantify carbon pools. We performed an accuracy assessment of both the FLM and FCCS classifications themselves and the LANDFIRE FLM and FCCS maps using a new set of 10,000 Forest Inventory and Analysis (FIA) plot data that had recently became available. We found that the both classification systems performed poorly and, as a result, the LANDFIRE FLM and FCCS maps had a poor accuracy (>15%). The reason for these inaccuracies had nothing to do with inadequate classification and mapping procedures, but rather they are a direct result of the tremendous spatial variability of fuels. We recently quantified the scale of this variability across space in another study and found that the scale of this accuracy assessment and mapping efforts do not match the scales at which fuels vary. Each surface fuel component had its own inherent scale with fine fuels varying at scales of 1 to 5 m, coarse fuels at 10 to 150 m, and canopy fuels from 100 to 500 m, and the variability of each fuel component was extremely large. Findings from this accuracy assessment have major implications for fuel mapping in that previous methods must account for the scale and variability of fuels in their design.

Bio: Robert E. Keane is a Research Ecologist with the USDA Forest Service at the Missoula Fire Sciences Laboratory His most recent research includes 1) developing ecological computer simulation models for the exploring landscape, fire, and climate dynamics, 2) conducting field research on the sampling, describing, modeling, and mapping of fuel characteristics, and 3) investigating the ecology and restoration of whitebark pine.

74. Estimation of Fireline Construction Rate for Large Wildland Fire Using Geospatial Perimeter Data

Author(s): Hari Katuwal, University of Montana
Dave E. Calkin, RMRS Human Dimensions

Thousands of wildland fires, most of which are suppressed at a relatively small size, occur each year on public land. A substantial amount of resources are spent on suppressing and managing wildland fires that escape. In addition, federal spending on large wildland fire suppression has been growing at an alarming rate. The trend shows no sign of reduction. Thus, cost containment, production efficiency and risk management have emerged as vital policy issues in wildland fire management. Fireline production rates and perimeter percentage contained are used for strategic and onsite fire management decisions. Efficient risk management requires careful evaluation and analysis augmented by accurate data. Nonetheless, there is a great deal of variation in the fireline production rate estimated in previous studies. Most of these analyses and estimates, with some exceptions, are based on either Incident Status Summary (ICS-209) data or expert opinion. However, i t has been argued that some of the estimates reported in ICS-209 might not be accurate. Anecdotal evidence suggests that there are inconsistencies on the reporting of fire containment. Inaccuracy in reported data raises the question on the validity for further use in research and strategic decision making. Subsequent estimation of production rates and other factors that determine suppression efficiency might be misleading. More importantly, use of inaccurate prediction can lead to misallocation of resources and eventually to inefficient risk management. It may compromise suppression efforts or result in inefficient allocation of resources creating shortages in other more pressing areas. In this study we explore the issue of misreporting and potential gaming of reported data. We compare daily percentage contained estimates reported in ICS-209 with the data obtained from fire perimeter progression maps to examine the discrepancy between these two estimates. Production rates are estimated using perimeter data generated from aerial and ground based observation. The results from this study will provide meaningful insights into the productivity and efficiency of fireline construction. Identification and better understanding of factors hindering productivity will help fire managers design strategies for effective risk management .

Bio: Hari Katuwal is a Postdoctoral Researcher in Wildfire Economics and Non-market Valuation at the University of Montana. Hari received his PhD in Economics from the University of New Mexico. He is an applied microeconomist, and his areas of specialization lie at the intersection of Econometrics and applied Microeconomics with a specific focus on Natural Resource and Environmental Economics. He uses surveys and data, apply economic theory and estimate econometric models to make policy recommendations. His current research focuses on wildland fireline production, efficiency, and wildfire risk assessment.

75. An Enhanced Spatial and Predictive Fire Danger Rating System for New Jersey

Author(s): John Hom, USDA Forest Service
Warren Heilman, USDA Forest Service
Xindi Bian, USDA Forest Service
Kevin Mccullough, USDA Forest Service
Nick Skowronski, USDA Forest Service
Jason Cole, USDA Forest Service

The New Jersey Forest Service has a critical need for refining the National Fire Danger Rating System (NFDRS) so that it is specific for the Pine Barrens. Much of the uplands are dominated by a highly flammable forest composed of Pitch Pine (Pinus rigida), dense scrub oaks (Quercus marlandica, Q. ilicifolia) and Ericaceous shrubs. The Pine Barrens are considered among the most volatile fire cycle vegetation in the East. Analysis of long-term (1930-present) weather records and wildfire history data indicates that wildfire occurrence in this region is largely decoupled from NFDRS indicesncommonly used by New Jersey fire managers, i.e. Buildup Index, Ketch Byram Drought Index, are not well correlated. We describe a framework for producing a real-time, spatial and predictive Fire Danger Rating System more responsive to the conditions found in New Jersey and the Eastern coastal Plain, based on spatial mapping and modeling of the NFDRS using GMT modeling for spatial registration of MM5 (predictive) mesoscale modeling. Spatial maps for the Anderson 13 and Scott and Burgan fire behavior fuel models were produced at 30m resolution by the Eastern LANDFIRE Prototype. LIDAR was used to map fuel structure and fuel loading to refine the fuel models. Daily operational mapping of NFDRS at 1 km resolution is presented using Google Earth display for distribution.

Bio: I am an interdisciplinary scientist with the Forest Service, Northern Research Station. Currently I am working on the validation of smoke dispersion models from low intensity fires, using tree ring analysis to predict adaptability to climate change, as well as research in the interaction of climate, invasive insects, and wildfires.

76. Hazardous Fuels Treatments and Wood Utilization in the Colorado Front Range

Author(s): Dan Len, USDA Forest Service R8

The Colorado Front Range has experienced some of the most severe wildfire events in the past several decades. As a result of these severe events and the need for forest restoration and hazardous fuels treatments in the urban interface, the US Forest Service has made every effort to increase the amount and effectiveness of hazardous fuels treatments on the National Forests.

The need for hazardous fuels treatment on National Forests combined with the decline of traditional forest products industry in Colorado created challenges in implementing forest restoration projects in the urban interface. In an effort to address these challenges a range of administrative tools are being used.

The various administrative tools used to implement forest restoration and hazardous fuels treatments include Service Contracts, Stewardship Contracts, Stewardship Agreements and Timber Sale Contracts.

Service Contracts are used to accomplish "service" work on National Forest System lands. Common activities include thinning of non-commercial trees where no forest products are removed.

Stewardship Contracts come in two forms. There is an Integrated Resource "Service" Contract and Integrated Resource "Timber" Contract. Stewardship Service Contracts involve soliciting proposals and the service work cost is greater than the timber value. Stewardship Timber Contracts involve harvesting timber that is of greater value than service work that is also included.

Stewardship Agreements are between USFS and Non-profit organizations such as Rocky Mountain Elk Foundation or National Wild Turkey Federation. These partners have mutual objectives and share in benefits and costs during implementation of projects.

Timber Sale Contracts include the sale of timber being sold to the highest bidder.

Hazardous fuels treatment project examples with advantages and disadvantages for each type of contract or agreement will be presented and discussed.

Bio: As Regional Woody Biomass Coordinator, USDA Forest Service Southern Region, responsibilities include coordination of USFS efforts to integrate of wood utilization with landscape restoration, renewable energy on National Forests and State & Private lands. Dan is a 33 year veteran with USFS. He spent six years as the Vegetation Management Program Manager on the Arapaho and Roosevelt National Forests, developing the Rocky Mountain Region's Long Term Stewardship Contract and served as USFS National Office's Small Wood or Woody Biomass Coordinator for National Forests and their partners. Dan holds degrees in Industrial Management, Auburn University and Forest Products, University of Idaho.

77. Woody Biomass for Thermal Energy in the Northeast and Midwest

Author(s): Lew McCreery, USFS Northeastern Area

The use of woody biomass for thermal energy is expanding in the Northeast and Midwest. Conversions are occuring in commercial, industrial, and institutional settings. The presentation describes the advanced wood combustion technologies being utilized and specific applications for the use of wood for energy. Case studies of facilities that have converted are presented. The Forest Service role in technical assistance is described as well as the financial and CO_2 reduction results are presented.

Bio: Lew McCreery is the biomass coordinator for the US Forest Service for the Northeastern Area, working closely with State Foresters, private industry, federal experts, local communities, and forest landowners to implement biomass and bioenergy projects. Mr. McCreery has a strong background in forest management science, as well as the practical realities of implementing biomass and bioenergy projects on the ground. This includes community energy and wood products project feasibility work (both engineering and economic), as well as impacts of biomass projects on forest conditions and local economies.

78. The technical and financial feasibility of using distributed scale thermochemical conversion to produce biochar from forest and range treatment residues

Author(s): Nathaniel Anderson, Rocky Mountain Research Station

Thermochemical conversion can be used to transform woody biomass into useful bioenergy and bioproducts that have the potential to offset treatment costs and reduce air pollution associated with open burning of treatment residues. However, the technical and financial viability of distributed scale conversion systems is often uncertain, especially for their deployment in the forest sector. Over the past four years, scientists at the U.S. Forest Service Rocky Mountain Research Station and the University of Montana have been engaged in an integrated research program to evaluate the technical and financial feasibility of using mobile and modular pyrolysis technologies to process woody biomass from forest and range treatments. Our emphasis has been on evaluating the commercial production of high quality energy gas and biochar, which is a fine-grained charcoal that can be used for fuel, as a soil amendment, or as raw material in the manufacture of activated carbon and other industrial products. This work includes a comparison of mobile versus centralized operations, field-based research to quantify the productivity, costs and financial performance of biomass conversion, evaluation of biochar as a soil amendment, and multiple assessments of biochar as a precursor to activated carbon. Our analysis reveals that distributed scale pyrolysis does have the potential to improve the economics of treatment through the production of value added products, but financial performance is sensitive to many variables, including productivity and conversion rate. An understanding the technical, logistical and financial dimensions of these systems is needed by technology firms, investors, and land managers to evaluate the potential costs and benefits of using thermochemical conversion to process fuel treatment residues.

Bio: Nate Anderson is a Research Forester with the US Forest Service, Rocky Mountain Research Station, in Missoula, Montana. His research is focused on quantifying the costs and benefits of forest products, including biomass. Ongoing projects include harvested wood products carbon accounting, an assessment of biomass utilization on the Uncompahgre Plateau in Colorado, the integration of advanced pyrolysis and gasification technologies into forest products supply chains, and financial and economic analysis of new systems for harvesting woody biomass. He has a PhD in Forest Resources Management from the State University of New York, an MS in Sustainable Development and Conservation Biology from the University of Maryland, and a BS in Biology from Bates College.

79. Linking Visual Range, PM2.5 Concentrations and the Air Quality Index - What do we tell the Public in Smoke-Filled Wildfire Situations?

Author(s): Susan M. O'Neill, USDA Forest Service
Mike Broughton, Fish & Wildlife Specialist
Mark Fitch, National Park Service
Peter W. Lahm, USDA Forest Service

Many states are investigating or already implementing a methodology developed in the arid intermountain west where concentrations of particulate matter with aerodynamic diameter less than or equal to 2.5 micrometers (PM2.5) are estimated from an observed visual range (VR) measurement. The PM2.5 concentration estimate is then linked to the EPA public health warning scale called the air quality index (AQI) to inform the public about potential health impacts from smoke from wildfire. This methodology is used in situations where monitoring data are not available and there is a need to inform the public about potential health consequences from regional-scale smoke episodes. Important caveats are: 1) the method only applies when relative humidity (RH) < 65%, and 2) the atmosphere must be predominantly impacted by smoke (i.e. low concentrations of PM2.5 from other anthropogenic sources). In this work, the Interagency Monitoring of PROtected Visual Environments (IMPROVE) light extinction equation was applied to investigate the correlation of VR and PM2.5 as an atmosphere becomes more smoky. This was done for various parts of the country where background anthropogenic concentrations can be more significant than in the arid inter-mountain west and where RH can typically exceed 65%. Results show that for regions where RH > 70% and non-negligible background anthropogenic concentrations exist, this VR/PM2.5/AQI methodology developed in the arid inter-mountain west may not apply. A national health-based air quality standard does not exist for short-term PM2.5 impacts, but the Environmental Protection Agency (EPA) has included this VR/PM2.5/AQI methodology in its Wildfire Smoke, A Guide for Public Health Officials and Canada has also developed a multi-pollutant (PM2.5, ozone, NO2) 3-hr based air quality health index (AQHI). The various state, EPA and international approaches to informing the public about potential health impacts from wildfire smoke will be presented along with the technical analysis of PM2.5 and VR based on the IMPROVE light extinction equation.

Bio: Susan O'Neill is a Research Air Quality Engineer with the USDA Forest Service Pacific Northwest Research Station, AirFire Team, and has a Ph.D. from the Laboratory for Atmospheric Research at Washington State University. She is an original developer of the BlueSky smoke modeling framework and research interests extend to all aspects of modeling fire emissions, smoke dispersion and transport, and smoke plume chemistry.

80. Where the Wind Doesn't Blow: A Climatology of Air Stagnation Events in the United States

Author(s): Alan Srock, Michigan State University
Sharon Zhong, Michigan State University
Joseph Charney, US Forest Service

Air stagnation events can greatly impact fire planning. Stagnant air can cause major complications for fires primarily because of diminished smoke ventilation, which in turn limits visibility and may negatively affect safety and public health. Warnings for air stagnation can halt a prescribed burn for an extended period of time, even if stagnation does not occur. Currently, there is no widely accepted definition of stagnation, as the frequency and duration of stagnation events varies greatly around the country. Additionally, the criteria required for a National Weather Service office to issue an Air Stagnation Advisory vary from one location to another. We wanted to build a climatology of air stagnation events that would be consistent everywhere, and could thus help fire managers when making burn decisions.

To build the climatology, we decided to start with a long-term dataset at the surface, where the effects of stagnation would affect fires most greatly. We collected hourly surface observations from stations around the United States from 1981 to 2010, and extracted the winds from each station for the entire period. After a perusal of the data, we selected the thresholds for a stagnation event as a maximum wind speed of 6 kt for at least 24 hours. Results from the surface analysis, including distributions of the duration of the event, the hour of the end of the event, and more will be shown. Further, to expand the spatial coverage of the surface observations, we will also present similar distributions and calculations from gridded surface datasets. Comparisons between surface observations and gridded datasets should help us determine confidence for stagnation occurrences in locations where surface stations are sparse.

Bio: Alan Srock is a post-doctoral researcher at Michigan State University. His background is in synoptic-dynamic meteorology, and he is now focusing on ways that large-scale weather can affect fire behavior.

81. Air pollution forecasting by coupled atmosphere-fire model WRF and SFIRE with WRF-Chem

Author(s): Adam K. Kochanski, University of Utah
Jonathan D. Beezley, Meteo France
Jan Mandel, University of Colorado Denver
Craig B. Clements, San Jose State University

Atmospheric pollution regulations have emerged as a dominant obstacle to prescribed burns. Thus, forecasting the pollution caused by wildland fires has acquired high importance. WRF and SFIRE model wildland fire spread in a two-way interaction with the atmosphere. The surface heat flux from the fire causes strong updrafts, which in turn change the winds and affect the fire spread. Fire emissions, estimated from the burning organic matter, are inserted in every time step into WRF-Chem tracers at the lowest atmospheric layers. The buoyancy caused by the fire then naturally simulates plume dynamics, and the chemical transport in WRF-Chem provides a forecast of the pollution spread. We discuss the choice of wood burning models and compatible chemical transport models in WRF-Chem, and demonstrate the results on case studies.

Bio: Adam Kochanski has received his PhD in Atmospheric Sciences in 2008 from the University of Nevada-Reno. He also has an MS degree in Chemical Engineering. In his graduate work, he has developed coupled atmosphere-ocean models including wind-wave interaction for the forecasting of the swell effect of the wind. Since his PhD, he has been at the Atmospheric Science Department at the University of Utah, where his research has focused on micrometeorology, atmosphere-land interaction, utilization of satellite and aircraft data, and modeling of wildland fire behavior.

Poster Abstracts

P1. The standardized fuel bed: a tool for capturing variation in fire weather among experimental low intensity fires.

Author(s): Dexter Strother, USFS Center for Forest Disturbance Science
Bob Kremens, R.I.T.
Joseph O'Brien, USFS Center for Forest Disturbance Science
Benjamin Hornsby, USFS Center for Forest Disturbance Science
Matthew Dickinson, USFS NRS

Experiments involving wildland fire are complicated by enormous variation in fire weather often unrelated to the treatments of interest. For example, temperature, wind speed, atmospheric humidity and fuel moisture vary both within and among burn days and even fires ignited within hours of each often will be burning under very different conditions. This variation might mask experimental treatment effects of interest. In an attempt to collapse this multivariate nuisance variation into a simple covariate, we have devised a standardized fuel bed that can be deployed in low intensity experimental burns. The fuel bed consists of 300 g of aspen (Populus tremuloides) excelsior spread over a 1 square meter area at a depth of 10 cm deployed within the experimental burn unit. The fuel bed equilibrates to atmospheric humidity in approximately 45 minutes. A dual band infrared radiometer is positioned 80 cm above the bed and collects fire radiative power measurements at 1 Hz. These can be integrated to give fire radiative energy estimates. The standardized fuel bed moisture response and fire behavior characteristics from a series of experimental burns conducted in test beds in Athens, Georgia and in prescribed fires at Eglin Air Force Base in Florida will be presented. This tool could help minimize among burn variation in fire behavior when burn conditions cannot be controlled.

Bio: Dexter Strother is a doctoral student at the University of Georgia Odum School of Ecology. He is also a member of the USFS Center for Forest Disturbance Science Fire Team. He is interested in fire ecology, fire behavior and distubance ecology in general.

P2. Validation of the WRF-Fire model using observation data from a prescribed burn experiment

Author(s): Xindi Bian, USDA Forest Service
Shaojun Lai, MSU
Sharon Zhong, MSU
Warren Heilman, USDA Forest Service
Joseph J. Charney, USDA Forest Service

Low-intensity prescribed fires (LIPF) can be a viable tool for managing forest ecosystems. However, LIPF may radically modify the atmospheric environment within canopy layers by inducing strong fire-atmosphere interactions. These interactions can lead to intense turbulence production in and around the fire front. As part of a broad Joint Fire Science Program project to develop modeling tools for predicting smoke dispersion from low-intensity fires, the USDA Forest Service - Northern Research Station conducted several LIPF experiments on a forested plot in the New Jersey Pine Barrens (NJSL) to collect meteorological and air-quality data that can be used for model validation. The observational data, from one of LIPF experiments, that took place on March 6, 2012 at NJSL has been used to valid the coupled WRF-Fire model. WRF-Fire combines the fully compressible and non-hydrostatic Advanced Research Weather Research and Forecasting model (ARW-WRF) with the surface fire behavior model, SFIRE, allowing users to model the growth of a wildfire and the dynamic feedbacks with the atmosphere. The coupling between fire and atmospheric environment is two-way: wind velocity from WRF is used in calculating the rate of spread of fires while the heat released from the fire feeds back into WRF dynamic affecting the atmosphere in the vicinity of the fire. The WRF-Fire has not been extensively validated using real-world data. This is because the couple model has been made available to user community only recently and because validation of such system requires detailed measurements of both fire behavior and conditions of the atmosphere surrounding the fire. The prescribed burn experiment provides a unique opportunity to validate WRF-Fire. Several simulations were conducted and the simulated heat release and the influence on temperature and wind fields appear to agree reasonably well with the observations from the towers in the burn area. Sensitivity studies suggest that it is necessary to invoke the WRF LES mode in order to capture the correct response of the atmosphere to the fire.

Bio: Xindi Bian is a meteorologist at the USDA Forest Service Northern Research Station. His research focuses on atmosphere interaction with the physical, biological, and social components of ecosystems at multiple spatial and temporal scales. His primary areas of research interest include real-time fire weather predictions, regional climate-ecosystem changes, hydrological cycles, boundary layer and turbulence studies, and atmospheric transport and dispersion.

P3. Assessing Canopy Fuels Across Heterogeneous Landscapes Using LiDAR

Author(s): Kenneth Clark, USDA Forest Service
Nicholas Carlo, Rutgers University
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Kenneth Clark, USDA Forest Service
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Melanie Maghirang, USDA Forest Service

LiDAR (Light Detection and Ranging) systems are indispensable tools for estimating 3-dimensional fuel structure of forest canopies at stand to regional scales. LiDAR data can provide significant advantages over biometric, inventory-based approaches to quantifying canopy fuels. These include the ability to conduct rapid, large-scale and high resolution inventories in a systematic manner, and an accurate quantification of damaged, non-uniform crowns that could be erroneously characterized using inventory-based methods. For a truly accurate determination of canopy fuels, it is essential to evaluate LiDAR signals against destructive harvest data, preferably with concurrent, sequential harvesting of trees to quantify fuels in 1-meter layers and LiDAR data acquisitions. This crucial step is frequently omitted from studies which have generated canopy fuel inventories using LiDAR technology. We are improving estimates of canopy fuel loading in Pitch pine (Pinus rigida L.) stands for wildland fire managers in the New Jersey Pinelands by integrating sequential tree harvests with repeated upward-profiling LiDAR sampling in 20 m x 20 m plots. We then use wide-ranging Airborne Laser Scanning (ALS) data to scale canopy fuel estimates across heterogeneous landscapes consisting of stands of various age, structure, and wildfire history. Here we report on; 1) the calibration of LiDAR data with biometric data derived from sequential harvests to quantify crown fuel weight (CFW) and canopy bulk density (CBD) in 1-meter height bins, 2) the comparison of profiling and scanning ALS data in Pitch pine stands of varying structure, and 3) the development and evaluation of initial landscape-scale canopy fuel loading maps. Regression equations developed from destructive harvests, upward-scanning profiling LiDAR data, and downward-scanning LiDAR data to predict CFW and CBD in 1-meter layers were all highly significant, with r2 values ranging from 0.71 to 0.98. Although the initial calibration of LiDAR using destructive harvests is time-consuming, unambiguous estimates of canopy fuels can then be used to produce highly accurate maps of canopy fuels for hazardous fuels assessments in forests and Wildland-Urban Interface. High resolution data such as those reported here can also be used in fire behavior and smoke dispersion models with a high degree of confidence.

Bio: Kenneth Clark is a Research Forester with the USFS Northern Research Station, located at the Silas Little Experimental Forest in New Lisbon, New Jersey. His research focusses on fire weather, hazardous fuel assessments, and the use of eddy flux measurements to quantify energy, water and carbon exchange in forests.

P4. Ground Zero Daily Smoke Production Values for NC Coastal Plain Organic Soil Fire - Pains Bay May / June 2011

Author(s): Gary Curcio, IPAFES, LLC

At times wildland smoke can present safety hazards and health concerns for nearby downwind transportation corridors or populated areas. If it persists to long this toxic cocktail stresses air quality. In eastern North Carolina during the Pains Bay Fire May through June 2011 firefighters and populace were exposed daily to a dense spreading surface smoke plume. The NC Forest Service Fire Environmental Branch and Incident Management Team smoke specialist were asked to assist and deploy particulate matter collecting stations, EBAMS. One station from the US Forest Service Missoula Technology and Development Center was deployed at ground zero to record the range of particulate matter exposure for day or night shift personnel as well as to assist in smoke modeling validation efforts. One PM2.5 - 24 hour sample set (May 26th, 2011) recorded an average particulate matter of 492.458 microns per cubicmeter with a maximum value 1362 microns per cubicmeter and a minimum value 106 microns per cubicmeter. To place these values in perspective they are compared to Environmental Protection Agency 24 hour standard 35 microns per cubicmeter. Under the Air Quality Index the average value of 492 microns per cubicmeter would have issued: a cautionary statement “Everyone should avoid any outdoor exertion; people with respiratory or heart disease, the elderly and children should remain indoors.”, and a health effect statement “Serious aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and the elderly; serious risk of respiratory effects in general population”.

Bio: GARY M. CURCIO; is Lead Forester for IPA Fire Environment Specialists earning B.S. Degree from Albright College and M.F. Degree from Duke University. As former NC Forest Service Fire Environment Branch Head served on several national interagency committees: Air-tanker Board, Single Engine Air-tanker, and Amphibious Air-tanker Task Groups, Fire Danger Sub-committee, Fire Environment Observations Unit and Smoke Committee. Currently co-investigator for research concerning organic soils: their availability to ignite and impact emission inventories and under contract with the USFS Air-fire Group for Smoke Mentoring, Modeling and Training. Also, deploys as an incident Fire Behavior Analyst or Air Resource Advisor.

P5. Real-Time Analysis of Fire Weather Prediction Accuracy: Year 2 Progress

Author(s): Stacy Drury, Sonoma Technology Inc

Fire weather forecasters, fire planners, and decision makers do not have easy access to information needed to verify the accuracy of fire weather forecasts and the products that rely on them to predict ignition potential. The Joint Fire Science Program (JFSP) funded development of a system that produces intuitive, easily understandable meteorological model performance assessments and provides end users with real’time information about meteorological model bias, model reliability, and overall performance of fire weather forecasts. We have produced a system that ingests data from RAWS and ASOS weather stations; analyzes the difference between observed and forecasted weather data to identify accuracy, bias, and uncertainty; and displays the analysis in an online map system. Users can view current, historical, and forecast weather data from WRF, NAM, NDFD, and GFS weather models for each weather station. In addition, observed and forecasted fuel moisture and fire danger rating indices using the National Fire Danger Rating System (NFDRS) and the Canadian Forest Fire Danger Rating System (CFFDRS) are displayed. Simple statistical analyses allow users to identify model bias and model accuracy. We have found that fire weather accuracy can be improved locally by using a simple mean bias measure. Every day for each station, the system calculates a mean bias measure over the past seven days. We apply this bias measure to the forecasted fire weather variables, such as air temperature and relative humidity, to adjust the fire weather metrics spatially and temporally in light of local model performance.

Bio: Stacy Drury is the Senior Fire Ecologist for Sonoma Technology Inc in Petaluma California. Stacy is involved with many projects including the Interagency Fuels Treatment Design Support System (IFTDSS), the Smoke Emissions Modeling Intercomparison Project (SEMIP), and the Real time assessment of Fire Weather Accuracy. Stacy has experience in many widely varied ecosystems including the Boreal forests of Alaska, western coniferous forests, and eastern decidous forests where he has conducted studies on fuel quantification. fuel consumption, and fire history.

