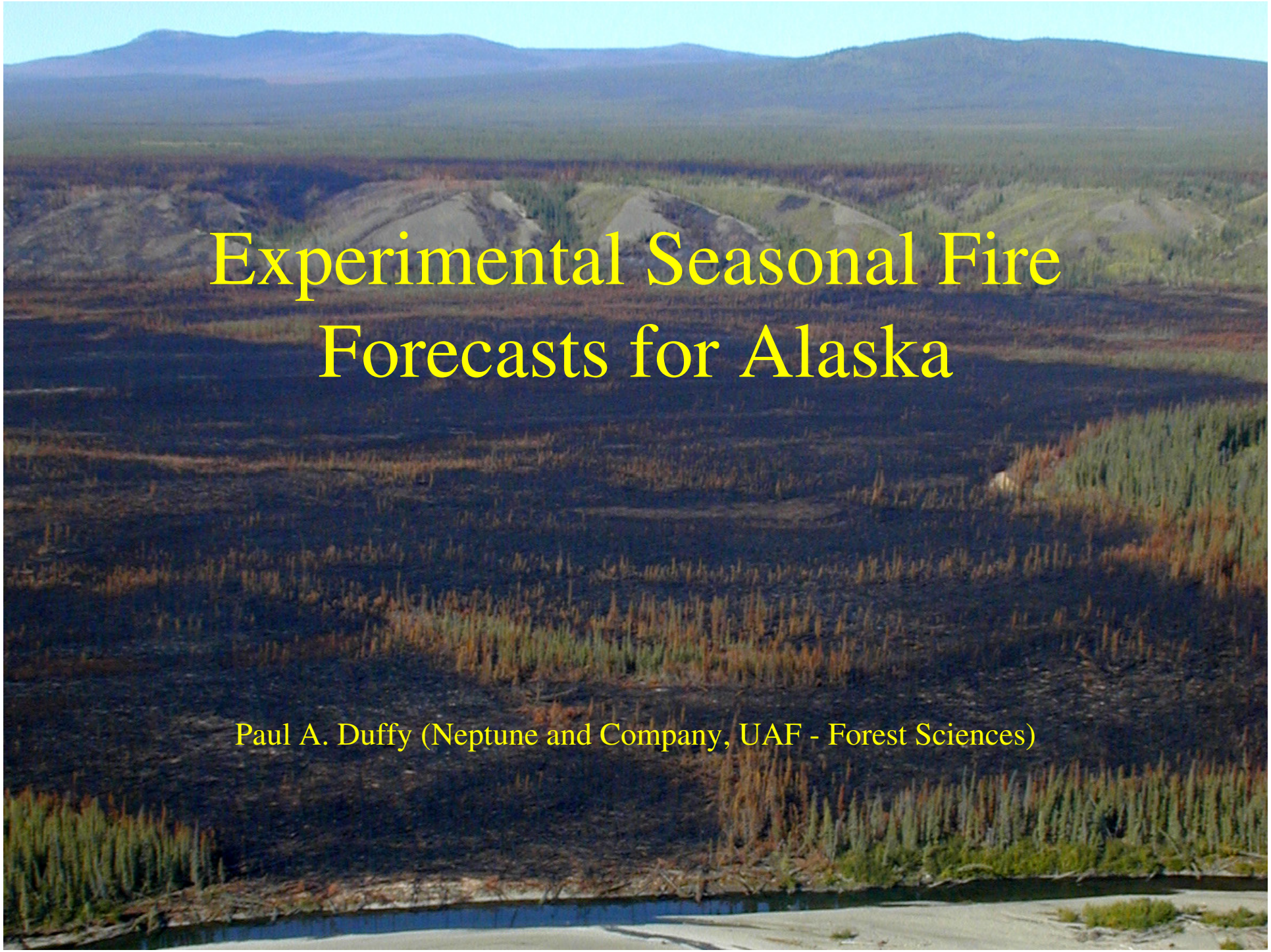


Experimental Seasonal Fire Forecasts for Alaska

Paul A. Duffy (Neptune and Company, UAF - Forest Sciences)

Outline

- Examine fire-climate linkages
- Review forecasting approach and output
- Discuss next steps

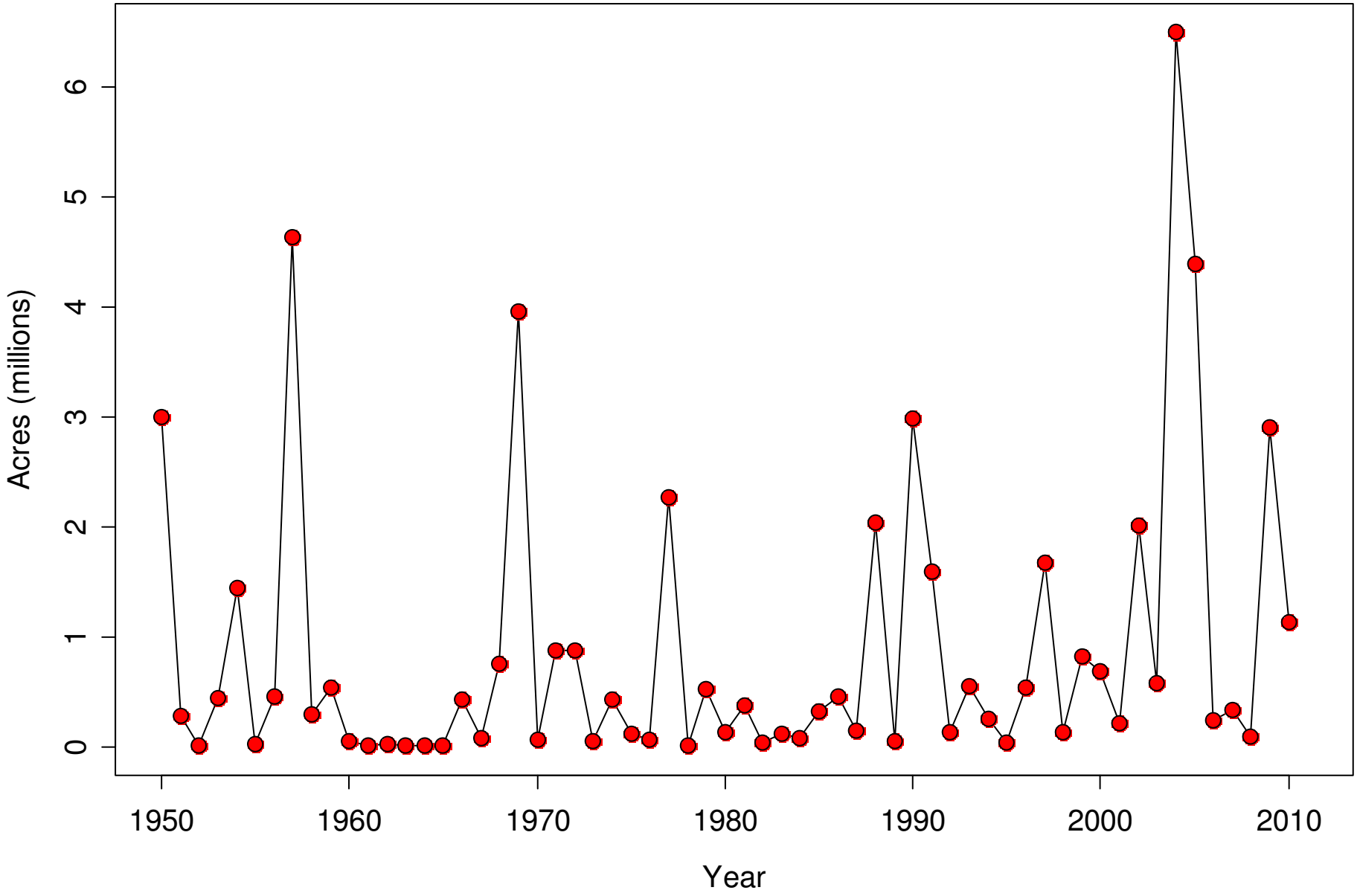
Why is Fire Important in Alaska?

