Using Landscape Models to Inform Climate Adaptation Strategies in the Southwest

William Flatley, Rachel Loehman, Lisa Holsinger, Andrea Thode, Windy Bunn, Alexander Evans, Donald Falk, Megan Friggens, Martha Sample, Craig Wilcox

Southwest FireCLiME

JOINT FIRE SCIENCE PROGRAM

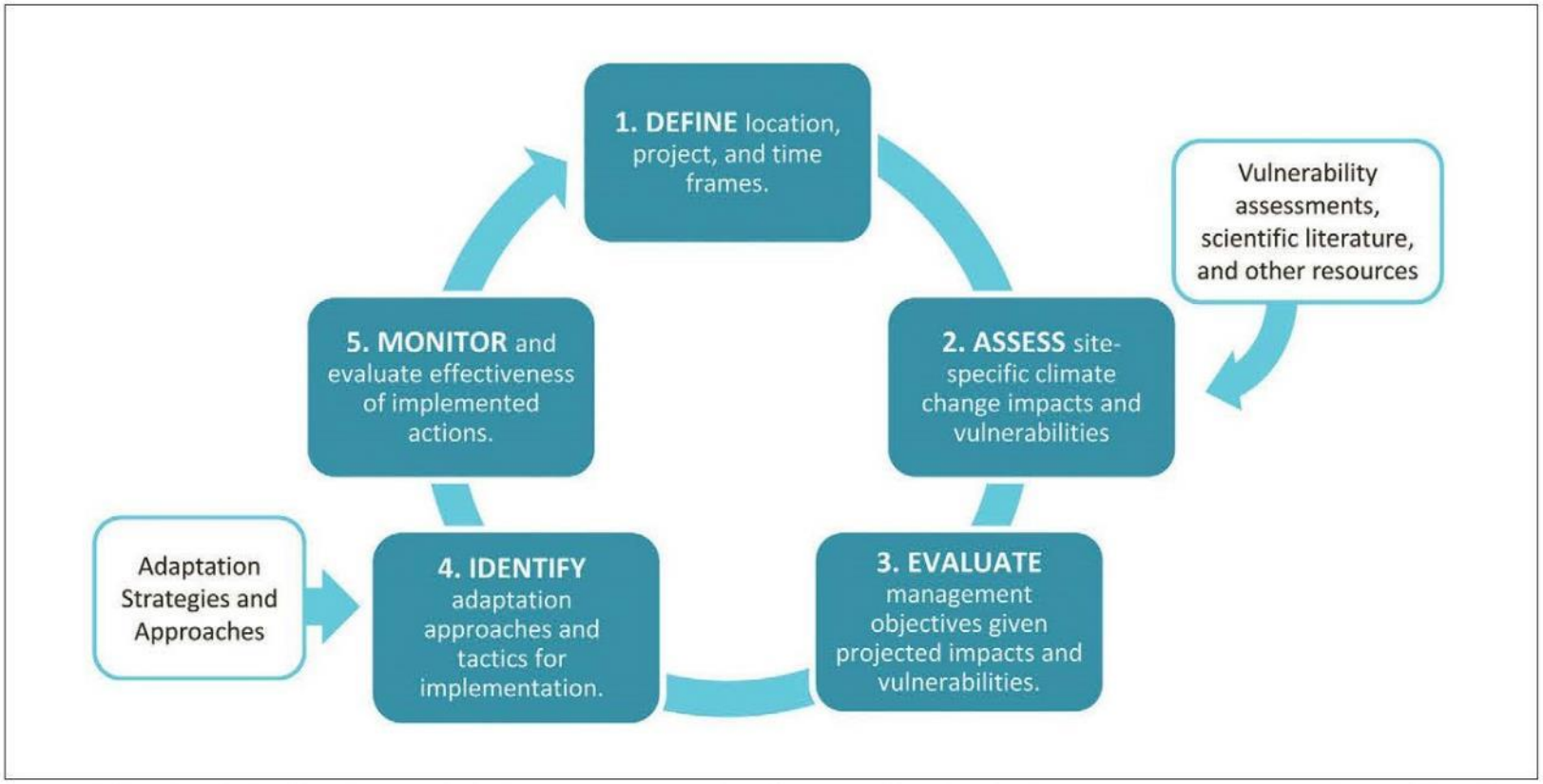


Figure 12.—An illustration of the adaptation process used to incorporate climate change as a management consideration and help ecosystems adapt to the anticipated effects of climate change. Additional resources provide information and tools that support the process.

