MODELING ALTERNATIVE FIRE RESPONSE POLICIES:

PROOF-OF-CONCEPT AND PRELIMINARY RESULTS

Karin L. Riley [1], Matthew P. Thompson [1], and Joe Scott [2]

[1] *Rocky Mountain Research Station, US Forest Service, Missoula, Montana*

[2] *Pyrologix, LLC, Missoula, Montana*

THE NEED TO EXPAND THE FOOTPRINT OF MANAGED FIRE

- Increasingly recognized by land managers

- Reasons
  - Ecological benefits
    - Widely recognized since the 1972 Leopold Report
    - Evidence has continued to mount since then
  - Reduce hazard
    - On average, 18 firefighters killed annually during the past decade

Black-backed woodpecker (*Picoides arcticus*)

THE NEED TO EXPAND THE FOOTPRINT OF MANAGED FIRE

- Challenges: a system of perverse incentives
  - Managers tend to face retribution if a fire damages homes or infrastructure
  - However, they tend to be rewarded for aggressively fighting fires
  - Pay is often linked to fighting fire

"Old Faithful Lodge during firestorm", 1988

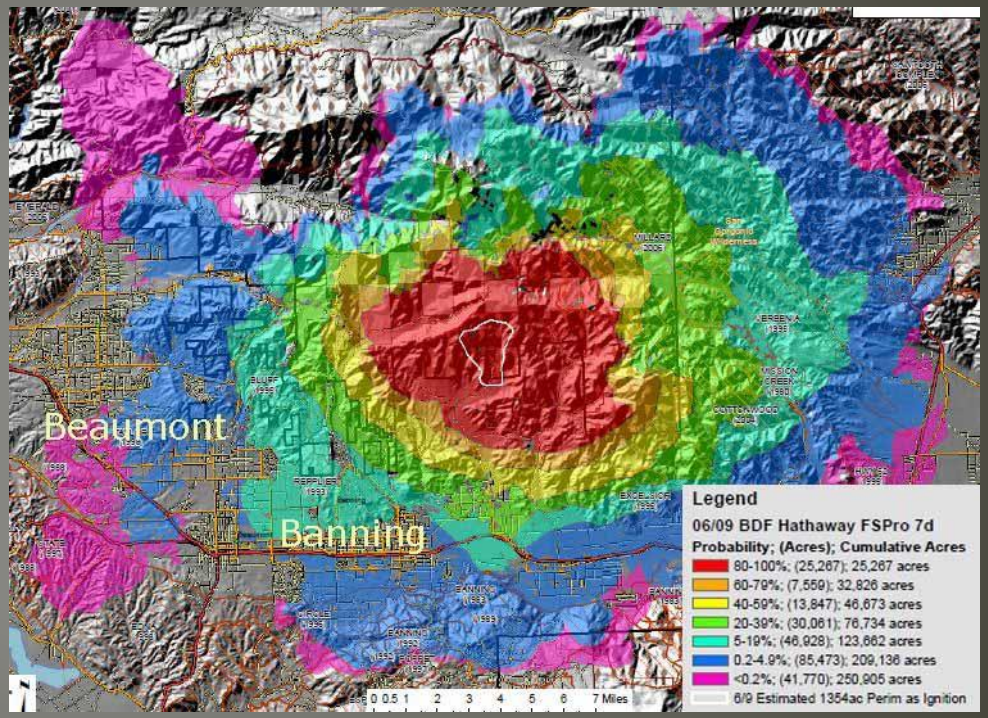
THE NEED TO EXPAND THE FOOTPRINT OF MANAGED FIRE

- Currently, spatial fire planning is now being integrated into:
  - landscape assessment and planning efforts
  - Land and Resource Management Plans (many National Forests are entering Forest Plan revision process)

- Current fire simulation models and risk assessment methods make this possible

THE ROLE OF FIRE MODELING AND RISK ASSESSMENT

- Fire modeling and risk assessment can help with some of the challenges
  - Identify probability that fire will affect values at risk
    - Benefit
    - Loss
  - Can be used during incidents
  - Starting to apply it also in a pre-fire planning context