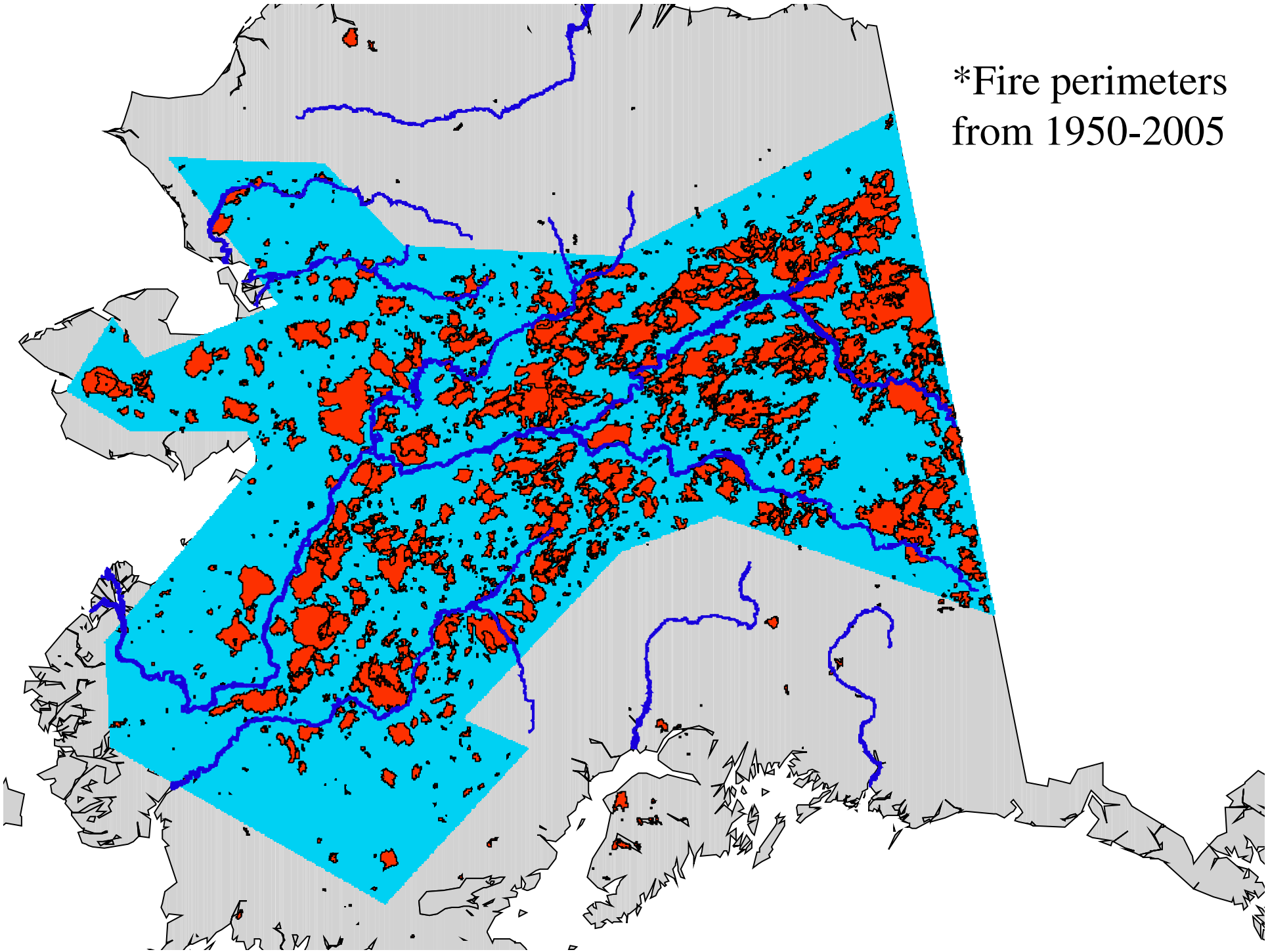
- Dominates the disturbance regime
- Succession modifies forest structure

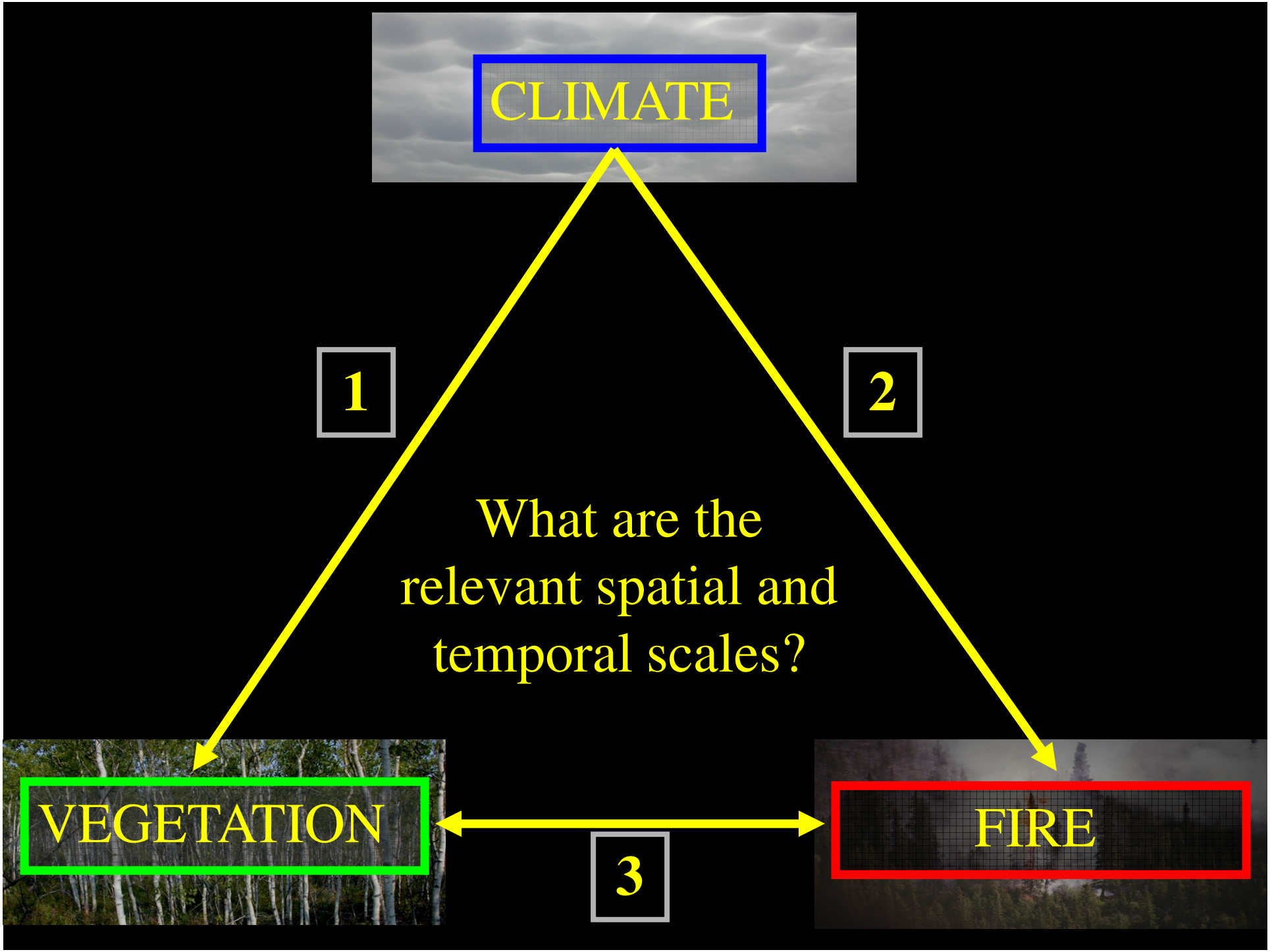
Why is Fire Important in Alaska?