From “Forest Adaptation Resources” GTR-NRS-87, Swanston et al. 2016

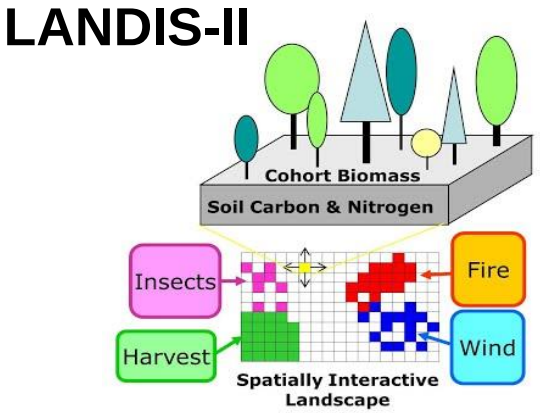
Adaptation Strategies

Swanston et al. 2016; Millar et al. 2007

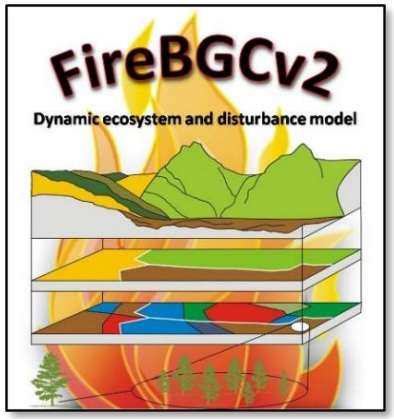
1. *Resistance* – buffer or protect from change
    - Rx burning, fire breaks, maintain refugia
2. *Resilience* – promote the return to normal conditions after a disturbance
    - Rx burning, thinning, promote heterogeneity/diversity
3. *Transition* – actively facilitate or accommodate change
    - Plant new species, remove maladapted species

LANDIS-II and *FireBGCv2*: Forest Landscape Simulation Models

- Simulate large spatial and long temporal scales
- Spatial processes: fire, seed dispersal, climate variability
- Simulate interacting disturbance and vegetation responses to climate
- Model individual tree species
- Can incorporate management activities