During incidents (FSPro) → firefighting tactics

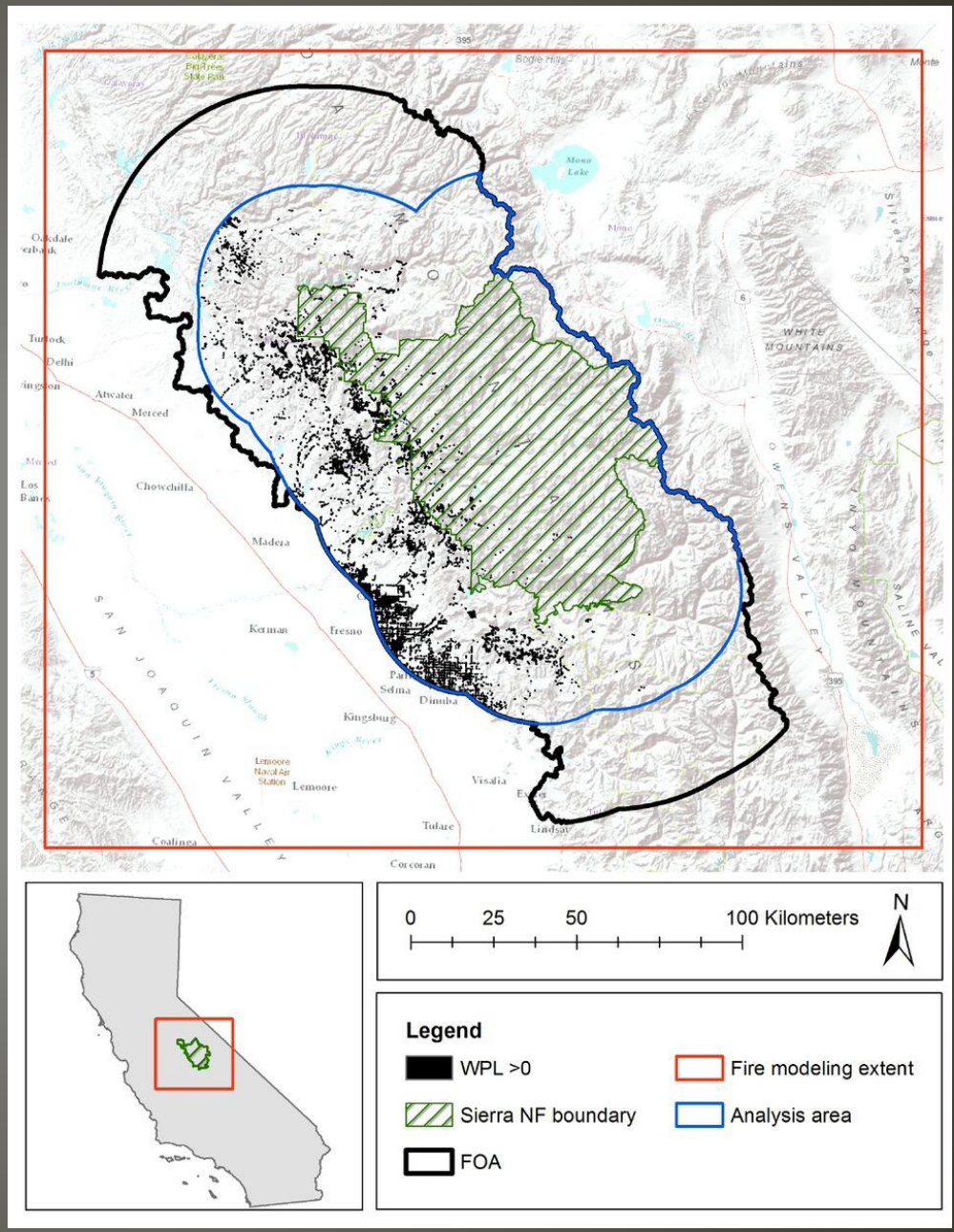
FIRE MODELING AND RISK ASSESSMENT

- The type of work on the previous slide is relatively mature

- *Critical gap is ability to understand and project how alternative response policies/strategies would lead to different outcomes on the landscape*