P6. Simulation of low-temperature dehydration of peat

Author(s): Alexander Filkov, National Research Tomsk State University
Denis Gladky, National Research Tomsk State University

Peat fires occur regularly. Despite pouring rains or attempts of firemen it is very difficult to extinguish peat fires. Fires can last during the considerable periods of time (from a week and to several years) and cover very large areas. Unfortunately, by the present time, it has not been developed a scientifically based system for the prediction of fires, which could estimate the probability of peat fires.

According to works of A.M. Grishin, it is necessary to specify the following basic factors influencing on the initiation of surface and peat fires: ability of fuel to ignition and ability of fuel to fire propagation. It is obvious, that they are directly connected with the moisture content and drying of fuel. Therefore, a solution of the problem on drying of fuel takes the important place in the prediction of fire hazard.

We assume that a layer of peat is dried under the influence of environment. It is considered the one-dimensional problem in the Cartesian coordinate system. A mathematical model for drying of a peat layer is one-temperature. Peat is considered to be a multiphase media consisting of a dry organic substance with a volume fraction, free and bound water with a volume fraction, and a gas phase. The set of equations was solved numerically by the iterated-interpolation method with the constant time step.

The conducted mathematical investigation shows that the obtained numerical results are in qualitative and quantitative agreement with the experimental data. For optimum accuracy, the maximum drying temperature should not exceed 330 K and the time of prediction is no more than one week. For the reason that the air temperature in the boreal zone is rarely higher than 320 K, we can draw a conclusion that the proposed model can be used to predict the behavior of moisture content and temperature in the layer of peat for the subsequent prediction of peat bog fires. It is established that we can use the averaged kinetics to predict dynamics of the moisture content of peat samples but not more than for three days.

Bio: EDUCATION 2010-Present Doctoral candidate, Tomsk State University, Tomsk. 2002-2005 PhD, Dissertation in Ecology (Physical and Mathematical Sciences), Tomsk State University, Tomsk. 1997-2002 Specialist, Faculty of Mechanics and Mathematics, Tomsk State University, Tomsk position 2009-Present Senior researcher, Laboratory of Modelling and Predicting Catastrophes, Tomsk State University, Russia. 2007-Present Associate professor, Faculty of Mechanics and Mathematics, Tomsk State University, Russia. 2003-Present Head of Education Laboratory of Physical and Computational Mechanics Department, Tomsk State University, Russia. 2002-2003 Junior researcher, Laboratory of Modelling and Predicting Catastrophes, Tomsk State University, Russia.

P7. The Twitter social media platform: the Southern Fire Exchange experience in fire science communication

Author(s): David Godwin, University of Florida

Many organizations have utilized internet based social media platforms (i.e. Twitter, Facebook, Pinterest) for establishing and expanding communication programs. This lessons-learned review poster focuses on the Southern Fire Exchange (SFE), which is the Southeastern U.S. branch of the Joint Fire Science Program national fire science consortium. The SFE is a collaborative program run jointly by the University of Florida, North Carolina State University, Tall Timbers Research Station, and the US Forest Service Interface South program. The SFE is designed to increase the availability and application of fire science information for natural resource management and to connect the research needs of fire managers with the research community. Beginning in May of 2011, the SFE began a Twitter outreach program after recognizing the unique opportunity that the Twitter platform offers for connecting daily with wildland fire practitioners, agency representatives, scientists, and academics. As of October of 2012, after over 2,000 "Tweets", the SFE Twitter program has acquired over 283 followers located in multiple US states and regions. While developing and tuning this outreach and communications program the SFE has developed low-cost analysis and tracking methods for assessing progress. The results of the on-going SFE Twitter program demonstrate the potential for other science outreach and delivery organizations to expand their audiences and connect with state-holders using free internet based social media platforms.

Bio: David R. Godwin is currently finishing his PhD in Forest Resources and Conservation at the University of Florida. He also has a MS in Forest Resources and Conservation from the University of Florida and a BS in Geography from Florida State University. He was a 2012 Presidential Management Fellows Finalist and a 2010 JFSP Graduate Research Innovation (GRIN) award winner. His research interests include forest and fire management influences on carbon dynamics as well as fire effects mapping using remote sensing.

P8. Relative comparison of fuel load estimates

Author(s): Scott Goodrick, USDA Forest Service

In determining the emissions from wildland fires, one of the key inputs is an esitmate of the amount of fuel available for consumption. There are a number of tools available to provide this estimate such as various photo series and remote sensing products. This study provides a relative comparison of fuel load estimates for specific sites using the various fuels maps available through landfire as well as estimates derived through use of photo series. For areas of frequent disturbance the photo series provided a better estimates of the fuel load.

Bio: Scott Goodrick is a research meteorologist with the USDA Forest Service Southern Research Station. Research focuses on smoke management, fire-atmosphere interactions and wind-related forest disturbance.

P9. Fire-Atmosphere Interactions During Low-Intensity Prescribed Fires in the New Jersey Pine Barrens

Author(s): Warren E. Heilman, USDA Forest Service
Shiyuan Zhong, Michigan State University
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John L. Hom, USDA Forest Service
Kenneth L. Clark, USDA Forest Service
Nicholas S. Skowronski, USDA Forest Service
Michael Gallagher, USDA Forest Service
Matthew Patterson, USDA Forest Service
Yongqiang Liu, USDA Forest Service

Of particular concern to fire and air-quality management communities, particularly in the eastern portion of the U.S., is the behavior and air-quality impacts of low-intensity prescribed fires for fuels management. For example, smoke from prescribed fires, which often occur in wildland-urban interface (WUI) areas in the eastern U.S., can linger in an area for relatively long periods of time and have an adverse effect on human health. Smoke from wildland fires can also reduce visibility over roads and highways in the vicinity of and downwind of these fires. The planning for and tactical management of low-intensity prescribed fires can be enhanced with models and decision support tools developed with a fundamental understanding of how the atmosphere interacts with these types of fires and the smoke they generate. As with measurements that have been carried out during more intense wildland fire field experiments such as the International Crown Fire Modeling Experiment (ICFME) and the FireFlux grass fire experiment, measurements of the atmospheric environment and fire-atmosphere interactions during low-intensity prescribed fires provide critical data for evaluating new and existing modeling systems. The observations also enhance our fundamental understanding of how atmospheric mean and turbulent circulations can affect the spread of these fires and local smoke dispersion. This paper describes and presents some initial observations of the fire-atmosphere interactions that occurred during two low-intensity prescribed fires carried out in the New Jersey Pine Barrens. We specifically focus on the atmospheric turbulence regimes that were present in the fire environments. The observational results set the foundation for subsequent analyses of how forest vegetation and ambient and fire-generated atmospheric turbulence affect local transport and diffusion of smoke from low-intensity wildland fires.

Bio: Dr. Warren E. Heilman is a Research Meteorologist with the USDA Forest Service - Northern Research Station in East Lansing, MI. He received his M.S. and Ph.D. degrees in Meteorology from Iowa State University in 1984 and

1988, respectively. His current research is focused on small-scale fire-atmosphere interactions and atmospheric boundary-layer turbulence effects on fire behavior and smoke dispersion.

P10. BlueSky Playground: A Web-Based Smoke Modeling Decision Support Tool

Author(s)
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Robert Solomon, Meteorologist, U.S. Forest Service AirFire Team

Fire exclusion across the United States is a major contributor to wide-scale changes in forest structure, alterations in species composition, and accumulation of forest floor material. Fuels treatments, including prescribed fires and pile burns, have become increasingly important as fire seasons continue to worsen in severity. In addition, standards for particulate pollution continue to tighten, requiring land managers that approve or conduct prescribed fires to manage smoke production carefully to minimize smoke impacts in sensitive areas.

BlueSky Playground is an interactive, web-based tool for estimating smoke emissions and resulting downwind smoke concentrations from wildfires, prescribed fires, and pile burns. It connects to fuel loading, fuel consumption, fire emissions, and smoke dispersion models utilizing the BlueSky Framework, providing access to powerful modeling tools in an easy-to-use interface. BlueSky Playground is part of the Wildland Fire Decision Support System Air Quality suite (WFDSS-AQ) and has been revamped recently to provide more useful tools and an updated interface for both wildfire smoke modeling and prescribed burn planning, including access to regional high-resolution forecast meteorology where available. The resulting system both provides better user controls over parameters affecting fire emissions, and allows for more advanced dispersion modeling.

Bio: Sean, with STI since 2003, conducts and coordinates STI's research and development at the intersection of wildland fires and air quality. He develops tools and techniques for evaluating how smoke impacts the environment and how those impacts can be reduced. He applies his knowledge of satellite remote sensing to interesting problems and enjoys finding the connections between disparate lines of research. Sean's love of play drives him to seek out new ideas, challenges, and opportunities both personally and professionally. Outside of STI, he enjoys music, games, sports, cooking, and his family.

P11. Simulating Prescribed Burn Events in the New Jersey Pine Barrens using ARPS-CANOPY

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Matthew Patterson, U.S. Forest Service, Northern Research Station

Smoke dispersion from wildland fires is a critical health and safety issue, impacting air quality and visibility across a broad range of space and time scales. Predicting the dispersion of smoke from low-intensity fires is challenging because it is sensitive to factors like near-surface meteorological conditions, local topography, vegetation, and atmospheric turbulence within and above vegetation layers. Existing integrated smoke dispersion modeling systems (e.g., BlueSky), which are designed for prediction of smoke from multiple sources on a regional scale, do not have the resolution and physics parameterizations necessary to adequately reproduce smoke from low-intensity fires, which can meander around the source and reside within forest canopies for an extended period of time. Thus, a project was launched by the Joint Fire Science Program (JFSP) to develop and validate modeling tools for predicting smoke dispersion from low-intensity fires.

As part of achieving this goal, the Advanced Regional Prediction System (ARPS) atmospheric model has been modified to allow simulation of flow through a multi-layer canopy. The effects of vegetation elements (e.g., branches, leaves) on drag, turbulence production/dissipation, radiation transfer, and the surface energy budget are accounted for through modifications to the ARPS model equations. The modified version of ARPS is referred to herein as ARPS-CANOPY.

This paper presents results from two recent modeling case studies of prescribed burns in the New Jersey Pine Barrens. To accurately represent regional and local forcing within the vicinity of the burn, a series of one-way nested simulations are executed, with horizontal grid spacing spanning from 8.1-km to 100-m. To account for the first-order effects of a wildland fire on the lower atmosphere, upward sensible heat fluxes are imposed within a fixed area of the model domain, with fire intensity and timing derived from observed data. For each case, momentum, scalar, and turbulence fields are compared between the innermost domain simulation and data obtained from a series of flux towers located inside and outside of the burn unit. This work is one part of a coordinated effort to evaluate the performance of atmospheric dispersion modeling systems; papers detailing data analysis efforts will be presented elsewhere at the conference.

Bio: I am a research associate working in the Department of Geography at Michigan State University. My background is in meteorology; I receieved my BS in 2003 from the University at Albany-SUNY, and my MS and PhD from North Carolina State University, in 2005 and 2009, respectively. My research intererest is numerical modeling of atmospheric processes, including wildland fire-atmosphere interaction, cold-air pool development inside basins and valleys, and the impact of forest canopies on the lower atmosphere.

P12. The Advantages and Disadvantages of the Pre-Formed Type III Fire Suppression Team

Author(s): Patrick Withen, Smokejumper, retired

This paper will explore the advantage and disadvantages of forming Type III Fire Suppression Teams prior to the engagement in the manner that Type I and Type II teams are now formed. Some jurisdictions have already experimented with this type of team formation. The features of teamwork, flexibility, effectiveness, safety, costs, decision making, transitions, and more will all be examined. The implications of pre-forming Type III teams will be explored in relation to how IC teams interact with the administrative unit in which the incident is located.
Bio: By Patrick Withen Affiliations: The University of Virginia at Wise. USFS, McCall Smokejumpers, Retired.

P13. Facilitating Knowledge Exchange About Wildland Fire Science

Author(s): Alan Long, Tall Timbers Research Station
Janean Creighton, Oregon State University
Vita Wright, USFS Human Factors and Risk Management RD&A

The Joint Fire Science Program's (JFSP) Knowledge Exchange Consortia Network is actively working to accelerate the awareness, understanding, and adoption of wildland fire science information by federal, tribal, state, local and private stakeholders within ecologically similar regions. Our network of 14 regional consortia provides timely, accurate, and regionally relevant science-based information to assist with fire management challenges. Regional activities, through which we engage fire managers, scientists and private landowners, include online newsletters & announcements, social media, regionally-focused web-based clearinghouses of relevant science, field trips & demonstration sites, workshops & conferences, webinars & online training, and syntheses & fact sheets. This poster provides an introduction to and map of the regional consortia.

Bio: Mary McFadzen, Northern Rockies Consortium Coordinator, Montana State University; Vita Wright, Northern Rockies Consortium Principal Investigator, USFS Human Factors and Risk Management RD&A, Missoula / NPS Branch of Wildland Fire, Fire Science & Ecology Program, Boise (vwright@fs.fed.us); Tony Cheng, Southern Rockies Consortium Principal Investigator, Colorado State University; Janean Creighton, Northwest Consortium Coordinator, Oregon State University; Gloria Edwards, Southern Rockies Consortium Coordinator, Colorado State University; Christian Giardina, Pacific Islands Consortium Principal Investigator, Institute of Pacific Island Forestry; Charles Goebel, Lake States Consortium Principal Investigator, Ohio State University; Tim Kline, California Consortium Coordinator, University of California; Leda Nikola Kobziar, Southern Consortium Principal Investigator, University of Florida; Alan Long, Southern Consortium Coordinator, Professor Emeritus, University of Florida; Helen Mohr, Appalachian Consortium Coordinator, Southern Research Station; Eugenie MontBlanc, Great Basin Consortium Coordinator, University of Nevada; Jennifer Northway, Alaska Consortium Coordinator, University of Alaska; Mike Pellant, Great Basin Consortium Principal Investigator, Bureau of Land Management; Elizabeth Pickett, Pacific Islands Consortium Coordinator, Hawaii Wildfire Management Organization; Scott Stephens, California Consortium Principal Investigator, University of California; Andrea Thode, Southwest Consortium Principal Investigator, School of Forestry, Northern Arizona University; Barbara Satink Wolfson, Southwest Consortium Coordinator, School of Forestry, Northern Arizona University; Sarah Trainor, Alaska Consortium Principal Investigator, University of Alaska; Tom Waldrop, Appalachian Consortium Principal Investigator, Southern Research Station; Robert Ziel, Lake States Consortium Coordinator, Ohio State University

P14. First results in characterizing the smouldering processes under the influence of heterogeneous moisture content

Author(s): Nuria Prat, University College Dublin
Guillermo Rein, Imperial College
Jon Yearsley, University College Dublin
Claire Belchcer, University of Exeter
Rory Hadden, University of Western Ontario

Smouldering is a slow, flame-less form of combustion. It can spread with sub-surface propagation through layers of soil with high organic matter (e.g. peat, humus, duff). Such fires are difficult to extinguish and can abruptly start a flaming fire, remove important amount of soil layers, causing damage to root systems, producing impacts as habitat loss and important carbon emissions. As moisture content is known to be the most important variable affecting smouldering propagation, the objective of this study is to characterize the smouldering combustion of peat with heterogeneous moisture content. A series of small-scale experiments will be presented looking at the effect of heterogeneous distributions of moisture content. Experiments were run in a 20x20x5cm tray to observe the horizontal spread process. Moisture content was manipulated by dividing the container into different moisture patches. The smouldering propagation was recorded using infrared camera and temperatures were registered using thermocouples. Spread rate and burning duration were calculated to inform about smouldering propagation. These results will be used to parameterize and validate smouldering fire models based in cellular automaton.

Bio: Nuria Prat, PhD candidate of School of Biology and Environmental Science, Earth Institute at University College Dublin (Ireland). Master in Environmental Science and Natural Resources at University of Santiago de Compostela (Spain). Thesis topic: Characterizing the dynamics and environmental impact of smoudering peat fires. Research interests: wildfire, smouldering dynamics, fire modeling, effects in soil properites, fire prevention.

P15. Background, methods and call for feedback on fuel and fire behavior data collection on active wildland fires

Author(s): Alicia Reiner, USDA Forest Service, Adaptive Management Services Enterprise Team
Carol Ewell, USDA Forest Service, Adaptive Management Services Enterprise Team
Scott Dailey, USDA Forest Service, Adaptive Management Services Enterprise Team
JoAnn Fites-Kaufman, USDA FS Region 5
Nicole Vaillant, Western Wildland Environmental Threat Assessment Center

Fire behavior measurements collected during active wildfires are paramount to fire behavior research. A USDA Forest Service Enterprise Team, Adaptive Management Services, (AMSET), has a module focused on collection of fire behavior data on wildland fire incidents, called the Fire Behavior Assessment Team (FBAT). The purpose of this talk is to outline the current methods and data variables collected in order to obtain feedback and to discern practical uses of this data with input from fire managers and the scientific community. Clearly identified uses for FBAT fire behavior and fuels data will allow for streamlining or enhancing FBAT data collection methods.

FBAT can be ordered by a (U.S.) fire incident through the National Interagency Resource Ordering and Status

System (ROSS), just as other fire crews and overhead are. The FBAT crew assimilates into incidents well due to their high level of wildland fire experience of the FBAT members, and the rapport the crew has with some Incident Management Teams. Plots are placed opportunistically ahead of the fire based on access, likely fire spread and behavior as well as fire management tactics. Pre- and post-fire data are collected for overstory, surface and ground fuels and vegetation. At each site, sensors and a digital video camera(s) enclosed in a fire safe box are set up to gather information about weather and fire behavior including 5-foot windspeed, flame height, rate of spread, and temperature profile through time .

With the help of peer-reviewers and collaborators, the data collected by FBAT could be utilized more effectively and methods could be improved. To date, FBAT fire behavior data has been used in case studies of fuel treatment effects on wildfire behavior and severity. A project assessing the effects of fire on Carbon emissions is utilizing FBAT fuels consumption data in California. Other potential applications of FBAT fuels and fire behavior data include smoke modeling and calibration of fire behavior applications. The FBAT program would like to continue into the future, only with the most useful of methods and with improvement feedback from the scientific and management communities on realistic applications of the data.

Bio: Ali Reiner works for the USDA Forest Service Enterprise Team called Adaptive Management Services, "AMSET" as a fire ecologist. She has completed several fuel characterization, treatment effectiveness and fire severity studies since starting with AMSET in 2006. Prior to working with AMSET, Ali worked as a firefighter on an engine and hotshot crews. Ali uses her experience in fire management along with her academic and ecological background to create strong science useful for land and fire management.

P16. Maps for the Masses: Improving Upon Printed Map

Author(s): Justin Shedd, North Carolina State University
Hugh Devine, North Carolina State University
Bill Slocumb, North Carolina State University

While nothing feels and looks like a printed map, recent developments in mapping technology have allowed for the dissemination of maps to a wider array of audiences and with greater speed. Maturing database management systems coupled with improved GIS server technologies function as the backbone for facilitating the creation of online maps. These stable systems have led to the rapid development of several different web mapping interfaces or web mapping applications.

Web mapping interfaces are not just one way information streets. They can be customized allowing a user to collect data and perform basic geographic analysis. Now a manager can see, near-real time, resources and assets that are nearby based on observations recorded in the field. Furthermore, this allows others (public) to view maps based on the most up-to-date information available.

The paper map will always play a vital role in the dissemination of data. But while the paper map is a snapshot in time, "QR" technology can now be included on a printed map, enabling a user to access a dynamic version of the printed map. The Fire Management Community depends on paper maps to communicate and orient themselves whether it's an active incident or during daily programmatic operations. Web Mapping Technologies will not replace the printed map, they will augment it.

Bio: Since 2005 Justin has been a Research Associate / GIS Specialist at North Carolina State University, College of Natural Resources. Where his work focuses on GIS and geospatial technologies and their application within the Fire Management Community. Past projects include object oriented mapping of woody debris, creation of fuel model/loading databases, distributed database design and deployment, database QA/QC, web map development, and providing training on new software. BA, Geography, UNC-Chapel Hill; MS, Spatial Analysis, NC State.

P17. A coupled approach to evaluating the dynamic linkage between fuel treatment effects on fuel matrices and effectiveness at reducing wildfire intensity and spread rate.

Author(s): Nicholas Skowronski, USDA FS
Robert Kremens, Rochester Institute of Technology
Kenneth Clark, USDA Forest Service
William Mell, USDA Forest Service
Michael Gallagher, USDA Forest Service
Albert Simeoni, Worcester Polytechnic Institute
Eric Mueller, Worcester Polytechnic Institute

Quantifying the effectiveness of fuel reduction treatments in moderating wildfire intensity and spread rates is vital to making sound policy and management decisions. Because of the variable nature of fire behavior as it responds to fuels, weather, and topography, it is impossible to characterize how various modifications to fuel matrices may influence fire spread and behavior in a repeatable manner without the use of mathematical models. Here, we present an approach that integrates pre- and post-treatment (prescribed fire and mechanical treatment) measurements of forest structure and fuel loading with the Wildland Fire Dynamics Simulator (WFDS), a computational fluid dynamics based model. The resulting database supports evaluation of both WFDS and real-world fuel treatments for a range of meteorological and forest structure scenarios. To measure the range of treatment effects on forest structure we have coordinated with our collaborators in the New Jersey Forest Fire Service and selected 20 fuel treatment areas (ca. 100 ha each) that will be intensively sampled for forest floor and shrub loading via field measurements and by airborne laser scanner (LiDAR, ALS) measurements of canopy structure and loading both before and after treatments. WFDS is simultaneously being implemented and evaluated through laboratory and extensive in-situ observations of the fire environment. The in-situ evaluation will include two fully instrumented burn experiments which include measurements of turbulence, heat flux, and other meteorological parameters at 12 understory and 2-4 above canopy towers, and quantified spread rates and flame intensity via airborne infra-red imaging. Treatment effectiveness will then be simulated and evaluated by integrating measured distributions of fuel loading found at the landscape scale into WFDS to determine the optimal degrees and configuration of treatments. The advantages and limitations of this approach will be compared to commonly used semi-empirical models.

Bio: Nicholas Skowronski is a Research Forest with the USDA Forest Service, Northern Research Station, RWU-NRS-06, Climate, Fire and Carbon Cycle Sciences in Morgantown, WV. Contact: nskowronski@fs.fed.us

P18. Smoke management in Australia and New Zealand, application of the BlueSky Modelling Framework

Author(s): Tara Strand, NZ Forest Research Institute
Robert Fawcett, Centre for Australian Weather and Climate Research (CAWCR), Bureau of Meteorology
Mick Meyer, CSIRO
Lachie McGraw, Department of Environment and Conservation
Grant Pearce, NZ Forest Research Institute
Veronica Clifford, NZ Forest Research Institute
Narasimhan (Sim) Larkin, USFS

Two case studies are underway to test the feasibility of using the BlueSky Modelling Framework (BlueSky Framework) for smoke emissions and surface concentration predictions in Australia and New Zealand. The BlueSky Framework has been used to create smoke modelling management tools in North America, but is yet to be tested for New Zealand or Australia, which typically differ in vegetation type from North America . The Margaret River fire was chosen for the Australian test case and the Waihopai Valley Burn for the New Zealand test case. The Margaret River fire was initiated in Spring 2011 to manage and reduce coastal scrub fuel near the town of Margaret River, Western Australia. Unique meteorology and terrain contributed to the development of the fire, which became uncontainable (November, 2011) and was driven by wind down the coastline towards the town itself. The smoke plume has an interesting footprint with a long conical plume on the windside and dispersion downwind forming a classical dispersal plume triangle. The Waihopai Valley Burn is a planned 1000 ha burn in complex terrain in the Marlborough region of New Zealand. The burn will take place sometime in April-July (Fall -Winter) 2013 , depending on fuel moisture content and prevailing weather conditions. The fuels are rangeland grass, rose-hip scrub, and bracken. The burn will be used by the Scion Fire research team to study fire behaviour and smoke plume development in complex terrain and in changing fuel types. The model predictions from the BlueSky Framework test case will be evaluated against collected observations.

Bio: Tara Strand, Scion, New Zealand Forest Research Institute

P19. The use of IR-diagnostics for registration of high-temperature objects screened by the layer of flame formed during combustion of plant fuels and pecularities of the flame temperature measurement in the study of wildland fires

Author(s): Egor Loboda, V.E. Zuev Institute of Atmospheric Optics Russian Academy of Sciences, Siberian Branch.

The work presents the experimental results regarding the influence of flame formed during combustion of plant fuels (PF) on the registration of a black body temperature (BB) using the methods of IR-diagnostics. Also, the work provides the coefficient of BB radiation attenuation by the layer of flame and some pecularities in the application of IR-diagnostics to solve this problem. The spectra of flame radiation are compared with the radiation spectrum of a black body.

The IR-radiation intensity of the flame and the black body model and their distribution of temperature were registered by the JADE J530SB thermal imager with a F0616 narrow-band dispersive optical filter with a spectral interval of 2500-2700 nm, which allows the temperature to be measured the in the range of 583-1773 K with a measurement error not exceeding 1% and a frame rate of 50 frames/s. In addition, the temperature in flame on the axis of BB and out of the thermal imager visibility was controlled by thermocouples (type WR) with a junction diameter of 50 microns. The flame temperature was additionally controlled by a thermocouple and it was adjusted the average value for the radiation coefficient of flame emissivity = 0,77.

During experiment, it was found that with the appearance of flame the temperature of the black body registered by the thermal imager does not increase by more than 10% of the true temperature of the black body Ð¢ ' '. In this case, the recorded temperature of the black body has multiple changes as well as the temperature changes in flame registered outside the visibility axis of the black body.

This work describes the pecularities of the flame temperature mesuarement in laboratory and field investigations of wildland fires. Also, the work provides the characteristic frequencies in the spectrum of the temperature change in flame.

This work was supported by Federal Targeted Program "Scientific and Scientific-Pedagogical Personnel of Innovative Russia in 2009-2013", no P 1109, REC no 02.740.11.0674, RFBR grant no 11-01-00673-a, 11-01-00228-a, and the Russian Ministry of Education under the Federal Targeted Program "Scientific and Scientific and Pedagogical Personnel of Innovative Russia" for 2009-2013.