- Interior Alaska contains 60 million burnable hectares (approx. equal to MT and ID combined)
- Average annual area burned is 340,000 ha median is 135,000 ha
- Largest year burned 2.6 million ha

Annual Area Burned in Alaska (1950-2010)




*Fire perimeters
from 1950-2005


CLIMATE
1
2
What are the relevant spatial and temporal scales?
VEGETATION
3
FIRE

Obvious link between climate/weather and fire

Spatial and temporal scales of interest…. not so obvious

2

Initial Statistical Model

- Quantify the linkage between fire and climate using in-season variables
- Use standard linear regression methods
- Not a forecast (yet)

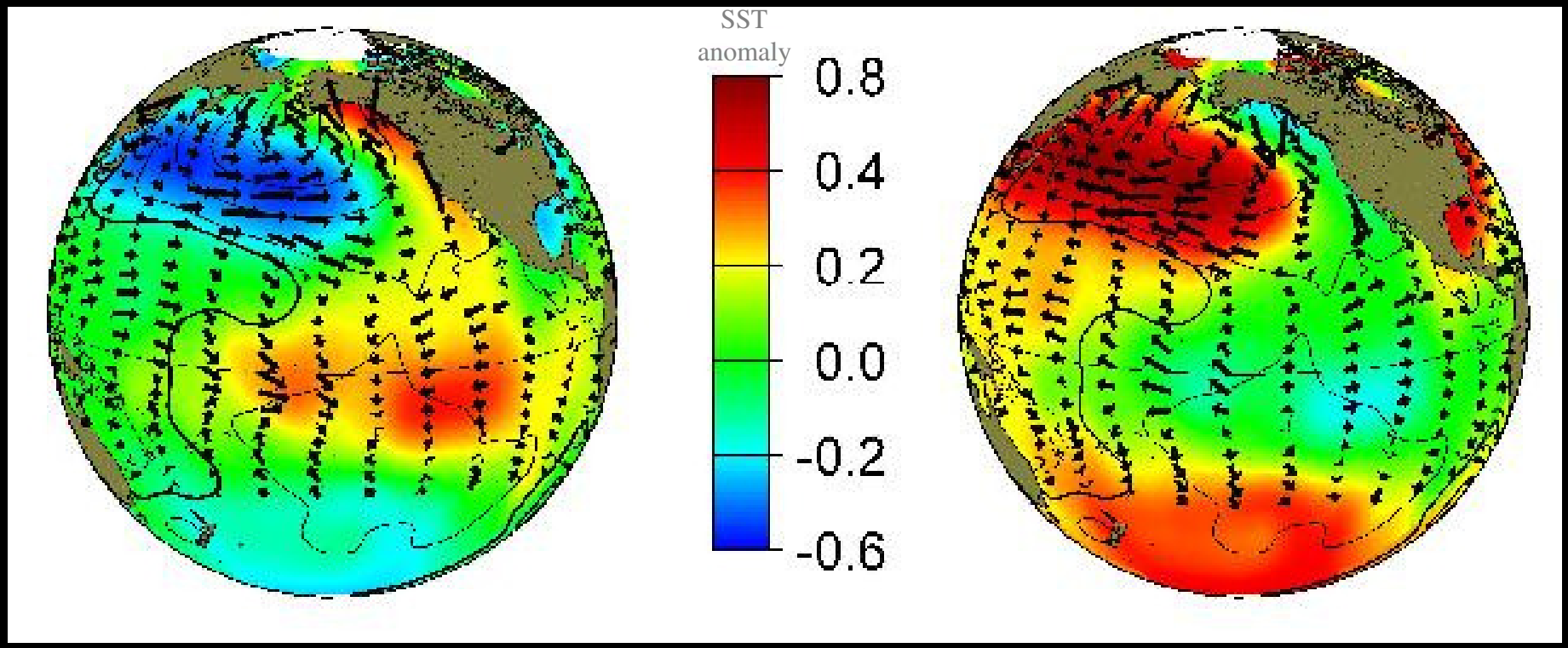
Initial Statistical Model

- Response: log(Annual Area Burned)
- 7 Explanatory Variables:
  - Monthly temperatures (April, May, June, July) and precipitation (June) from Western Region Climate Center
  - Teleconnection indices from PDO (JISAO) and East Pacific NOAA-Climate Prediction Center
- R-squared for the model is 0.79

