Early Season Forecasting of Fire Activity in Alaska

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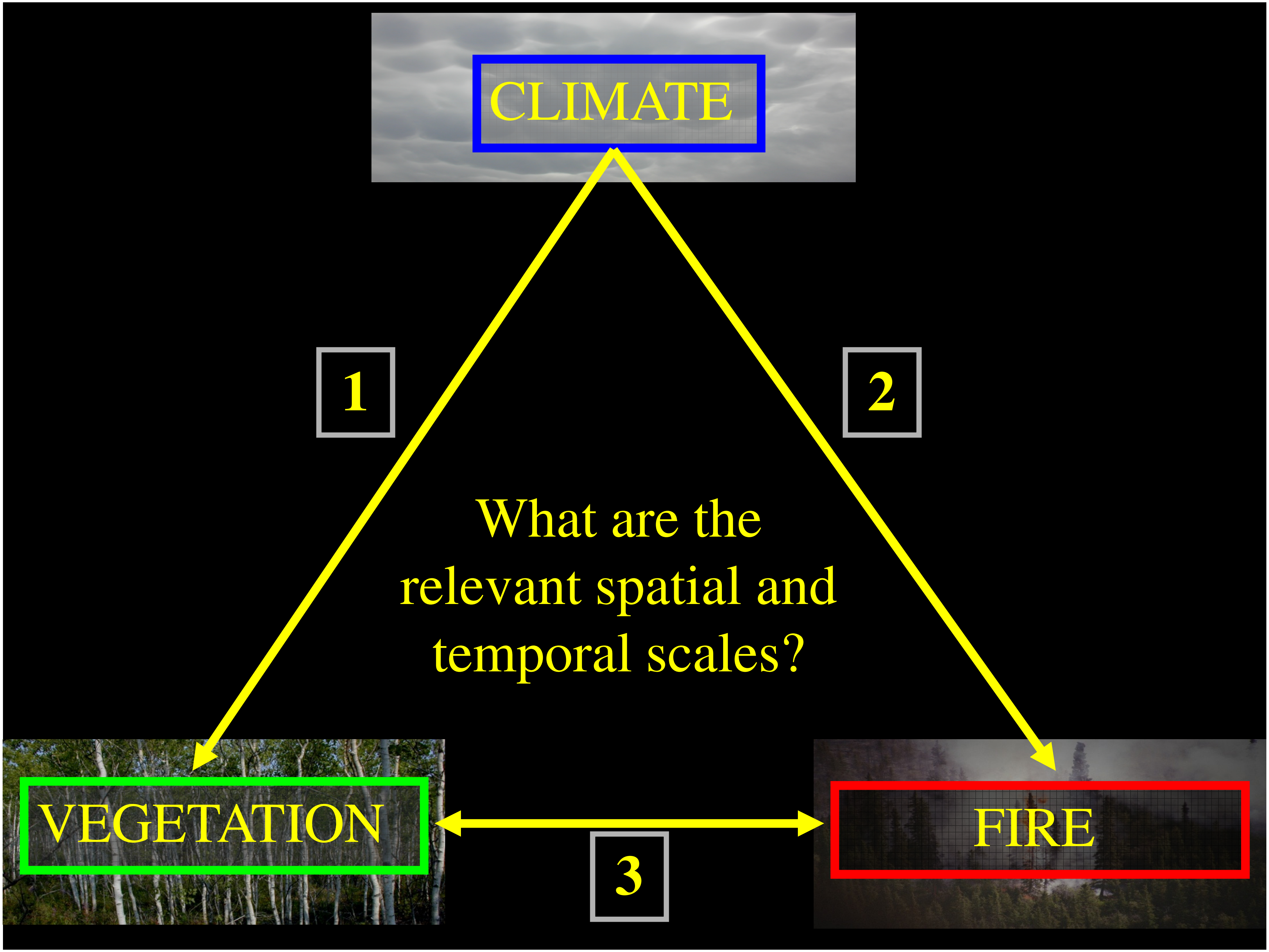
Why is Forecasting Important?