STUDY DESIGN

- Case study landscape: Sierra National Forest
  - Part of broader Southern Sierra Risk Assessment
  - Well-studied area
    - fuel treatment opportunities and backlog (North et al)
    - fuel treatment opportunities (Scott et al.)
    - spatial response planning (Thompson et al.)
  - "Excellent vision, leadership, and engagement from fire and fuel managers in the Region", who remain engaged collaborators



STUDY DESIGN: FIRE SIMULATION APPROACH = FSIM

INPUTS

Spatial Fuels Data (Static Condition: LandFire)

Fire Weather: Time Series Analysis

Large Fire Occurrence (Historical Records)

Fire Behavior (Spread Rate, Fireline Intensity)

Large Fire Ignition

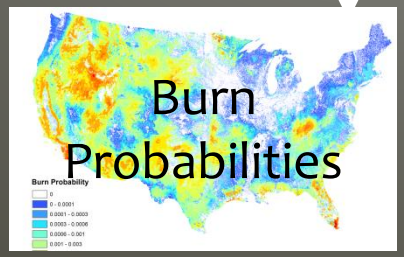
MODEL COMPONENTS

Fire Growth Model (Minimum Travel Time Algorithm)

Fire Suppression

OUTPUTS

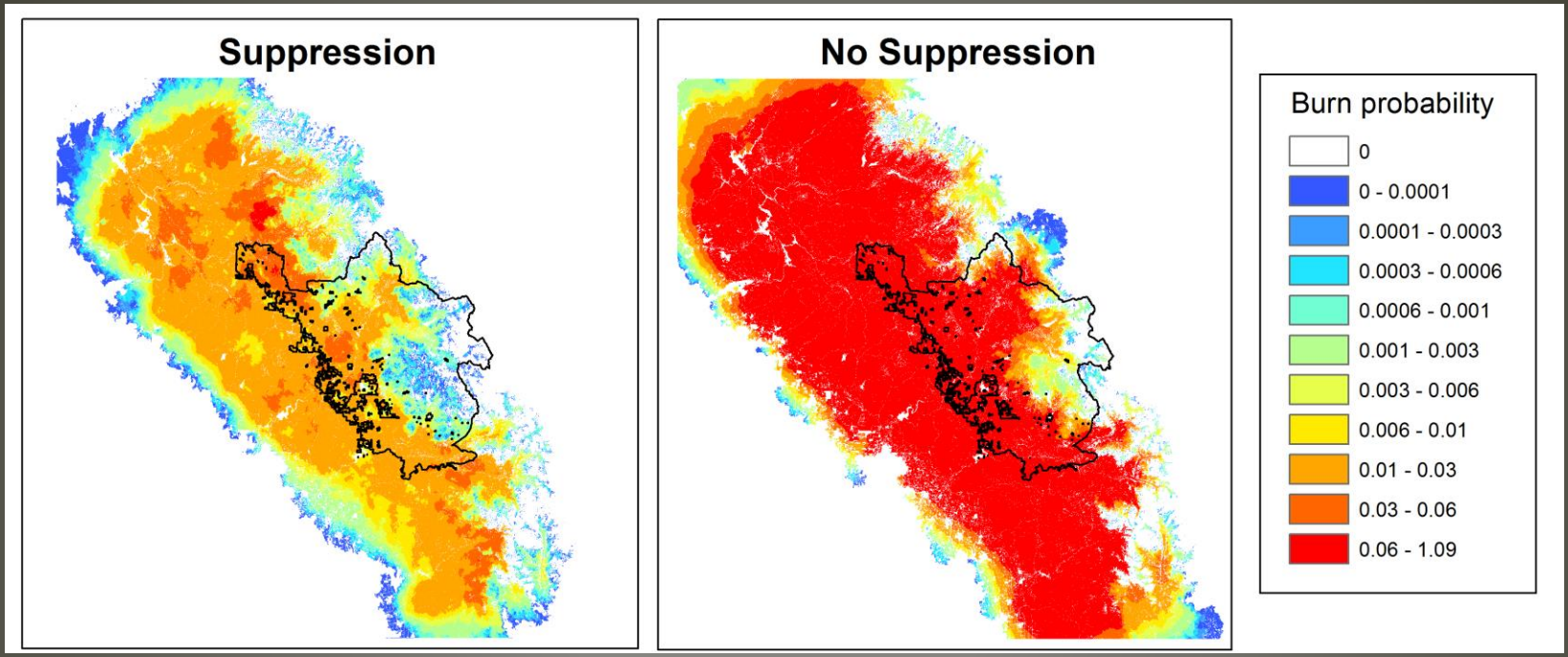
Fire Sizes, Dates, Durations, Locations



Intensity probabilities

Fire Perimeters

PRELIMINARY RESULTS

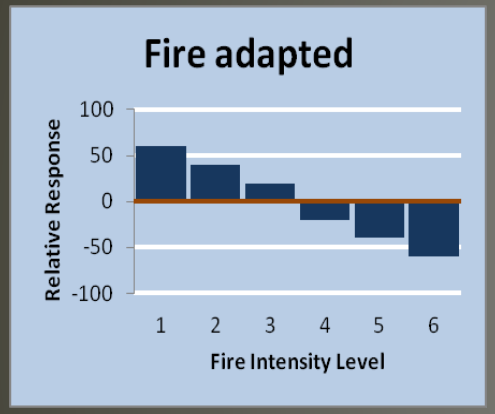


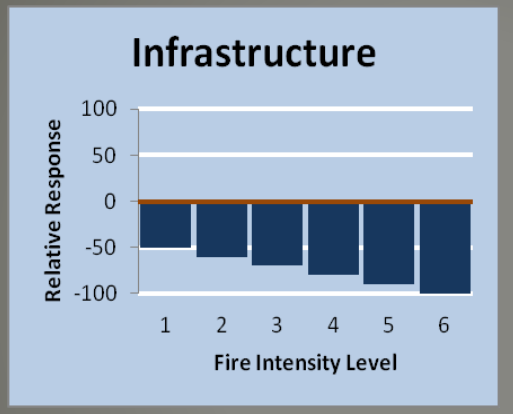
- *Lower burn probability*
- *Shorter duration (median 4 vs. 30 days)*
- *Smaller (median 104 vs. 14,960 acres)*

Full suppression | **Managed fires** | **No suppression**

WHERE FIRE IS A BENEFIT, OR LOSS

- Conditional Net Value Change = the change in Highly Valued Resources expected if the pixel burns