Pacific Decadal Oscillation

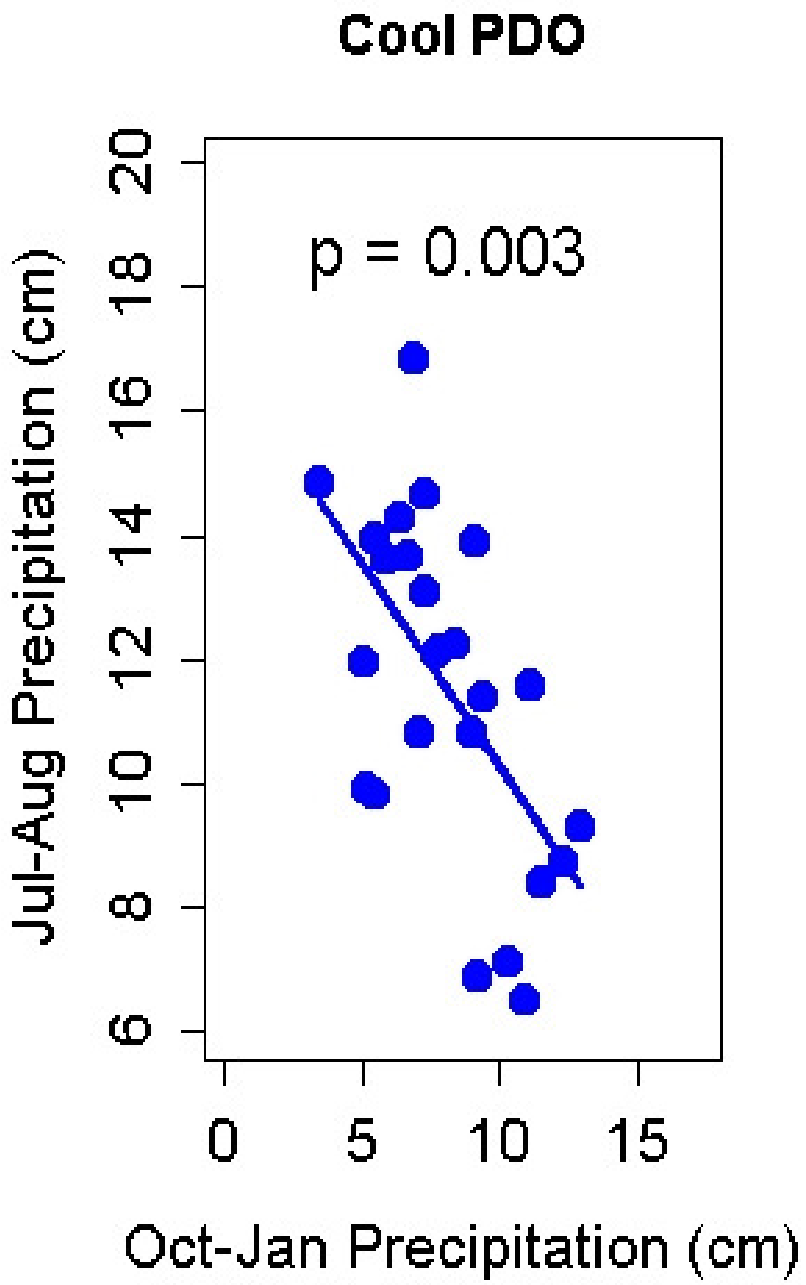
Warm Phase

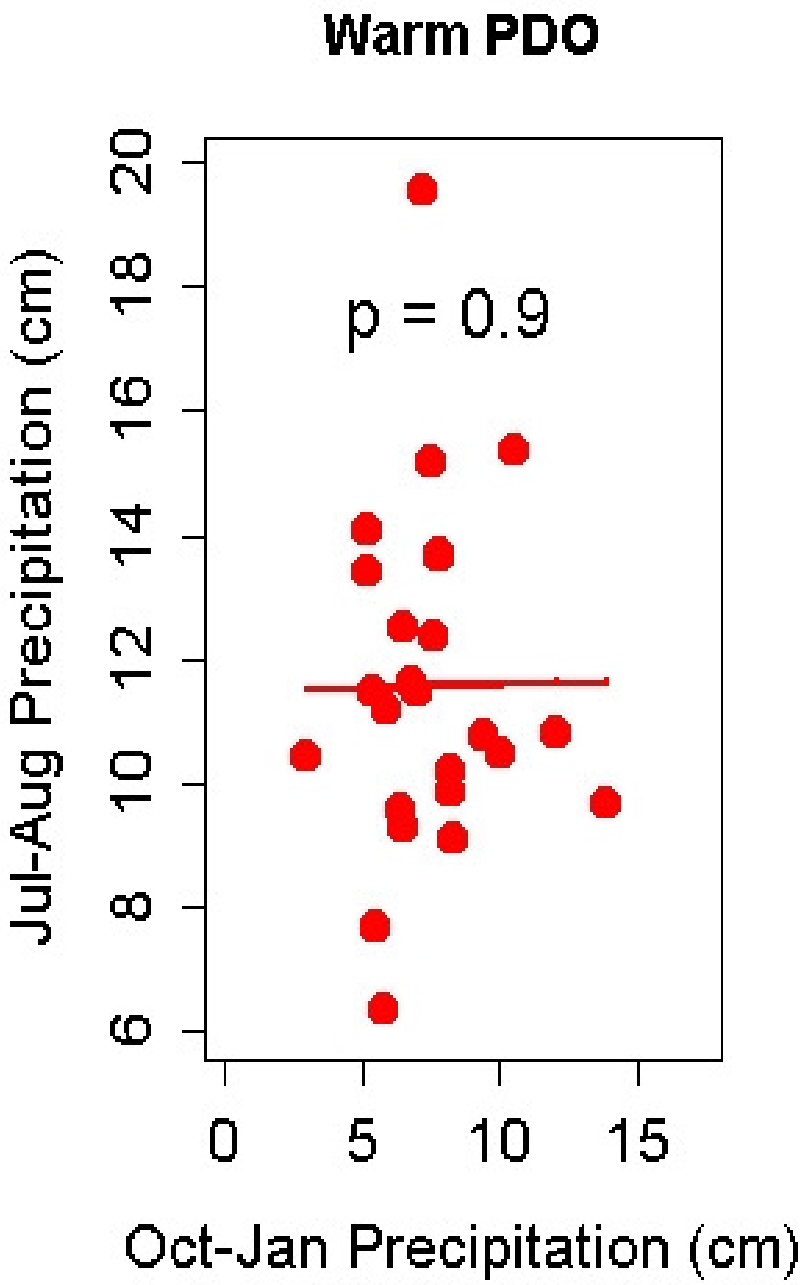
Cool Phase



PDO and the Aleutian Low

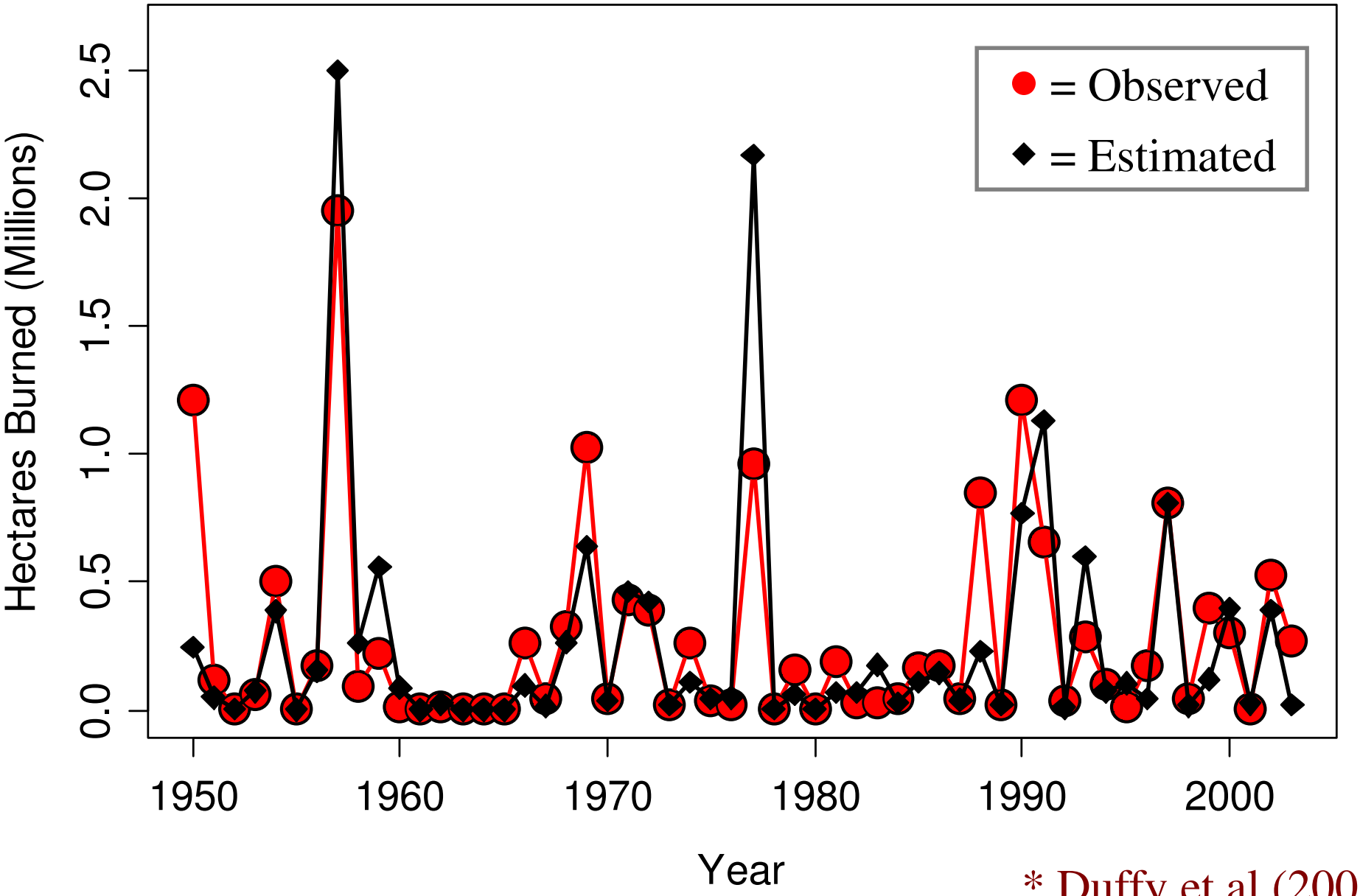
- Shift from cool to warm phase results in intensification and SE movement of AL
- Dominant Easterly flow for the Interior
- Results in warmer and drier summers





* Duffy et al (2005)