- Goal of forecasting is to provide managers with one more piece of information that they can use to make decisions

- Early season forecasts can be used to ensure necessary resources are made available to the extent possible


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

2

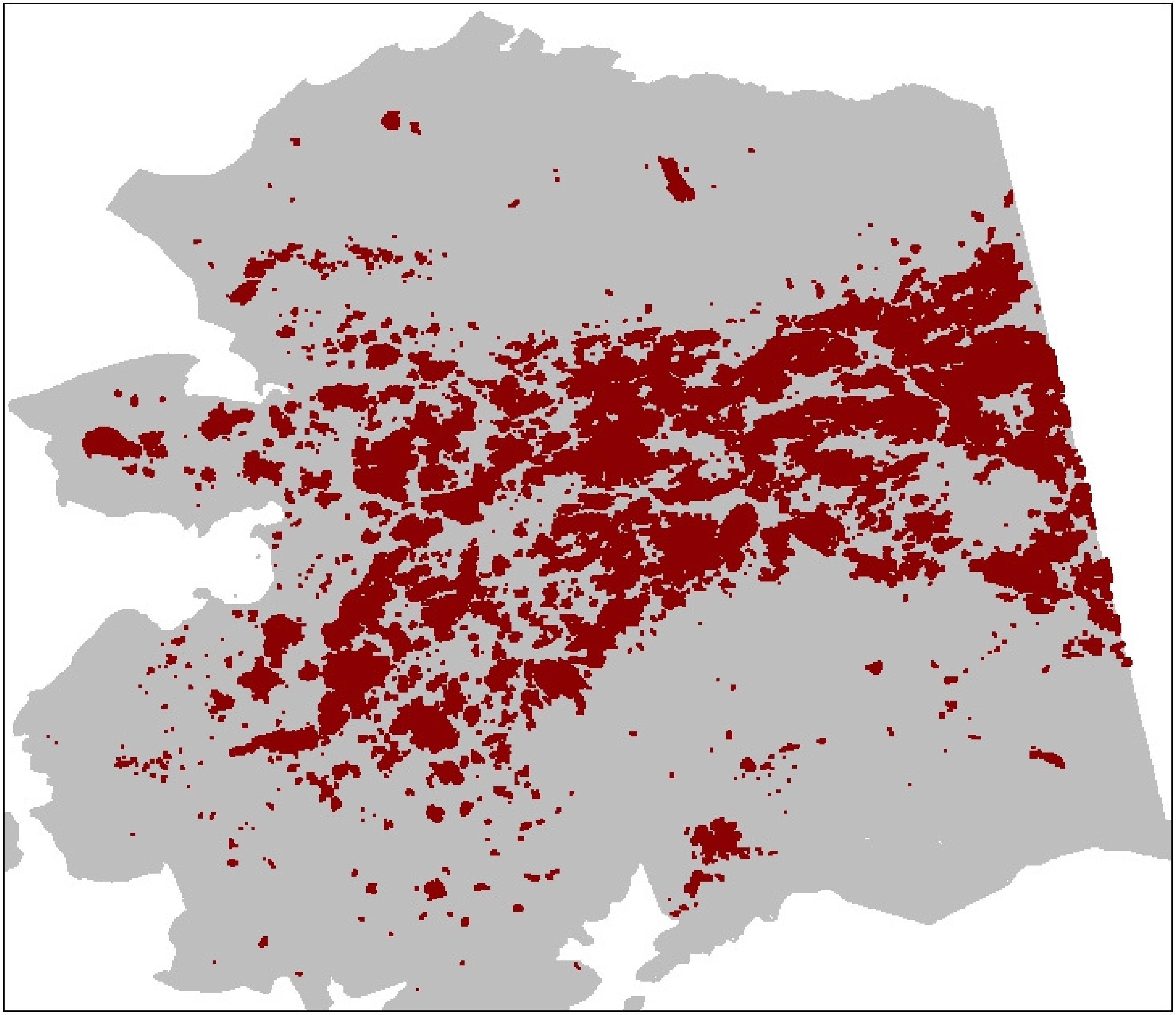
Obvious link between climate/weather and fire during the summer

Can the early season atmospheric circulation help develop a forecast?