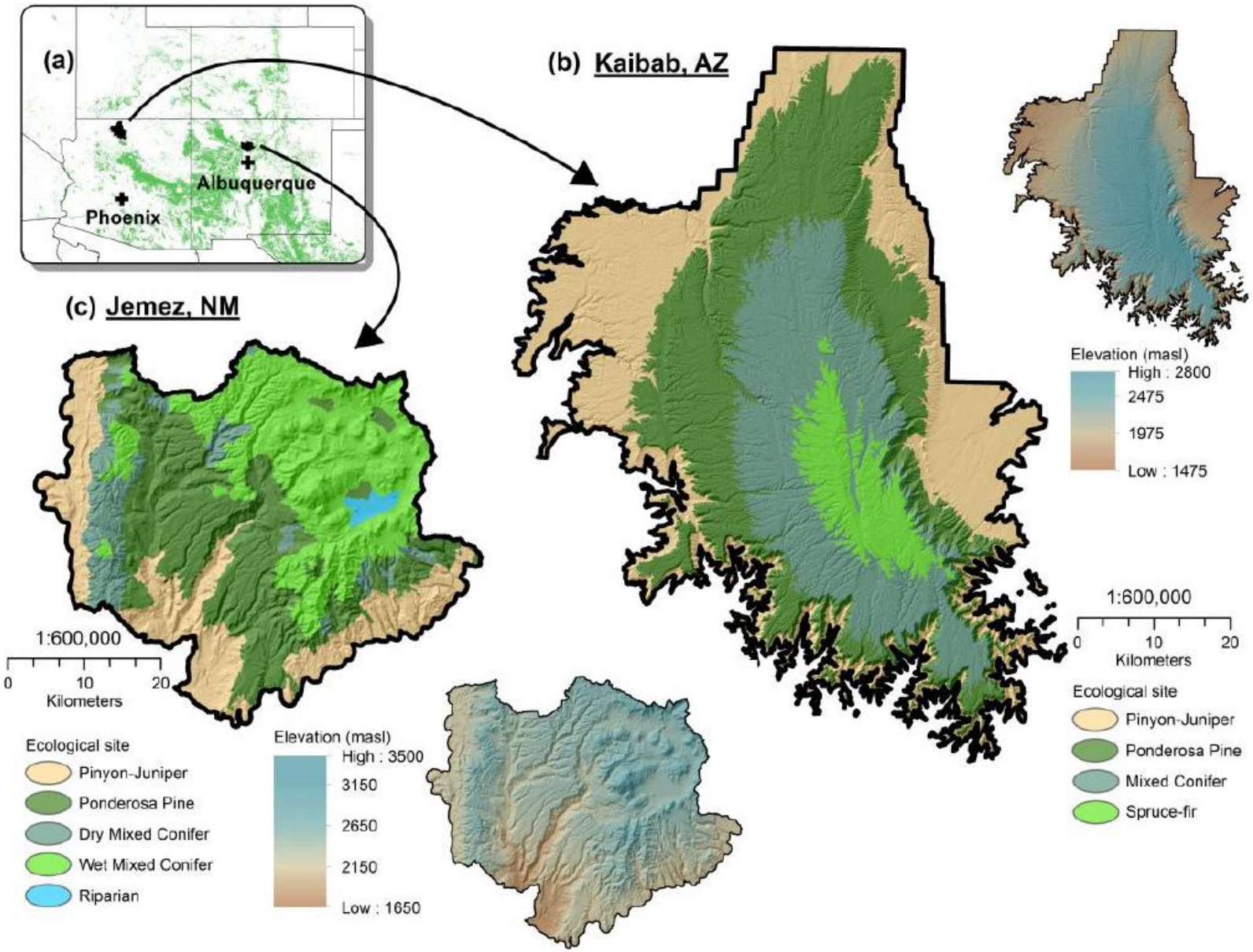


http://www.landis-ii.org/



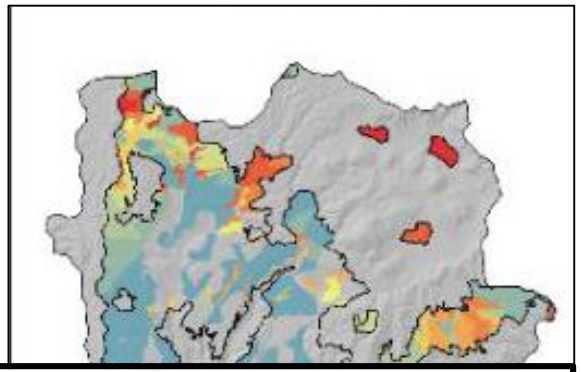
Keane, R. E., R. A. Loehman, and L. M. Holsinger. (2011), Gen. Tech. Rep. RMRS-GTR-255.

Study Landscapes: Jemez, NM and Kaibab, AZ



Modeling design

Jemez, BAU Treatments



Landscapes:

1. Kaibab Plateau, AZ – LANDIS-II model
2. Jemez Mountains, NM – FireBGCv2 model

Climates:

forests

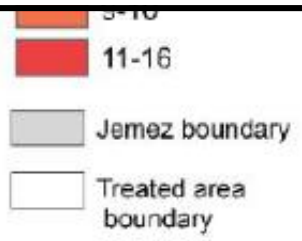
MDPI

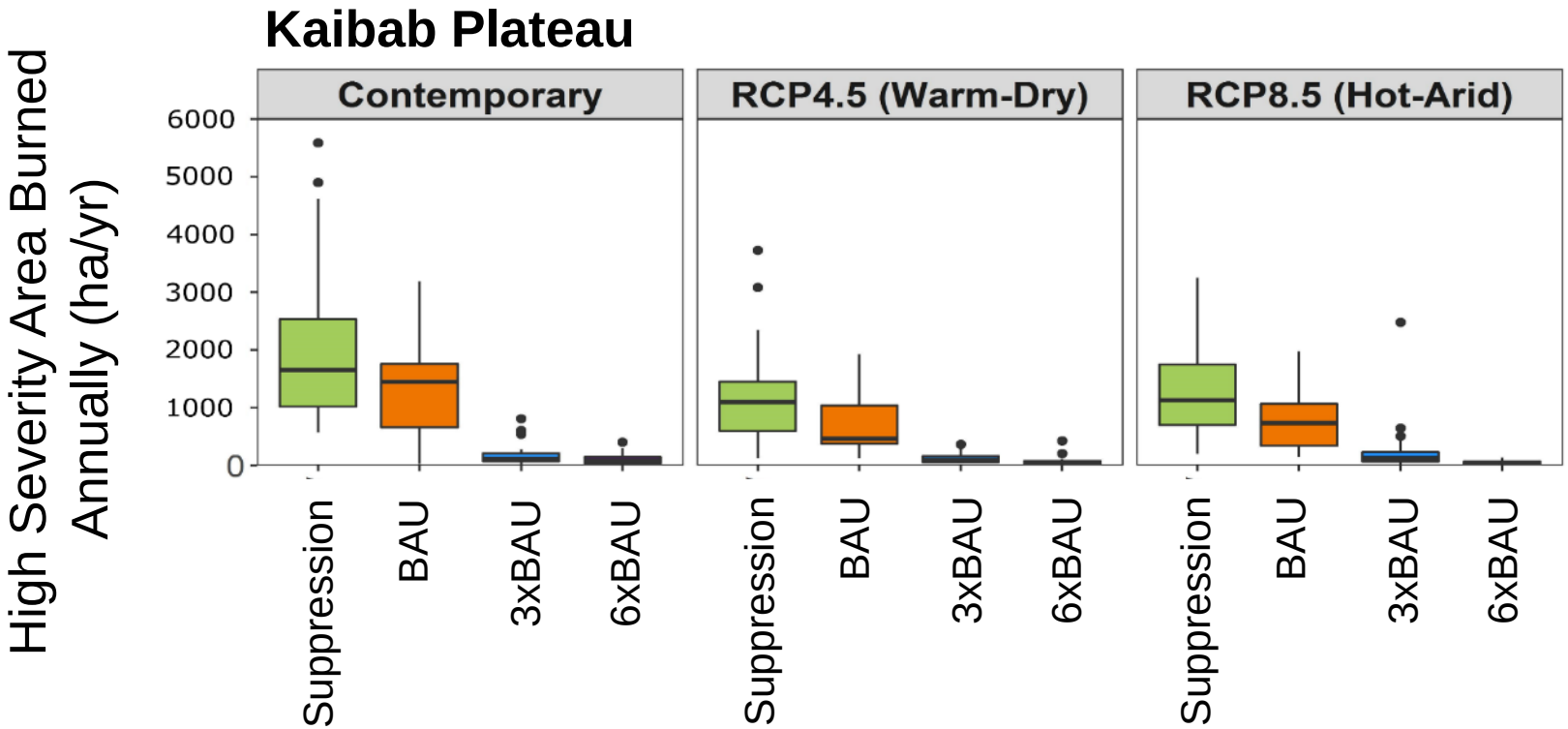
Article

Can Land Management Buffer Impacts of Climate Changes and Altered Fire Regimes on Ecosystems of the Southwestern United States?

Rachel Loehman [1,*], Will Flatley [2], Lisa Holsinger [3] and Andrea Thode [4]

3. *3xBAU (4.5%)* – Thinning and Rx burns, 22 year rotation
4. *6xBAU (9%)* – Thinning and Rx burns,11 year rotation