Regression Model from 2005

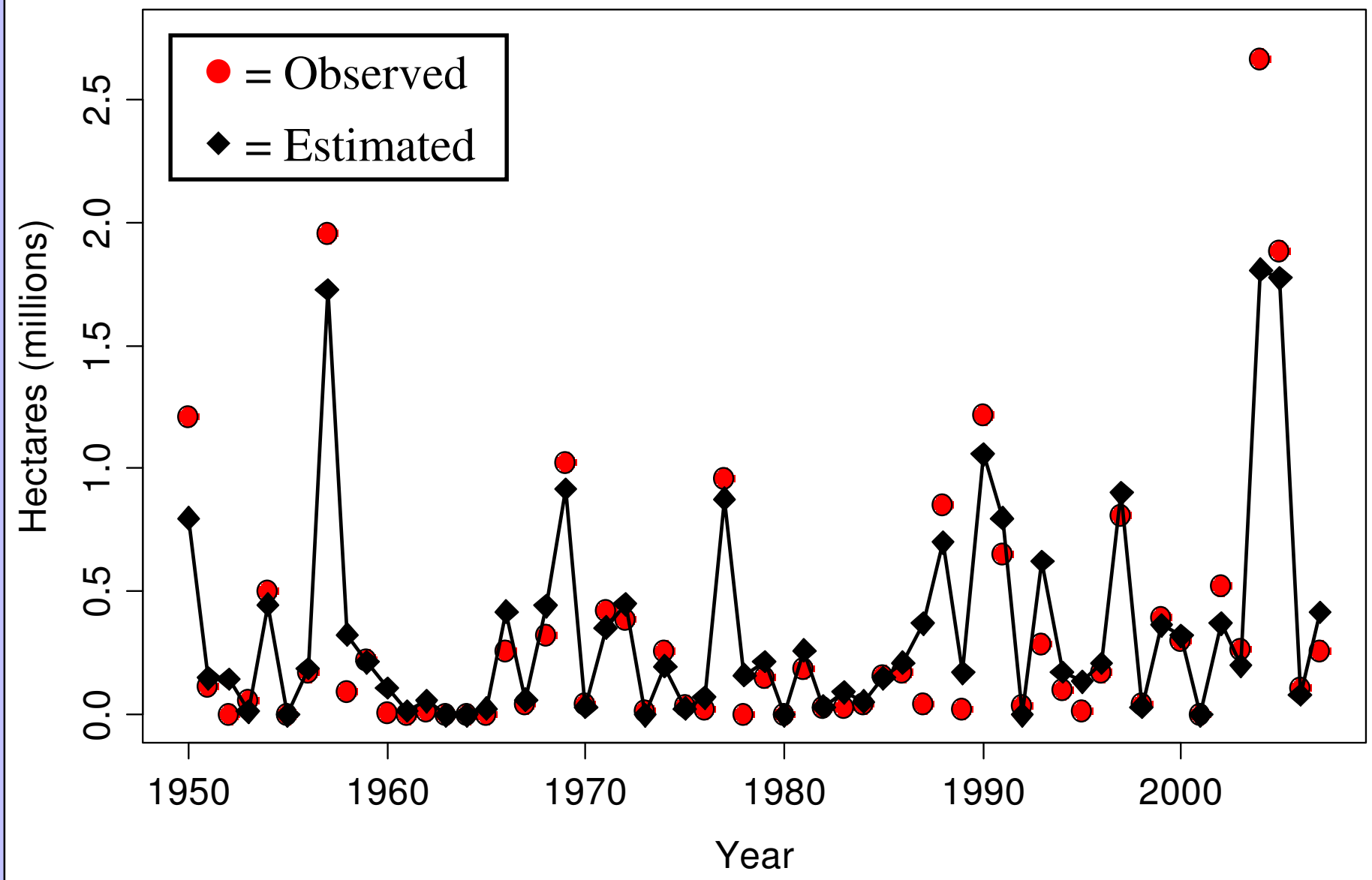


* Duffy et al (2005)

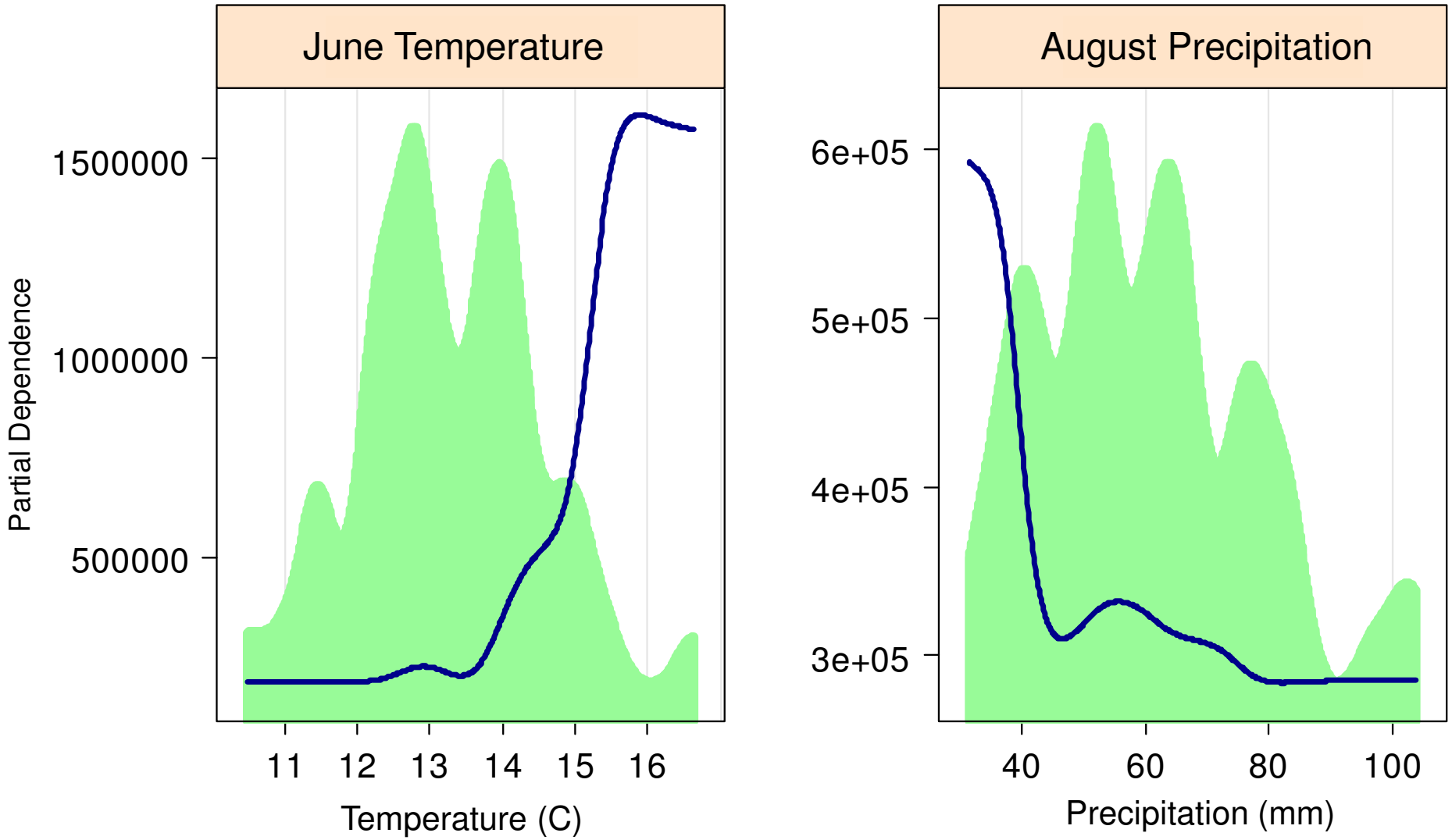
Alternative Statistical Models

- Stochastic gradient boosted regression tree algorithm (GBM)
- Minimize expected loss function over the function-space not parameter-space
- More flexible than regression

Observed vs. GBM estimated Area Burned in Alaska



Partial Dependence Plots for GBM model



*** Vertical axis shows expected hectares as a function of the explanatory variable**

Building Predictive Models

- This is the 7th year we've produced forecasts
- Methods have evolved and improved
- Next step is to apply GBM approach using "pre-season" variables

Building Predictive Models

- More emphasis on correctly identifying large fire years
- Currently, this process is performed monthly for March through June
- http://www.snap.uaf.edu/fire_prediction_tool/

Experimental Forecast of Area Burned for Interior Alaska

Forecast | Methodology | Using Long Lead Forecasts | About

The purpose of this experimental forecast is to provide managers with a forecast of the area burned in Interior Alaska for the upcoming fire season. The forecast falls into one of the three categories:

- **Low** (less than 500,000 acres)
- **Moderate** (between 500,000 and 1,500,000 acres)
- **High** (greater than 1,500,000 acres)

Median Forecast for the 2010 season is 1,570,000 acres (High) as of the end of May.