Bio: Loboda E.L., Ph.D., Scientific field: IR-diagnostic of fires, reseach flame properties

P20. Development of an ArcGIS fire frequency, fuel accumulation, seasonality and prioritization tool to facilitate prescribed fire decision making on the Talladega National Forest, Alabama

Author(s): Jonathan M. Stober, District Biologist, Shoal Creek Ranger District, Talladega National Forest
Geoff Holden,Forest Geospatial Program Manager, Francis Marion and Sumter National Forests

Prescribed fire is used widely to mitigate wildfires and restore ecosystems. However, there are few tools developed to evaluate fires cumulative impact, calculate frequency, examine seasonality and estimate fuel accumulation to facilitate decision making in targeting successive prescribed fire application. An ESRI shapefile of all wildfire and prescribed fire events was assimilated from 1978-2012 for the 95,100ha (235,000ac) Talladega Division in east central Alabama. A python script-based tool was developed for ArcGIS 10 to calculate the duration of time in the dataset in years and months divided by the total number of fire events in each polygon to calculate the annualized average fire return interval, years of fuel accumulation (date last burned), and frequency of growing to dormant season fire events. The tool allows for dynamic entry of the analysis period and creates a geodatabase output in a designated work space. Development of a comprehensive fire database that can calculate generalized fuel accumulation will allow for more targeted pairing with appropriate smoke dispersion conditions and better smoke management. Calculations of fire frequency will determine if adequate fire return intervals are occurring to the landscape and focus on areas that need increased effort to meet frequency targets for restoration. The tool can also locate areas with historic wildfires which may benefit from targeted prescribed fire to reduce liability and dampen wildfire recurrence. The fire frequency tool can ultimately illustrate and facilitate better planning, prioritization and decision making in future prescribed fire events.

Bio: Jonathan M. Stober, District Biologist, Shoal Creek Ranger District, Talladega National Forest, Heflin, AL. jstober@fs.fed.us
Geoff Holden,Forest Geospatial Program Manager, Francis Marion and Sumter National Forests, Columbia, SC. gholden@fs.fed.us

P21. Synthesizing Knowledge on Crown Fire Behavior in Conifer Forests: We Could Use Your Help!

Author(s): Marty Alexander, University of Alberta
Miguel G. Cruz, CSIRO Ecosystem Sciences and Climate Adaptation Flagship, Bushfire Dynamics and Applications Group
Nicole M. Vaillant, USDA Forest Service Pacific Northwest Research Station

The Joint Fire Science Program (JSFP) is supporting a project aimed at synthesizing the currently available information on crown fire behavior in conifer forests (e.g., the onset of crowning, type of crown fire and the associated spread rate and fireline intensity). The JFSP 09-S-03-1 project website is: http://www.fs.fed.us/wwetac/projects/alexander.html. In addition to summarizing the existing scientific and technical literature on the subject, we are actively seeking assistance from individuals in the form of field observations of crown fires and related experiences as well as still pictures and video footage; for example, do you have a favourite YouTube presentation? We are looking for firsthand experiences of rare or perhaps unusual observations like independent crown fire runs or specific cases of conditional crown fire activity and crown fire cessation as well as instances of long-distance spotting (>2 km) from active crown fires along with the associated environmental conditions: What was happening climatically? What were the fuel types? Was there anything out of the ordinary? Did suppression play a role? Finally, we are interested in hearing from you as to your opinions on the subject of crown fires and any specific questions and/or research needs/knowledge gaps or areas in fire behavior training that you would like to see addressed in this crown fire behavior synthesis project. For example, when implementing mastication fuel treatments how much material can be left onsite or how long after a mastication treatment is the potential risk of crown fire alleviated? Are there gaps in knowledge pertaining to crown fire such as the desire for better assessments methods for assessing crown fire risk in a particular conifer forest stand type? Finally, we would really like to hear your general thoughts and experiences pertaining to crown fire. The project team members that are in attendance would particularly like to hear about situations that are unique to the southern United States in regards to crown fire behavior in conifer forests.

Bio: Dr. Marty Alexander is currently an adjunct professor of wildland fire science and management at the University of Alberta after having retired from a career in fire research with the Canadian Forest Service (1976-2010) in which he specialized in fire behavior with a particular emphasis on crown fires. Dr. Miguel Cruz is a senior bushfire research scientist with CSIRO in Canberra, Australia and has extensive field and modelling experience with crown fire behavior in both conifer forests and tall shrubland fuel complexes. Dr. Nicole Vaillant is a fire ecologist with the Western Wildland Threat Assessment Center specializing in fuel treatment planning and fire behavior modelling.

P22. The Fire and Fuels Application (FFA): a suite of fire management tools

Author(s): Susan Prichard, University of Washington
Roger Ottmar, Pacific Wildland Fire Sciences Laboratory, U.S. Forest Service

The Fire and Environmental Research Applications Team (FERA) has developed a suite of fire management tools that includes the Fuel Characteristic Classification System (FCCS), Consume, the Fire Emission Production Simulator (FEPS), Pile Calculator, and the Digital Photo Series (DPS). These software applications are routinely used by land and fire managers, air quality regulators, and researchers for fire and fuels planning and ecological assessments. FERA's fire management tools are now integrated into the Fire and Fuels Application (FFA), a web-based application that combines the functionality of the individual applications and allows seamless data transfer between calculations. Within the FFA, the FCCS, Consume and FEPS are now calculator modules with a dynamic user interface that is output driven. For example, if a user wishes to calculate total consumption and emissions for a planned burn unit, they are promted to select or create fuelbeds and input day of burn data required for Consume's predictions of consumption and emissions. FFA provides a link to the Digital Photo Series for reference during fuelbed editing. The FFA is also designed to communicate with other systmes that can provide networked services, such as BlueSky Framework, the Interagency Fuels Treatment Decision Support System (IFT-DSS), and the Wildland Fire Emissions Information System (WFEIS). The FFA uses the same modeling framework as IFT-DSS and offers a similar user experience. With its large fuels dataset and ability to represent a wide array of fuel complexes, the FFA has numerous applicaitons, from small-scale fuel reduction projects and prescribed burn planning to large-scale emissions and carbon assessments. Researcher can use the FFA software for land management, fire projections, and other analyses. Regulatory agencies will use the FFA to calculate fuel consumption and/or emissions to manage smoke and estimate burn permit fees.

Bio: Susan Prichard is a research scientist at the School of Environmental and Forest Sciences, University of Washington. She is a fire ecologist with an emphasis on fuel treatments, fire modeling, and forest dynamics following disturbance.

P23. The Interagency Fuels Treatment Decision Support System (IFTDSS): Current Software Tools and Data Available Online for Fuels Treatment Planning

Author(s): Stacy Drury, Sonoma Technology Inc

The Software Tools and Systems Study was initiated by the Joint Fire Science Program (JFSP) and the National Interagency Fuels Coordination Group in March 2007 to address the proliferation of software systems in the fire and fuels treatment domain. In 2008, the Interagency Fuels Treatment Decision Support System (IFTDSS) software framework was designed to organize and manage the many software systems and data used for fuels treatment planning and to make these tools available to fuels treatment planners through a single user-friendly, web-based system. Since 2008, the IFTDSS development team at Sonoma Technology, Inc. has worked closely with the JFSP and other stakeholder groups to develop a flexible system to manage the software tools and data. This presentation will provide an overview of the current tools and data available for use within IFTDSS. At this time, software tools for assessing fire behavior and fire effects have been implemented in several workflows. Workflows are specific modules that provide software tools and data to support business needs for fuels treatment planning and management. Current workflows include prescribed burn planning, hazard analysis, risk assessment, fuels treatment location, and fuels treatment effectiveness.

Bio: Stacy Drury is the Senior Fire Ecologist for Sonoma Technology Inc in Petaluma California. Stacy is involved with many projects including the Interagency Fuels Treatment Design Support System (IFTDSS), the Smoke Emissions Modeling Intercomparison Project (SEMIP), and the Real time assessment of Fire Weather Accuracy. Stacy has experience in many widely varied ecosystems including the Boreal forests of Alaska, western coniferous forests, and eastern decidous forests where he has conducted studies on quantifying fuels, fuel consumption, and fire history.

P24. An Integrated Research Approach to Improving the Balance of Protection and Comfort of Wildland Firefighter Clothing

Author(s): Roger Barker, NCSU Center for Research on Textile Protection and Comfort

The California Department of Forestry and Fire Protection (CAL FIRE), has concluded that physiological heat stress may now be an even greater concern to wildland firefighters than burn injury risk. Advances in burn protection, through the use of flame resistant (FR) materials and added clothing layers, have come at the expense of increasing clothing related heat stress. This presentation will describe a comprehensive research program that is advancing measurement technologies for wildland protective clothing on two related fronts: measurement of clothing heat transfer and moisture management associated with heat stress and wear comfort, and measurement of clothing radiant heat protection. This effort is using new measurement technologies to characterize a systematically selected group of wildland clothing state-of-the-art materials and ensemble constructions. The findings from combined laboratory based studies are being used to provide an unprecedented technical and practical basis for enhanced performance requirements for wildland firefighter protective clothing. This research is expected to provide an improved technical basis for the NFPA 1977 Standard requirements for heat stress, or total heat loss (THL) and radiant protective performance (RPP). It is coordinated with field trials being conducted by the California Department of Forestry and Fire Protection (CAL FIRE).

Bio: Dr. Roger Barker is the Burlington Distinguished Professor in the Department of Textile Engineering, Chemistry and Science and Director of the Center for Research on Textile Protection and Comfort (T-PACC) at NC State University. He is an internationally recognized researcher in textile measurement technology and engineering with applications to fire protective materials, and clothing comfort and heat stress. He is a member of NFPA, ASTM and ISO committees developing of standards for measurement for PPE. He holds BS and MS degrees in physics from the University of Tennessee and a PhD in Textile and Polymer Science from Clemson University.

P25. From Sweating Plates to Sweating Manikins: Evaluating the Role of Clothing Materials in Reducing the Risk of Heat Stress in Wild land Firefighting

Author(s)Marika Walker, North Carolina State University

NFPA 1977 currently relies on total heat loss (THL) tests made on the fabric materials used in the construction of a protective clothing ensemble. Sweating plate THL tests, made on swatch samples of flat fabric, do not provide information on the effect of garment air layers, underlying garments, or reinforcing materials in different sections of the clothing. This creates an immediate testing gap since wildland clothing ensembles are typically constructed using multiple layers of fabrics in different parts of the clothing to provide enhanced radiant protection. Further, the sweating plate THL cannot provide information about the effects of garment fit on body heat loss. This is an additional measurement deficiency since it is well known that loose fitting clothing enhances ventilation and heat loss. The research performed in this study utilizes advanced laboratory measurement systems, located at the Textile Protection and Comfort Center (T-PACC). The sweating hot plate, advanced sweating manikin testing technology, and virtual models were used to evaluate the impact of different heat resistant fabrics and clothing layers on the heat transfer associated with clothing related heat stress in wildland firefighting. Protocols have been developed and will be used to conduct controlled human wear studies in environmental and work conditions representative of wildland firefighting conditions. Correlations will then be made between the data from the wear trials, sweating plate, sweating manikin, and virtual model to establish a scientific basis for THL performance specifications for wildland protective clothing.

Bio: Presenting Author: Marika Walker

P26. From RPP to RadMan: the Role of Clothing Materials in Protecting against Radiant Heat Exposures in Wildland Forest Fires

Author(s): Kyle Watson, North Carolina State University

Advances in clothing thermal comfort must consider the fundamental need to provide adequate protective insulation against the hazardous heat exposures encountered in wildland fire fighting. This presentation will review the basis for establishing radiant heat exposure levels in wildland firefighting operations and testing methodologies employed to evaluate the thermal protective performance of fabric materials used in wildland protective gear. The results of this research have developed a new bench-scale testing platform that uses water cooled thermal sensor technology and an advanced skin burn injury model to provide a more accurate prediction for the onset of burn injuries resulting from the transmission of radiant heat. This presentation will also highlight the RadMan™ system, a new full-scale instrumented manikin technology developed to measure the radiant heat protection provided by firefighter suits. This systems-level testing approach used by RadMan™ is providing new insights about how different heat resistant fabrics, base layers, and garment fit affect the skin burn protection. The new knowledge from this research will be useful to identify and develop clothing materials that offer optimum protective performance against radiant heat exposures encountered in wildland firefighting.

Bio: Presenting Author: Kyle Watson

P27. Moisture Management: Evaluating Sweat Absorption in Wildland Firefighter Protective Clothing Materials and Effects on Wear Comfort

Author(s): Julisha Joyner, NC State University

Wildland firefighting operations, typically involving strenuous work in stressful environments, can produce sweating conditions that can significantly affect perceived comfort. This presentation will describe research that measured the ability of different textile materials used in heat resistant suits to absorb liquid moisture and to dry, once saturated. It will compare the results of fabric evaluations made using different laboratory testing methodologies, including a gravimetric absorption test system and other tests of fabric moisture management and wickability. These measures are providing a better understanding of the role of fiber and fabric construction and the importance of clothing base layers to sweat management in wildland firefighting. Finally, this presentation will describe how measures of liquid moisture management, together with measurement of the mechanical, surface, and thermal properties of fabrics, will be used to understand and predict the impact of wildland firefighter suits on their response to the comfort of their clothing.

Bio: Presenting Author: Julisha Joyner

P28. Whitebark pine regeneration following a prescribed fire in west central Alberta

Author(s): David Finn, Alberta Gov't, ESRD

During the last century, Whitebark pine (Pinus albicaulis) has experienced a major decline in range and numbers in western North America due to a number of causes, of which fire exclusion is considered to be one of. In 2009 the Department of Alberta Environment and Sustainable Resource Development in partnership with Parks Canada executed a 14000 acre prescribed burn in sub-alpine and montane forest in the R11 Forest Management Unit. The fire objectives were to return fire as an ecological process to the landbase, reduce mountain pine beetle habitat and reduce the likeliehood of a large scale wildfire in that mountain corridor. The prescribed burn occurred in lodgepole pine, englemann spruce and sub-alpine fir forest communities with some involvement in limber and whitebark pine communities. In 2010, following the fire, both limber and whitebark pine were placed on Alberta's endangered species list, creating the need for a restoration plan for both species. This poster reports on fire use in Whitebark pine communities and regeneration of whitebark pine within the Upper Saskatchewan prescribed burn mentioned above. Specifics of the poster discuss the importance of fire refugia within the burn area, the role of Clarke's nutcracker in colonizing burned areas with limber and whitebark pine and fire behaviour implications in applying fire in and around whitebark pine communities.

Bio: David Finn, Wildfire Technologist, Clearwater Area, Alberta Environment and Sustainable Resource Development

David Finn is an employee of the Department of Alberta Environment and Sustainable Resource Development with 25 years of service. He is currently responsible for overseeing fire use and prescribed fire in the R11 Forest Management Unit in west central Alberta. David also serves on National type one Incident Management Teams in Canada as a Fire Behaviour Analyst and Planning Section Chief. David resides in Rocky Mountain House, Alberta and his interests include guitar, banjo, wood and metal working and anything to do with being in the mountains.

P29. Semi-empirical Fire Spread Simulator for Utah Juniper and Chamise Shrubs

Author(s): Tom Fletcher, Brigham Young University

The wide range of scales involved in wildland fires is a challenge, since empirical models generally need more physics and full computations require excessive amounts of computer time. Therefore, a semi-empirical model was developed as an attempt to bridge the scale gap between full simulations and empirical correlations. Ignition and flame characteristics of fuel segments (3 to 6 cm lengths) burned in a laboratory flat-flame burner system were used in a semi-empirical multi-element fire spread simulator for chamise (Adenostoma fasciculatum) and Utah juniper (Juniperus osteosperma) shrubs. The simulator consists of five modules which address key aspects of wildfire spread: fuel element locations, fuel element physical parameters, fuel element flame behavior, fluid flow, and flame-flame interactions. Fuel element locations are assigned based on L-systems, a branch of fractal theory. Fuel element parameters are assigned based on correlations to laboratory measurements of samples. One or more fuel elements are ignited, producing flames in the model according to experimental correlations. The fire propagates through the shrub when flames from burning leaves engulf neighboring leaves, which in turn ignite according to experimentally correlated preheat times. Overlapping flames are enlarged proportionally to the volume of overlap. Convective heat transfer mechanisms are embedded in the model due to the use of data from the flat flame burner. The simplicity of models used for fluid flow, fuel heating and flame behavior permits fast computations. The shrub models for chamise and juniper were studied parametrically. Shrub-scale burn experiments performed on chamise in a wind tunnel were then compared to model simulations. Simulation predictions of flame height, fraction of shrub burned, burn time, burn path and flame angle were analyzed, demonstrating the simulator?s sensitivity to moisture content, wind speed and amount of fuel. These simulations demonstrate a more sophisticated fuel element placement algorithm than was presented previously with a manzanita shrub model.

Bio: Dr. Thomas H. Fletcher is a Professor in the Department of Chemical Engineering at Brigham Young University. He received a PhD in Chemical Engineering from BYU in 1983. He worked for seven years at the Combustion Research Facility at Sandia National Laboratories in Livermore, California. He has been on the faculty at BYU for the last 21 years, and is currently serving as Associate Chair. He has been working on fire spread in live wildland shrubs for over ten years. His research interests include pyrolysis of low grade fuels and biomass.

P30. Providing science to managers: The Francis Marion-Sumter National Forest Prescribe Fire Prioritization Model: A Logistical and Ecological Approach to Management

Author(s): Reginald Goolsby, US Forest Service

As targets increase, so do the demands on fire management officers (FMOs) to prioritize treatment areas. Prescribed fires accomplish multiple objectives including reducing hazardous fuels, improving wildlife habitat, aiding listed species and increasing resource access. Researchers have provided guidance to help FMOs reintroduce fire into the landscape most appropriately; yet dialogue between scientists and managers is still not what it should be. FMOs need knowledge in a format understood by the "boots on the ground" rather than the scientific community. At the request of its FMOs, The Francis Marion and Sumter National Forest developed a fire prioritization model founded on fire science and understood by management to answer the questions of "when to burn, where to burn, how to burn, and why to burn."

The burn prioritization model ranks treatment areas on ecological and logistical scores and allows users to set optimal burning constraints such as days since rain, KDBI, relative humidity, temperature, and season of burn to achieved desired resource goals. The goal of many burns is ecological restoration therefore some criteria such as percent of fire-dependent vegetation, departure from desired condition, and presence of listed species were factored in. Some logistical score criteria factored in were ignition patterns, fireline construction and holding, road closures, smoke management and personnel requirements.

The model allows managers to enter day of burn environmental conditions which the model provides the user with the optimum location to burn to achieve desired management results.

The advantages of this model over others is that it closes the gap that has divided researchers and science from the on the ground technicians actually managing the land. Researchers now have an interactive way to descriptively describe the best optimal way to achieve resource objectives in a format that easy to understand by the managers applying the tool.

Bio: Reginald Goolsby is a fire ecologist trainee on the Francis Marion and Sumter National Forest in South Carolina. He received his B.A. in communications from Furman University and his Masters in Forestry Resources from Clemson University.

P31. Fuels or microclimate? Biological and physical controls over fire feedbacks at tropical savanna-forest boundaries.

Author(s): William Hoffmann, North Carolina State University
Augusto C. Franco, University of Brasilia

Fire-vegetation feedbacks play an important role in governing the distribution of tropical savanna and forest. The low flammability of forest is often attributed to the cooler, more humid microclimate under the closed canopy. Recent evidence, however, suggests that fire became frequent in tropical savanna regions primarily because of the spread of C4 grasses about 10 million years ago, implying a critical role of grasses for fire-vegetation feedbacks. To understand the relative importance of microclimate versus grasses in governing fire regimes in savanna, we measured air temperature, relative humidity, wind speed, and fuel characteristics at eight savanna-forest boundaries in Brazil. We then used BehavePlus4 to model fire behavior in response these variables. We found abrupt changes across the boundary in all measured variables except total fuel load, with savanna having greater wind speed, air temperature, and fuel loads but lower relative humidity, fuel moisture, and fuel bulk density. Based on these measurements, the BehavePlus4 predicted savanna fires to be faster, more intense, and with greater flame lengths, relative to forest. A sensitivity analysis indicated that the primary cause of these differences was the low fuel bulk density characteristic of grassy fuels, with smaller contributions from wind speed, fuel moisture, and fuel load. These results emphasize the importance of the global spread of C4 grasses and the consequences it had for shifts in the distribution of biomes.

Bio: Bill Hoffmann has studied fire ecology in Brazilian savannas (Cerrado) since 1991, and has more recently begun studying fire in longleaf pine ecosystems. Current research focuses on understanding how vegetation-fire feedbacks govern the distribution tropical savanna and forest biomes and understanding the physiological processes that determine plant responses to fire.

P32. Improving Upon the Wildland Fire Portion of the National Emissions Inventory

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Pete Lahm, USFS

In part because air quality standards have tightened, accurately quantifying the smoke from wildland fires has become increasingly important. Fire smoke can be a major contributor to particulate matter, black carbon, greenhouse gases, and ozone precursors, highlighting the need for accurate wildland fire emissions inventories. Previous work has demonstrated that estimates of wildland fire emissions vary greatly depending on the methods employed and that there is a significant lack of fire activity information for prescribed burns and small fires, which both occur at a much higher frequency than larger fire events, but are largely unaccounted for or ill represented in national data sets. This project aims to improve emissions inventories by broadening the sources of fire activity data. We are gathering local fire activity data from various state land and air quality management agencies, assessing the temporal and spatial quality of the data sets, and using the SmartFire2 system to reconcile local data with the national data sets currently used in the U.S. Environmental Protection Agency's National Emissions Inventory. We present comparisons that illustrate how the use of additional local wildland fire activity data improves the accuracy of the National Emissions Inventory.

Bio: Mr. Huang has been actively involved in a number of wildland fire-related projects at STI. Most recently, he developed the 2011 and 2010 wildland fire emissions inventory for the U.S. Environmental Protection Agency as part of the National Emissions Inventory. Prior to that he produced a wildland fire greenhouse gas emissions inventory for the U.S. Fish and Wildlife Service for 2006-2010. In recent past, Mr. Huang also evaluated fuel loading, fire behavior and fire effects models, and made inter-model and model-to-observation comparisons for the Interagency Fuels Treatment Decision Support System and the Smoke and Emissions Model Intercomparison Project.

P33. Development and Evaluation of the Physics-based WIldland-Urban Interface Fire Dynamics Simulator

Author(s): Anthony Bova, Colorado State University - Dept. of Forest & Rangeland Stewardship
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Alexander Maranghides, NIST - Fire Research Division
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Eric Mueller, Worcester Polytechnic Institute

Given the state of current computer technology, physics-based fire models generally cannot provide simulations of wildland fire spread quickly enough for operational use. The utility of physics-based models lies rather in their use to create "numerical experiments" that can inform computationally faster, empirically-based models. In addition, they can be used to develop new hypotheses regarding fire behavior to assist in the design of physical experiments. The open-source model suite Wildland-Urban Interface Fire Dynamics Simulator (WFDS) contains a physics-based model of wildland fire that is built upon the structure fire model, FDS, developed by the National Institute of Standards and Technology. WFDS comprises a boundary fuel model for simulating unresolved surface vegetation, and a fuel element model for simulating individual trees or vegetation canopies. WFDS validation uses measurements from laboratory-scale fire spread experiments and field-scale prescribed burns and wind measurements. Here, we discuss completed and ongoing validation efforts regarding the component models in WFDS, such as radiation transport, as well as the performance of the whole model in simulating phenomena such as fireline behavior.

Bio: Anthony Bova is a research associate at The Colorado State University Department of Forest & Rangeland Stewardship. He earned an M.S. in Environmental Engineering from the Ohio State University, where he received a NASA Fellowship, and has over ten years of experience as a modeler and experimentalist in the fields of wildland fire, fire effects and atmospheric dispersion.

P34. Development of an empirical model to predict fire movement across an ecotonal gradient

Author(s): Michael Just, North Carolina State University
William A. Hoffmann, North Carolina State University
Matthew G. Hohmann, US Army Corps of Engineers ERDC - CERL

The longleaf pine (Pinus palustris) ecosystems of the eastern US are fire-maintained and have high biodiversity. Unfortunately, these ecosys tems have become some of the most threatened. However, there has been a renewed interest in the conservation of these systems including active, fire-based management. Within the North Carolina Sandhills region there are longleaf pine – grass savannas which contain inclusional wetlands (i.e. pocosins) and of particular interest are the ecotones between savannas and pocosins as they host high plant diversity and rare species.

Savannas and pocosins exhibit very different fire regimes - fire promoting versus fire suppressing - where uplands are expected to burn on average every 2.2 years and wetlands every 7-50. Thus, managing effectively for both systems requires information about fire movement across the ecotonal gradient. We are quantifying the effects of vegetation structure, weather conditions, and topography on fire movement. Our objective is to determine the degree to which vegetation structure influences fire spread in this ecotone and the control that fire exhibits over vegetation distribution.

We established 114 transects along savanna – pocosin ecotonal gradients in 74 study sites prior to burning. In equally spaced plots (n=528) along each transect we used ten vegetation classes and recorded height, percent cover, vertical density, litter depth, and canopy cover. We collected living and dead fuels along a subset of transects (n=19) to characterize fuels with respect to vegetation structure. Following fire we measured the extent of fire spread along each transect. To quantify gradients in microclimate across three representative ecotones, we set up stations to continuously monitor the environment within paired savanna and pocosin sites. We collected continuous data on precipitation, soil moisture, coarse and fine fuel moisture, fuel temperature, air temperature and relative humidity, wind speed and direction, and net radiation. We derived topographical information from GIS data.

We are developing empirical statistical models to predict the extent of fire movement across the ecotonal gradient and into pocosins and to understand feedbacks between vegetation and fire. These models will provide greater insight into fire-based management along these dry to wet ecotonal gradients.

Bio: Michael Just is a second year Ph.D. student under the mentorship of Dr. William Hoffmann in the Department of Plant Biology at the North Carolina State University. He has a B.S. and a M.S. in Natural Resources and Environmental Sciences from the University of Illinois Urbana-Champaign where he studied the effects of land-use change on Indiana bat (Myotis sodalis) hibernacula. His current interests and research are focused on applied fire ecology .

P35. An Investigation of the Sensitivity of Wind and Temperature in the Lower Atmosphere to Canopy and Fire Properties

Author(s): Michael T. Kiefer, Michigan State University
Shiyuan Zhong, Michigan State University
Warren E. Heilman, U.S. Forest Service, Northern Research Station
Joseph J. Charney, U.S. Forest Service, Northern Research Station
Xindi Bian, U.S. Forest Service, Northern Research Station

In a series of idealized experiments, we use the recently developed ARPS-CANOPY model to examine the sensitivity of turbulent and mean flow in the roughness sub-layer (2-4 times tree height) to canopy, fire, and ambient atmospheric conditions. Specific parameters examined in this study include canopy density, ambient surface/canopy heating, and background wind speed. ARPS-CANOPY is a modified version of the Advanced Regional Prediction System (ARPS) model in which the effects of vegetation elements (e.g., branches, leaves) on drag, turbulence production/dissipation, radiation transfer, and the surface energy budget are accounted for through modifications to the ARPS model equations. To account for the first-order effects of a wildland fire on the lower atmosphere, upward sensible heat fluxes are imposed within a fixed area of the model domain.