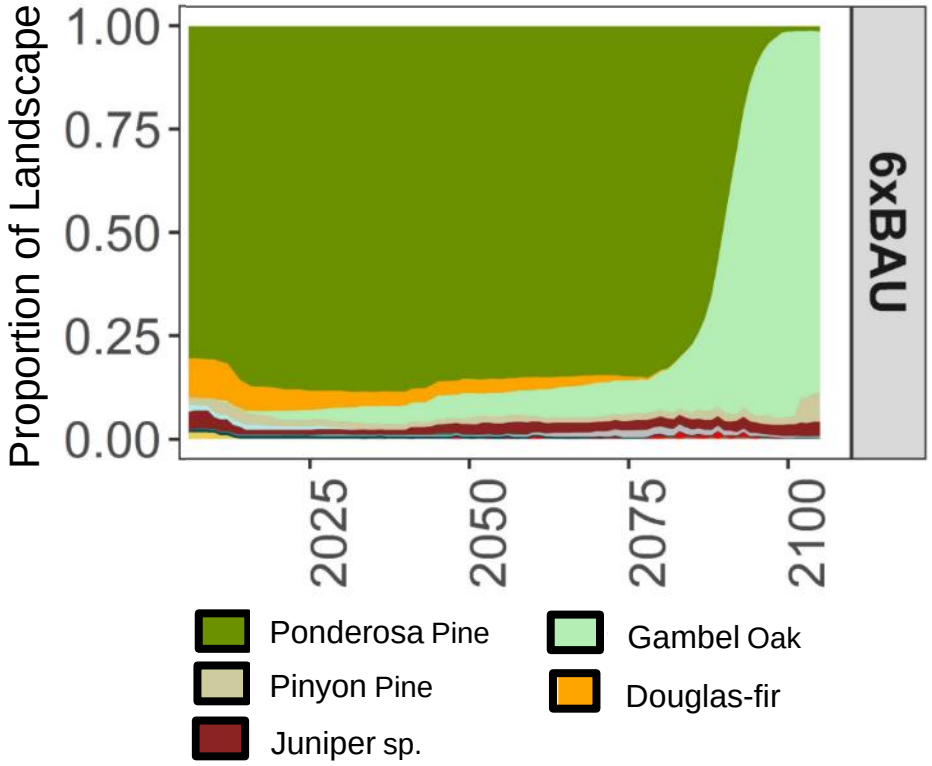
Landscape Modeling ->

Resistance

Resilience

Transition

Jemez Mountains, RCP 8.5 and 6XBAU



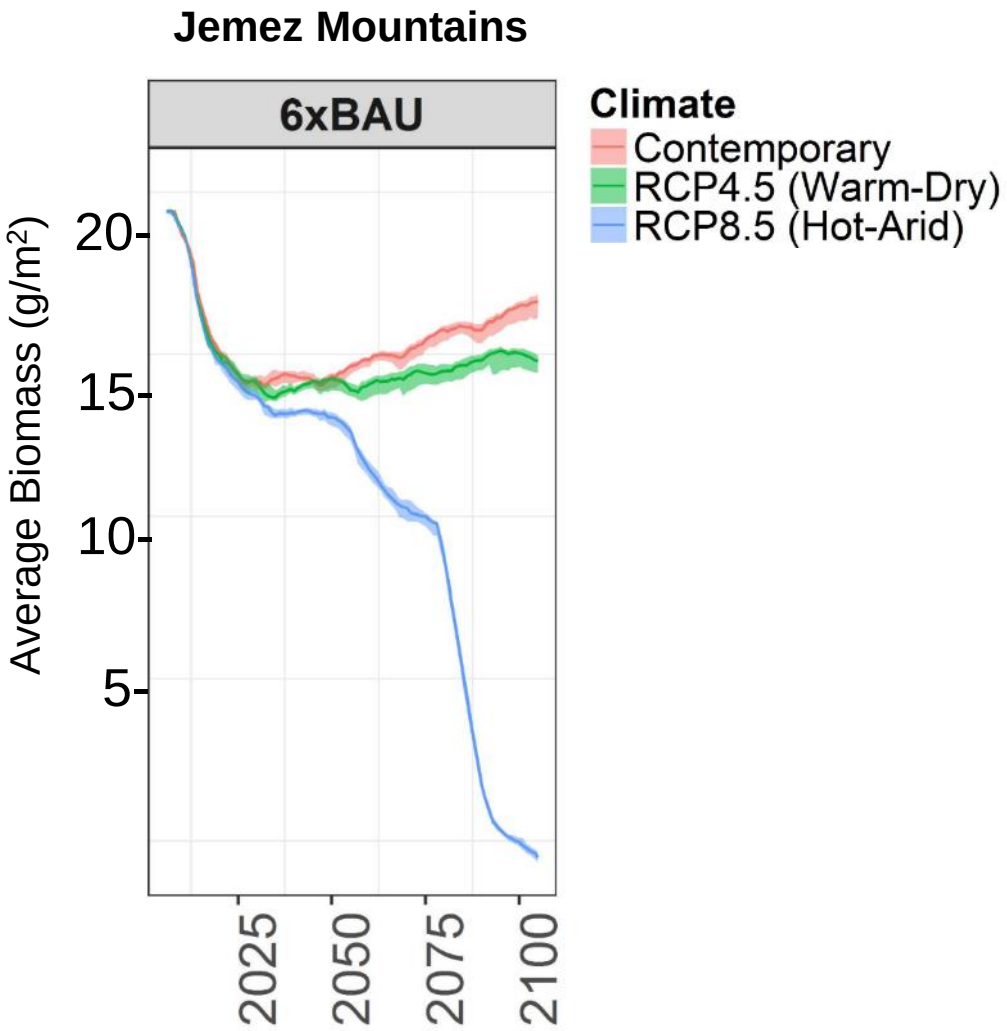
- Compositional change from ponderosa pine to oak
- Turnover from fire, drought, and regeneration failure