1,101,000 acres have burned as of September 9th

http://fire.ak.blm.gov/content/sitreport/current.pdf

- There is a 5% chance that less than 500,000 acres will burn.
- There is a 40% chance that between 500,000 and 1,500,000 acres will burn.
- There is a 55% chance that more than 1,500,000 acres will burn.

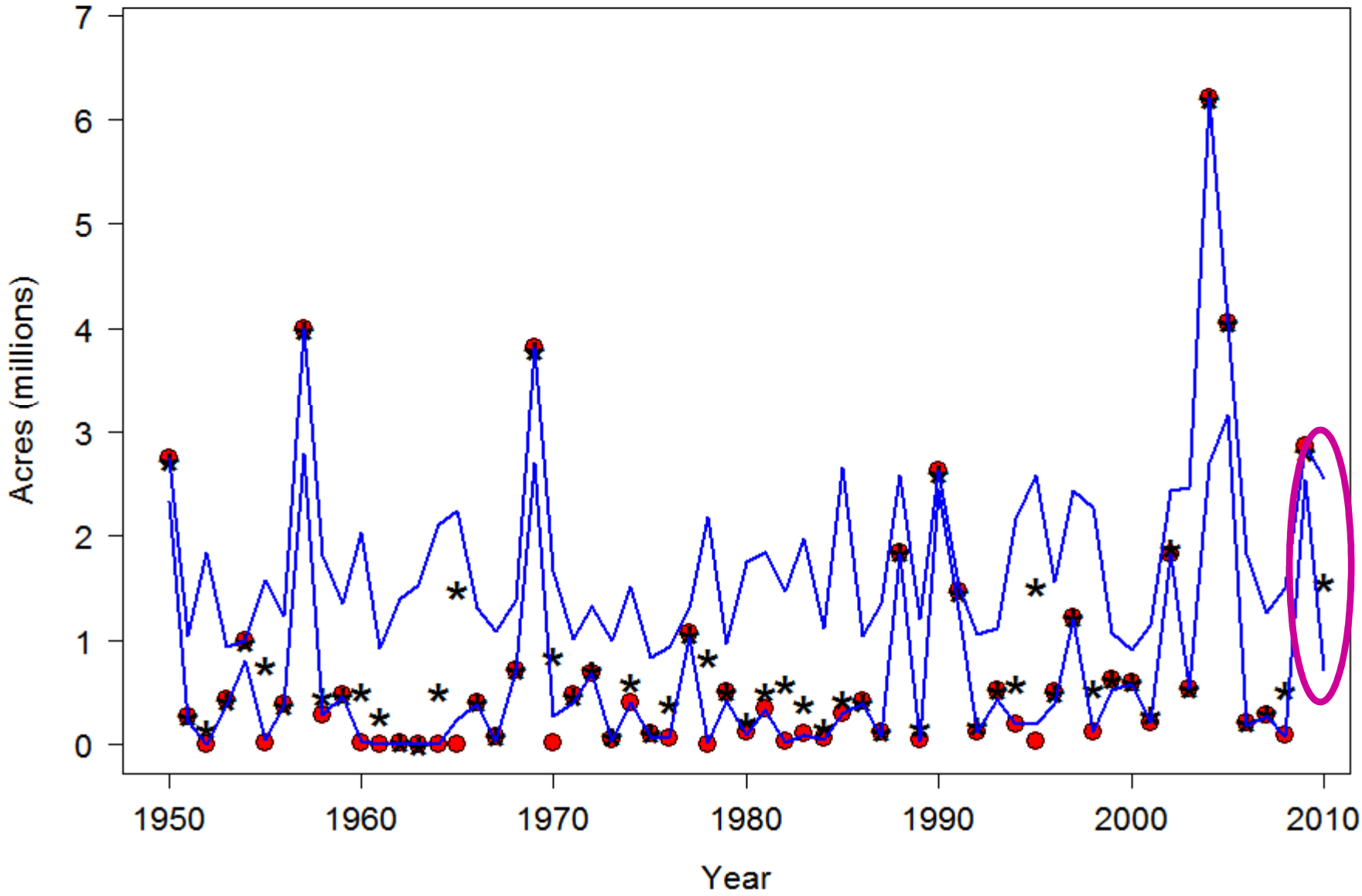
Approximately 1,125,000 acres burned in 2010

Building Predictive Models

- May Model from 2010
  - Pacific North American (May)
  - East Pacific/North Pacific (Jan, May)
  - Polar (Jan, Feb avg)
  - May Temperature (Average across 7 stations)