This study is part of a Joint Fire Science Program (JFSP) project with the goal of developing and validating modeling tools for predicting smoke dispersion from low-intensity fires. Thus, we conclude the presentation with some discussion of the relevance of our findings to prediction of local smoke dispersion from low-intensity fires, and more specifically, how improved understanding of atmospheric model sensitivities can assist smoke managers in the interpretation of smoke prediction products.

Bio: I am a research associate working in the Department of Geography at Michigan State University. My background is in meteorology; I receieved my BS in 2003 from the University at Albany-SUNY, and my MS and PhD from North Carolina State University, in 2005 and 2009, respectively. My research intererest is numerical modeling of atmospheric processes, including wildland fire-atmosphere interaction, cold-air pool development inside basins and valleys, and the impact of forest canopies on the lower atmosphere.

P36. LANDFIRE Fuels Mapping: Overview of Status and Methods

Author(s): Donald Long, USDA Forest Service

The LANDFIRE program has been creating 30 meter maps of a wildland fuel and associated fuel attributes across the entire United States for the fire management community since 2007. Since the beginning of this effort, state of the art methods in mapping both surface and canopy fuels have been employed to meet management needs at tactical, strategic, and national levels.Improvements and updates to these original data were released for use in the spring of 2011. In the spring of 2013, LANDFIRE will release it's third updated version of these data. This presentation will provide an overview of the chronology of methods used to produce, refine, and update LANDFIRE fuel data products. It will also focus on some specific uses of the data at a variety of scales using a variety of fire behavior and fire effect models.

Bio: Donald Long has been working at the Missoula Fire Lab for the Rocky Mountain Research Station of the Forest Service since 1994. During this time he has been involved with a number of vegetation and fuel mapping projects. He began working on the LANDFIRE project in 2003, leading succesion modeling efforts and vegetation map unit development and implementation for the project up through 2010.Since then, he has been with the Fire Lab's Fire Modeling Instiute as the science lead for LANDFIRE.

P37. The National Wildfire Coordinating Group (NWCG) Smoke Committee (SmoC)

Author(s): Pete Lahm, USDA Forest Service
Susan O'Neill, USDA Forest Service

The National Wildfire Coordinating Group's (NWCG) Smoke Committee (SmoC) provides interagency leadership, coordination and integration of air resource and wildland fire management objectives. Air quality is critical to human health and welfare and fire is an important disturbance process in many wildland ecosystems. The SmoC strives to support successful management and utilization of wildland fire while appropriately addressing smoke impacts, for public and fire personnel health, welfare and safety. Members are from the Bureau of Land Management, Fish & Wildlife Service, National Park Service, Bureau of Indian Affairs, US Forest Service, and the National Association of State Foresters (eastern and western representatives), as well as the Natural Resources Conservation Service, the National Association of Clean Air Agencies (NACAA), The Nature Conservancy (TNC), and Department of Defense (DoD). Other subject matter experts and stakeholders contribute as needed. SmoC has three subcommittees; the Technical Smoke Topics Subcommittee, the Training Subcommittee and the Smoke Managers Subcommittee. SmoC also operates several task teams such as the Smoke Management Guide Revision, the HYSPLIT Trajectories in Spot Weather Forecasts (in cooperation with NOAA), and the Retrospective Emission Inventory Task Teams. SmoC has partnered with the University of Idaho and Fire Research and Management Exchange System (FRAMES) developing a website (www.frames.gov/smoke), which has interactive training on "Smoke Management and Air Quality for Land Managers" that reflects the latest in air quality regulations, and an online Workshop – "Effective Communication for Smoke Management in a Changing Air Quality Environment". Other projects include an assessment of smoke training in NWCG courses and task books. An assessment of the proliferation of smoke training in key wildfire incident management positions was conducted and is the basis for broad recommendations for air quality training of the wildland fire community currently being developed. SmoC supports these activities as well as smoke exposure and smoke monitoring via the development of cache of instruments. More information about SmoC can be obtained at www.myfirecommunity.net "Air Quality and Fire Issues."

Bio: Pete Lahm is the Air Resource Specialist for the USDA Forest Service, Fire and Aviation Management, in Washington, DC. Starting in 2004, Pete has led the Forest Service's smoke management efforts developing technical approaches and policies related to smoke impacts. Since 2009 he has chaired the National Wildfire Coordinating Group's Smoke Committee. Prior to 2004, Pete managed the Arizona Interagency Air Resource and Smoke Management Program. He chaired the Western Regional Air Partnership's Fire Emissions Joint Forum from 1996-2004. Pete holds a Master's of Environmental Management from Duke University.

P38. Predicting litter and live herb fuel consumption during prescribed fires in native and old-field upland pine savannas of the southeastern United States

Author(s): Angela M. Reid, Tall Timbers Research Station and Land Conservancy
Tracy L. Hmielowski, Louisiana State University
Kevin M. Robertson, Tall Timbers Research Station and Land Conservancy

This project identified predictors of fuel consumption for the dominant fuel bed components (litter (<0.6-cm diameter dead material) and live herbs) during 217 prescribed fires in native longleaf pine (Pinus palustris Mill.) and old-field loblolly pine (Pinus taeda L.) – shortleaf pine (Pinus echinata Mill.) savannas in the southeastern United States. Additionally, these data were used to validate the First Order Fire Effects Model (FOFEM) fuel consumption computer model using custom and default fuel loads. Regression models using empirical data suggested that litter and live herb fuel consumption can be predicted in part by a combination of the variables prefire litter and live herb fuel loads, litter and live herb fuel moisture, litter fuel bed bulk density, season of burn, years since fire, days since last rain ≥ 0.64 cm, relative humidity, energy release component, community type, pine and hardwood basal areas, and the Keetch – Byram drought index. FOFEM ' s prediction of fuel consumption for litter, live herbs, and duff combined using default fuel loads was 1.5 times the measured fuel consumption (where duff fuel load was zero). Refinement of FOFEM ' s fuel load and consumption calculations in the studied community types using the newly collected data and suggestions for model improvement would provide more accurate air quality inventories and assist in guiding appropriate regulation of prescribed fire in order to protect land manager's right to use prescribed fire. Validation of widely used fuel models is important to undertake for all ecosystems using prescribed fire as a management tool to ensure the best possible predictions.

Bio: Angie Reid has been working as the Fire Ecology Research Biologist at Tall Timber Research Station and Land Conservancy in Tallahassee, FL for 3 years. She is orginally from Minnesota but atteneded Texas Tech University to receive her Bachelor of Science in 2007 then on to Oklahoma State University to recieve her Master of Science in 2009. She has conducted rangeland, wildlife, and fire research in Kenya, Montana, Oklahoma, and Florida.

P39. Moisture dynamics and probability of sustained flaming of masticated fuelbeds in the Canadian boreal forests

Author(s): Tom Schiks, University of Toronto

Wildfire risk mitigation is a leading focus among wildfire agencies, as increasing human development continues to expand the wildland-urban interface in many regions of Canada. One aspect of the FireSmart program involves forest fuels management surrounding communities in an effort to decrease potential fire behaviour and improve the capability of fire suppression resources. The mastication (i.e. mulching, chipping) of thinned trees and understory is becoming an increasingly popular fuel treatment, as this presents an economically viable option over extraction and transport off-site. This treatment redistributes fuels into a compact layer on the forest floor, reducing potential crown fire behaviour. However, little is known about how this fuel treatment may influence the moisture dynamics and availability of surface fuels, along with surface fire behaviour. The objectives of this study were: (i) to assess moisture dynamics at multiple depths through the fuelbed profile, and; (ii) to determine the probability of sustained flaming under a range of moisture contents in both the laboratory and field. Thus far, a lack of empirical research, few documented observations and minimal standardized mastication prescriptions have left Canadian fire agencies, researchers and the public questioning the implications of this fuel management technique. These investigations were conducted at multiple sites in Alberta and the Northwest Territories to acquire a preliminary characterization of masticated fuels within Canada's boreal forests.

Bio: Tom Schiks is a graduate student with the Faculty of Forestry at the University of Toronto. He holds a Bachelor of Science in Natural Resource Management from the University of Guelph.

P40. Dry slots and large fire growth in the United States: A case for better utilization of satellite water vapor imagery

Author(s): Fred Schoeffler, Sheff LLC

Wildland fire weather forecasting is an important facet of mesoscale and synoptic meteorology. Indeed, the very first Standard Firefighting Order deals precisely with weather - Keep informed on fire weather conditions and forecasts. Moreover, two of the 18 Watch Out Situations deal specifically with wind and dryness.

It is well documented in the available literature that surfacing mid- to upper-tropospheric weather is responsible for dry air intrusions. Most times, these dry intrusions manifest themselves as clearly visible dark bands in the satellite water vapor imagery, referred to as dry slots. These dry slots usually result in abrupt surface drying and strong, gusty winds often radically influencing wildland fire behavior and hence fire growth. These phenomena can be significant safety issues for fire managers, especially for those fireline supervisors and firefighters on or near the firelines. Therefore, dry slot recognition and warnings clearly address the rules in the Standard Firefighting Orders and would allow for better recognition and mitgation of the 18 Watch Out Situations.

Dry slots are particularly well documented for Australian wildfires thanks to the work of Dr. Graham Mills and others. Due in large part to their research and efforts, the Australian Bureau of Meteorology utilizes dry slot forecasting and nowcastying on a regular basis during their bushfire seasons. In fact, they even utilize a 'dry slot poster' to better educate and inform their fire managers to 'beware the dry slot.' However, little is known or documented for such dry slot occurences in the United States. In the cases examined, taken from the existing literature, it will be shown that several wildland fires in the U.S. have in fact been influenced by these dry slots resulting in extreme and unusual fire behavior and large fire growth. One of the issues addressed by the author is the fact that the 'dry slot' term is not very well used in the United States.

Excerpts regarding the 2006 Texas and Oklahoma wildfire season will address the downsides of strictly relying on modeling forecasts as they are documented to have under-predicted the winds and overestimated the relative humidities. To further emphasize the water vapor imagery issue, positive research excerpts from the literature regarding the benefits of utilizing water vapor imagery in nowcasting and forecasting will also be addressed.

A case will be made for more consistent utilization of water vapor imagery and dry slot nowcasting and forecasting in the United States resulting in more accurate fire weather meteorology.

Bio: Fred J. Schoeffler - presently an Emergency Wildland Fire Supervisor with the Coconino National Forest in Flagstaff, AZ on a Call-When-Needed basis. Retired from the U.S. Forest Service in 2007 after 34 years of wildland fire, 26 of those as the Payson Hot Shot Crew Superintendent. Active in Wildland Fire Supervision, Leadership, Entrapment Avoidance, and Fire Weather and Fire Behavior Research, especially water vapor imagery and dry slots.

P41. LiDAR Applications at Mammoth Cave National Park; Constructing a 3-D Fire Fuel Database

Author(s): Justin Shedd, North Carolina State University
Caroline Noble, National Park Service
John Wall, North Carolina State University
Hugh Devine, North Carolina State University

This poster documents the methodology followed in developing a 3-dimensional vegetation structure dataset using Light Detection and Ranging (LiDAR) data at Mammoth Cave National Park. The use of LiDAR within forestry and fire management has grown over the past decade. While research has tended to focus on small scale investigations, the ability to discern forest metrics (e.g. Canopy Bulk Density, Height to Live Crown and Canopy Height) over large areas (i.e. park level) could significantly benefit fire management. Furthermore, LiDAR data may prove beneficial in quantifying fuel loading per a given area, e.g. burn unit, compartment, watershed, leading to the development of a tiered list of areas in need of fuels management.

In order to process data for an entire park, the process was automated.As such, several Python scripts were written to compute the various forest metrics from the LiDAR data. Derived results included a vertical vegetation map containing various forest metrics. From the forest metrics, the homogeneity of the forest was discerned. Furthermore an accessibility assessment was carried out on historic roads to determine which historic roads could be opened for administrative use.

Bio: Currently a Master of Geospatial Information Science and Technology (MGIST) student at NCState University with a BS in Anthropology from the College of Charleston. Actively looking for employment.

P42. Structure-level fuel load assessment and analysis in the wildland-urban interface: A demonstration of LiDAR and spectral remote sensing methodologies.

Author(s): Nicholas Skowronski, USDA FS
Richard Lathrop, Center for Remote Sensing & Spatial Analysis, Department of Ecology, Evolution & Natural Resources, Rutgers University
Scott Haag, Center for Remote Sensing & Spatial Analysis, Department of Ecology, Evolution & Natural Resources, Rutgers University
Jim Trimble, Center for Remote Sensing & Spatial Analysis, Department of Ecology, Evolution & Natural Resources, Rutgers University
Kenneth Clark, USDA Forest Service

The prevention and suppression of wildland fires within wildland urban interface (WUI) and intermix communities is of international interest. There is a need to provide fuel loading and classification data at the scale of communities, subdivisions, and individual structures. Individual structure assessments are currently carried out by on the ground personnel in a subjective manner for individual structures using guidance from NFPA 1144. A more automated and consistent methodology for deriving critical parameters at large scales, and at the resolution of individual structures, would increase our knowledge base for pre-fire planning, suppression operations, the implementation of treatments, measuring treatment effectiveness, and for more detailed and informative post-fire analysis. Our objective wa s to develop and validate a methodology that allows for the assessment of wildland fuels on an individual structure basis at a landscape scale. The project was undertaken for a set of target communities in, and adjacent to, the New Jersey Pinelands National Reserve (5569 total structures). Using a combination of high resolution multispectral imagery and airborne laser scanner (ALS) data along with an object-oriented classification system, we estimated the percent of coniferous forest cover and the three-dimensional fuel load within 100' and 300' of each individual structure. We also developed a composite risk rating for each structure that took into account fuel type, fuel load, and distance from contiguous forest areas. Results were compared with structure assessments collected in the field by the New Jersey Forest Fire Service. The relationship between LiDAR derived canopy bulk density (CBD) and the independent field estimates of canopy cover indicated a strong linear relationship (r2 = 0.66), providing support for the methodology. Results illustrate increased variability in fuel loads in the 100' buffer vs. the 300' buffer, indicating that there are fine scale differences that may be lost due to spatial averaging when using a coarser, grid-based, approach. Analyses using a local parcel database indicate that ca. 75% of the structures in this study have ownership of less than 50% of the 100' feet buffer around their building, illustrating the issue of multiple ownerships when attempting to reduce fuels in the WUI.

Bio: Nicholas Skowronski is a Research Forester with the USDA Forest Service, Northern Research Station, NRS-06: Climate, Fire and Carbon Cycle Sciences in Morgantown, WV. nskowronski@fs.fed.us

P43. ArcFuels10: An ArcGIS 10 toolbar used for fuel management planning and wildfire risk assessments

Author(s): Nicole Vaillant, PNW Research Station - WWETAC
John Anderson, BalanceTech
Alan Ager, PNW Research Station - WWETAC

Fire behavior modeling and geospatial analyses can provide tremendous insight for land managers as they grapple with the complex problems frequently encountered in wildfire risk assessments and fire and fuels management planning. Fuel management often is a particularly complicated process where the benefits and potential impacts of fuel treatments need to be demonstrated in the context of land management goals and public expectations. The fuel treatment planning process is complicated by the lack of data assimilation among fire behavior models and weak linkages to geographic information systems, corporate data, and desktop office software. ArcFuels10 is a streamlined fuel management planning and wildfire risk assessment system which creates a trans-scale (stand to large landscape) interface to apply various forest growth and fire behavior models within an ArcGIS platform to design and test fuel treatment alternatives. The new version of ArcFuels has been implemented on Citrix at the Forest Service Enterprise Production Data Center, eliminating the need for desktop GIS, improving connectivity to the corporate geospatial databases housed at the data centers, and enabling sharing of information among Forest Service employees.

Bio: Nicole Vaillant is a fire ecologist at the Western Wildland Environmental Threat Assessment Center which is part of the Forest Service Pacific Northwest Research Station

P44. Making the invisible physical: effectively communicating fire weather in the third dimension

Author(s): Darren Clabo, South Dakota School of Mines and Technology
Effectively communicating changes in fire weather phenomena in the third-dimension has been a challenge for meteorologists. Meteorological features such as changes in winds aloft, changes in stability, and changes in atmospheric moisture are largely invisible to the firefighter on the ground and can emerge quickly and generate rapid changes in fire behavior, ultimately impacting firefighter safety. Changes in these above-surface atmospheric conditions may be initiated by changes in broader scale weather patterns that are best diagnosed by tools that meteorologists employ and are not often used or available to firefighters. Despite efforts in presenting these meteorological concepts in NWCG sanctioned fire behavior courses and other training efforts led by subject matter efforts, little emphasis is given beyond the classroom in communicating and reinforcing these concepts that are difficult for firefighters to visualize. Moreover, meteorologist skill levels to clearly articulate or creatively simplify technical fire weather concepts (threats, trends, timing, magnitude) through briefings and text products must be addressed and improved to help ensure the success of decision support. Recommendations in this presentation are intended to improve these lines of effective communication, with the ultimate goal of improving situational awareness when the invisible weather threats are overhead waiting to emerge.

Bio: Darren Clabo is the State Fire Meteorologist for South Dakota, Incident Meteorologist, and an Instructor within the Department of Atmospheric Sciences at the South Dakota School of Mines and Technology.

P45. Turbulence and energy fluxes during prescribed fires in the New Jersey Pine Barrens

Author(s): Kenneth Clark, USDA Forest Service
Nicholas Skowronski, USDA Forest Service
Michael Gallagher, USDA Forest Service
Warren Heilman, USDA Forest Service
Xindi Bian, USDA Forest Service
John Hom, USDA Forest Service
Matthew Patterson, USDA Forest Service

Smoke emission models currently require a number of assumptions regarding turbulent transfer of gasses and particulates within and above the forest canopy. Many of these assumptions can be evaluated using eddy flux and meteorological measurements, but it is important that field measurements quantify heat and momentum transfer processes correctly, because instruments are likely operating beyond their performance thresholds within the fire environment. Our solution is to evaluate forest energy balance terms during fires, as is often employed to ensure the accuracy of longer-term carbon and water flux measurements above forests. We compared energy release calculated from measurements of fuel consumption to turbulence and energy exchange estimated from eddy covariance and standard meteorological measurements during four operational prescribed fires conducted in the Pine Barrens of New Jersey. Fuel consumption was quantified using pre- and post-burn sampling of the forest floor and understory. At least one above-canopy flux tower within the burn block and two “control” flux towers in unburned stands were operated during each prescribed fire. Pre-fire, sensible and latent heat fluxes accounted for an average of 97% of available energy at each stand, calculated from net radiation and heat storage in the canopy air space, biomass and soil. During prescribed fires, fuel consumption on the forest floor and in the understory ranged between 5.1 to 9.8 metric tons ha-1, representing 44 to 53% of pre-burn loadings, respectively. Corresponding heat of combustion values calculated from fuel consumption data and measured fuel moisture contents ranged between 6,693 to 12,894 kJ m-2. Above-canopy energy release during these fires calculated from the “excess” sensible and latent heat flux was 4,824 to 7,256 kJ m-2, accounting for 45 to 56% of estimated heat of combustion. Heat storage in canopy air space was large, but soil heat storage was relatively minor, likely due to burning of the litter layer and not the organic layers. We then discuss possible sources of error in both fuel consumption and eddy flux measurements. Despite some sampling limitations, simultaneous quantification of fuel consumption and energy fluxes during fires using landscape-scale tower networks is valuable for evaluating predictive plume dispersion models.

Bio: Kenneth Clark is a Research Forester with the USFS Northern Research Station, located at the Silas Little Experimental Forest in New Lisbon, New Jersey. His research focusses on fire weather, hazardous fuel assessments, and the use of eddy flux measurements to quantify energy, water and carbon exchange in forests.

P46. Atmospheric stability’s influence on rate of spread and plume rise

Author(s): Kara Yedinak, Washington State University
Brian Lamb
Steve Edburg
Janice Coen

Wildfire has long been treated as a spatially static energy and emissions source when simulating climate impacts and air quality. These assumptions do not take into account the dynamic exchange between wildfires and the atmosphere, both of which evolve in both space and time. By treating these two pieces as a coupled dynamical system, the influence between wildfire behavior and atmospheric dynamics can be explored. The relative influences of surface parameters such as fuel loading, moisture, and wind speed, have been previously qualitatively investigated. However, very little work has been done to better understand the role lower-atmosphere dynamics play in the fire-atmosphere system. One parameter of particular interest is atmospheric stability, which explains the dynamics in the atmospheric boundary layer; the layer of our atmosphere directly influenced by turbulent mixing from heating and cooling of the Earth’s surface. The majority of current wildland-fire-behavior modeling techniques assume either the atmosphere doesn’t influence the fire or it is always neutral (e.g., no enhancement or suppression of vertical motion by surface heating or cooling). Here, we investigate the validity of this assumption using the coupled fire-atmosphere model WRF-Fire. WRF-Fire combines a detailed atmospheric

turbulence model with the Rothermel fire spread model. At each time step, local winds influence the fire rate of spread. Likewise, changes in surface heating from the fire alter local winds, thus capturing coupled fire-atmosphere dynamics. Simulations were completed for three stability cases (neutral, mildly unstable, and strongly unstable) over a simulated grassland fire. Results are presented in terms of the sensitivity of rate of fire spread and plume rise to changes in stability conditions. This work begins to tease apart the role atmospheric stability plays in the dynamics of larger coupled fire-atmosphere systems, and may lead to more accurate fire spread predictions.

Bio: Kara Yedinak is finishing up her Ph.D. in engineering science with the Laboratory for Atmospheric Research (LAR) at Washington State University. LAR is an interdisciplinary graduate program focusing on air quality with an emphasis on interactions between the biosphere and atmosphere. At LAR, Kara is pursuing her interests in links between fire behavior and the atmosphere to better understand the role and scale of wild-land fire in air quality. She is also an avid mountain biker and musician.

P47. Fire Severity Assessment in the Allegheny Highlands of Virginia

Author(s): L. Nikole Swaney, The Nature Conservancy, George Washington National Forest, United States Forest Service
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Marek Smith, The Nature Conservancy and
Daniel Buckler, The Nature Conservancy

In 2006, land managers and ecologists from several Appalachian states met to develop approaches for restoring the historic role of fire to oak- and pine-dominated ecosystems throughout the region. This meeting launched the Appalachian and Southern Blue Ridge Fire Learning Networks (FLN), a collaboration of ten demonstration landscapes representing nine states. During spring 2012, wildfires burned approximately 40,000 acres within the Allegheny Highlands of western Virginia, one on the FLN demonstration landscapes. Known as the Easter Complex, these wildfires were an unprecedented event for a region that has not historically experienced wildfires at this scale. The fires affected a variety of ecological systems and national forest management areas, including designated Wilderness areas and previously treated prescribed burned areas. The fires also resulted from a variety of ignition sources and were managed through a combination of natural progression and different firing techniques and patterns. Taking advantage of the opportunity to learn about the effects of fire on a landscape-scale, FLN partners embarked upon a burn severity assessment in summer 2012, utilizing Rapid Assessment of Vegetation Condition after Wildfire (RAVG) satellite imagery and the Composite Burn Index protocol. The goals of the study include: mapping fire severity in conjunction with firing patterns and techniques, illustrating variances in fire severity throughout wildfire and prescribed fire areas, and evaluating the Easter Complex as a case study for wilderness area management. The assessment will continue in the 2013 growing season to evaluate long-term fire effects with the aid of Monitoring Trends in Burn Severity satellite imagery

P48. Numerical experiments to provide functional relationships that describe differential heating around a tree bole

Author(s): Anthony Bova,The Ohio State University
Gil Bohrer, The Ohio State University, Dept. of Civil, Environmental and Geodetic Engineering
Matthew Dickinson, U.S. Forest Service - Northern Research Station
William Mell, U.S. Forest Service - Pacific Wildland Fire Sciences Lab

Tree boles exposed to surface fires are usually heated unevenly, with greater heat transfer, and therefore scarring, occurring on the leeward sides. Models of tree stem injury and mortality resulting from uneven heating require accurate estimates of stem surface heat flux that, to date, do not exist. As a step toward providing functional relationships to characterize uneven stem heating, we present preliminary results of numerical modeling of heat flux profiles at different heights around the circumferences of tree boles exposed to surface fire. The open-source modeling suite Wildland-Urban Interface Fire Dynamics Simulator (WFDS) was used to create a factorial set of simulations of fire spread past tree boles. Bole diameter, wind speed and fire intensities or fuel loading were varied in the simulations. The roles of the local wind Reynolds number and fire intensity in estimating uneven heating and leeward flame heights will be discussed.

Bio: Anthony Bova has over ten years of experience as a modeler and experimentalist in the fields of wildland fire, fire effects and atmospheric dispersion. He holds a M.S. in Environmental Engineering from the Ohio State University.

P49. Fuel Element Combustion Properties for Live Wildland Utah Shrubs

Author(s): Tom Fletcher, Brigham Young University
Chen Shen, Brigham Young University

Current field models for wildfire prediction are mostly based on dry or low-moisture fuel combustion research. To better study the live fuel combustion behavior and develop the current semi-empirical bush combustion model, a laminar flow flat-flame burner was used to provide a convection heating source to ignite an individual live fuel sample. In this research project, four Utah species were studied: Gambel oak (Quercus gambelii), canyon maple (Acer grandidentatum), big sagebrush (Artemisia tridentata) and Utah juniper (Juniperus osteosperma). Leaf geometrical parameters measured included individual leaf total mass, thickness, leaf width (W), leaf length (L), and moisture content (MC). Time-stamped images of combustion behavior along with time-dependent mass data were recorded via LabVIEW system. Combustion characteristics were determined by an automated MATLAB routine modified for operating Utah species images of experimental runs, including time to ignition, time of flame duration, time to maximum flame height, time to burnout, and maximum flame height.