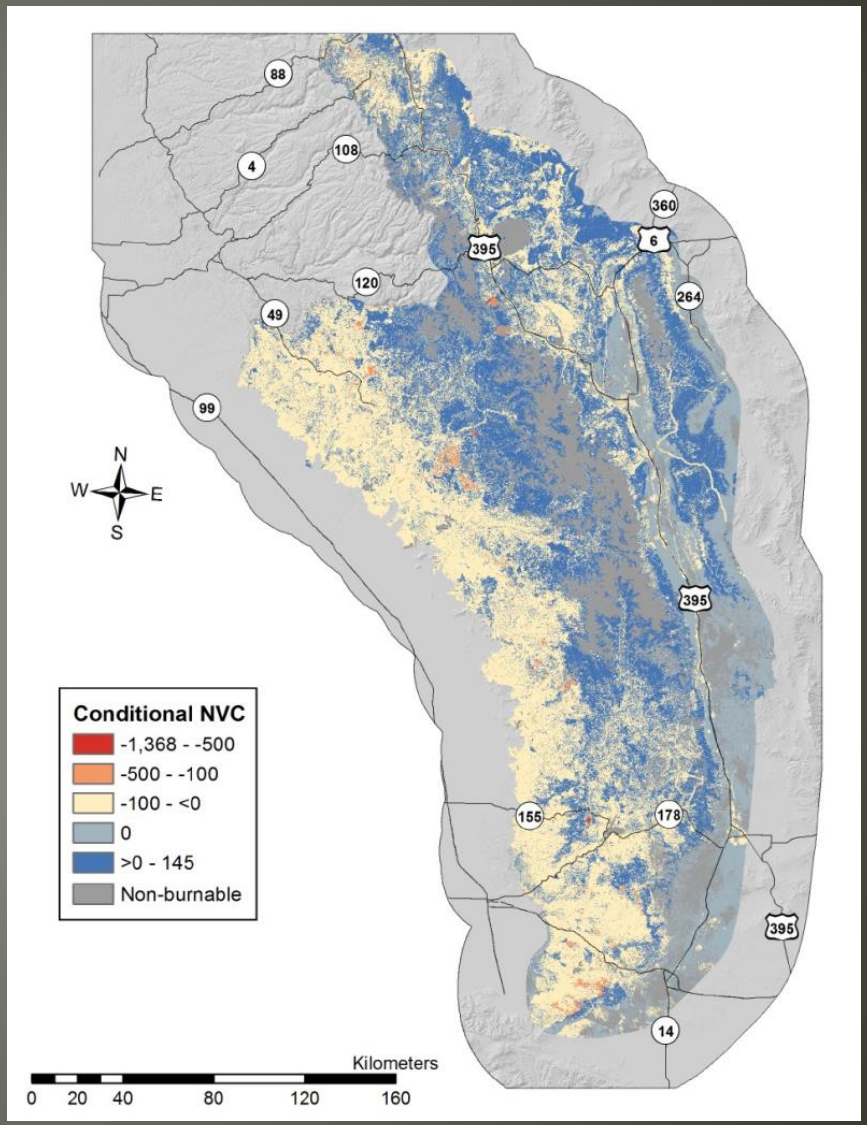




Description:
Strong benefit at low fire intensity decreasing to a strong loss at very