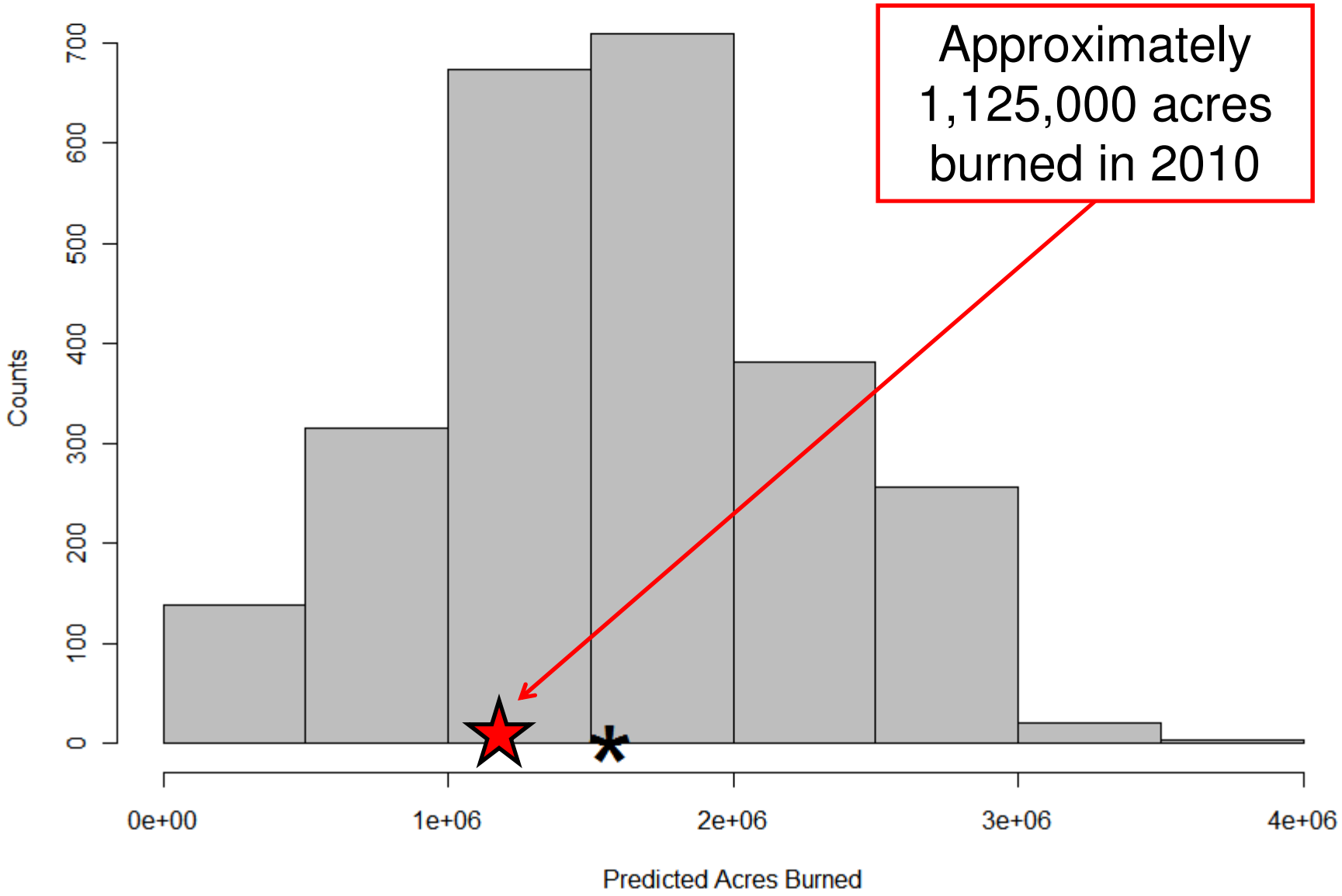
* End of May Model

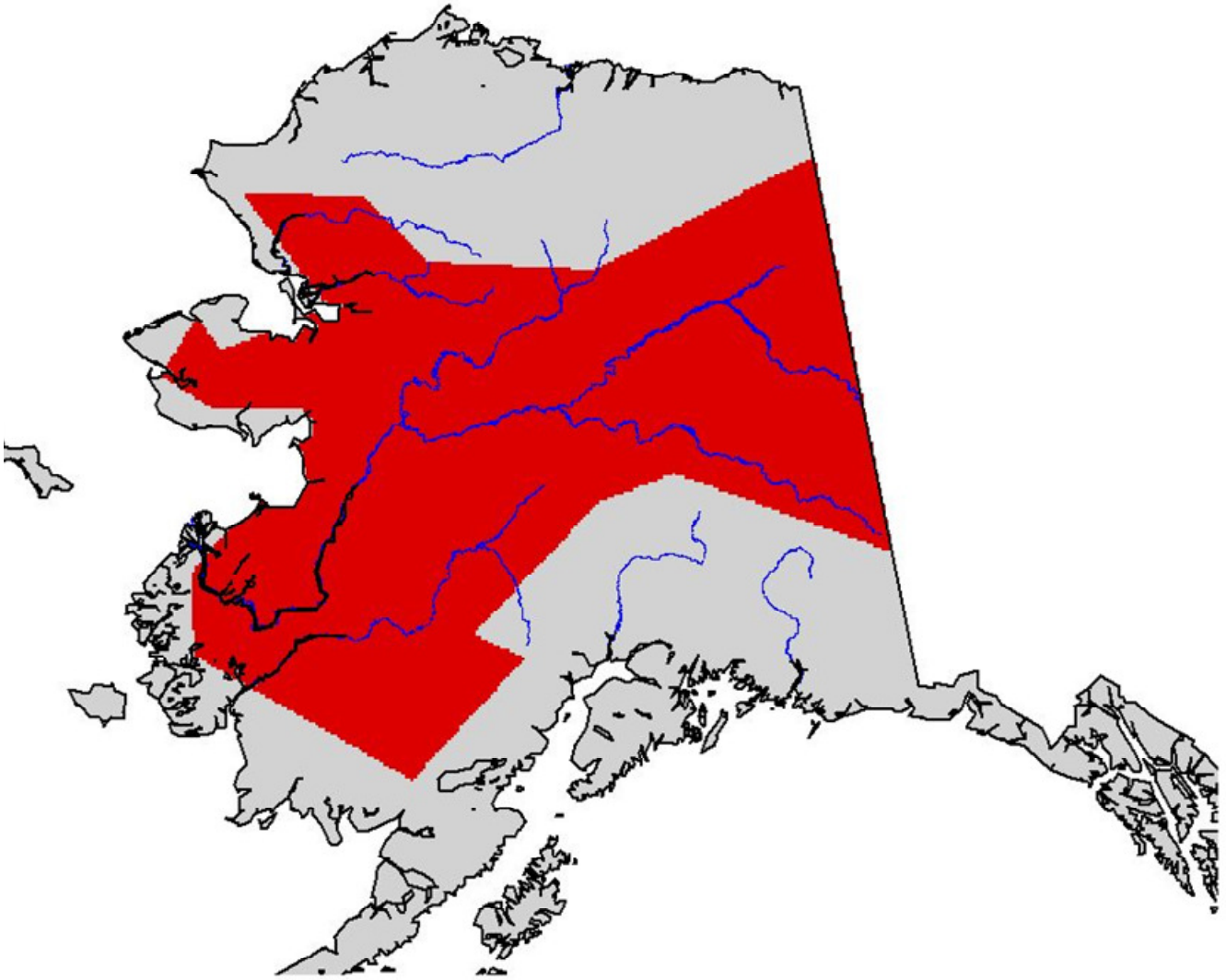
80% Uncertainty Intervals of Cross-Validated Predictions



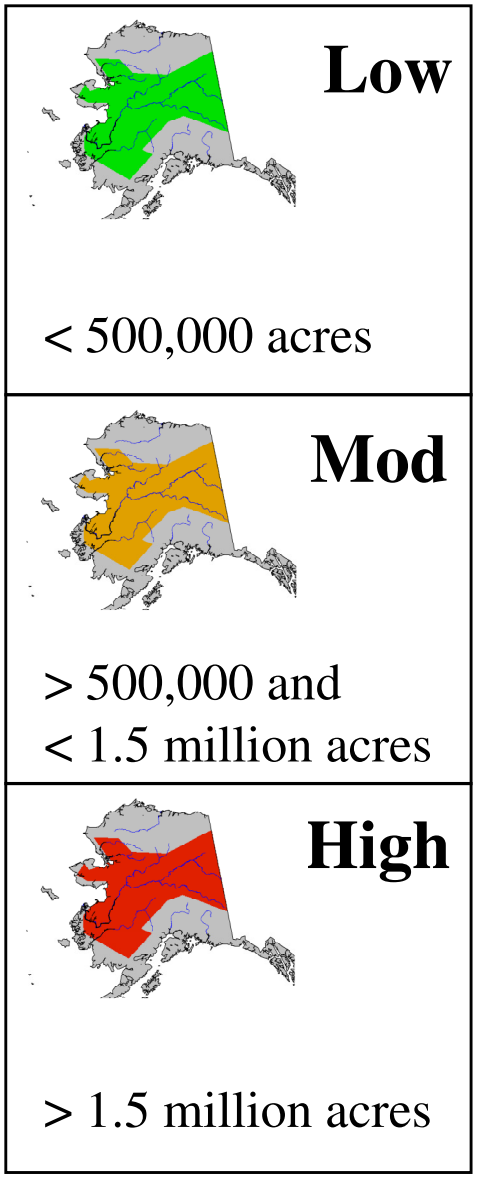
*Cross-Validation performed by re-fitting the model 5000 times, each time eliminating 29 years of data