Estimation Model Development

- The response of interest is annual area burned for the entire state
- Why this?
- Large enough region that we can more easily ignore the ignition component

Statewide Fire Scars for 1940-2011



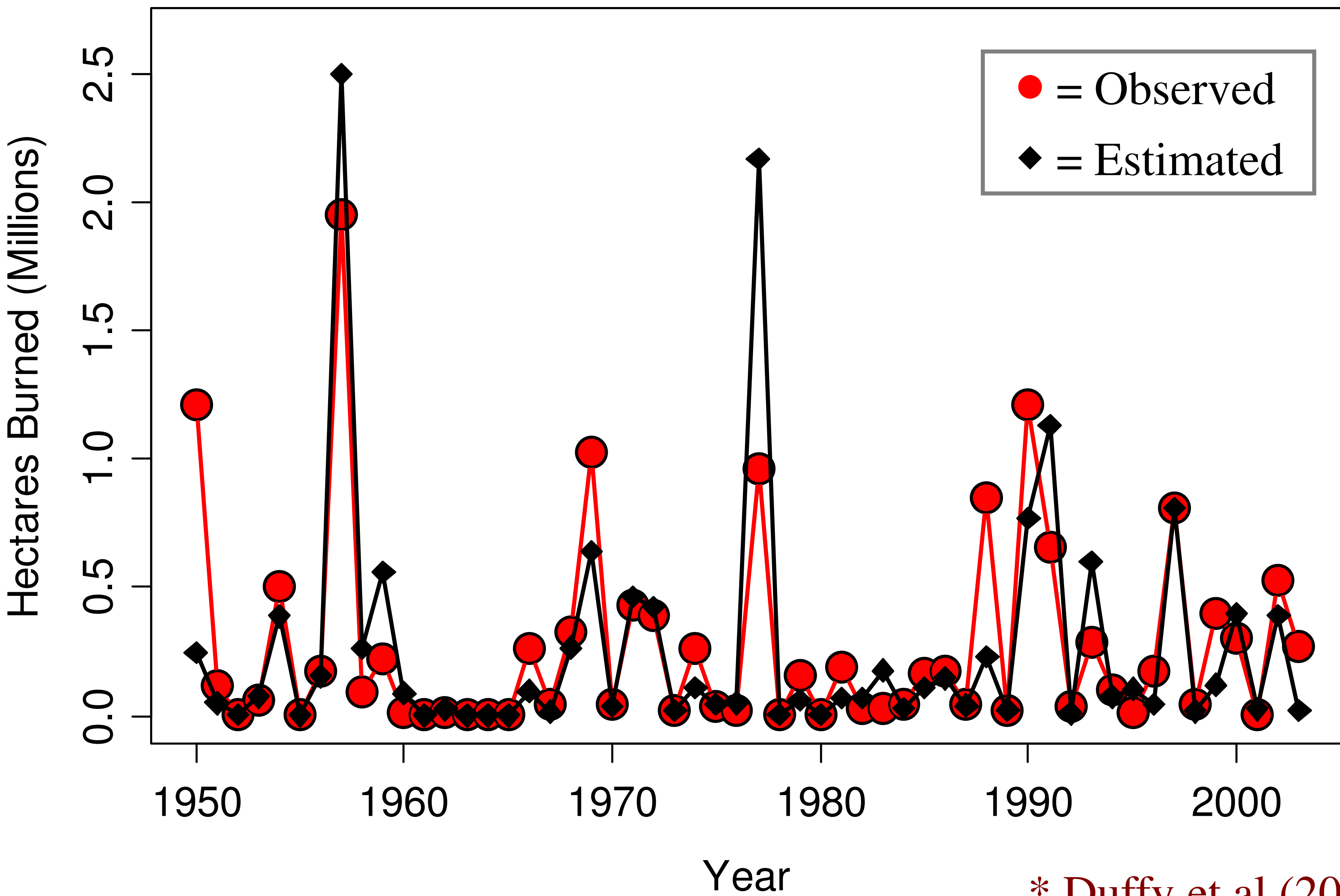
Statistical Model Development

- 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

Observed and Estimated Area Burned for 1950-2003



* Duffy et al (2005)