Landscape Modeling ->

Resistance

Resilience

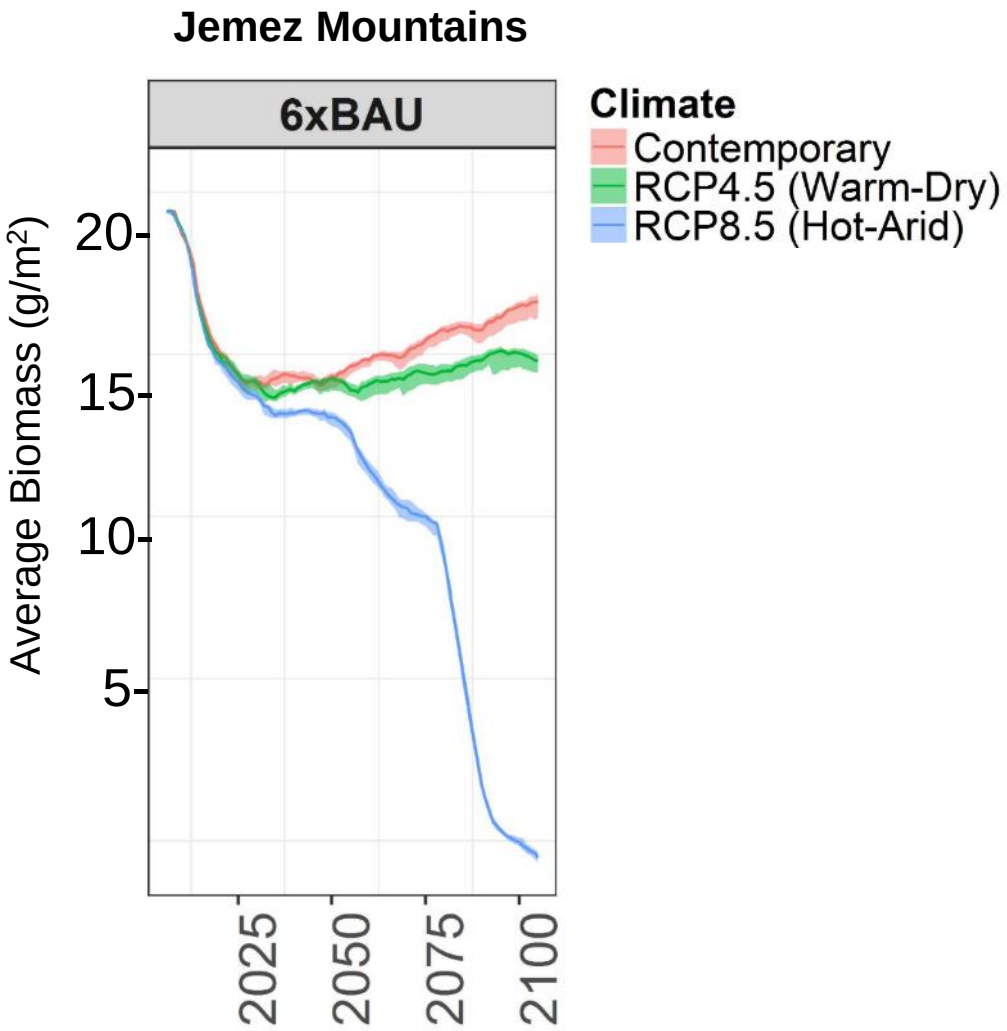
Transition



- Biomass declines in response to climate
- Moderate vs. major climate change scenarios make a big difference

Landscape Modeling ->

Resistance (?)
Resilience (?)
Transition (?)