Qualitative results included various combustion phenomena like bursting, brand formation and bending. Sparks accompanied with leaf material bursting out were observed for Utah juniper sample combustion mostly before ignition, especially for segments cut from top of the branch. Quantitative results included exploration on best prediction equations for leaf geometrical properties and combustion characteristics. A beta distribution was used to predict the distribution of mdry. Multiple linear regressions were performed on other leaf geometrical properties and combustion characteristics. Minimized Bayesian information criterion (BIC) value models were achieved by stepwise regression analysis and compared to the previous empirical prediction models. A linear correlation between flame area (determined by images) and flame height was observed. The semi-empirical bush combustion model was adapted to simulate Gambel oak and canyon maple, with leaf placement and bush structure based on observations of wildland shrubs.

Bio: Dr. Thomas H. Fletcher is a Professor in the Department of Chemical Engineering at Brigham Young University. He received a PhD in Chemical Engineering from BYU in 1983. He worked for seven years at the Combustion Research Facility at Sandia National Laboratories in Livermore, California. He has been on the faculty at BYU for the last 21 years, and is currently serving as Associate Chair. He has been working on fire spread in live wildland shrubs for over ten years. His research interests include pyrolysis of low grade fuels and biomass.

P50. Achieving Economic Efficiencies and Sustainability of Wildland Fire Programs in the National Park Service: An Analytical Approach to Investment Priorities and Workforce Management

Author(s): Jesse Duhnkrack, NPS - Intermountain Region
Andy Kirsch, NPS - NIFC
Liz Struhar, NPS - Southeast Region

Faced with constrained budgets and the need to create a sustainable organization that meets National Park Service (NPS) mission needs, a system was developed to facilitate cost-effective allocations of personnel and funding. The system uses mathematical processes to examine park wildland fire workloads by analyzing five different program attributes: (1) number of wildfires, (2) frequency of large wildfires, (3) amount of area within each park that is proximal to park infrastructure and park boundaries where recurring treatment of hazardous fuels is likely, (4) amount of area within each park – on average – that should burn annually (either from wildfire or prescribed fire) in order to maintain the historical fire regime(s), and (5) the total number of active days in the analysis period. The analysis provided a method to stratify NPS park units with similar wildland fire workloads into sets or "bands". Each band was examined in closer detail in order to characterize the workload and inform expert opinion for the minimum level of permanent staffing necessary. A regression analysis was used to arrive at minimum permanent staffing levels for each individual park. Seasonal staffing levels for preparedness and fuels management were also derived through a similar process. The staffing levels suggested by the system have been integrated into a framework for workforce management which is being used by agency leadership to meet projected budget declines over the next three years. Separate analyses were conducted in order to determine whether fire occurrence and fuel conditions at a park warrant the need for a wildland fire engine or helicopter, and if so, how many. Additionally, analyses were created in order to determine the need for mobile tactical resources, as well as the appropriate number of FTE for staffing central (regional and national) offices.

Bio: National Park Service, Intermountain Region; Lakewood, Colorado. Early career program leadership and management experience at Yosemite, Sequoia, and Grand Canyon National Parks. Served as FMO at Rocky Mountain National Park from 1997 to 2005, focused on fuel reduction/wildfire mitigation, initial response, managing wildfires, fire effects monitoring, and adaptive management techniques. Currently assigned to the Intermountain Regional Office, he is responsible for a wide range of wildland fire duties, including operations, safety, training, with the primary focus being on strategic planning. Jesse has a BS degree in Environmental Science with an emphasis in Ecosystem Analysis from Western Washington University.

P51. Ramifications of (In)Accurate Corporate Geospatial Databases

Author(s): Justin Shedd, North Carolina State University
Andy Kirsch, National Park Service
Hugh Devine, North Carolina State University
Caroline Noble, NPS
Liz Struhar, NPS

Geographically speaking, everything is related to something else and typically the closer the objects are to each other the more they impact each other; a similar statement could be made about geospatial databases and the models and decision support systems into which they feed. Data, more specifically the lack thereof or the inaccuracy of existing data has far reaching implications on other databases, models and decision support systems. Decision support systems and models; whether they are budget, ecosystem, climate, smoke emission, fire spread, etc., rely heavily on the existence of geospatial datasets based on fire occurrence. These problems can be compounded as local database are rolled up into regional or national datasets, especially when protocols for quality control at the local level vary considerably.

This poster will visualize the cascading impact geospatial datasets within National Park Service's Fire and Aviation Management have on each other. The National Park Service Southeast Region recently completed a quality control check of their fire occurrence database correcting erroneous reports, eliminating duplicate reports, and adding reports for which historically only paper records had existed. Results of the National Park Service's Planning Data System model will be shown, illustrating the impact that missing and erroneous data has on decision support systems outputs. Additionally, this cleanup effort resulted in geospatial fire reporting guidelines as well as bringing to light management issues with current fire reporting practices.

Bio: Since 2005 Justin has been a Research Associate / GIS Specialist at North Carolina State University, College of Natural Resources. Where his work focuses on GIS and geospatial technologies and their application within the Fire Management Community. Past projects include object oriented mapping of woody debris, creation of fuel model/loading databases, distributed database design and deployment, database QA/QC, web map development, and providing training on new software. BA, Geography, UNC-Chapel Hill; MS, Spatial Analysis, NC State.

P52. Assessing conditions that lead to nighttime smoke problems

Author(s): Scott Goodrick, USDA Forest Service
Zachary Robbins, University of Georgia

Reduced visibility on roadways due to the presence of smoke and fog represents a major hazard to the public and a significant area of concern for prescribed burn managers. The most widely used tool for specifically predicting the potential for visibility problems related to smoke/fog is the low visibility occurence risk index (LVORI) which relates nighttime relative humidity and atmospheric dispersion to the likelihood of a vehcile accident occurring. The original research on LVORI was limited to vehicle accidents in Florida over a 3 year period. This study expands the geographic region considered to the entire Southeast and examines the relationship of weather parameters to the occurrence of fog and fatal vehicle accidents. The goal of the work is to provide a consistent methodology for evaluating meteorological conditions that may lead to nighttime smoke/fog problems that considers time of year and geographic location. Initial findings show that LVORI can work well during the winter months for radiation fog cases. Other fog types are not well captured by LVORI and its utility outside of winter is greatly reduced due to a strong false alarm rate.

Bio: Scott Goodrick is a research meteorolgosit with the USDA Forest Service Southern Research Station. Research focus includes smoke management, fire-atmosphere interactions and wind-related forest disturbance.

P53. The Oak Woodlands and Forests Fire Consortium

Author(s): Keith Grabner, USGS - Columbia Environmental Research Center
Michael Stambaugh, University of Missouri
Joe Marschall, University of Missouri

The purpose of the Oak Woodlands and Forests Fire Consortium (OWFC) is to promote the dissemination of fire information across a section of the interior U.S. and serve the fire information needs of natural resource managers working in oak-dominated and oak-pine communities such as woodlands, forests, savannas, and barrens. The consortium aims to promote fire information sharing and work towards establishing partnerships among fire professionals. To achieve this goal the consortium has been assisting with workshops, conference symposiums, webinars, and publishing a quarterly newsletter. Additionally the consortium has been using social media like facebook, twitter, and vimeo. Come talk with us about how the consortium can help with your fire information needs.

Bio: Keith Grabner is an Ecologist with the U.S. Geological Survey Columbia Environmental Research Center. He has been working an a forest ecologist for 15years with USGS. He earned a BS in Forestry from the University of Maine and a MS in Forestry from the University of Missouri.

P54. Characterization of fuel structure and estimations of biomass using 3D terrestrial laser scanning

Author(s): John Hom, USDA Forest Service
Yong Pang, Chinese Academy of Forestry
Dan Zhao, Chinese Academy of Forestry
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Anssi Krooks, Finnish Geodetic Institute
Pasi Raumonen, Tampere University of Technology
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Jonathan Dandois, University of Maryland, Baltimore Co.
Kenneth Clark, USDA Forest Service
Nick Skowronski, USDA Forest Service
Matthew Patterson, USDA Forest Service
Michael Gallagher, USDA Forest Service

Advances in 3D terrestrial laser scanning (TLS) algorithms allows for reconstructing topologically consistent tree architecture from TLS point clouds to calculate the volume of woody stems including branches. This method gives locations, lengths, and widths/taper functions of stem+branches, that can be used for characterizing fuels, i.e. crown base height, canopy bulk density, fuel loads, canopy characteristics and spatial location of vegetation for fire spread models. Our use of 3D scanning lidar is part of our current research in biomass/carbon, fire and fuels, and differences in tree structure to see how well our existing allometric equations work across environmental and disturbance gradients. As part of an international collaboration, single trees and plots with multiple stems were scanned with the help of the Chinese Academy of Forestry and Univ. of Maryland, Baltimore Co. scientists using a Riegl VZ400 TLS in urban and rural locations.. Additional TLS point cloud data was recently obtained with a FARO 3D 120 TLS in the New Jersey Pine Barrens. To calibrate / validate the algorithms developed by our Finnish collaborators, we are using an ongoing Forest Service study funded by the Joint Fire Science Program which is harvesting tree plots and obtaining biomass by 1 m bin heights in conjunction with an upward looking portable profiling lidar, and previous downward scanning lidar to detect fuel reduction. Estimates of biomass will be compared using allometric equations, TLS point cloud algorithm estimates, and whole tree biomass harvesting and 1 m bin heights.

Bio: I am an interdisciplinary scientist with the Forest Service, Northern Research Station. I am currently working on validating smoke dispersal models from low intensity fires, using tree rings to predict adaptibility to climate change, and the interaction of climate, invasive insects, and wildfires. My research interests include fuels mapping, fire weather, and fire danger.

P55. The Southwest Fire Science Consortium: An opportunity in fire science and management

Author(s): Barbara Satink Wolfson, Northern Arizona University School of Forestry
Andrea E. Thode, Northern Arizona University School of Forestry
Molly E. Hunter, Northern Arizona University School of Forestry
Peter Z. Fulé, Northern Arizona University School of Forestry
Alexander Evans, Forest Guild
Jose M. Iniguez, USDA Forest Service, Rocky Mountain Research Station
Donald A. Falk, University of Arizona, Laboratory of Tree Ring Research
The Southwest is one of the most fire-dominated regions of the US. Currently, in the Southwest, there are several localized efforts to develop fire science information and to disseminate it to practitioners on the ground in a practical manner. However, many of these efforts were moving in parallel, without thoughtful interaction among projects. Managers and scientists are often not aware of each other or of the external resources available. We developed a Consortium to bring these parallel efforts together to be more efficient and inclusive, allowing future fire science issues to be addressed from a broader perspective with more information, more partners, and more resources. With support from the Joint Fire Science Program (JFSP), we initiated the Southwest Fire Science Consortium to promote communication and meet fire knowledge needs of scientists and managers. We have organized the Southwestern Fire Science Consortium around three key questions: (1) What do people need to know? Information needs are assessed through workshops, surveys, and organization of a community of practice of wildland fire professionals; (2) What information is already known? Synthesis of existing science; and (3) What are the key information gaps between what we need to know and what is already known? This question leads to the identification of critical areas for new research and management experiments. By focusing on these key questions we hope to provide a mechanism for managers, scientists, and policy makers to interact and share science in ways that can effectively move new information to management practices and facilitate new research based on management needs.

Bio: Barb Satink Wolfson has a BS and MS in Forestry, specializing in fire ecology, from Northern Arizona University and has been the Coordinator for the Southwest Fire Science Consortium since August 2011.

P56. Effects of mastication on fire behavior and post-fire tree mortality in pine flatwoods ecosystems

Author(s): Jesse Kreye, Mississippi State University
Leda Kobziar, University of Florida

Mechanical fuels treatments are being used in fire prone ecosystems where fuel loading poses a hazard, yet little research quantifying fire behavior in these treatments currently exists. Mastication is an increasingly used fuels treatment method being widely implemented across the USA and elsewhere. Mastication is a treatment method that converts shrub and small tree understories into compact surface fuelbeds through mechanical shredding. While few experimental studies have been conducted in masticated fuels, they have primarily been composed of fine woody debris. Palmetto/gallberry understories in the pine flatwoods of the southeastern USA result in fuelbeds dominated by foliar litter when masticated and likely result in different burning behavior and effects. In order to quantify fire behavior in these treatments and address potential consequences, we examined the effects of mastication on fire behavior, and subsequent fire effects, from field experiments in pine flatwoods of northern Florida, USA. We compared fire behavior (flame height and rate of spread), fuel consumption, and fire damage to trees (basal charring, crown scorch, and crown consumption) between treated and untreated experimental field sites in Osceola National Forest. Our results indicate that while mastication may reduce fire behavior when sites burn, tree mortality may ensue under certain circumstances.

Bio: Jesse Kreye is a postdoctoral research associate in the Department of Forestry at Mississippi State University.

P57. Using crib fires to predict flame residence time

Author(s): Sara McAllister, USDA Forest Service
Mark Finney, USDA Forest Service

The flame residence time is an often discussed parameter in spreading wildfires and it has implications for both fire behavior and fire effects modeling. Curiously, no one theory exists for its prediction. Expressions in the literature range from linear up to even a quadratic dependence on the fuel thickness. Even the definition of flame residence time itself is confusing, with inconsistent definitions such as the flaming duration of particle, a fuel bed, or at a 3D coordinate. These discrepancies are but one hurdle that must be overcome to better understand fire spread, especially in crown fires. In non-homogeneous, clumpy fuels such as tree crowns, if one clump of fuel burns out before the next can ignite, fire spread is stopped. Additionally, there is evidence that the flame zone depth, which is also related to residence time, may influence spread rate, even in surface fires. This presentation will take a look through the literature and discuss the lack of knowledge about this key parameter. The crib-fire literature from the fire protection engineering community may provide some clarity and insight into this predicament through analysis of burning rates. The application of the results of crib fire burns to fine fuels in wildland fires will be discussed, along with some preliminary experimental findings.

Bio: Sara McAllister is a Research Mechanical Engineer with the US Forest Service at the Rocky Mountain Research Station's Missoula Fire Sciences Laboratory in Missoula, MT. She is part of the group in the National Fire Decision Support Center that is focused on understanding the fundamentals of fire behavior. Her work primarily deals with the heat transfer and combustion aspects of ignition, burning rates, and spread of wildland fires.

P58. Fire Intensity and Regime on Vegetation Dynamic in Climate Change Context in West African Savanna

Author(s): Aya Brigitte N'DRI , University of Abobo-Adjama (Ivory Coast)

This experience aimed at determining the fire intensity value in a West African humid savanna and understand the impact of the fire intensity and fire regime on savanna vegetation, in climate change context. Different fire intensities were simulated on two plots of 3.72 ha each, delimited in two shrubby savanna of the Lamto reserve (Ivory Coast). Two fire regimes have been performed, the mid-season fire (January) and the late fire (April). Two fuel levels (single: C1 and double: C2) have been simulated. For each fire regime, fire intensity was determined and it increases with the fuel quantity (1259 356 kW m-1 and 3380 1472 kW m-1 respectively for C1 and C2). The re-growth speed of grasses layer is also dependent of the fuel quantity or fuel load. It increases with it and is higher after the mid-season fire than the late fire. The average intensity of the mid-season fire (2966 2233 kW m-1) is not significantly different from that of the late fire (1673 1124 kW m-1). Damages or debarking caused by fire on adult trees were observed. Those damages appear to initiate the external cavity observed on trees, whereas these cavities are detrimental to trees trunk mechanical resistance. They generally affect adult trees of Crossopteryx febrifuga species which is also the most commonly hollowed species.

Bio: Dr. N'DRI Aya Brigitte, PhD- Ecology, co-supervised by Pierre et Marie Curie (Paris, France) and Abobo-Adjam (Abidjan, Ivory Coast) Universities.
Assistant professor at the University of Abobo-Adjam / Researcher at the Lamto Ecological Research Station (N'Douci).Field Research: Savanna Ecology and Fire research / Woody vegetation dynamic.
Research activities. May-July 2012: Internship at the CSIRO/TERC (Darwin, Australia). Participation to experiments realting to: (i) fire regime and frequency on plants and animals and on fire behaviour in Territrory Widlife Parc, (ii) contribution of savanna fires in the greenhouse gas emission on Tiwi Island.
Since 2009: Member of RIPIECSA-Ivory Coast project. 2007-2011: Member of BIOEMCO laboratory, ENS (Paris, France).

P59. Fuel treatment effectiveness over 10 years in California forests

Author(s): Alicia Reiner, USDA Forest Service, Adaptive Management Services Enterprise Team
Scott N Dailey, USDA FS Adapative Management Services Enterprise Team
Carol Ewell, USDA FS Adaptive Management Services Enterprise Team
JoAnn Fites-Kaufman, USDA FS Region 5

Nicole Vaillant, Western Wildland Environmental Threat Assessment Center
Erin Noonan, Wildland Fire Management RDA

Expansive stand replacing crown fire is the most negatively impacting fire type in many of the coniferous ecosystems within California. The most successful way to change potential fire behavior is to reduce surface fuels, increase the canopy base height and reduce canopy bulk density. Benefits of fuel treatments at the stand-level have been well studied and proven effective at reducing wildland fire intensity and severity. However, little is known about how long treatments last, or how often they will need to be re-treated to maintain desired levels of reduced fire behavior and effects.

As part of a long-term fuel treatment effects monitoring project data was collected at 89 permanent plots representing 28 fuel treatment projects on 14 national forests in California from 2001 to 2012. Fuel treatments ranged from prescribed fire only, thinning only, mechanical understory treatments such as mastication, and a combination of thinning plus understory fuel reduction treatments. Forest and fuels inventory data was collected before treatments and up to 10 years after treatment (1, 2, 5, 8, and 10 year post treatment intervals) for each plot.

The purpose of this study is to examine longer-term effectiveness of fuel treatments in terms of fuel loads and simulated fire behavior. Additional synergistic analyses were completed to compare fire modeled outputs from custom versus standard fuel models using the Fire and Fuels Extension of the Forest Vegetation Simulator and the effects of fuel treatments on aboveground carbon stocks over time.

Bio: Ali Reiner is an employee of a USDA Forest Service Enterprise Team called Adaptive Management Services, "AMSET" as a fire ecologist. She has completed several fuel characterization, treatment effectiveness and fire severity studies since starting with AMSET in 2006. Prior to working with AMSET, Ali worked as a firefighter on an engine and hotshot crews. Ali uses her experience in fire management along with her academic and ecological background to create strong science useful for land and fire management.

P60. Development of Wildfire Ignition Risk Prediction Model from Transportation Corridors using Fluid Mechanics Analogy

Author(s): Ravi Sadasivuni, Mississippi State University
Shanti Bhushan, Mississippi State University
William H Cooke, Mississippi State University

Human induced fires are frequent, severe and widespread in our ecosystems. Several fire risk description models have been used by the US Forest Service for management and evaluation of wildfire damage to forest resources. These models use correlations between the observational data and geographical, climatic and vegetation components to obtain fire risk potential indices. Studies have shown that anthopogenic factors cause more than two-thirds of all wildfires in the US, which are not included in above models. There are few models which account for both fuel loads and ignition sources, but account for only selected anthopogenic factors, for example city pollution interaction or road density. In this study, an ignition potential model is developed by categorizing the anthopogenic factors into local and global variables, and model them using Fluid Mechanics analogy. T he global variables (city population) are modeled as Gravity model, whereas the local variables are modeled as convective (traffic volume) and diffusive fluxes (transportation corridors) across the local region boundaries. The ignition potential is then integrated with fuel potential by using a multiplicative operation. The model couples the multi-criteria behavioral pattern in a single dynamic equation, where the global and local behavioral factors are accounted separately to enhance predictive capability. The model coefficients are evaluated using the 18 year wildfire data in southeast Mississippi region, wherein transportation corridors are identified to be most influential factors for wildfire ignition . Up to 60-70% of the fires lie within 1.5 kilometer buffer of the primary and secondary roads, and the distribution decays exponentially as the distance from the road increases. The rails show an interaction behavior similar to the primary roads. As rails usually run parallel to the roads, their contributions taken together shows 30% more fires. The model is implemented in a Fortran Code and validated for simplified representation of the Hattiesburg, MS region. As expected, the peak potential distribution is predicted in the city sub-urban areas along the roads with high traffic volume, and at the road intersection connecting multiple cities. The model predictions are encouraging as 55% of the historical fires occur in the high risk zones .

Bio: R. Sadasivuni, a PhD student in Geosciences Department. He holds advanced degrees in Philosophy/Geography and Remote Sensing engineering from India and Master's in Geosciences at Mississippi State University. Before joining Mississippi State University, he worked as a remote sensing analyst in several companies like CGG Pan India and COWI. He worked with transportation and environmental research projects, and involved in new and innovative approaches that bring benefits to wildfire research. His research interests focus on advanced use of raster analysis for creating complex surfaces that deliver understanding of cost surfaces using gravity models from socioeconomic components in the wildfire research.

P61. Local variability in understory microclimate is explained by LiDAR-derived measures of canopy structure

Author(s): Michael Gallagher, Silas Little Experimental Forest, USDA Forest Service
Nicholas Skowronski, Carbon, Fire, and Climate Sciences, USDA Forest Service Northern Research Station
Bryan Ryder, School of Environmental and Biological Sciences, Rutgers University
Kenneth Clark, Silas Little Experimental Forest, USDA Forest Service
Melanie Maghirang, Silas Little Experimental Forest, USDA Forest Service
Michael Farrell, Silas Little Experimental Forest, USDA Forest Service

The ability to predict fuel moisture content and fire risk is crucial to fire and fuels management, but is limited by the accuracy of meteorological predictions scaled across forested landscapes. Scaling is especially important where canopy disturbances increase hazardous fuel loading and alter microclimate; but is often hindered by the difficulty of assessing structural variability in canopies and associated microclimatic trends. Recent studies have highlighted the utility of LiDAR to rapidly and repeatably quantify canopy structure with high spatial resolution; however, few attempts have been made to improve fuel moisture and fire risk predictions using LiDAR data as a means of scaling microclimatic trends. Here we present the preliminary findings of our ongoing study, which attempts to integrate fine-scale forest microclimate measurements and LiDAR-sensed forest canopy structure. We characterized the range and trends of variability that affect fuel moisture regimes under disturbed and undisturbed canopies. Half-hourly understory weather data, collected during the summer of 2012 at five stands within the Silas Little Experimental Forest, were analyzed for trends and compared to canopy structural attributes sensed with LiDAR. Daytime temperatures throughout the air column increased as canopy cover decreased with the most variability occurring at the forest floor where temperatures ranged 11 C on average at 13:00 hr. Trends in daytime relative humidity were also closely related to canopy cover, with lowest values occurring in the most open plot and highest values occurring in the most densely covered plot. These results indicate that fine fuel moisture dynamics, and thus fire danger, is partially regulated by canopy structure suggesting that fine-scale measurements of canopy structure may allow us to develop more accurate spatial fire danger products. Ongoing investigation under a greater range of canopy conditions coupled with comparisons of predicted versus field assessed fuel moisture will provide key components for improved fire risk and fuel moisture models across stands and landscapes characterized by heterogeneous canopy structure.

Bio: Michael Gallagher is a full-time Forestry Research Technician for the USDA Forest Service's Northern Research Station and student in Rutgers University's Ecology and Evolution graduate program. His research interests include the effects of canopy disturbance on fire danger, fuel moisture dynamics, and the utility of LiDAR in predicting microclimatic trends in forests with heterogeneous structure.

P62. Wildland fire suppression modeling using Wildfire Analyst

Author(s): Nicole Simons, San Diego State University

Wildland fires are a naturally occurring phenomenon in many parts of the world, but in some locations recent changes in climate and population have led to a substantial increase in fire intensity and frequency. In fall 2003 and 2007, the United States experienced several catastrophic wildland fires. In order to respond and control these significant events effectively and efficiently, emergency operation personnel and decision makers must have the ability to forecast the intensity, rate, and direction at which a fire will spread in order to determine optimal allocation of resources and suppression strategies. Unfortunately there is a paucity of research on what impact suppression tactics have on wildland fires. This paper reports on the results of new research about the interaction between suppression tactics and their influence on fire behavior in Mediterranean shrublands. Data about the 2003 and 2007 wildfires in Southern California were augmented by interviews with emergency personnel, analysis of firefighting manuals, and historical prescribed burns; and used to construct a suppression knowledge base. This knowledge base is currently being integrated into the fire behavior modeling system, Wildfire Analyst. Wildfire Analyst is a spatially explicit, cellular automata fire behavior modeling system that uses an innovative way of treating firebreaks by representing the firebreak width as independent of cell size. The equations used in Wildfire Analyst to calculate the influence of a firebreak on fire behavior have been modified by taking into account the environmental and physical components of a fire and procedural rules from the fire suppression knowledge base. Statistical tests will be used to determine the validity of the modified suppression component and sensitivity of the outputs to changes in model inputs. The paper also reports about the results of comparative analysis, in which fire suppression calculations obtained from FARSITE were compared with those obtained from the modified Wildfire Analyst. The results from both models will be evaluated quantitatively by using Cohen kappa coefficient, Sørensen similarity index, and Jaccard similarity coefficient to compare two areas and qualitatively by visual assessments to each other and historical fire events.

Bio: Nicole Simons is a joint doctoral candidate in Geography between San Diego State University and the University of California, Santa Barbara. She is a pyrogeographer and her research explores operational fire behavior modeling, decision making during fire events, and suppression efforts influence on fire behavior. Nicole's primary focus is Mediterranean climates of Southern California with extensive field work conducted in San Diego County, California.

P63. LANDFIRE Processes, Products and Applications: Data and Tools for Managers

Author(s): Jim Smith, The Nature Conservancy
Kori Blankenship, The Nature Conservancy
Sarah Hagen, The Nature Conservancy
Jeannie Patton, The Nature Conservancy
Randy Swaty, The Nature Conservancy

The proposed poster demonstrates how LANDFIRE works at national, regional and large sub-regional landscapes (such as fire management units). Tools and guidance are available to help users review and modify the data as needed for finer scale applications. In addition to explaining the LANDFIRE process and products, this poster highlights real-world examples of applying the products for calculating nation-wide conservation risk, assessing state-wide forest conditions and comparing landscape-level vegetation restoration strategies based on return-on-investment.

