Final Report (August 2008), JFSP AFP 2005-4, Task 1

Project Title/Number: **Geo-Spatial Wildland Management Tool–**
Cumulative Watershed Effects Extension / 05-4-1-16

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This final report details findings and deliverables of this Joint Fire Science Project. This report covers the development and application of GeoWEPP for cumulative watershed effects from June, 2006 until May, 2008. During this period, development and application of a complementary JFSP project (04-04-1-12) which officially ended in March, 2007, was also occurring. The 04 project focused on erosion and mitigation following wildfire, whereas this project was focused on the development of GIS tools for watershed modeling associated with fuel management activities. This report will focus on the activities and products that were specifically associated with fuel management, or were necessary for both wildfire and fuel management. Details of activities in the wildfire project can be found in the final report of JFSP project 04-04-1-12, submitted in March, 2007. More details on the background, methods, and tools of both wildfire and fuel management are presented on our continuously updated project web page (http://www.geog.buffalo.edu/~rensch/geowepp/). Although the project is now complete, the PIs continue to work on improving the tools and on providing support for the Forest Service, BLM, NRCS, and other agencies, universities, and private consultants on the applications of the products of this project.

A brief Synopsis and Summary of Findings

The 04 project converted the GeoWEPP technology from an ArcView application to an ArcGIS 9.1 application. This required a complete rewriting of the GeoWEPP code in Visual Basic. As part of this new interface, the PRISM rainfall database was incorporated to allow users to develop climate files for remote areas. When ESRI introduced ArcGIS 9.2, it was necessary to modify the software, as well as when version 9.3 was released. Small changes in the ESRI software often require modification of the GeoWEPP tools. Example applications for completing cumulative watershed effects analysis were developed and are distributed with the software. Documentation for GeoWEPP has been written and can be downloaded from the project webpage. This documentation describes not only how to run GeoWEPP, but how to import the user's own GIS data for an area of interest, and how to carry out a CWE analysis to reduce fuel loads through a spatial and temporal scheduling of management activities.

Databases were developed to complement the new GIS tools, and improvements were made within the WEPP model itself to better model steep forest watersheds with shallow soils. With WEPP, subsurface lateral flow modeling was improved, and the lateral flow that left the hillslope was added to the channel runoff. This dramatically improved GeoWEPP's ability to model runoff from forest watersheds. The perennial vegetation routines within the WEPP model were also improved to better describe forest and rangeland vegetation. New soils and vegetation databases were developed for the WEPP model to support these new features, and GeoWEPP, and these databases are not included with downloads of the WEPP model.

During the time of this project and beyond, validation of the GeoWEPP technology for forest conditions is ongoing. Six peer-reviewed papers were published and eleven papers were presented at professional meetings, one written report was prepared for Forest Service Region 1, and the GeoWEPP technology was

presented four times to NFS or other watershed managers.

Field Experiments

There were no field experiments funded in this project.

Deliverables Crosswalk Table

Proposed	Delivered	Status
Website		
- *Expand GeoWEPP model documentation*	GeoWEPP - The Geo-spatial interface for the Water Erosion Prediction Project. Available on the project web site: http://www.geog.buffalo.edu/~rensch/geowepp/	Complete
- *developed new case studies (BAER and CWE)*	Minkowski, Martin. 2007. Burned Area Emergency Response (BAER) Exercise for GeoWEPP (ArcGIS 9.x). Available on project web site. Minkowski, Martin. 2008. Cumulative Watershed Effects (CWE) Exercise for GeoWEPP (ArcGIS 9.x) URL: Available on project web site.	Complete
Software Development		
- *Modify GeoWEPP to be compatible with ArcGIS 9.2 and 9.3*	Available on project web site.	Complete
- *Expand the applicability of the tool for multiple or large watersheds.*	GeoWEPP can now be rerun for multiple sub watersheds without restarting the program.	Complete
Software Customization		
- *develop custom interfaces and menus within the latest version of ArcGIS for BAER analysis*	GeoWEPP for ArcGIS 9.x - BAER version (customized version for Burned Area Emergency Response Teams) Available by request from PIs.	Complete