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Resistance (?)
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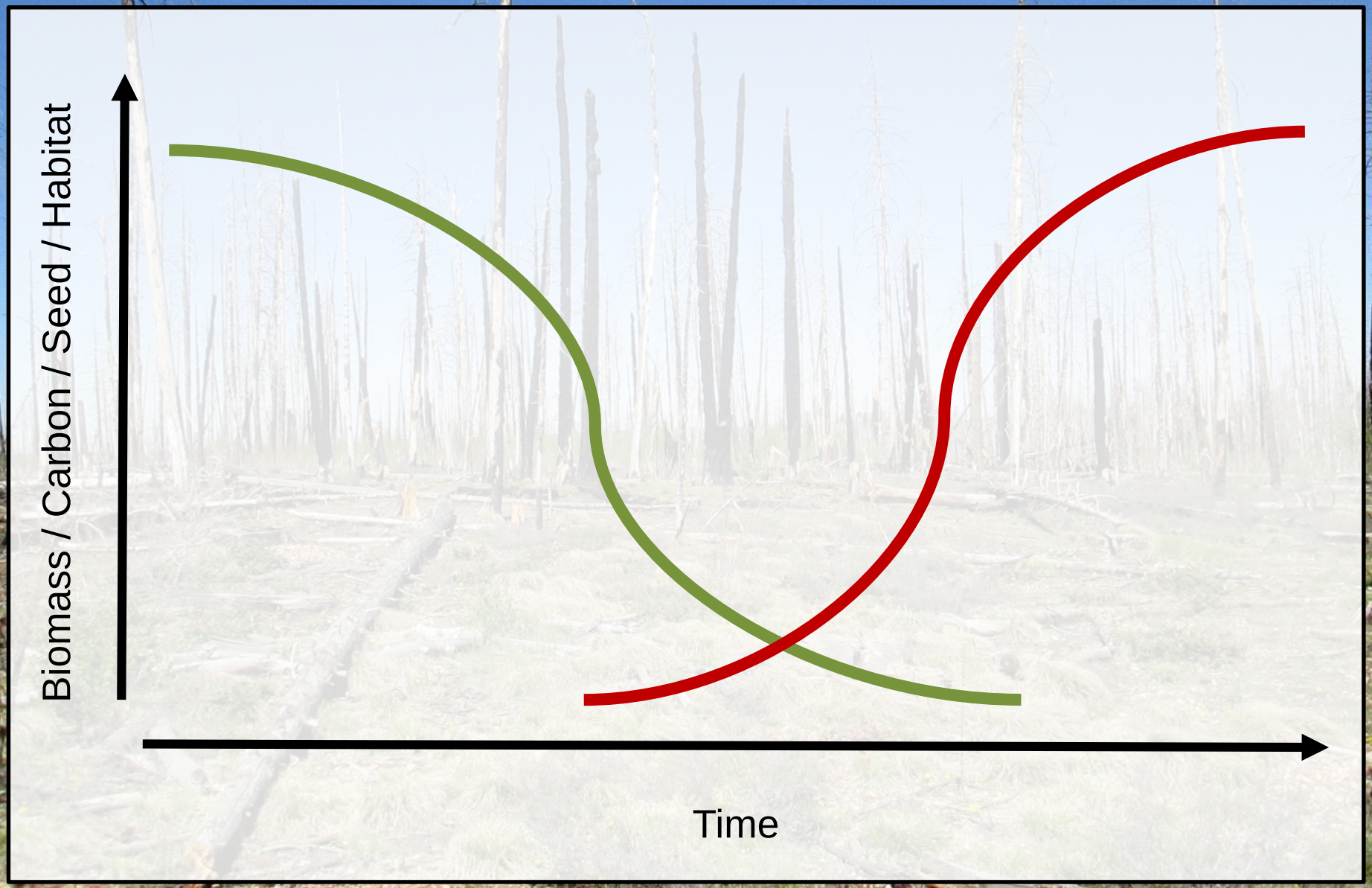
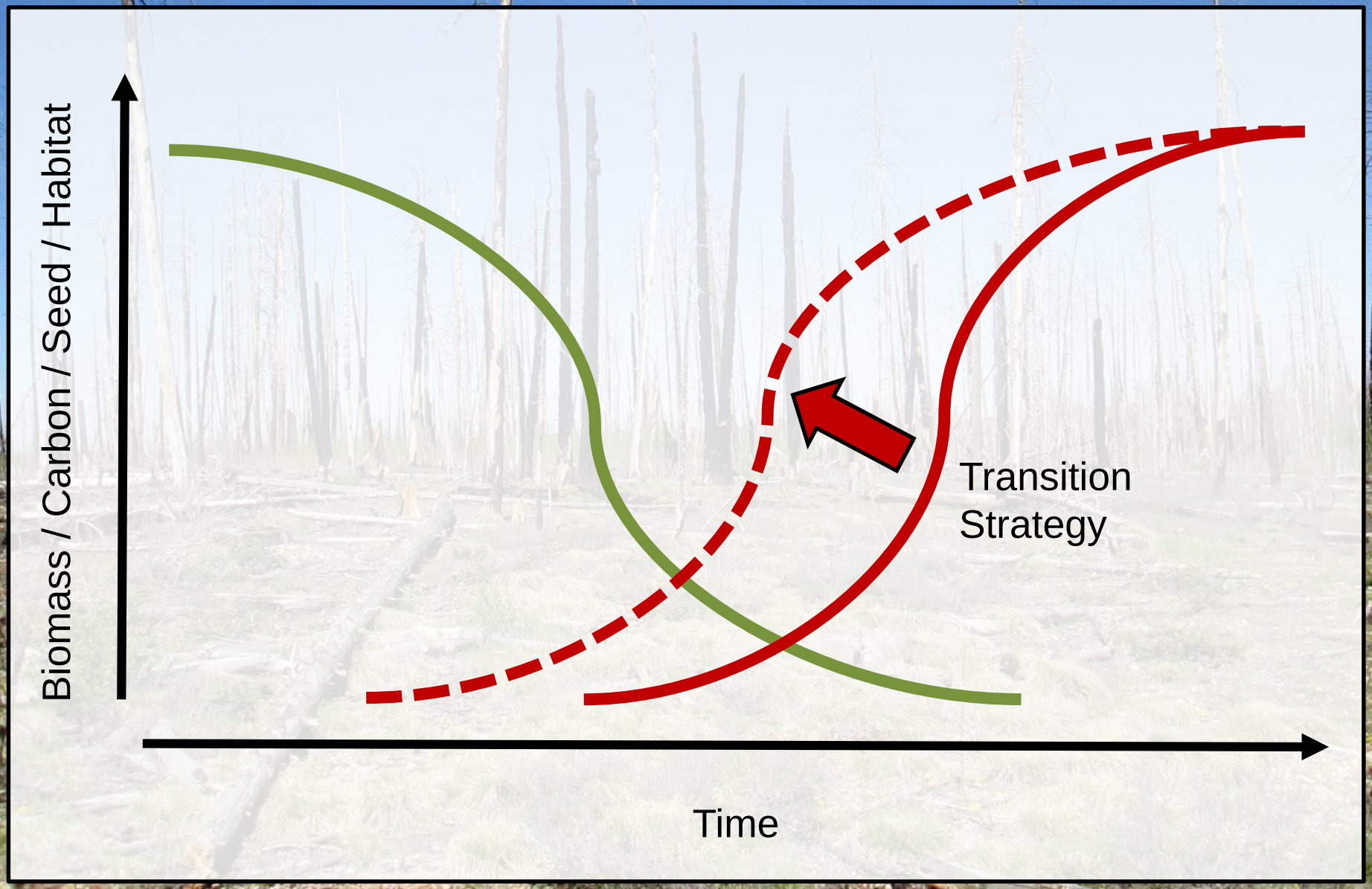
Transition (?)