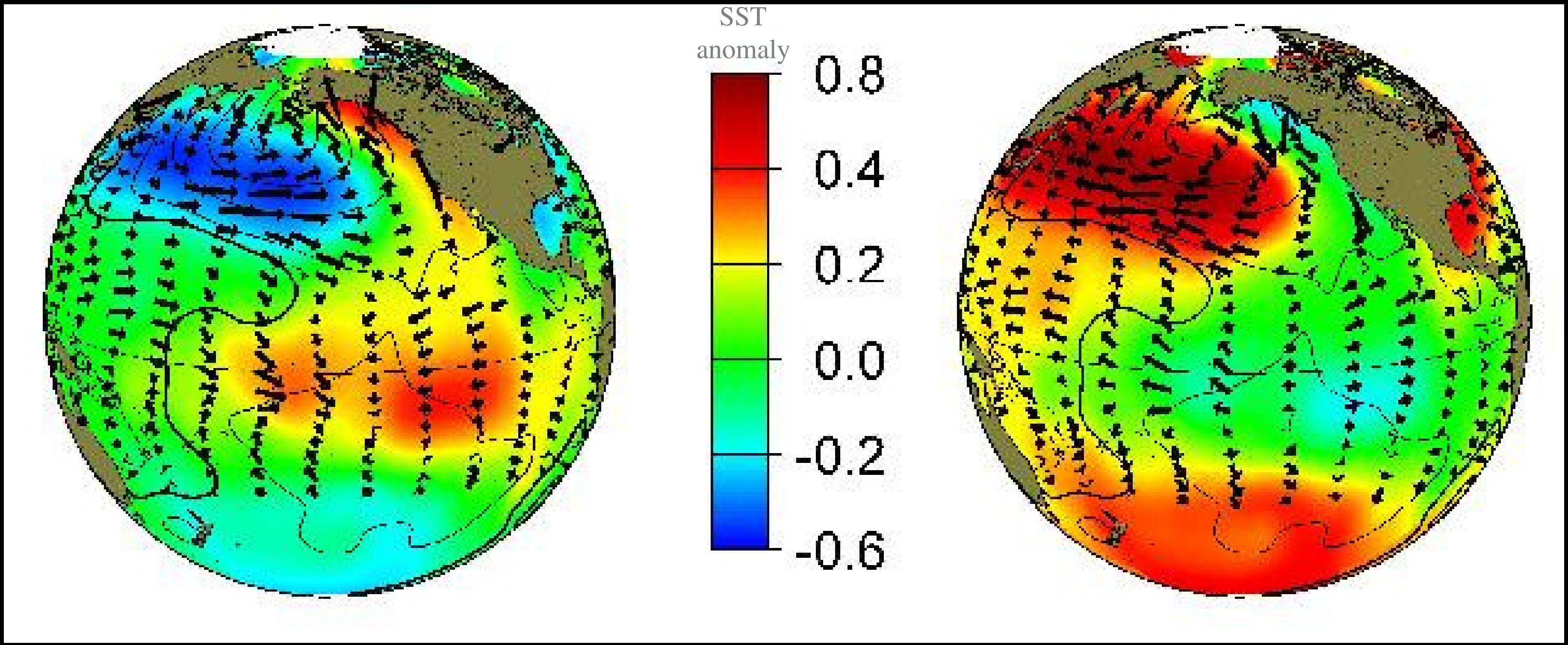
Building Predictive Models

- Next step is to apply GBM approach using “pre-season” variables
- Construct a statistical model with information from several different teleconnection indices

Atmospheric Teleconnections

- ENSO is probably the most familiar
- Recurring and persistent shift in atmospheric circulation and/or sea surface temperatures