Bio: Jim is currently the TNC Project Lead for LANDFIRE. Jim earned a B.S in Timber Management and M.S. Forest Biometrics from the University of Georgia, and a Ph.D. in Forest Biometrics and Remote Sensing from Virginia Tech. Jim spent the next 13 years on the Forestry faculty at Virginia Tech, achieving the rank of Associate Professor. Jim has also worked in the commercial sector, and was the Director of Forest Information Systems development for Champion International Paper Company and International Paper Company

P64. Comparing the RAWS and RTMA Datasets to Help Analyze Surface Characteristics

Author(s): Alan Srock, Michigan State University
Sharon Zhong, Michigan State University
Michael Kiefer, Michigan State University
Joseph Charney, US Forest Service
Xindi Bian, US Forest Service

The RAWS network was created to provide a dense array of surface observations in regions of high weather interest. Many of the RAWS sites are located within state and national forests and grasslands, which means the data from these observing sites can be essential for fire managers to help determine local weather conditions. However, siting characteristics can vary greatly for these RAWS platforms from one location to another; for example, some sites are located beneath a dense canopy, while others are in an open field. These factors can contribute to systematic differences between a RAWS observation and point weather data from other sources (e.g., models, smoothed analyses).

n order to quantify differences between RAWS observations and other analyses, we needed to compare RAWS to an independent dataset with excellent spatial coverage and hourly temporal resolution. After multiple comparisons, we chose to use the Real-Time Mesoscale Analysis (RTMA) created at NCEP. For the period analyzed, the RTMA did not ingest RAWS data, though it does presently. (Note that the RTMA is considered as our "truth" for this study, but the RAWS is likely more accurate at the observation location.)

We examined two years of hourly RAWS and RTMA observations, and focused specifically on the Great Lakes and Northeast. We excluded stations which reported <90% of possible observations, to eliminate stations which were missing large chunks of data. Next, statistical comparisons of temperature, relative humidity, and wind speed were calculated for each of the 201 stations in our final dataset. Results from some key stations will be shown, as well as some trends that appear in multiple stations. Eventually, this work will be posted on a website so end users can easily access our results; this website will be available for perusal at the presentation.

Bio: Alan Srock is a post-doctoral researcher at Michigan State University. His background is in synoptic-dynamic meteorology, and he is now focusing on ways that large-scale weather can affect fire behavior.

P65. A Synopsis of the 2012 National Prescribed Fire Use Survey Report

Author(s): Pete Lahm, USDA Forest Service
Jeremy Bailey, The Nature Conservancy
Kimberly Vanhemelryck, USFWS

Annual wildfire activity has been tracked for decades. Much less is known about prescribed fire activities. How much and where prescribed fire occurs year to year, and to what degree it meets resource needs is poorly understood. A national evaluation that specifically focuses on the scale at which prescribed fire occurs, what programs support prescribed fire, and identifies factors that limit prescribed fire use is nonexistent. These are all relevant questions necessary to make informed policy and programmatic decisions.

To gain a better understanding of prescribed fire use, the National Association of State Foresters and the Coalition of Prescribed Fire Councils collaborated in early 2012 to conduct a national prescribed fire use survey of all state agencies responsible for prescribed fire activities. Federal prescribed fire data is not included.

Bio: Kim Van Hemelryck is the Fuels Management Specialist for the US Fish and Wildlife Service, Branch of Fire Management, in Boise, Idaho. Kim has over 23 years of experience in wildland fire while working for the federal government. Kim started her career in the Forest Service in 1987 as a seasonal firefighter on the Okanogan National Forest in Washington State. She has worked for the US Forest Service, National Park Service, and Bureau of Land Management in various suppression and fuels jobs at the Local, Regional, and National level. She has worked at the National Interagency Fire Center since 2003 focusing on prescribed fire, policy, and hazardous fuels reduction. Kim is a member of the National Wildfire Coordinating Group's Fuel Management Committee (FMC) that is the parent group to the Fire Use Sub-Committee. Kim has been a Prescribed Fire Council Executive Board Liaison since June 2012.

P66. Using Landsat imagery to monitor post-fire forest dynamics in upland oak forests on the Cumberland Plateau, Kentucky

Author(s): Mary Arthur, University of Kentucky
Christine McMichael, Morehead State University
Gretchen Sovkoplas, University of Kentucky

Throughout the central hardwood and southern Appalachian regions, forest managers use prescribed fire to address a suite of management objectives. When such management occurs on federal land, monitoring is mandated to determine the efficacy of prescribed fire to achieve stated objectives, yet limited funding for such efforts restricts the number, size and spatial array of monitoring plots. Based on its use in other forested ecosystems, satellite remote sensing data have the potential to provide inexpensive monitoring of post-fire vegetation effects in central hardwood and southern Appalachian forests. We used Landsat imagery collected from 2002 through 2010 to examine post-fire change in several spectral vegetation indices (SVIs) for three treatments: unburned, twice burned, and burned five times; differences among landscape positions were also examined. Analysis of variance results demonstrated that values of the Normalized Difference Vegetation Index (NDVI) were significantly different between treatments, and with landscape position, nearly every year. Significant differences in NDVI were also observed in some years for the interaction of treatment and landscape position. Less consistent, yet still significant, differences in these factors (and combinations of factors) were also found using the Kauth-Thomas Greenness and Moisture indices. Our analyses of changes in these SVIs not only revealed alterations to vegetation with burning, but also showed some recovery during years without burning. Overall, our results indicate that multi-temporal Landsat imagery has utility for monitoring forest dynamics following prescribed burning in these hardwood ecosystems.

Bio: Mary Arthur is Professor of Forest Ecology in the University of Kentucky, Department of Forestry. Her research program addresses three primary focal areas, the ecological effects of prescribed fire in upland oak ecosystems in the central Appalachians, the role of forest change and species composition on ecosystem processes, and the impacts of invasive plants on the alteration of ecosystem dynamics. She has published over 65 refereed journal articles, and has been funded by the USDA-NRI, NSF, and USDA-USDI Joint Fire Science Program.

P67. Fire Induced Tree Mortality following Lightning Ignition in the Ouachita Mountains, AR

Author(s): Virginia McDaniel, US Forest Service
Jason Milks, The Nature Conservancy
Rebecca J. Finzer, US Forest Service
James M. Guldin, US Forest Service
Ayn J. Shlisky, US Forest Service

In 2011, the southern United States experienced a severe drought that resulted in extreme fire danger. In the Ouachita Mountains of southwestern Arkansas, more lightning ignited fires occurred than in any year in recorded history. Most fires were contained with full suppression, but one lightning ignition occurred in a remote and rugged area of the Ouachita National Forest. In the interest of restoring the natural role of fire to the landscape and, fire fighter and public safety, mangers decided to let it burn within a designated containment area of 1500 acres (i.e. manage the fire with less than full suppression). Given the hot, dry conditions there was concern that overstory tree mortality may exceed the Forests' acceptable limit. We installed thirty-four randomly placed 10 meter radius circular plots directly after the fire. We identified and measured all trees over one inch DBH and determined scorch height and percent, char height, and live or dead status. Since we were unable to collect pre-burn data, we used immediate post-burn conditions to reconstruct the pre-burn composition of live versus dead trees. Plots were re-measured one-year post-burn to determine mortality and changes in tree composition. Preliminary analysis suggests that mortality was greater on south facing slopes than north facing slopes and increased with slope percent. However, overstory mortality one-year post-burn did not exceed the Forests' acceptable overstory tree mortality limit. The long term outlook for the southern region includes hotter and drier conditions. This study will provide resource managers with information on fire caused tree mortality during droughts in the southeastern US and will allow more informed decisions to be made on the necessity of suppressing wildfires versus allowing them to play their natural role under these environmental conditions.

Bio: I received my undergraduate and graduate degrees in Biology from Grinnell College (Grinnell, IA; 1996) and Western Kentucky University (Bowling Green, KY; 2000) respectively. I began my career with the federal government with the National Park Service (NPS) at Mammoth Cave NP, KY. I continued with NPS for 10 years doing botany, fire ecology and invasive plant work across the US. In 2006, I joined the research branch of the Forest Service in Asheville, NC. I currently work in Hot Springs, AR with the Ecology and Management of Southern Pines Unit and continue to doing research on fire ecology, fuels management, and botany.

SPECIAL SESSION 1 (Tuesday 1:30-3:40 and Thursday 1:10-2:50)

Behavior and Ecological Consequences of Smoldering Fires

While much work has been conducted to understand aboveground fire behavior and its ecological effects, smoldering combustion in ground fuels has received less attention, yet fires in these fuels have important ecological consequences. Smoldering fires may burn for long durations and their rate and direction of spread, intensity, and fuel consumption can be difficult to characterize and predict. Smoldering fuels include accumulations of organic matter as primarily duff and peat. Duff occurs in many coniferous ecosystems where fire frequency and decomposition lag; many once fire-prone ecosystems that have suffered fire exclusion now have substantial accumulations of these fuels. Smoldering fuels also occur as deep organic soil horizons, such as peat, that have accumulated under long durations of hydric conditions. The accumulation of fuel in long unburned forests presents an ecological hazard when long duration heating damages roots and/or basal cambium of overstory trees. And where prolonged drought conditions occur as a result of large climate cycles, such as La Nina/El Nino patterns, or as a potential result of climate change, the exposure of wetland ecosystems to possible fire may have unintended consequences. The research presented in this session will add insight into how smoldering fires ignite and spread and what ecological effects occur as a result.

Presentations within this Special Session include:

1. Ecological consequences of smoldering fires in long-unburned longleaf pine forests, Morgan Varner
2. Kalimantan Peat Fires: Field and Laboratory Observations, Kevin Ryan
3. Linking smoldering experiments with simple cellular automata models of smoldering combustion, Jon Yearsley
4. Modeling Smoldering Combustion of Forest Duff, Christopher Dugaw
5. Linking Smoldering Duff Temperatures to Surface Thermal Infrared Images, Jing Cao
6. Moisture Limits of organic soil ground fires in North Carolina pocosin and pond pine fuel types, James Reardon
7. Pile Age and Fire Effects, Clint Wright
8. Determinants of smoldering in cypress swamps: landscape factors and implications for carbon release, Adam Watts
9. The role of pine cones as a vector for duff ignition, Jesse Kreye
10. An approach to bridge the gap between combustion and geoscience: emissions and dynamics from smoldering fires, Rory Hadden

SS1.1 Ecological consequences of smoldering fires in long-unburned longleaf pine forests

Author(s): J. Morgan Varner, Department of Forestry, Mississippi State University

The exclusion of fire results in drastic changes for many formerly fire-prone ecosystems. In southeastern USA landscapes where longleaf pine dominated, these effects include changes in community structure, composition, and alteration of ecosystem processes. Reintroduction of fire into fire-excluded remnants causes a cascade of effects that stem from the absence of fire. With fire excluded, senesced litter accumulates and generates a well-developed forest floor. Here, I present results from a decade of reintroduction fires in long-unburned pinelands. Ignition of these forest floor fuels in restoration fires results in long-duration smoldering combustion that heats underlying mineral soil, stresses and kills trees, and leads to dramatic plant community shifts. Smoldering of these fuels can occur for days following ignition, with strong spatial patterns in consumption. I'll present lab and field observations of ignition, spread, and extinction of these fires, underscoring how poor current understanding is. I'll discuss the effects of these fires on underlying soil heating and subsequent tree stress and mortality of large trees. In addition to these areas where we have developed a greater understanding of the mechanisms that generate the patterns, I'll speculate on plant community and ecosystem effects and where future research should be focused in longleaf pine and other fire-excluded coniferous ecosystems.

Bio: Dr. J. Morgan Varner is Assistant Professor of Forestry at Mississippi State University, where he teaches and leads research focused on the ecology and management of fire and forests. He received a Ph.D. from the University of Florida and holds a M.S. from Auburn University and a B.S. from the University of Idaho. He has been active in prescribed fire councils in the US, co-founding and chairing the Northern California Prescribed Fire Council and serving on the Steering Committee of the Mississippi Prescribed Fire Council. He serves on the Editorial Boards of the journals Forest Science and Fire Ecology.

SS1.2 Kalimantan Peat Fires: Field and Laboratory Observations

Author(s): Kevin Ryan, USFS, Missoula Fire Sciences Laboratory
Mark A. Cochrane, South Dakota State University
Nasrul Ischan, Kalimantan Forests and Climate Partnership
James Reardon, Missoula Fire Sciences Laboratory
Bob Yokelson, University of Montana,
Grahame Applegate, Kalimantan Forests and Climate Partnership

Tropical peat swamp forests (PSF) are areas of high biodiversity and carbon storage. Rapidly expanding populations and major global markets for tropical forest products are causing major changes in land use. Almost without exception fire is used following logging for the conversion of PSF, resulting in large greenhouse gas (GHG) emissions. Major questions remain as to whether agricultural burning and draining of peatlands is consistent with sustainable agriculture. Major questions also remain as to the extent to which fires, either intentionally set to circumvent logging restrictions or escaped from agricultural burning, are destroying rainforests and degrading peatlands. A collaborative study has been developed between US, Australian, and Indonesian institutions to better understand fire's role in GHG emissions in Southeast Asian peatlands. The initial pilot area is the Kalimantan Forests and Climate Partnership (KFCP) which is actively involved in a REDD+ demonstration activity including peatland hydrology and peat monitoring and estimating changing carbon stocks in the Ex-Mega Rice Project area in Central Kalimantan. Logging, burning, and drainage canals have resulted in conversion of millions of hectares of Kalimantan PSF to croplands or degraded peatlands. Loss of peatlands due to heterotrophic respiration (decomposition) and consumption by fire are major sources of GHG. Shrinkage (compaction) due to drying and consolidation, subsequent to canal building, also leads to changes in peat depth, but does not directly contribute to GHG. Major uncertainties as to the relative contribution of decomposition, combustion, and compaction to peat subsidence currently confound attempts to characterize the importance of tropical peatlands to the global carbon cycle. A field campaign in KFCP resulted in the observation of on-going peat fires and collection of peat samples. Peat samples from drained and selectively logged forests that experienced a range of peat degradation levels from unburned to multiple burns were collected. Laboratory studies currently underway are examining bulk density; C:N; S content; mineral content; atmospheric emissions of CO2, trace gases and particles; and moisture-combustion relationships. This paper presents an overview of the social and biophysical problems faced in understanding peatland fire dynamics and the potential for peatland rehabilitation. Initial results will be presented as well as plans for an extensive 2013 field study.

Bio: Kevin C. Ryan, Research Forester – Specialization: Fire Ecology of upland and peatland forests, woodlands and rangelands, kryan@fs.fed.us Kevin is a Fire Scientist-Ecologist at the Missoula Fire Sciences Laboratory. He holds BS and MS degrees from Colorado State University and a PhD from the University of Montana. Since coming to the Lab in1979 he has been a Research Forester, Project Leader, and Program Manager. From 2004 to 2008 he was the Program Manager for the Fire Lab's LANDFIRE Program. After 14 years in research management he returned to full time research in 2009. In his 39 year career in forest fire research Kevin has studied fuels, fire behavior, and fire effects aimed at understanding combustion and heat transfer processes affecting fire severity, the effects of fire injury on the physiology, growth, and insect ecology of trees, and the role and use of fire in wetlands. Results of his R&D inform fuel treatment and restoration guidelines and landscape-level ecological modeling. Kevin has authored over 100 journal articles and technical reports. He is currently serves as the Secretary for the International Association of Wildland Fire's Board of Directors.

SS1.3 Linking smouldering experiments with simple cellular automata models of smouldering combustion

Author(s): Jon Yearsley, University College Dublin
Claire Belcher, University of Exeter
Rory Hadden, University of Western Ontario
Nuria Prat, University College Dublin
Guillermo Rein, Imperial College London

Smouldering combustion is of particular relevance in ecosystems with carbon rich soils, such as peatlands. Topical examples of large peatland fires are the tropical peatland fires in Indonesia and the Russian peatland fires near Moscow, which have caused habitat loss and large-scale greenhouse gas emissions. Our understanding of this form of combustion will advance, and our ability to manage these wildfires improve, by combining data with theoretical models of smouldering combustion. Currently the modelling of smouldering fires has received poor attention, but recent experimental data are characterising the behaviour of smouldering peat fire across a range of environmental conditions (e.g. moisture and O2 availability). We present the development of several simple, cellular automata models that are based upon spatial modelling of infectious diseases. We assimilate experimental data on smouldering peat fires into the model and relate the data to the parameters of the model. The results can be used to characterise the large scale behaviour of a smouldering fire. We present applications to small-scale issues of peat combustion as a function of moisture, and to large-scale questions of smouldering wildfires during the past 350 million years of Earth history.

Bio: Jon Yearsley leads an Ecological Modelling Research Group at University College Dublin, Ireland. The research of the group centres on ecological invasions and dispersal, with an emphasis on the effect of environmental heterogeneity upon the invasion process. The work combines data with theoretical models and uses systems of: smouldering fire in peatlands, larval dispersal of marine invertebrates, dispersal of small mammals and establishment of biocontrol species.
http://www.ucd.ie/bioenvsci/ourstaff/academic/yearsleyjon

SS1.4 Modeling Smoldering Combustion of Forest Duff

Author(s): Christopher Dugaw, Humboldt State University

Despite the ecological importance and managment consequences of smoldering combustion there is a dearth of models that address smoldering ground fires. I will present a model that builds on classic models of duff ignition by Frandsen (1997) and heat and moisture transport (Campbell 1995). The model tracks combustion state, temperature, and moisture across a two dimensional landscape. Thus, the model may predict spatial patterns of consumption. I will also summarize recent efforts to paramaterize and validate model using labatory and field burns in long-unburned longleaf pine forests in northern Florida.

Bio: Chris Dugaw is an Associate Professor of Mathematics at Humboldt State University. His research focuses on mathematical and statistical modelling in ecology and wildland fire.

SS1.5 Linking Smoldering Duff Temperatures to Surface Thermal Infrared Images

Author(s): Jing Cao, Humboldt State University

Thermal infrared imaging is a valuable tool for evaluating surface fires, but its utility in smoldering ground fires has not been thoroughly examined. We studied the relationship between duff temperatures measured by thermocouples and surface temperature measured by thermal infrared. Time series analysis was conducted to test the ability to predict duff temperature using surface temperature. Specifically, the duff temperature response variable was fitted to ARIMA models with time trend and surface temperature as independent variables. In 34 of the 37 time series analyzed, a model with temperature as a regressor was the best model (i.e. had the lowest AICc value). Although results suggest a connection between duff and surface temperatures, surface thermal infrared images are not sufficient to predict duff temperatures.

Bio: Jing Cao is a graduate student in the Department of Mathematics in Humboldt State University. She received bachelor's degrees in Mathematics and Economics from Humboldt State University. She is interested in applying mathematical models and statistical methods to ecological data.

SS1.6 Moisture Limits of organic soil ground fires in North Carolina pocosin and pond pine fuel types

Author(s): James Reardon, RMRS Fire Science Lab

Gary Curcio, IPA Fire Environment Specialist, La Grange North Carolina

In the southeastern United States, pocosin, and pond pine fuel types on organic soils and mineral soils with thick organic horizons are of special concern to fire managers. These fuel types are widespread on the coastal plain and they are characterized by high surface fuel loadings and sites with reported organic soil depths of up to 5 m. Fires in these fuel types are a challenge to fire managers because ignitions can quickly "blow up", making fire runs that defy control efforts and ground fires that can remain active for months after the surface fire has been suppressed.

Due to the lack of a suitable method to evaluate ground fire risk, fire managers rely heavily on broad guidelines developed from local knowledge and past experience. Previous research has also demonstrated that commonly used indices of fire danger which are solely based on meteorological inputs are inconsistent indictors of smoldering potential. These indices do not incorporate hydrological processes that are an important part of soil moisture dynamics on these organic soil sites.

Laboratory burning was conducted to delineate the moisture limits of sustained smoldering in these soils. A model was developed to estimate the smoldering potential (ESP) over a range of moisture contents. The ESP model is a simple model requiring only soil moisture and soil mineral content as inputs. It is representative of common situations where lightning strikes, the passage of flaming combustion fronts or burning embers are short term ignition events, after which sustained smoldering and soil consumption are dependent on soil moisture content and soil characteristics.

Our current research has focused on improving this laboratory based model of the smoldering moisture limits and the field testing of this model using prescribed burns conducted in North Carolina. The results from prescribed burning are consistent with the results of our laboratory burning. These burns were conducted on a range of sites and demonstrate that this model has wide applicability.

Bio: I am currently a Forester/Ecologist with the RMRS Fire Science Lab. My worked has focused on soil heating, soil moisture measurements and smoldering combustion of organic soils.

SS1.7 Pile Age and Fire Effects

Author(s): Clinton S. Wright, U.S. Forest Service
Alexander M. Evans, Forest Guild
Karen A. Haubensak, Northern Arizona University

Many thousands of piles are burned each year in the West to dispose of thinning and harvesting slash and reduce the risk of severe wildfires. Burning piles is safer than broadcast burning and is thought to cause less damage to the environment than a severe wildfire. The nature and magnitude of pile burning impacts is relatively unstudied, however, so we still need to know more about burning piles to protect our natural resources. To examine how time since piling and season of burning influence fire effects we built 50 slash piles each near Naches, WA on the Okanogan-Wenatchee NF and on the north side of Santa Clara Canyon on the Santa Clara Pueblo north of Santa Fe, NM. Half of the piles were built in the fall of 2011 and half were built in the spring of 2012; a portion of the inventory of piles will be burned during the spring and fall burning seasons for 2.5 years following pile construction. We are monitoring how burning piles of different ages in different seasons affects below and above ground heat fluxes during burning, fuel consumption, charcoal formation, soil chemistry, canopy damage, and vegetation recovery to quantify the overall impacts of pile burning on forest resources. Initial analyses indicate that impacts are concentrated beneath the central portion of burning piles. Temperatures in excess of 370 degrees C were recorded at the soil surface beneath the pile centers. The belowground heat pulse declined

substantially with depth; temparatures less than 80 degrees C were recorded 5 cm beneath the pile centers. Fuel consumption is generally quite high, but a considerable amount of residual charcoal is left on site following pile burning. Assessments of the short-term effects of pile burning on ground vegetation coverage and composition and soil chemistry are pending further sampling.
Bio: Clint Wright is a Research Forester with the U.S. Forest Service, Pacific Wildland Fire Sciences Laboratory in Seattle, WA. He studies fuel measurement and characterization and fire effects in forest and rangeland ecosystems nationwide.

SS1.8 Determinants of smoldering in cypress swamps: landscape factors and implications for carbon release

Author(s): Adam Watts, University of Florida
Leda N. Kobziar, Associate Professor, University of Florida

Wildfires during severe droughts can produce smoldering combustion in the organically-derived peat or muck soils found in swamps, peatlands, and other wetland ecosystems. Normally inundated, these soils can store large amounts of carbon and release it over extended periods when smoldering combustion is initiated and leads to ground fires in these soils. Aside from substantial human and societal costs, the combustion of soils high in organic matter can potentially cause a number of ecological effects. There is a need to better understand factors that contribute to the extent of smoldering combustion, yet the amount of research in these systems tends to be limited for a number of reasons. I studied soil-moisture effects on smoldering combustion in the organic soil of isolated cypress swamps, using the low-relief landscape of Big Cypress National Preserve (Florida, USA) as a model system. In a lab study, soil moisture content near the surface (upper 10 cm) did not predict vertical depth of soil combustion; however, mass loss of organic carbon from soil profiles was negatively related. Spatial variation in soil moisture was also examined as a predictor of potential soil combustion. A weak but positive relationship exists between distance from swamp edges and upper-layer soil moisture, indicating that some moisture effect on smoldering may be present toward the centers of larger swamp patches. Conservative estimates of soil organic content in cypress peats (approximately 41% by mass, compared to a figure of 50% sometimes used in similar studies) indicate substantial potential for soil carbon loss (over 4 kg m^2) from wildfires in cypress swamps. Finally, I provide some recommendations for future efforts to study ground fires in these regionally important ecosystems.

Bio: Adam Watts has studied ecological restoration, fire ecology, and landscape ecology in Florida ecosystems. He also has worked with unmanned aircraft as remote sensing tools for natural resource applications. A native of Mississippi and a former Peace Corps agroforestry volunteer, Adam completed his Ph.D. at the University of Florida in 2012 and specialized in the fire ecology of wetland landscapes. He is currently a postdoctoral research ecologist with the Fire Lab in UF’s School of Forest Resources and Conservation.

SS1.9 The role of pine cones as a vector for duff ignition

Author(s): Jesse Kreye, Mississippi State University

While fire behavior and ecological effects of flaming combustion has been given considerable attention, our understanding of smoldering combustion is still much lacking. The ecological effects of smoldering fires have been documented, however their ignition and subsequent behavior is relatively unclear. We conducted laboratory burning experiments to evaluate the role of pine cones as an ignition vector in forest floor fuels collected from long-unburned longleaf pine forests of the southeastern USA. Ignition of duff (Oa and Oe horizons) was influenced by the mass of litter (Oi horizons) above it, however the presence of a longleaf pine cone was the primary vector of duff ignition. Long duration heating of cones on the forest floor may be a critical element in the spatial variability of duff consumption during fires in long-unburned pine ecosystems.

Bio: Presenter: Jesse Kreye Department of Forestry Mississippi State University

SS1.10 An approach to bridge the gap between combustion and geoscience: emissions and dynamics from smoldering fires

Author(s): Rory Hadden, University of Western Ontario

Smouldering of peat lands leads to the largest fires on earth. It is estimated that these fires release emissions equivalent to 15% of man-made carbon emissions annually as well as resulting in significant habitat loss. Peat fires are common in tropical regions during the dry season (e.g., recurrent haze events in South East Asia) and smouldering megafires are common occurrences in the boreal region (e.g. Russia 2010 and 2012). Recently smouldering fires have been reported in Arctic regions. Most lab-based work on peat smouldering to date has featured discrete measurement of burning behaviour and emissions without a clear linkage between the two. Our work seeks to begin bridging this gap between combustion science and geoscience. We use a lab-based experimental approach to investigate the reaction chemistry, combustion dynamics and the emissions from small-scale experiments. Smouldering was initiated in samples of sphagnum moss peat weighing 80 g by a radiant heat flux. The duration and intensity of this heat flux was varied (7.5–40 kW/m2 for 1 min, 10 min and total experimental duration) as well as the composition and velocity of the air flow through the sample (9–35% [O2], 0–300 mm/s). Smoulder dynamics were extracted using mass loss and temperature measurements across the range of burning conditions. Real-time measurements of CO and CO2 production were recorded to allow the emissions to be linked to the smoulder dynamics. During peat smouldering, a three-step reaction framework with two distinct mass loss regimes was consistently observed. These two regimes are dominated by peat pyrolysis and char oxidation reactions respectively. Regime I is therefore controlled by the ignition intensity with mass loss rates ranging from 5–9.5 g/s/m2 over the heat fluxes studied. Regime II is more strongly affected by the air flow with average mass loss rate increasing from 1–1.5 g/s/m2 over the air flows studied. Air flow had no significant effect on Regime I. Detailed characterization of the CO and CO2 emissions from experiments was undertaken and the evolution of the emissions during the experiment duration is linked to the reaction chemistry. Yields of CO and CO2 increase with increasing heat flux during peat pyrolysis and are on the order of 0.1 and 0.6 kg/g respectively. During char oxidation, the yields increase to 0.5 and 2 kg/kg respectively. These yields differ significantly from those of flaming fires (0.05 and <1 kg/kg respectively). The measurement of CO and CO2 emissions and linking these to the smoulder dynamics could allow lab-scale results to be scaled up to real peat fire events.