- *Write tutorials for BAER and Cumulative Watershed Effects analysis*	Documents available on project web site.	
Data Input Tools		
- *develop import utilities to use data provided by wildland management agencies*	Documents available on project web site.	Complete
Database		
- *extended the WEPP database for soils and vegetation*	To better model vegetation for CWE analysis, altered WEPP to better model perennial vegetation, and developed files for perennial forests and rangelands. To incorporate lateral flow into runoff from forest hillslopes, altered WEPP science and interface codes, and developed a new set of soil files to include templates for lateral flow. Both sets of data are now distributed with the WEPP Windows model that complements GeoWEPP, and can be accessed online at: http://topsoil.nserl.purdue.edu/nserlweb/weppmain/	Complete
Training Workshops		
- *assist with wildland erosion workshops to present the most current GeoWEPP version, receive feedback , improve, or add new features.*	1. Feb 26-28, 2007. NRCS WEPP Workshop, Davis, CA. Attendance about 20 from NRCS and NFS. 2. Mar 13-16, 2007 BLM Workshop, Phoenix, AZ. Attendance, about 30. 3. April 15-18, 2008. BLM Workshop, Phoenix, AZ. Attendance, about 30. 4. May 6-7, 2008. WEPP workshop. Ogden, UT (Sponsored by USDA Forest Service Region 4).	Complete
	Even though JFSP funding will no longer be available, GeoWEPP workshops are currently planned for the Winter of 2008-09 sponsored by the EPA in Arkansas and the Spring of 2009 supported by the BLM in Arizona. There will likely be a Forest Service Region 1 workshop sometime in FY09.	In planning stage

User Assistance - consultations on applying GeoWEPP to forest conditions (most significant CWE analysis requests only)	1. Jul, 2006 Assist FS Region 4 Specialist to apply GeoWEPP to Aspen management. 2. Jul – Sep, 2006: Train visiting professor from Turkey on applying GeoWEPP to a mixed watershed in Turkey. 3. Aug, 2006, Assist FS Region 5 Specialist to apply GeoWEPP to Fuel Management analysis 4. Feb – Sep, 2007: Carryout out CWE analysis using GeoWEPP for Big Bear Lake Watershed in San Bernardino NF, funded by NFS. Provide comprehensive report. 5. Aug, 2007: Assist Prof. at Auburn Univ., Alabama, in understanding how to use WEPP technology for cumulative watershed analyses. 6. Aug-Sep, 2007: With support from Region 1, validate GeoWEPP for 4 subwatersheds, two of which received fuel treatments, in Tenderfoot Experimental Forest, Montana. Written report provided. 7. Nov., 2007: Assist Amy Dean and John Deulac, EDM Consultants, Ft. Collins, in setting up WEPP files to run GeoWEPP Watershed analysis for Roosevelt/Arapaho NF near Pike's Peak. 8. From March, 2008: Assist Gregg Teasdale, Army Corps of Engineers, Walla Walla, WA, in developing an approach to analyzing sources of sediment and mitigation options in the forested areas of the Clearwater and Lower Snake Basins, mainly in Idaho	Complete Ongoing
Support and Training of Graduate Students	From Sep, 2006: Support and mentor one PhD student at University at Buffalo programming GeoWEPP and supporting workshop activities. Sep – Dec, 2007: Training one MS Exchange student from the Univ. of Bologna, Italy, on the application of GeoWEPP technology to a mixed watershed in Italy. From Sep, 2006: Mentor one PhD student at WA State Univ currently working on enhancing GeoWEPP hydrologic and snow melt modeling capabilities From Jan, 2008: Assist Kahled Harden, PhD student in Austria, in general watershed modeling with GeoWEPP in the Palestinian territories.	Complete In Progress