Pacific Decadal Oscillation



* Figure courtesy of Hare IPHC

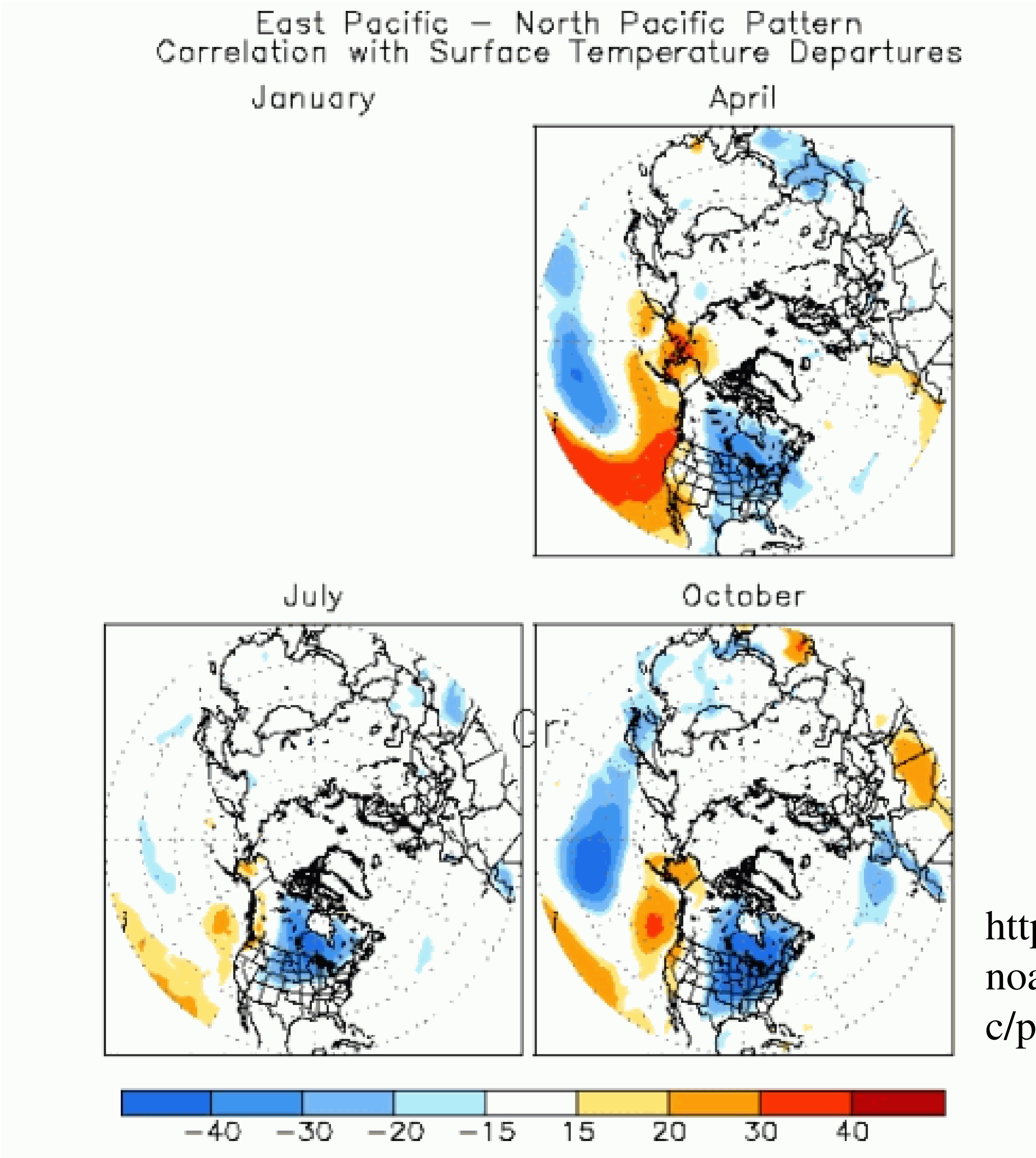
Building Predictive Models

- Currently, this process is performed monthly for March through August
- Data are available at the end of each month