Bio: Rory M. Hadden, University of Western Ontario Guillermo Rein, Imperial College London

Special Session 2 (Tuesday 1:30-3:40)
Fire Culture: Using the Humanities to Revive the Ancient Link of People and Prescribed Fire

For many millennia, people have used fire to shape landscapes, and conversely, fire has shaped us. This inextricable link continues today. The "hard science," operational and technical aspects of wildland fire management (especially fire suppression, but also, to some degree, the human dimensions arena) have grown by leaps-and-bounds in the last few decades, and must continue to grow as the land becomes increasingly fragmented, society changes and wildfire hazards increase. But despite these major advances, we have largely missed something in our human dimensions efforts. Over the last century, at least in the United States, the role of the humanities in wildland fire has been given short shrift. We encourage the global wildland fire community to increase its efforts to make people aware of the ways in which people and fire are inescapably linked through art, literature and history. After our lead speaker introduces the session, our next presenter will discuss her work reconnecting people and prescribed fire by restoring Douglas fir and ponderosa pine grasslands while enhancing public safety at Banff National Park, in the corridor through which people first brought fire into the continent. Following this path through time and place, we will then focus on the existing and emerging artwork, literature, history and concepts connecting people and fire in southeastern North America, and hopefully, we will inspire the global wildland fire community to further revive the unique role of the humanities and fire in other parts of the world.

Presentations within this Special Session include:
1. Fire-Ties: Ritual and Ceremony as Ways to Link People and Conserve Fire Landscapes, Johnny Stowe
2. Is a Picture Worth a Thousand Fires?, Philip Juras
3. Lightning Fire, Anthropogenic Fire, and Other Factors Maintain Southern Grasslands, Reed Noss
4. Fire in the Longleaf Ecosystem - Using the Popular Media for Opposing Outcomes, Rhett Johnson
5. By the light of the fire: The history of humans and fire in the Canadian Rockies, Jane Park

SS2.1 Fire-Ties: Ritual and Ceremony as Ways to Link People and Conserve Fire Landscapes

Author(s): Johnny Stowe, SC Department of Natural Resources

Ritual and ceremony are vital to societies. Today, though, we seem to think of them primarily in historical contexts, rather than as contemporary necessities. Or else we fail to think much about them at all, even as we conduct or witness them. The degree of "civilization" in societies appears in many cases to be negatively correlated with the importance of certain rituals and ceremonies, with more "developed" societies attaching less importance to these ancient, "primitive," cultural practices. Considering the many harmful and accelerating impacts of "developed" societies on the natural world, I propose that those of us who have abandoned these practices review, and in some cases revive, certain of the rituals and ceremonies that once bound us to the land, and to one another. I draw on the work of human ecologists, historians, philosophers, land managers, local folks and other critical thinkers, as well as on personal experience, to show how ritual and ceremony can be linked with prescribed fire to help us maintain reverence for and conserve fire-dependent landscapes, while binding people of shared vision and values together.

Bio: Johnny Stowe is forester, wildlife biologist and heritage preserve manager for the South Carolina Department of Natural Resources, and a private landowner who has burned the southern landscape for 45 years. His interests include the link between humans and fire, especially the heritage of fire in Southeastern North America. His presentation will focus on the role of ritual and ceremony to bind people and fire with place and time. He will also serve as lead speaker and moderate the session.

SS2.2 Is a Picture Worth a Thousand Fires?

Author(s): Philip Juras

Nineteenth century portrayals of America's frontier landscapes by artists such as Thomas Moran and Albert Bierstadt played an important role in the development of an American conservation ethic. Their dramatic portrayals of untamed nature and the awesome forces that shaped it fed an American conceptualization of wilderness that has influenced several decades of private land use and public policy. Wildland fire, though certainly one of the powerful forces that shaped the landscapes these artists depicted, was generally missing from their perspectives. Coming mainly from long-settled, fire-suppressed parts of the East, it is likely that these artists neither understood the role of fire in the environment nor spent enough time in fire dependent environments to observe it firsthand. Had they, the conservation discussions sparked by their paintings might have been different. In presenting my own artwork, informed by history, natural sciences, and volunteer time spent on controlled burns in my home state of Georgia, I offer a southeastern view of the effects those artists missed. These paintings depict active fires as well as the Eden-like landscapes they produce in a few of the intact, fire managed, old growth longleaf pine environments that remain in the lower Southeastern coastal plain. To experience these remnants is to journey back to the vast fire dependent landscape inhabited and managed by Native Americans for thousands of years--landscapes that would later be the first impression of the new world for European and African arrivals. Painting provides a tangible way to bring that long ago experience into today's discussion of land management and the future of prescribed fire.

Bio: Juras holds a BFA (1990) and a MLA (1997) from the University of Georgia, works independently as an artist, and necessarily volunteers on prescribed burns. His paintings present a well-informed view of the southeast before European settlement. His recent museum exhibitions portrayed the southern wilderness as William Bartram experienced it in the 1770s. The accompanying exhibition book, published by the Telfair Museum and distributed by the University of Georgia Press, earned Juras the 2012 Georgia Author of the Year Award (Specialty Book category) from the Georgia Writers Association.

SS2.3 Lightning Fire, Anthropogenic Fire, and Other Factors Maintain Southern Grasslands

Author(s): Reed Noss, University of Central Florida

Grasslands of various types, including savannas and woodlands dominated by longleaf and other pines, were a prominent part of the southeastern United States ("the South") prior to European settlement. Fossil evidence suggests that savanna and related vegetation dominated the lower portion of the South (the Coastal Plain) for much of the last 20 million years, with intermittent connection along a Gulf Coastal Corridor to similar vegetation in the Great Plains, southwestern U.S., and Mexico. Various factors maintained grassland vegetation across the South, including climate change (i.e., occasional periods of dry climate, which favored grasses over trees), lightning-ignited fire, mega-herbivores, hydrology, and extreme soils and aspects. With the arrival of humans from Asia more than 14,000 years ago, mega-herbivores declined and fire probably became even more important in the maintenance of southern grasslands. The role of humans in creating and maintaining grasslands has been controversial, with some anthropologists and popular writers claiming that humans created virtually all grasslands in the South and elsewhere. Evidence suggests, however, that climatic conditions and lightning ignitions in the Coastal Plain were more than adequate to maintain grassland prior to widespread alteration of the landscape by EuroAmericans. To the north, lightning remained prevalent, but burning by Native Americans and by later white settlers probably was more important for maintaining grassland in some areas. Some southern grasslands, especially on extreme substrates, are capable of persisting for long periods of time with little or no fire. The importance of fire and other factors in maintaining grasslands in the South apparently varied among grassland types, but also within particular types over time.

Bio: Reed F. Noss is Provost's Distinguished Research Professor at the University of Central Florida.

SS2.4 Fire in the Longleaf Ecosystem - Using the Popular Media for Opposing Outcomes

Author(s): Rhett Johnsonn, Longleaf Alliance

The long term decline in longleaf pine ecosystems has been exacerbated by the decreasing presence of fire in the landscape. Lightning ignited fires were a constant occurrence in the region prior to human presence. Early native populations continued to use fire to maintain the open grassy conditions common to fire driven longleaf forests, as did early settlers. During the early century, foresters and others, fearing the destructive nature of fire in the forest, mounted a sophisticated and successful campaign to eliminate fire in the forests of the South. Employing the media available at the time, forestry organizations collaborated to aggressively combat the rural South's practice of using frequent fires to manage the forest. The "Dixie Crusaders"crisscrossed the region with then state-of-the-art movies shown on the sides of barns and country stores, extolling the dangers of fire in the forest. Later efforts employed lurid posters to link the exclusion of fire to larger national interests. The nearly fatal blow came with the popularization of Smokey Bear, who became one of the most recognized advertising personalities in the country. The Disney movie, Bambi, placed forest fires in the pantheon of childhood terrors for a generation of young Americans. As science began to reveal the value of fire in the forest, the effort to change public opinion struggled to keep pace. In the mid- 1990's, The Longleaf Alliance, was formed to advocate the restoration and conservation of longleaf ecosystems. In that effort, classroom materials, including posters, drawings, and lesson plans were created for use in elementary and middle schools to educate about the ecosystem's cultural, historical, and ecological significance. Collaboration with a popular public television series, Discovering Alabama, led to several episodes explaining the beneficial role of fire in longleaf forests. Later, the producer of that series authored a novel aimed at middle and high schoolers entitled Longleaf, which explained the relationship between fire and the longleaf ecosystem. The Alliance has taken those materials to scores of classrooms and schools across the region, reaching thousands of children. A recent book, Longleaf: Far as the Eye Can See, written and photographed by Bill Finch, John Hall, Rhett Johnson and Beth Maynor Young, is now available.

Bio: Rhett Johnson is the co-founder and President of The Longleaf Alliance. He is the Director Emeritus of Auburn University's teaching and research forest, the Solon Dixon Forestry Center, and was on the School of Forestry and Wildlife Sciences faculty for 27 years before retiring in 2006. He has held leadership positions in several professional forestry and wildlife organizations and was inducted into the Alabama Forestry Hall of Fame in 2008. Rhett is a Society of American Foresters Fellow and was named the Alabama Forest Conservationist of the Year in 2006 and the Wildlife Conservationist of the Year in 1996.

SS2.5 By the light of the fire: The history of humans and fire in the Canadian Rockies

Author(s): Jane Park, Banff National Park

Since the last ice age, the Canadian Rockies have been the home to indigenous people who have burned the land to shape it to their needs. In the Ya Ha Tinda ranch area, referred to as the 'mountain prairie' by the Stoney First Nations, fire was used to rejuvenate grasslands in order to draw game into more easily hunted valley bottoms. As European settlement encroached on the landscape, a period of fire suppression further influenced the land by creating large tracts of forest and a significant decrease in overall ecosystem health and biodiversity. By 1983, Park managers in Banff National Park began to recognize the need to restore long term ecosystem processes such as fire, and a new era of prescribed fire began. While the linkages between humans and fire in this region of North America are strong, modern society has created a disconnect between people and the ecosystems within which they live. In order to implement a professional and extensive prescribed fire program, Parks Canada has developed an innovative and creative communications program to engage and inform the public. While fire scientists and operational land managers plan the fire, communications specialists are now using art, music, video and interactive programming to encourage understanding of and appreciation for the prescribed fire program. I will discuss the intimate link between people and fire in the Canadian Rockies, and describe the creative products and programs that Parks Canada is using to further that connection in modern times.

Bio: Jane Park is currently working as the Fire and Vegetation Management Specialist in Banff National Park, Alberta, Canada. She obtained her B. Sc. in Environmental Science at the University of Winnipeg and M.Sc in Forest Ecology at the University of Calgary. In the past 10 years working for Parks Canada, she has worked in fire and resource management throughout the Canadian Rockies in Banff, Kootenay and Yoho National Parks. She has also worked in the Canadian Arctic in Vuntut National Park and Northwest Coast in Gwaii Haanas National Park where she worked very closely with local First Nations on conservation issues.

Special Session 3: Standing on the Shoulders of A Giant: A Tribute to George M. Byram (1909-1996) - Pioneering Scientist in Forest Fire Research (Wednesday 1:20 – 4:10)

Presentations in this Special Session include:
1. Honoring Those That Have Come Before Us: Introductory Remarks to the Special Session, Marty Alexander
2. George Byram: Father of Wildland Fire Science, Dale D. Wade
3. George Emerges from the Smoke -- The Early Years of G.M. Byram, Darold E. Ward
4. George M. Byram -- A Forest Fire Research Pioneer: Perspectives of a Colleague, Ralph M. Nelson, Jr.
5. Learning from Those Who Came Before Us: Closing Remarks to the Special Session, Martin E. Alexander

SS3.1 Honoring and Learning From Those That Have Come Before Us: Introductory and Closing Remarks to the George M. Byram Special Session Tribute

Author(s): Marty Alexander, University of Alberta

Paying homage to those individuals who have been leaders in their own particular aspect of the wildland fire field represents a noble activity.

I can think of no researcher during the formative years of wildland fire research that has had more of a lasting impact scientifically, on both fire research and fire management, than George Byram. He spent most of his U.S. Forest Service career in Asheville, North Carolina, moving to the Southern Forest Fire Laboratory (SFFL) in Macon, Georgia in 1964. Several of his lasting contributions to wildland fire science bear his name and rightly so. For example, Byram's fireline intensity, the Keetch-Byram Drought Index, Byram's wind profiles, and Byram's Convection Number, just to name a few.

The vast majority of us never had the good fortune to personally meet George Byram or hear him speak at a conference. However, there are several folks still around that got to know him on both a professional and a personal basis including Ralph Nelson, Jr., Dale Wade and Darold Ward who have now all retired from full-time work following distinguished careers in forest fire research with the U.S. Forest Service. These gentlemen worked with George Byram at the SFFL from 1964 until Byram's retirement in 1968. In preparing their presentations for this conference, they have sought out others, most notably Wayne Adkins and Bob Martin, for additional perspectives on George Byram, but whom unfortunately will not be able to physically attend this conference.

Byram's publications would certainly constitute one form of his endearing legacy in wildland fire science, but what was George Byram, the man, like? The intent of this special session is to provide conference attendees with a unique opportunity to learn more about one of the true pioneers in forest fire research.

It is my humble opinion that we have much to learn from fire research pioneers like George Byram as we look to the future. They faced a multitude of unknowns as they forged ahead. Their work, both published and unpublished, can serve as a source of inspiration to the present generation of fire researchers and those that follow. Some of the stories shared by their colleagues provide insights into their personalities that we all would do well to try and emulate.

Bio: Dr. Marty Alexander retired in November 2010 as a Senior Fire Behavior Research Officer with the Canadian Forest Service stationed at the Northern Forestry Centre in Edmonton, Alberta, following 34.5 years of public service. He is currently an Adjunct Professor at the University of Alberta. His research and technology transfer efforts have focused on practical applications of wildland fire behavior knowledge, including firefighter safety. In 2003, he received the IAWF's Wildland Fire Safety Award. Marty is presently a member of the IAWF Board of Directors and serves on the Editorial Advisory Board for the International Journal of Wildland Fire.

SS3.2 George Byram: Father of Wildland Fire Science

Author(s): Dale Wade

George Byram's accomplishments read like the tree of fire science knowledge. The breadth, depth, importance and durability of his contributions lead to the inescapable conclusion that George Byram is truly The Father of Fire Science. His sole professional agenda was to create knowledge. He excelled at providing solutions to practical problems faced by fire managers and time after time demonstrated his ability to describe the basic physical concepts and formulate the mathematical relationships that governed the problem in question. In so doing, Byram provided true solutions that have withstood the test of time rather than band-aids that, although increasing understanding and providing a remedy, merely treat symptoms and require continual patches. Unlike many of today's fire researchers who spend their careers behind a computer developing models that, however useful, are not real, George recognized the difference between vicarious research and field based experience; he would thus first observe the problem to be solved in a variety of natural settings to gain an understanding of its intricacies before developing a line of attack. He was one of those rare individuals without an ego or self-promoting agenda who freely shared his wisdom, insights and analytical skills carrying on a brisk international correspondence with both novices and distinguished colleagues. The result was the scientific foundation for a wide range of fire management disciplines including combustion chemistry, fire physics, fire behavior, and fire danger rating that current fire researchers continue to cite as they extend Byram's pioneering work. George provided the definitions for concepts such as fire intensity, combustion rate, moisture time lag and available fuel. Using his knowledge of thermal dynamics and fluid mechanics coupled with his analytical abilities, he developed the physical theory and mathematical equations for fire propagation and energy release that tie fire behavior to atmospheric conditions. He described the transition from 2-dimensional to 3-dimensional (blow-up) fires, described adverse wind profiles and quantified erratic fire behavior such as fire whirls. He derived the scaling laws that allow the behavior of prototype field fires to be reproduced on a smaller scale in the laboratory for more detailed study. He improved fire detection, contributed to suppression manning guides and red flag and watch-out criteria for fireline personnel. He was instrumental in development of the index that relates relative drought to fire management, was involved in examination of the thermal properties of fuels, the spotting process, ignition probability, basic fuel concepts including the effect of moisture, and mechanisms of fire damage including lethal plant temperature thresholds. He was a srong advocate of wildland fire documentation. In short, George was involved either directly or indirectly in virtually every aspect of fire science except perhaps heavy equipment design, air quality and economics. His uncanny ability to clearly elucidate and define seemingly intractable problems, then compartmentalize and prioritize the various components into a comprehensive, orderly plan of attack as exemplified by his 1960 problem analysis for the Southern Forest Fire Laboratory which laid out a visionary plan of action that current fire researchers would do well to familiarize themselves with. His chapters in Fire Control and Use first published in 1959 and updated in 1973 continue to be a 'must read' for every budding fire scientist.

My talk briefly describes the magnitude, difficulty and complexity of the mid 1930's Southeastern fire situation that Byram transferred into and highlights some of George's contributions to fire management and fire effects. I share a few memories and anecdotes that provide insight into the personality traits that defined this pioneer of fire research and endeared him to those of us who had the distinct privilege and pleasure to cross paths with the Father of Fire Science.

Bio: Dale D. Wade, 1957-2002:inc straw-boss southern California Hot Shot Crew; Forester, Fire Team Leader & Project Leader SRS USFS. Currently consultant: The Rx Fire Doctor, LLC Professional Registration: Certified

Prescribed Burner in Alabama, Florida, Georgia, and South Carolina Honors and Awards (Since 2000) 2000. Member of Team that received a USDA Secretary's Group Honor Award for Excellence. 2000. US Forest Service "National "Excellence in Prescribed Fire" award. 2002. Joint Fire Sciences Board award 2002 US Forest Service Southern Research Station "Superior Science" award. 2003 Association for Fire Ecology: 1st recipient of the Herbert Stoddard Sr. Lifetime Achievement award. 2005 Fellow, Society of American Foresters 2006 Clay Co NC Soil & Water Conservation District "Educator of the Year" Award Publications: 140+

SS3.3 The Early Years of George M. Byram

Author(s): Darold Ward, Enviropyronics, LLC

George M. Byram was an outstanding fire researcher having published many papers regarding the fundamentals of fire. His understanding of fire began early on the Byram Ranch in Bear Valley located in Grant County, Oregon between Canyon City and Burns. He was born in Burns in 1909 one year after the Malheur National Forest (NF) was established by President Theodore Roosevelt. The Family cattle ranch was established by his grandfather who came to the area soon after gold was discovered along Canyon Creek in 1862. Fire was used frequently for maintaining quality grazing on the NF both by cattlemen and sheep men. The Malheur NF surrounds the ranch on three sides and one of the reasons given for establishing the Forest was to keep the sheep men and cattlemen apart. George was home-schooled on the ranch and it is reported that his mother had trouble challenging George with enough new books and materials. Soon after George became a teenager, the family moved to the Portland area where he attended public schools and the family operated a butcher shop with beef from the family ranch being sold there. Later, they moved to Whittier, CA where George got to know a person by the name of Richard Nixon. He returned to Portland receiving his B.S. degree in Physics from Reed College in 1932. He distinguished himself through his work at Reed College and was the 5th person to receive a degree from the new department working under Dr. A. A. Knowlton (Knowlton Hall is the name of the present physics building at Reed College). Dr. Knowlton had a keen interest in atmospheric physics and taught weather observation personnel during WWII. George was an athlete at Reed College specializing in gymnastics and wrestling. His senior project examined a method for measuring smoke plume visibility and he spent four years from 1932 to 1936 working in the Forest Service on smoke visibility studies before going to graduate school at the University of California at Berkeley for a year. Probably through his early education and the many observations of fires and plumes from fires led to his interest in the interactions of the atmosphere with the development of blowup fires. During 1936, George and Elizabeth were married and shortly after their marriage traveled to Asheville, NC where he began working for the Southeastern Forest Experiment Station. His work in identifying smoke plumes and visibility research continued, but he became more and more interested in factors contributing to fire growth. There are many stories about home fire experiments and other interesting hobbies that George had with mushroom hunting and astronomy. His son gained a PhD from MIT and his daughter married a physicist and now lives on her mother's ranch in North Dakota. The speakers that follow will be discussing the intricacies and significance of George's work, his early years were important in cultivating the mind that discovered so many principles about fire that we use today in describing and quantifying fires of all types. Thank you, George!

Bio: Fire behavior and fire effects research in the Southeast from 1966 to 1980. Smoke management research in the PNW from 1980 to 1988 and Project Leader of smoke characterization at the Missoula Fire Laboratory until retirement in 2001. Worked at Goddard Space Flight Center with Enviropyronics from 2001 to present on special assignments.

SS3.4 George M. Byram -- A Forest Fire Research Pioneer: Perspectives of a Colleague

Author(s): Ralph Nelson, USDA

George Marsden Byram spent 36 years as a US Forest Service fire researcher, most of them with the Southeastern Forest Experiment Station in Asheville, NC. He was a gentleman in the eyes of those who knew him. He made important contributions in many research areas. I think all forest fire researchers have been influenced in some way by his work.

My talk begins and ends with reflections on the influence George Byram had on me personally and on others who either knew him or knew of his work.

George helped in the development of fire danger rating systems in the South. In 1940 he designed the Appalachian Fuel Moisture Scale for weighing basswood slats. He derived mathematical expressions for the Buildup Index and Burning Index used in the southern fire danger rating systems. In 1951 George used case studies of major wildfires to relate fire whirls and spotting to atmospheric turbulence and instability. In 1954 he suggested that the low-level jet wind profile is often associated with major wildfires. He contributed two chapters to the 1959 textbook on forest fire control and use. In Chapter 3 George described the combustion of forest fuels; Chapter 4 discussed how a normally behaving fire can suddenly increase its intensity, endangering firefighters. He developed an energy criterion for anticipating blowup and demonstrated its use. In the 1960s George's research concentrated on modeling fire whirls, mass fires, and fire spread. He presented experimental data demonstrating how horizontal jets and intermittent tongues of flame contribute to new fuel ignitions in wind-driven fires. During this time George also introduced the moisture timelag and completed the technical development of the Keetch-Byram Drought Index.

Three papers by George appeared in the early 1970s -- on fire whirls, testing his scaling laws for mass fires, and using pure heat sources in fire modeling. These papers were the final contributions from a distinguished researcher whose ability to effectively address relevant problems still leads the way for us today.

Bio: Ralph M. Nelson Jr. is a former Wood Technologist/Mechanical Engineer with USDA Forest Service Fire Research. He holds degrees from NC State College and the University of Washington. His research dealt with various aspects of wildland fire behavior and fuel moisture relationships. He retired in 2001 after 44 years of service and now lives with his wife Sally in Leland NC.

Special Session 4: (Wedneday 1:20 – 4:10 and Thursday 9:30 – 10:40 and 1:10- 2:50)
A data set for fire and smoke model development and evaluation--the RxCADRE project

An integrated, quality-assured fuels, atmospheric, fire behavior, fire mapping, smoke and fire effects data set is lacking for development and evaluation of fire and smoke models. To begin the acquisition of such a data set, a group of 20 scientists pooled their own operational in-kind resources and collaboratively collected fuels and fire data on prescribed fires in the southeastern United States in 2008 and 2011. This was called the Prescribed Fire and Combustion and Atmospheric Dynamics Research Experiment (RxCADRE). In 2012, the Joint Fire Science Program funded the improvement and continuation of the RxCADRE effort, focusing on integrated, fine and operational scale scientific measurements within 6 identified core fire scientific disciplines: 1) fuels, 2) meteorology, 3) surface fire behavior, 4) event-scale fire mapping, 5) smoke, and 6) fire effects. The project targeted critical data needs outlined by members of the fire modeling community. During the fall of 2012, the RxCADRE effort collected data on 6 rapidly and uniformly ignited replicated burn blocks (100m X 200m) and 3 operational scale fires (200-400 ha) at Eglin Air Force Base, Florida. A grass or grass/shrub fuelbed dominated 8 of the research blocks while one operational block was a managed southern pine forest.

This larger, more coordinated and robust RxCADRE research project with 90 scientists and technicians participating will provide a high quality, integrated fire data set for model testing and evaluation. This special session offers 15 presentations that cover a range of RxCADRE project topics including an overview of the project, data collection and preliminary results from each of the RxCADRE discipline areas, information on data management of large data sets, and insight into new scientific approaches towards a more quantitative understanding of fire behavior.