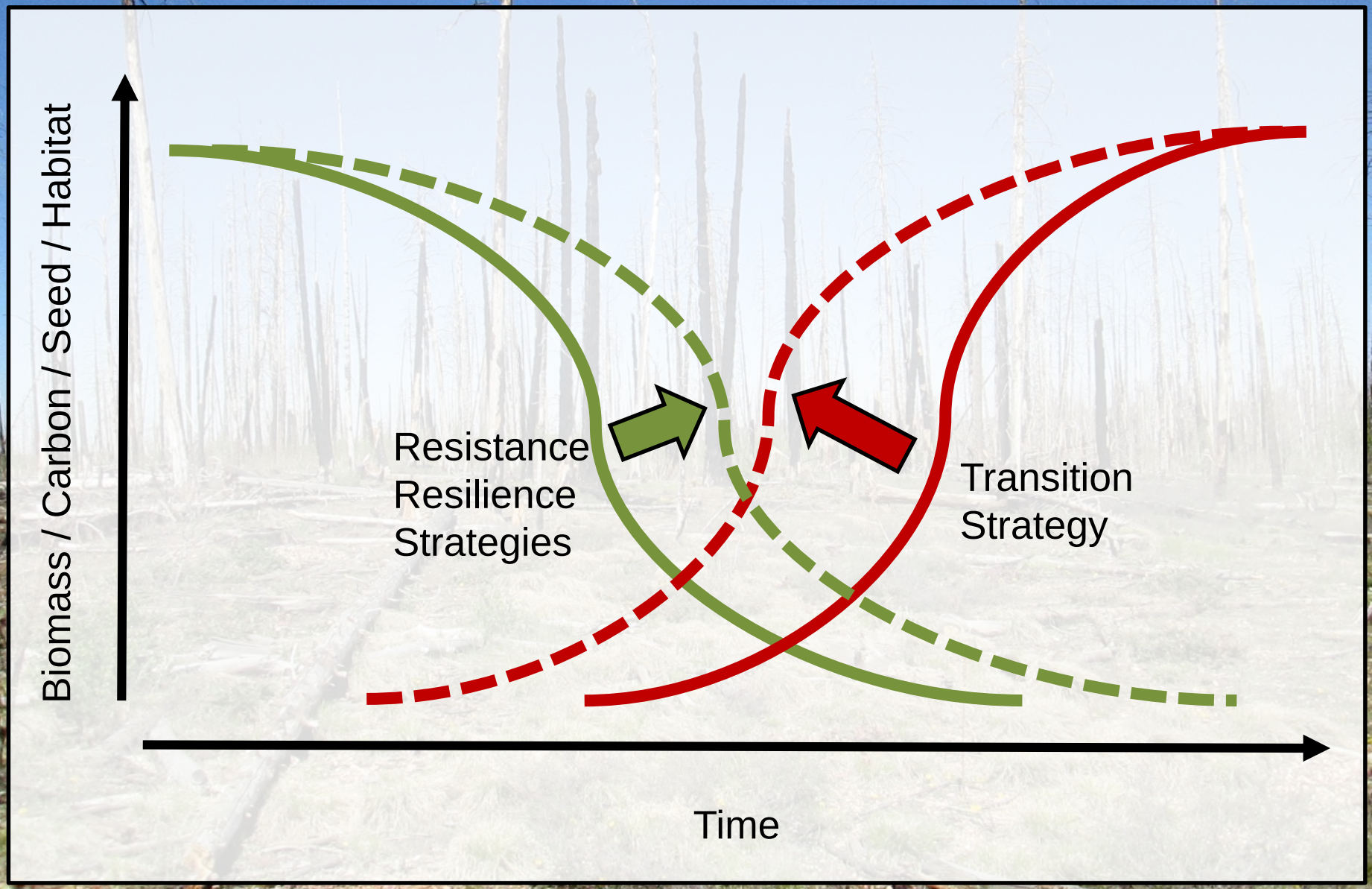
The Transition



The Transition



The Transition



Conclusions

- Transition strategies will be important as landscape reorganizes under future climate conditions
- LSMs can be useful tools for evaluation of transition strategies
  - Duveneck and Scheller 2015; Hof et al. 2017
- Resistance, Resilience and Transition strategies may all be important even if much of the landscape will eventually transition

Many thanks to:

SW FireCLIME project team:

Anne Bradley, Windy Bunn, Don Falk, Megan Friggens, Pete Fulé, Dave Gori, Shaula Hedwall, Lisa Holsinger, Robert Keane, Larissa Yocom-Kent, Tessa Nicolet, Jack Triepke, Craig Wilcox, Martha Sample

FireBGCv2 modeling:

FHiRE project team: Tom Swetnam, Chris Roos, Matt Liebmann, John Welch, TJ Ferguson, Pueblo of Jemez

National Science Foundation

USFS Rocky Mountain Research Station Fire Sciences Lab

LANDIS-II modeling:

Pete Fulé, David Robinson, Casey Teske

Arizona Technology and Research Initiative Fund

Southern Rockies Landscape Conservation Cooperative

Bureau of Reclamation

Vulnerability Assessment ***AND*** Landscape Modeling

- VA: identify landscape components of greatest concern
- LM: quantify impacts at the landscape scale

- *e.g. soil burn severity and debris flows*