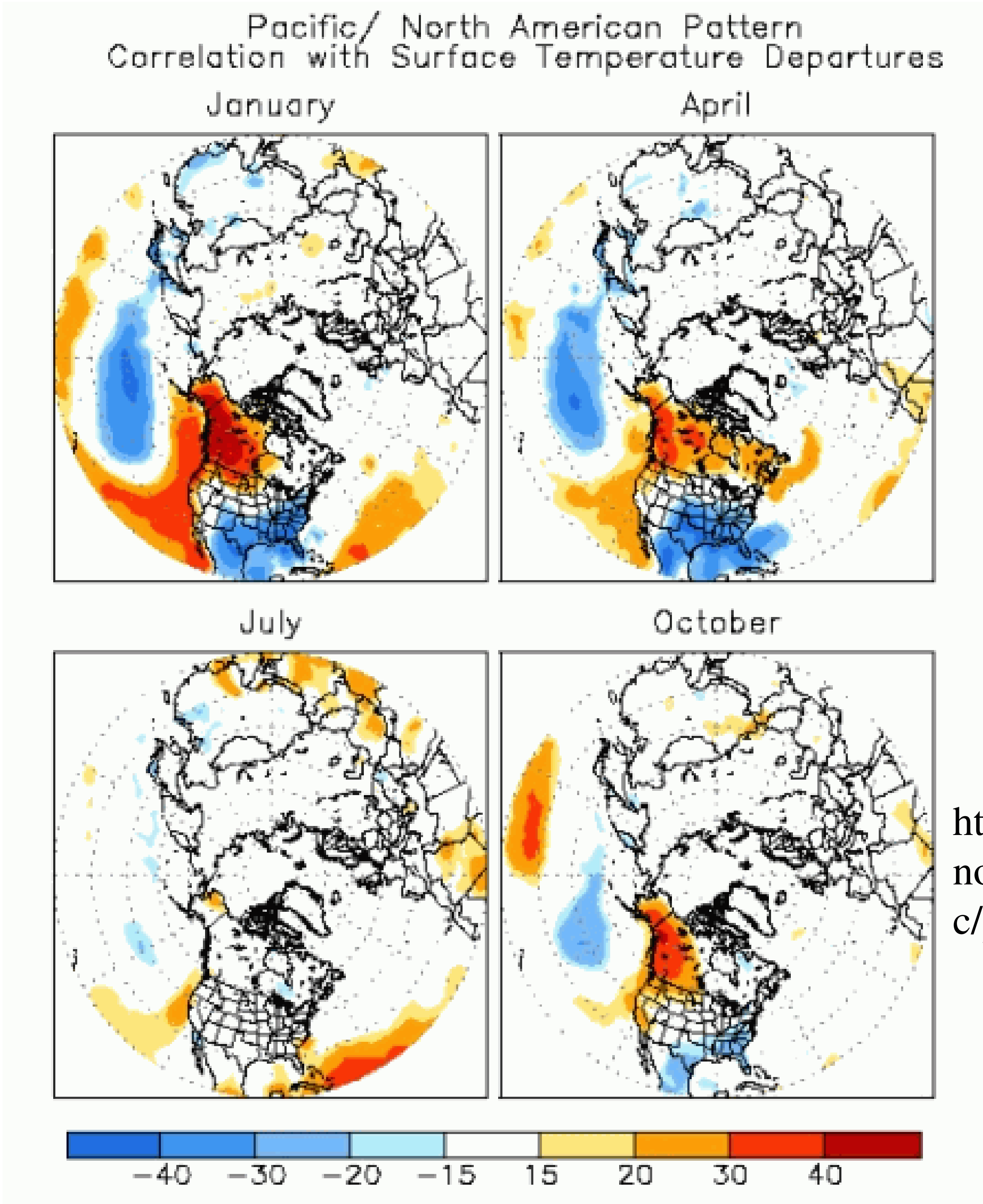
Building Predictive Models

- Use a stepwise procedure to select the teleconnections to be used for explanatory variables
  - Polar (Jan, Feb avg)
  - East Pacific/North Pacific (Jan to May average)
  - Pacific North American (May)
  - May Temperature