Peer-reviewed Publications and Dissertations

1. Conroy, W. J., R. H. Hotchkiss and W. J. Elliot. 2006. A coupled upland-erosion and instream hydrodynamic-sediment transport model for evaluating sediment transport in forested watersheds. *Trans of the ASBE* 49(6):1-10.
2. Crabtree, B. E. 2007. Variable source area hydrology modeling with the Water Erosion Prediction Project (WEPP) Model. MS Thesis, Univ. of Idaho, Moscow
3. Elliot, W. J. 2006. Predicting watershed impacts of forest fuel management with WEPP technology. Proceedings of the 8th Federal Interagency Sedimentation Conference. Reston, VA: USGS. 8 p.
4. Elliot, W. J., I. S. Miller and B. Glaza. 2007. Erosion risks in selected watersheds for the 2005 School Fire located near Pomeroy, Washington on predominately ash-cap soils. IN. Page-Dumroese, D., R. Miller, J. Mital, P. McDaniel, and D. Miller, (tech. eds.). Volcanic-Ash-Derived Forest Soils of the Inland Northwest: Properties and Implications for Management and Restoration. 9-12 November 2005, Coeur d'Alene, ID.
5. Renschler, C.S., and D.C. Flanagan. 2008. Site-Specific Decision-Making Based on GPS RTK Survey and Six Alternative Elevation Data Sources: Soil Erosion Prediction. *Transactions of the ASABE* 51(2): 413-424.
6. Zhang, J. X., K. T. Chang, and J. Q. Wu. 2008. Effects of DEM resolution and source on soil erosion modelling: a case study using the WEPP model. *International Journal of Geographic Information Science* 22: 925–942.

Presentations

1. Zhang, J. X., J. Q. Wu, W. J. Elliot, S. Dun, and K. Chang. 2006. Effects of DEM resolution on forest hydrologic and erosion prediction using WEPP. Paper No. 062179. Presented at the 2006 ASABE Annual International Meeting, 9-12 July, 2006, Portland, OR. 15 p — Complete
2. Elliot, W. J. 2006. WEPP (as modified) R1 validation study. Presented to the Northern Region Soil and Water Workshop. 20 Nov., 2006. Missoula, MT.
3. Elliot, W. J., P. R. Robichaud and B. D. Glaza 2006. Cumulative Watershed Effects. Presented at the Region 1 Soil Science Meeting, Missoula, MT. 9 January.

4. Elliot, W. J. 2007. Predicting Background and Risk-based Sedimentation for Forest Watershed TMDLs Presented at the Fourth Conference on Watershed Management to Meet Water Quality Standards and TMDLS. San Antonio, TX, 10-13 March, 2007. St. Joseph, MI: American Soc. Of Ag and Bio. Engrs. 8 p
5. Elliot, W. J. and I. S. Miller. 2007. A forest watershed analysis using GeoWEPP technology. Presented at the 2007-2008 ASAE PNW Annual Meeting. 14 Sept., Moscow, ID. St. Joseph, MI: ASAE.
6. October 2, 2007, Adopting ICWater for Postfire Sediment Transport following wildfire. Missoula, MT.
7. Renschler, C.S. 2007. Integrated Natural Resources Management is Integrated Disaster Management: Developing a Watershed Community Resilience Index. Symposium "Katrina Disaster and Sustainable Coastal Development: An Integrated Perspective and the Role of Land and Water Sciences" ASA-CSSA-SSSA International Annual Meetings 2007, New Orleans, LA.
8. Renschler, C.S. 2008. Integrated Extreme Events Management: Burned Area Emergency Response and Cumulative Watershed Effects Analysis with GeoWEPP. US Department of Agriculture-Agricultural Research Service Southwest Watershed Research Center. Tucson, AZ.
9. Elliot, W. J., P. R. Robichaud, S. Lewis and C. Busskohl. 2007. Erosion following wildfire: Prediction, mitigation and monitoring. Presented at the Fall Meeting of the Inland Empire Chapter of the Soil and Water Conservation Soc of America. 19 October, Dayton, WA.
10. Elliot, B., and C. Renschler. 2008. Using GeoWEPP to support burned area emergency rehabilitiation. Presented at a Special Session on Burned Area Emergency Response at the Conference on Fire in the Southwest: Integrating Fire into the Management of Changing Ecosystems. 28-31 January, 2008. Tucson, AZ. Davis, CA: Assoc. of Fire Ecology.
11. Elliot, W. J. 2008. The challenge of developing TMDLs for forest watersheds. Presented at the 4th Biennial Tahoe Basin Science Conference, 17-19 March. Incline Village, NV.