high fire intensity.

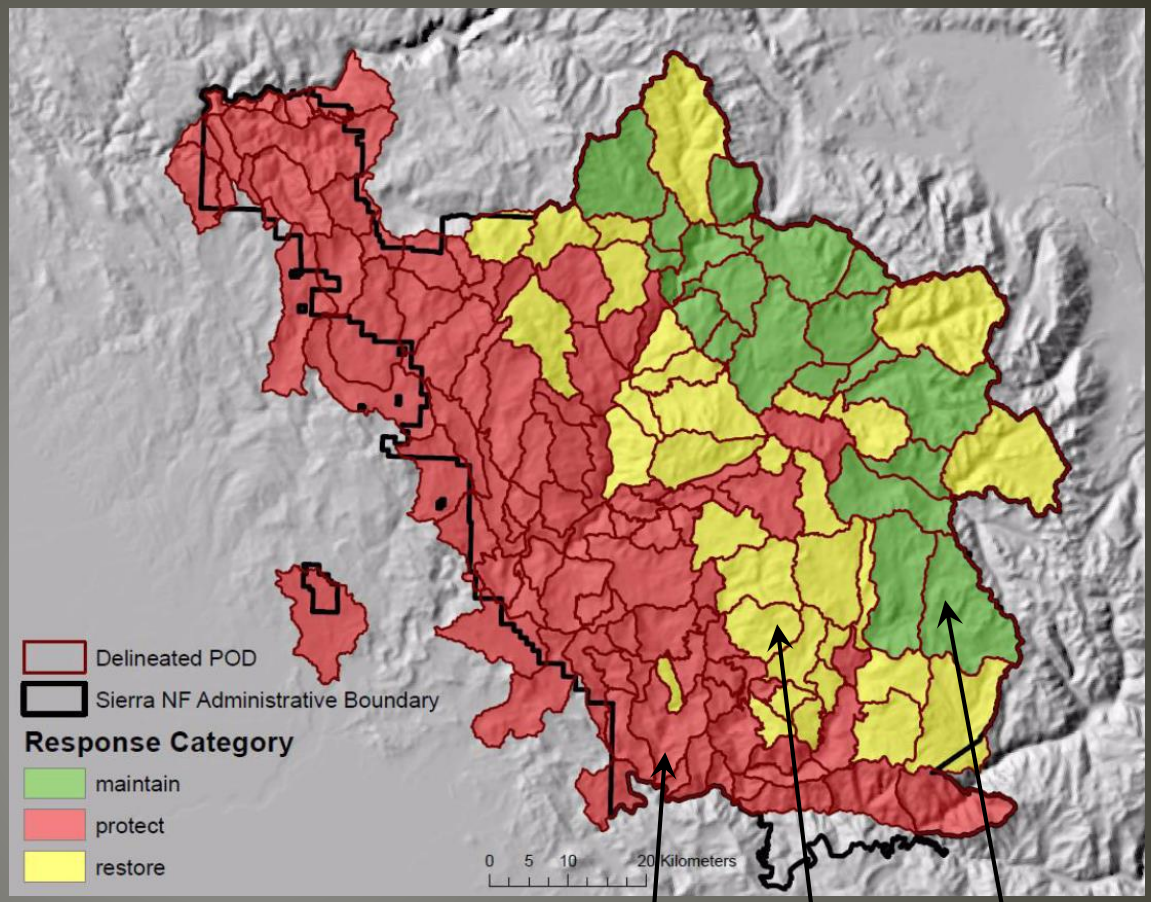
Description:
Moderate to strong loss as fire intensity increases.