Distribution of May 2010 Predictions from GBM

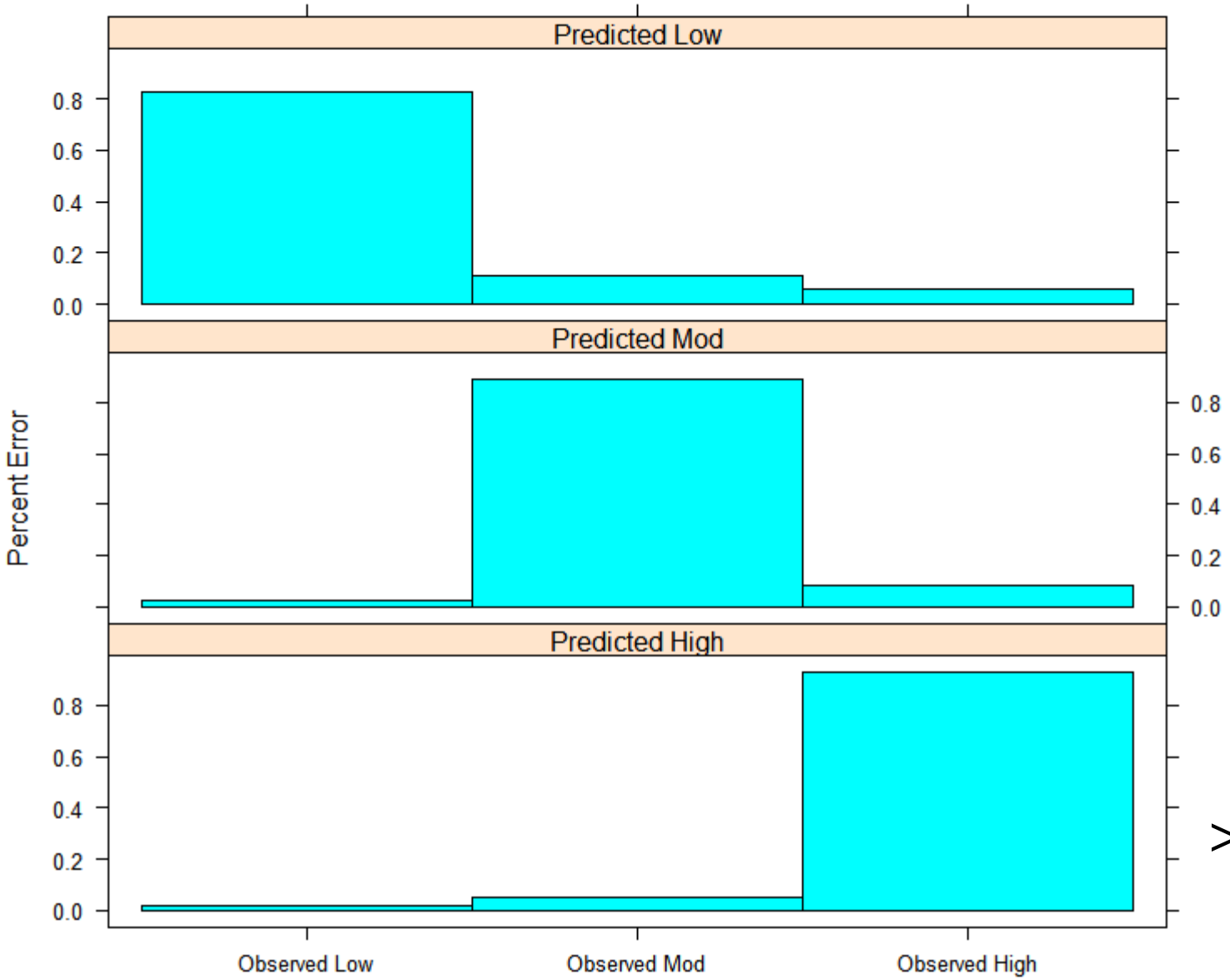




Median May prediction is 1,570,000 acres



Error Table for Predictions Based on May Data



< 500,000 ac

> 1,500,000 ac

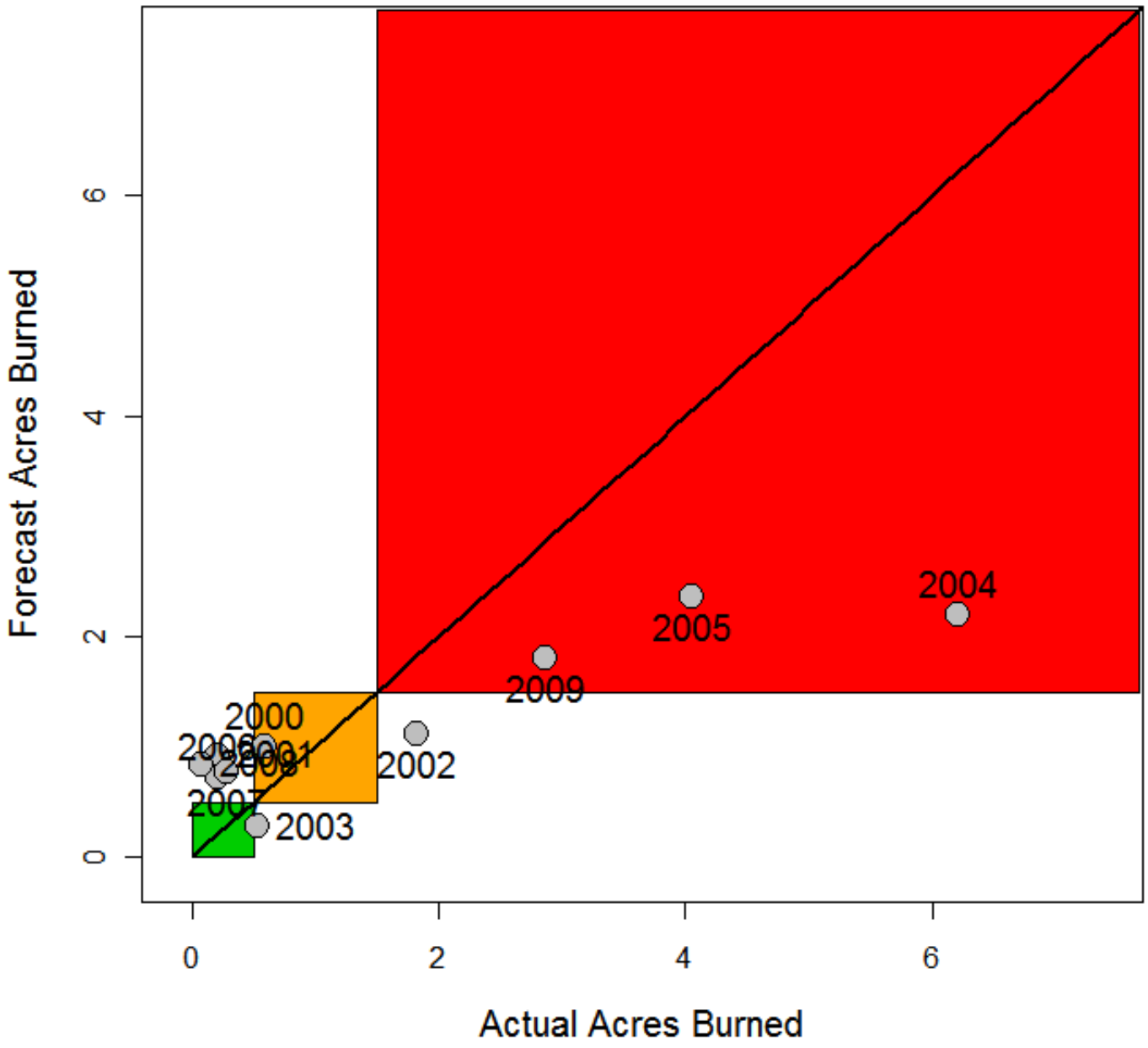
< 500,000 ac

> 1,500,000 ac

Historical Performance

- Imagine it is March 2000….
- What type of forecast would this product obtain using only the data from 1950-1999?
- Now use this same approach for 2000-2008

Historical Forecasts with May 2009 Model



Conclusions

- Annual area burned in Alaska is strongly driven by climatic factors
- This link can be used to generate forecasts
- Experimental forecasts will be available monthly
- http://www.snap.uaf.edu/fire_prediction_tool/

Conclusions

- This work can be the first step in the development of a decision framework
- Framework can incorporate manager input regarding the determination of thresholds for categories
- Decisions can be supported using this framework

Acknowledgements

- Alaska Wildland Fire Coordination Group
- National Oceanic and Atmospheric Administration, U.S. Department of Commerce
- Alaska Center for Climate Assessment and Policy
- Scenarios Network for Alaska Planning