1. Prescribed fire Combustion and Atmospheric Dynamics Research Experiments Overview, John Hiers
2. Data management of the Prescribed Fire Combustion and Atmospheric Dynamics Research Experiment (Rx-CADRE) Bryce Nordgren
3. Ground Measurements of Fuel and Fuel Consumption from Experimental and Operational Prescribed Fires at Eglin Air Force Base, Florida, Roger Ottmar
4. Ground LiDAR fuel measurements of the Prescribed Fire Combustion and Atmospheric Dynamics Research Experiment (Rx-CADRE), Carl Seielstad
5. Relationships between pre-fire fuels, fire radiative energy, and post-fire ash, Andrew Hudak
6. Meteorological measurements during the Prescribed Fire Combustion and Atmospheric Dynamics Research Experiment (Rx-CADRE), Craig Clements
7. Integrating ground, airborne, and satellite measurements on prescribed fires, Matthew Dickinson
8. Ground Based Measurements of Energy Release and Air Flow in Experimental and Operational Prescribed Fires in Grass and Long Leaf Pine Woodlands, Bret Butler

9. RxCADRE: Fine scale spatially explicit fire measurements, Joseph O'Brien
10. Merging Unmanned Aircraft Collected Aerial Imagery to Map the 2012 Rx-CADRE Prescribed Burn Plots, Gregory Walker
11. Supporting RxCADRE Fire Measurements with Unmanned Aircraft Systems, Thomas Zajkowski
12. New scientific investments and approaches to fire behavior modeling, William (Ruddy) Mell
13. The RxCADRE project: Ground-based emission and plume dynamics measurements, Brian Potter
14. Aerial and Ground Measurements of Emissions from Prescribed and Laboratory Forest Burn, Brian Gullett
15. Airborne measurements of smoke chemical composition, plume rise, and smoke dispersion from operational prescribed fires in Florida, Shawn Urbanski

SS4.1 Precribed fire Combustion and Atmospheric Dynamics Research Experiments Overview

Author(s): John Hiers, Eglin AFB, AF Wildland Fire Center

An integrated, comprehensive, quality-assured data set has been identified as a critical need to development, validate, and evaluate next generation fire and smoke models. Unfortunately, existing data sets are limited in scope, hindering our ability to tackle fundamental fire science questions. To facilitate the acquisition of such integrated fire-atmospheric datasets, a group of over 20 scientists pooled their own operational in-kind resources and collaboratively instrumented and collected fire and fuels data on prescribed fires in the southeastern United States in 2008 and 2011. This effort was called the Prescribed Fire and Combustion and Atmospheric Dynamics Research Experiment (RxCADRE). In 2012, the Joint Fire Science Program funded the improvement and continuation of the RxCADRE effort, focusing on integrated, fine-scale and operational-scale scientific measurements within 6 identified core fire scientific disciplines including 1) fuels, 2) meteorology, 3) surface fire behavior, 4) event-scale fire mapping, 5) smoke, and 6) fire effects. The project targeted critical data needs as outlined by members of the fire modeling community. The RxCADRE effort collected integrated datasets on 15 burns over the three sampling years, ranging in scale from 1.5-1500 ha. In 2012, burns included a rapidly and uniformly ignited replicated burn blocks (100m X 200m) and 2 operational scale burn blocks (400 ha) during the fall of 2012 at Eglin Air Force Base, Florida. The major fuel type for the 2012 burn was grass, with a minor component of shrub, and one large block was dominated by a managed, southern pine forest.

RxCADRE will provide a high quality, integrated fire data set for model testing and evaluation. This introduction provides an overview of the project, setting the stage for twelve oral presentations that cover a range of RxCADRE project discipline areas, information on data management of large data sets, and insight into new scientific approaches towards a more quantitative understanding of fire behavior.

Bio: J. Kevin Hiers is currently Fire Management Officer at Eglin AFB as part of the Air Force Wildland Fire Center. Eglin AFB has one of the largest prescribed fire programs worldwide, annually burning >100,000 acres. As Fire Ecologist for the Jones Research Center from 2006-2008, he worked with numerous scientists to establish the RxCADRE project. He is dedicated to integrating fire science and management to advance our understanding of fire behavior, prescribed fire management, and fire effects. He received his M.S. in Ecology from the University of Georgia in 1998 and has published more than 30 scientific articles on fire ecology and management.

SS4.2 Data management of the Prescribed Fire Combustion and Atmospheric Dynamics Research Experiment (Rx-CADRE)

Author(s): Bryce Nordgren, USDA Forest Service

Large field experiments are necessary in order to collect information which can be used to evaluate and guide the development of wildland fire models. Technological development in the form of new instruments (such as terrestrial and airborne LIDAR) and new platforms (such as UAVs carrying video and still cameras) has increased the amount of detail which can be captured on any given experiment. This detail is reflected not only in a larger overall archive size, but in a larger number of files. This talk presents the method by which the RxCADRE project organizes it's project repository to facilitate the location of data by project members, as well as the preparation of metadata which will accompany the archive when it is transitioned to a permanent repository.

Bio: Bryce Nordgren is a physical scientist with the Fire, Fuels and Smoke program of the Rocky Mountain Research Station in Missoula, MT.

SS4.3 Ground Measurments of Fuel and Fuel Consumption from Experimental and Operational Prescribed Fires at Eglin Air Force Base, Florida

Author(s): Roger Ottmar, US Forest Service

Ground measurements of fuel loading and consumption collected for eight research burns conducted at Eglin Air Force Base (Florida) are presented. Prescribed fires were set on six 100 X 200 m replicate experimental blocks and two 400 hectare operational blocks. A grass/shrub fuelbed dominated most of the research blocks, although a portion of one 400 ha block also included managed southern pine forest with litter, grass, shrub, and woody fuel components. Twenty-five preburn and twenty-five postburn clip plots, 1 m2 each, were established at 20 m intervals around three sides of each small experimental block. Eight, 1 m2 preburn clip plots and 16, 1 m2 postburn clip plots were established at each of three highly instrumented plots (HIPs) located in each of the larger operational blocks. For both experimental and operational fires, all fuel material from the preburn and postburn clip plots was collected and separated into fuelbed components , oven dried, and weighed to determine preburn and postburn fuel loading. Consumption was calculated by subtracting average preburn loading from average postburn loading by fuelbed component for a block or HIP. Fuel moisture content samples were collected just prior to the burn for shrub (stems and leaves), grass, small and large woody material, litter and duff. The fuel loading, fuel moisture, and fuel consumption data will be useful to science disciplines studying fire behavior, wind flow, heat flux, smoke production, plume dynamics, smoke concentrations, and soil and vegetative effects. The data will also provide important input variables for evaluating fuels, fire behavior, smoke and fire effects models such as the Wildland Fire Dynamics Simulator (WFDS), FIRETEC, BehavePlus, Consume, the First Order Fire Effects Model (FOFEM), and BlueSky.

Bio: Roger Ottmar is a Research Forester, with the Fire and Environmental Research Applications Team, Pacific Wildland Fire Sciences Laboratory, Seattle, Washington. Roger leads efforts to develop: 1) a natural fuels photo series; 2) Consume, a model to predict fuel consumption and emission; and 3) the Fuel Characteristic Classification System to build and characterize fuelbeds for the United States and the world. He consults on the assessment of wildland firefighter exposure to smoke and leads the RxCADRE, individual researchers and research teams from across the United States that collaboratively instrument and collect data to characterize fire-atmospheric dynamics during prescribed fires.

SS4.4 Ground LiDAR fuel measurements of the Prescribed Fire Combustion and Atmospheric Dynamics Research Experiment (Rx-CADRE)

Author(s): Carl Seielstad, The University of Montana
Eric Rowell, The University of Montana

Empirical validation of fire and smoke models requires detailed characterization of fuel properties in undisturbed fuel beds, necessitating application of non-destructive sampling techniques and remote sensing approaches. Terrestrial laser scanning (TLS) appears to be a viable method for deriving spatially-explicit 3-D fuels data at fine grain, yet there is considerable uncertainty in how laser point clouds obtained from oblique perspectives relate to fuel parameters such as height, bulk density, and surface-area-to-volume ratio. In the RxCadre experiments, we use a TLS to scan many replicates of fuel beds of different sizes, e.g., 16m 2 , 400m 2 , and 2000m 2 . Destructively sampled plots located adjacent to the fuel beds are imaged in each scan in order to develop relationships between laser-derived metrics and fuel properties. These relationships are used to map fuels across burn units and to compare with independent measurements of fire propagation and flux. In this paper, we describe methods of data collection and processing, present preliminary results, and address the strengths and limitations of laser scanning for describing the amount, character, and spatial variability of fuels at a variety of scales.

Bio: Dr. Seielstad is a scientist for the National Center for Landscape Fire Analysis (NCLFA) in the College of Forestry and Conservation at UM. His work focuses on fundamental fuel measurements using laser scanning. Applications for his research include forest inventories, carbon assessments, fire behavior models, and fire effects. He received Bachelors and Masters Degrees from Dartmouth College (1990) and The University of Georgia (1994), respectively, and began working for the NCLFA after completing a Ph.D. in Forestry at The University of Montana (2003), where he studied fuel characteristics beneath tree canopies using airborne laser scanning.

SS4.5 Relationships between pre-fire fuels, fire radiative energy, and post-fire ash

Author(s): Andrew Hudak, USFS Rocky Mountain Research Station
Robert L. Kremens, Rochester Institute of Technology
Eva K. Strand, University of Idaho
Alistair M.S. Smith, University of Idaho
Matthew B. Dickinson, USFS Northern Research Station
Roger D. Ottmar, USFS Pacific Northwest Research Station
Kevin L. Satterberg, USFS Rocky Mountain Research Station

In this talk, we will describe relationships between ground and airborne remote sensing measurements of fuels, fire radiative energy, and fire effects during operational prescribed fire research burns (see other talks in this special session "A data set for fire and smoke model development and evaluation-the RxCADRE project"). Prescribed fire experiments were conducted in longleaf pine ecosystems that are frequently burned to maintain desirable structural and functional ecosystem traits. Fuel loads, fuel consumption, and vegetation cover were characterized in pre- and post-fire clip plots, and estimated from near-ground metrics derived from airborne LiDAR data. Percent cover of ash, char, exposed soil, and residual green and non-photosynthetic vegetation, were measured at points co-located with the fuel plots. Fire radiative energy (kJ m2) was derived from sequential thermal infrared images collected during the fires with the airborne thermal imaging system, calibrated to units of fire radiative power (W m2), and integrated over the duration of the fire. Our aim is to upscale the plot-level measures to the unit level based on statistical relationships with the airborne LiDAR and sequential thermal imagery. We will also look at trends between measurement data collected in 2008, 2011, and 2012 across different prescribed burn units with variable surface fuel loads. Preliminary analyses based on only the 2008 (n=5) prescribed burns revealed a mean surface fuel consumption of 3.5 (0.7) tonnes/ha and a mean percent consumption of 52.4 (8.9) %. There was a significant correlation between percent consumption of surface fuels and percent cover of white ash, an indicator of complete combustion. Furthermore, pre-fire percent cover of grasses, forbs, and other fine fuels was a good indicator of how well the fire spread, and combustion completeness. The frequently homogeneous surface fuel distributions on flat terrain make longleaf pine ecosystems advantageous for prescribed fire research and fit well with operational management objectives. Relationships between physically-based, quantitative measurements at multiple scales will help to advance fire science for the benefit of fire managers, as RxCADRE and other fire researchers demonstrate the utility of airborne remote sensing data to augment or partially replace time-consuming ground measurements.

Bio: Andrew Hudak is a Research Forester with the USDA Forest Service Rocky Mountain Research Station in Moscow, Idaho. Hudak conducts applied landscape-level research on forest and rangeland vegetation structure and function in relation to fire and other natural and anthropogenic disturbance agents using field and remotely sensed data. Hudak specializes in developing empirical models that relate field attributes to remotely sensed data, to provide improved maps for the benefit of land managers. Hudak received his BS degree from the University of Minnesota in 1990 and his PhD from the University of Colorado in 1999.

SS4.6 Meteorological measurements during the Prescribed Fire Combustion and Atmospheric Dynamics Research Experiment (Rx-CADRE)

Author(s): Craig Clements, San Jose State University

Meteorological measurements made during the experiment include tower based in-situ micrometeorological measurements, Doppler lidar and microwave profiler measurements of plume structure and plume dynamics. The in situ micrometeorology measurements include a suite of 3-d sonic anemometery, heat flux radiometers, fine-wire thermocouples, and fast-response barometry. In addition, the CSU-MAPS (California State University-Mobile Atmospheric Profiling System) includes a 32 m tower equipped with 6 levels of micrometeorological instrumentation. The CSU-MAPS will be deployed outside of the burn units for atmospheric profiling of winds and temperature. The Doppler lidar and microwave profiler are truck mounted and will be deployed approximately 1 km away from the burn units in order to capture plume height and fire-induced circulations. The scanning routines for the Doppler lidar will include both horizontal PPI (Plan Position Indicator) and vertical RHI (Range Height Indicator) for captuing the spatial structure of the plume and fire-induced winds.

Bio: Craig Clements is an Associate Professor of Meteorology at San Jose State University and specializes in micrometeorology and fire-atmospheric interactions.

SS4.7 Integrating ground, airborne, and satellite measurements on prescribed fires

Author(s): Matthew Dickinson, US Forest Service
Charles Ichoku, NASA
Ralph Kahn, NASA
Wilfrid Schroeder, NOAA
Jason Faulring, Rochester Institute of Technology
Robert Kremens, Rochester Institute of Technology
Joseph Mauceri, Rochester Institute of Technology
Andrew Hudak, US Forest Service

An ongoing challenge in fire measurement is obtaining quantitative and validated measurements of fire power (kW m2) and energy (kJ m2) across a range of spatial and temporal scales, measurements that will serve a range of purposes. Our approach to measurement has been hierarchical, where characterization of the fire heat budget at high temporal resolution and small spatial extent from instruments deployed near the ground is used to calibrate and evaluate measurements of fire radiation obtained at moderate temporal resolution (~5 min sampling rate) and extent (~500 ha) from sensors flown on manned aircraft. In turn, with airborne estimates of fire radiated power at the scale of burn units, we have obtained coincident satellite measurements of fire radiated power from MODIS and are working to evaluate those estimates. In an upcoming Rx-CADRE field campaign (November 2012), we are working to coordinate the timing of fires and ground and airborne measurements with optimal satellite image acquisition windows for not only the MODIS sensors, but also the VIIRS and MISR sensors. In this talk, we will describe ground, airborne, and satellite measurement and analysis methods and results and describe how measurements of fire heat release can be used to advance ecological and smoke science (see other talks in this special session "A data set for fire and smoke model development and evaluation-the RxCADRE project"). Moreover, unmanned Aerial Systems measurements will be incorporated into the November 2012 campaign and are expected to improve our ability to characterize fire heat budgets with measurements obtained at temporal and spatial resolutions intermediate to those just described. Rx-CADRE is focused on prescribed fires to allow for a high level of control on fire characteristics and to develop improved methods and understanding that can be applied to wildfires.

Bio: Matthew Dickinson is a Research Ecologist with the US Forest Service's Northern Research Station and is based in Delaware, Ohio. Matthew's core research interests lie in understanding and predicting the ecological effects of fire that arise relatively directly from fire behavior. In this effort, fire behavior measurements and predictions from models are used to determine exposures of flora and fauna to heat and gases which, in turn, cause injury and mortality. These direct ecological effects of fires serve as a starting point for understanding fire effects on ecosystems. Problems are cross-disciplinary, involving collaboration across disciplines.

SS4.8 Ground Based Measurements of Energy Release and Air Flow in Experimental and Operational Prescribed Fires in Grass and Long Leaf Pine Woodlands

Author(s): Bret Butler, US Forest Service, Rocky Mountain Research Station, Missoula Fire Sciences Laboratory
Dan Jimenez, US Forest Service, Rocky Mountain Research Station, Missoula Fire Sciences Laboratory

Improved and increased understanding of fire intensity and its influence on flora, fauna, and air quality is critical to effective fire management. This is especially true in areas like the Southeastern US where intense and extensive prescribed burning is utilized to manage long leaf pine and other ecosystems. In an effort to measure and characterize fire behavior fire scientists measured fire-atmospheric dynamics on prescribed fires in plots ranging from 2 to200 ha selected in southern pine grass and woodlands. Specifically here are addressed measurements of air temperature, radiant and convective heating and horizontal and vertical air flow in and around a spreading fire front. We also report wind direction and speed from a high density array of wind anemometers spaced around the burn area. Ultimately information and knowledge gained from this effort will be used to improve capabilities to predict fire intensity and its effects on fire dependent ecosystems.

Bio: Bret Butler is a Research Mechanical Engineer in the Fire Fuels and Smoke Research Work Unit at the US Forest Service Fire Sciences Laboratory in Missoula, MT. His research focuses primarily on experimental characterization of fundamental heat and combustion processes in wildland fire. Research applications include fire behavior modeling, links between fire behavior and its effects on flora, high resolution surface wind modeling, and firefighter safety. Bret holds a Ph.D. in Mechanical Engineering from Brigham Young University (1992).

SS4.9 RxCADRE: Fine scale spatially explicit fire measurements

Author(s): Joseph O'Brien, USDA Forest Service
Benjamin Hornsby, USDA Forest Service
Louise Loudermilk, USDA Forest Service

Spatially explicit fire behavior measurements are useful for linking fire behavior to fire effects, fuels to their combustion characteristics and understanding fire spread. Here we report the results spatially explicit fire behavior measurements taken during the 2012 RxCADRE campaign. We describe a measurement system capable of capturing nadir infrared thermographic data that can be readily combined with other spatial measurements of fuels or vegetation such as LiDAR and vegetation imagery. We were able to capture fire behavior in several 4 x 4 m plots at a resolution of < 1 cm2 in both the grassland and forest vegetation. Rates of spread ranged from 0.044 ms-2 to 0.62 ms-2 and the total energy released per plot varied from 120 to 290 kJ. We examined the spatial patterns in fire behavior and found two significant scales of spatial autocorrelation. Semivariogram analysis illustrated distinct spatial autocorrelation of energy release at the submeter level (< 1 m range), and also detected hotspots of similar energy release within plots. These hotspots are not necessarily spatially autocorrelated, but have similar energy release and represent discrete patches of higher intensity fire likely driven by both variation among patches of fuels and the impact of the neighboring patches on combustion. Examination of the patterns of fire behavior through the plots also indicated the importance of convective processes in driving fire spread, especially direct impingement of flames and short distance spotting in the immediate vicinity of the flaming front.

Bio: Joe O'Brien is a Research Ecologist for the USFS Southern Research Station Center for Forest Disturbance Science. His interests are in the fire ecology of subtropical and tropical fire dependent ecosystems, especially long needled pine forests of the SE US and Caribbean.

SS4.10 Merging Unmanned Aircraft Collected Aerial Imagery to Map the 2012 Rx-CADRE Prescribed Burn Plots

Author(s): Gregory Walker, University of Alaska Fairbanks
Bruce Cervensten, University of Alaska Fairbanks
Catherine Cahill, University of Alaska Fairbanks

The purpose of the Prescribed Fire Combustion Atmospheric Dynamics Research Experiments (Rx-CADRE) is to characterize fire dynamics and link those fire dynamics with fuel, first-order fire effects, and smoke transport. During the 2012 Rx-CADRE mission at Eglin AFB in Florida, small unmanned aircraft collected raw visible and long wave infrared imagery to observe fire dynamics and fuel changes during a series of prescribed burns.

This presentation describes both the raw imagery collected in low-flying mapping missions over the control plots as well as the data products in both the visible and long wave infrared bands that have been produced from the imagery collection missions. The imagery was collected with a small, 2.5 pound, unmanned aircraft flying at altitudes as low as 20 meters and captures the vegetation condition both prior to the burn as well as post burn. The imagery was collected with adequate overlap to enable Structure-From-Motion (SfM) algorithms to be incorporated to build a digital surface model and overlay the imagery collections on that model. This imagery was used to build georeferenced orthomosaics of the grassland and forested plots that were burned during the 2012 Rx-CADRE experiment. In addition, images gathered during the burns were georeferenced using GPS data, making it possible to overlay pre-burn, burn, and post-burn imagery.

SS4.11 Supporting RxCADRE Fire Measurements with Unmanned Aircraft Systems

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Matthew B. Dickinson, USFS Northern Research Station

The Prescribed Fire Combustion Atmospheric Dynamics Research Experiments project purpose (Rx-CADRE) is to characterize fire dynamics at burn unit scales (≈ 1 to 1000 ha) and link those fire dynamics with fuel, first-order fire effects, and smoke transport.

Unmanned Aircraft Systems (UAS) were first flown in the 2011 field campaign collecting infrared imagery over a large prescribed fire in longleaf pine savanna. These flights showed that UAS could support Rx-CADRE by successfully collect scientific data during the burn. Based on this success the UAS mission for the 2012 field campaign was expanded to include meteorological measurements, smoke sampling, and high resolution ortho-photography in addition to thermal infrared imagery during the prescribed burns.

During the 2012 field campaign up to four UAS operated by the University of Alaska Fairbanks, and Eglin 96th Test Wing were collecting data in conjunction with two manned aircraft. To ensure the safety of the aerial data collection Eglin Mission Safety Board reviewed the operational plan prior to the field campaign to ensure that it complied with Eglin range regulations. UAS operations were integrated into the incident command system enabling the UAS to collect measurements when and where the researchers needed them. This presentation will describe what information is available to researcher and how to access this data through the Data Set for Fuels, Fire Behavior, Smoke and Fire Effects Model Development and Evaluation portal.

Bio: Tom Zajkowski started working for the Remote Sensing Application Center in 1999 as a Remote Sensing Instructor and Aerial Photography Pilot. This includes communications equipment, sensors, and platforms. Tom serves as a liaison to NASA for the Wildfire Research Applications Project (WRAP). The WRAP has successfully flow large UAS including the Altair, and Ikhana over large wildfires from 2006-2008. In addition to the large UAS RSAC is working with the WO-FAM to develop standard operating procedures and contracting requirements for small to medium UAS for land management applications.

SS4.12 New scientific investments and approaches to fire behavior modeling

Author(s): William Mell, U.S. Forest Service, Pacific Wildland Fire Sciences Lab
Anthony Bova, Colorado State University

Over approximately the last decade a number of new fire behavior modeling approaches have been developed that make use of modern computational platforms and numerical methods. These models capture, in a comprehensive and explicit manner, the coupled physical processes driving fire behavior. They are able to provide predictions of the component physical processes such as convective and radiative heat fluxes and fire atmosphere coupling. This puts a greater demand on measurements taken in the field, or in the laboratory, to provide suitable validation data sets. For example, these models can predict local fireline heat fluxes, the progression and dimensions of the entire fire perimeter, and incorporate the influence of vegetation heterogeneity and discontinuity. This presentation will contain an overview of these models, the state of their validation, and their needs in terms of validation data sets from measurements in both the field and the laboratory.

Bio: William (Ruddy) Mell is a combustion engineer at the U.S. Forest Service Pacific Wildland Firesciences Lab. His expertise is in fire behavior modeling with an emphasis on collaboration with experimentalists. His current activities are focused on improving our understanding of wildland-urban interface fire behavior and the effectiveness of current risk assessment and mitigation approaches

S4.13 The RxCADRE project: Ground-based emission and plume dynamics measurements

Author(s): Brian Potter, USDA Forest Service
Gary Curcio, IPA Forest Environment Specialists
Tara Strand, Scion Research
Susan O'Neill, USDA Forest Service
Mark Moore, USDA Forest Service
Miriam Rorig, USDA Forest Service
Sim Larkin, USDA Forest Service
Candace Krull, USDA Forest Service

Ground based measurements of the smoke plume from the RxCADRE fires are essential if the project is to yield a comprehensive data set usable for evaluating smoke transport and dispersion models. During each of the 400 ha burns, particulate matter (PM 2.5), black carbon, and carbon monoxide sensors were stationed downwind of the burn units. Visible image cameras were deployed along the flank and downwind of the fires, taking time lapse images of the smoke plume. The smoke sensor data can be used, along with the fire behavior, consumption, and airborne smoke data to examine consumption, emissions, and transport models. The photographs of plume movement can be analyzed to determine the vertical and horizontal velocities of smoke puffs in the plume.

These velocities can then be compared with the in situ velocity measurements from the project, as well as used to evaluate airflow simulations in coupled fire-atmosphere models. They can also be used to evaluate the plume models used for smoke transport and dispersion.

Bio: Brian Potter is a research meteorologist, specializing in the study of plume dynamics and fire-atmosphere interactions on multiple scales. Susan O'Neill is an air quality engineer whose work addresses the modeling and measurement of smoke transport and dispersion from wildland fires. Both scientists are members of the AirFire Team, USDA Forest Service, based in Seattle, Washington.

SS4.14 Aerial and Ground Measurements of Emissions from Prescribed and Laboratory Forest Burns

Author(s): Brian Gullett, U.S. Environmental Protection Agency, Office of Research and Development, National Risk Management Research Laboratory
Johanna Aurell, National Research Council Post Doctoral Fellow to the U.S. Environmental Protection

Emissions from prescribed and laboratory forest burns were sampled and compared. Three field sampling campaigns of prescribed forest burns were conducted throughout the southeast U.S. A 4.3 m diameter, tethered, helium-filled aerostat was used to loft a 20 kg instrumented sampling platform and an all terrain vehicle was used to mount an identical ground-based sampling platform. Both platforms carried a sampling instrumentation package termed the "Flyer". The Flyers were equipped for continuous measurement of CO2, black carbon, and particle size distribution as well as batch sampling of PM2.5, volatile organic compounds (VOCs), and polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). At each prescribed burn location, combustible biomass was collected and transported to the U.S. EPA's 70 m3 open burn laboratory facility for testing and analysis. Emission factors for PM2.5, VOCs, PCDD/PCDF, and black carbon from both laboratory and field studies and aerial and ground-based emissions measurements will be presented and compared.

Bio: Johanna Aurell is a National Research Council Post doctoral Fellow to the U.S. Environmental Protection Agency. Her research interests include determination of emission factors from open and diffuse combustion sources. She received her PhD in Environmental Chemistry at Umea University, Sweden.

SS4.15 Airborne measurements of smoke chemical composition, plume rise, and smoke dispersion from operational prescribed fires in Florida

Author(s): Shawn Urbanski, US Forest Service

We will present airborne measurements of the smoke chemical composition, plume rise, and smoke dispersion of plumes from two large prescribed burns studied as part of the RxCADRE Project. Smoke emitted by fires is a complex mixture of particles and trace gases, the composition of which vary significantly with factors such as fire behavior, fuel type and fuel condition. In this presentation we focus on the smoke components carbon dioxide (CO2), methane (CH4), Carbon Monoxide (CO), and fine particulate matter (PM2.5). CO and CH4 are resistant to atmospheric removal by photochemical reactions and thus serve as potent transport tracers of fire emissions. We will our airborne measurements of CO and CH4 concentrations to evaluate the VSmoke and VSmoke-GIS smoke dispersion models. The CO and CH4 concentration fields will also be used in an inverse modeling exercise to map the footprint of the prescribed fire emission source strength. These fire emission footprints will provide a 'top-down' constraint on the magnitude and spatial and temporal variability of emissions from the prescribed fires. This 'top-down' constraint on fire emissions will be used to evaluate the widely used Fire Emissions Production Simulators (FEPS) model.

Bio: Shawn Urbanski is a research physical scientist with the US Forest Service. His research includes emissions quantification and field experiments for the validation of smoke emission/transport models. The emission quantification research involves laboratory and field experiments to characterize the composition of emissions from prescribed burning and wildfires and development of improved wildland fire emission inventory methods. The model validation research involves the deployment of airborne instrumentation to acquire measurements of plume rise, chemical composition, and dispersion of smoke from wildfires and prescribed burns. The field measurements provide datasets to quantitatively evaluate emission estimates, plume rise models and high-resolution smoke dispersion forecasting models.

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