$$cNVC = \sum_{i}^{n} FLP_i * RF_i$$



FIRE SUPPRESSION RESPONSE CATEGORIES

Potential Operational Delineations (PODs) as spatial units for modeling



Schema for assigning response category

Response Category	In Situ cNVC	Source cNVC
Protect	-	-
Restore	-	+
Restore	+	-
Maintain	+	+

Suppression on

Managed fire

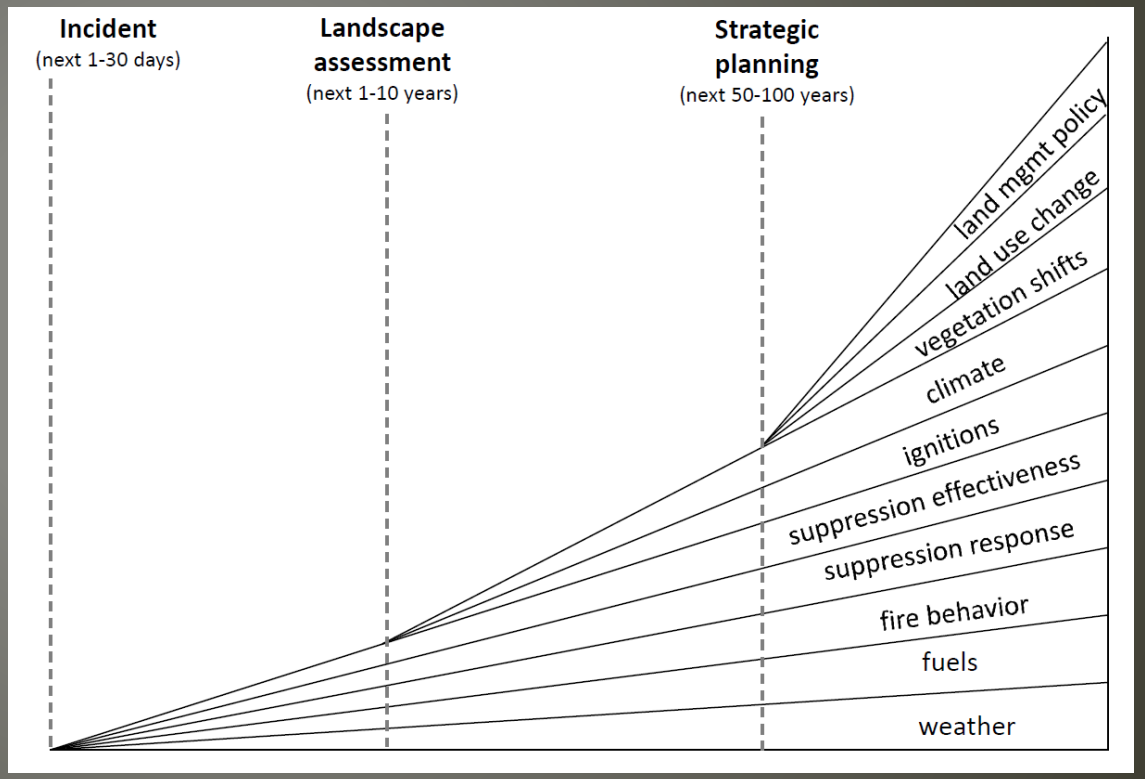
Suppression off

FUTURE WORK (THIS SPRING)

- Managed fire in FSim
  - Decreased initial attack (increase number of large fire ignitions)
  - Less aggressive extended attack (increase perimeter trimming)
  - Apply different suppression policies to different parts of the landscape in separate runs, then “stitch” runs together
- Managed fire by post-processing FSim
  - Allow some fires to burn during certain seasons or certain weather conditions

FUTURE WORK: CHALLENGES

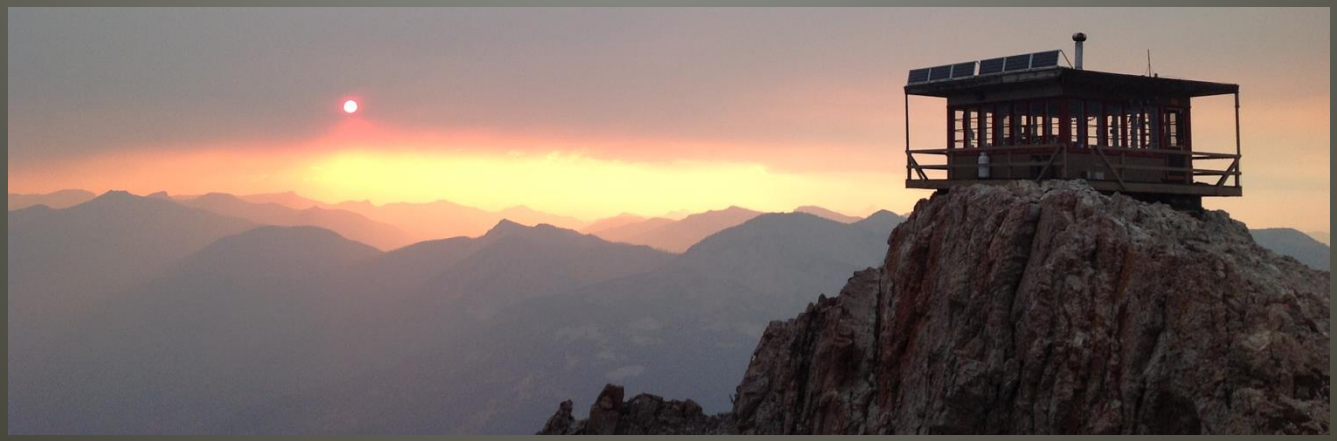
- Effect of fires on the landscape: begin to work with temporal component (5-10 years into future)
- Challenges because landscape is bifurcating due to stochastic disturbance – can't predict the future!
  - Uncertainty in landscape
    - » Location and extent of disturbance (fire, beetle, etc)
    - » Development and land use change
    - » Vegetation growth and mortality
    - » Timber harvest, fuel treatment, and restoration
  - Uncertainty in weather
    - » Climate change: hopefully not too much within 5-10 years



Increasing uncertainty in fire modeling with planning horizon

FUTURE WORK

- Handling uncertainty with Monte Carlo simulations and scenario planning
  - Choose a random 5 years from a simulation and identify the fire perimeters
  - Use fire perimeters to update landscape
  - Run FSim on new landscape
  - Repeat for different fire years (addressing stochasticity in fire)
  - Repeat for different suppression policy
- Results: Can we see the result of allowing more fire on the landscape within 5 years? Does the stochasticity in fire dwarf the amount of variability across suppression policies? My guess is that it's likely.



QUESTIONS?

Karin Riley
kriley@fs.fed.us

Prescribed Fire, Banff Park