* End of May Model



http://www.cpc.ncep.noaa.gov/data/teledoc/pna_tmap.shtml



http://www.cpc.ncep.noaa.gov/data/teledoc/pna_tmap.shtml

Current Model

- Advantages
  - Works reasonably well
  - Relatively simple to interpret

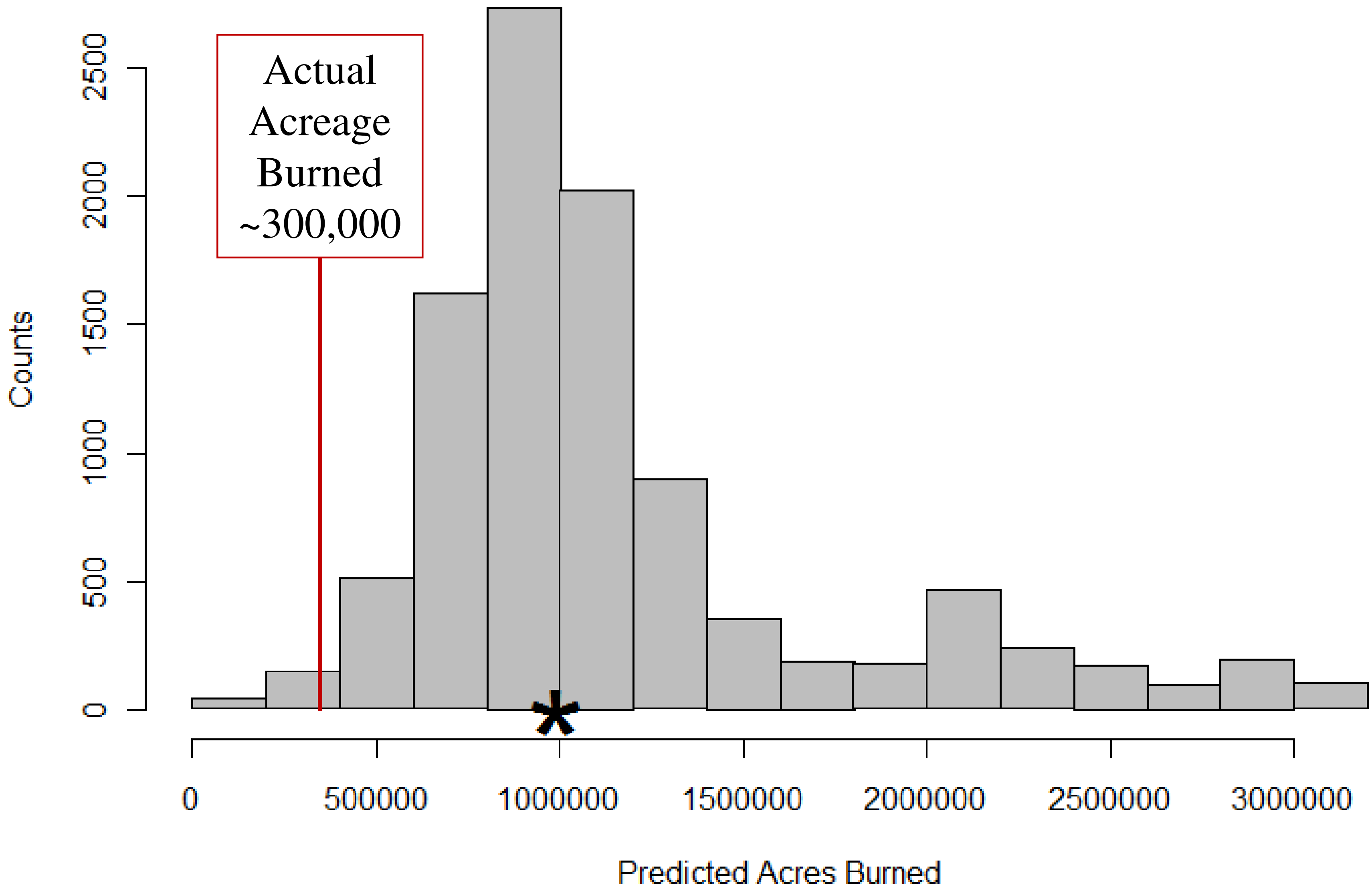
- Disadvantage
  - No information about where fires are most likely

Gradient Boosting Models

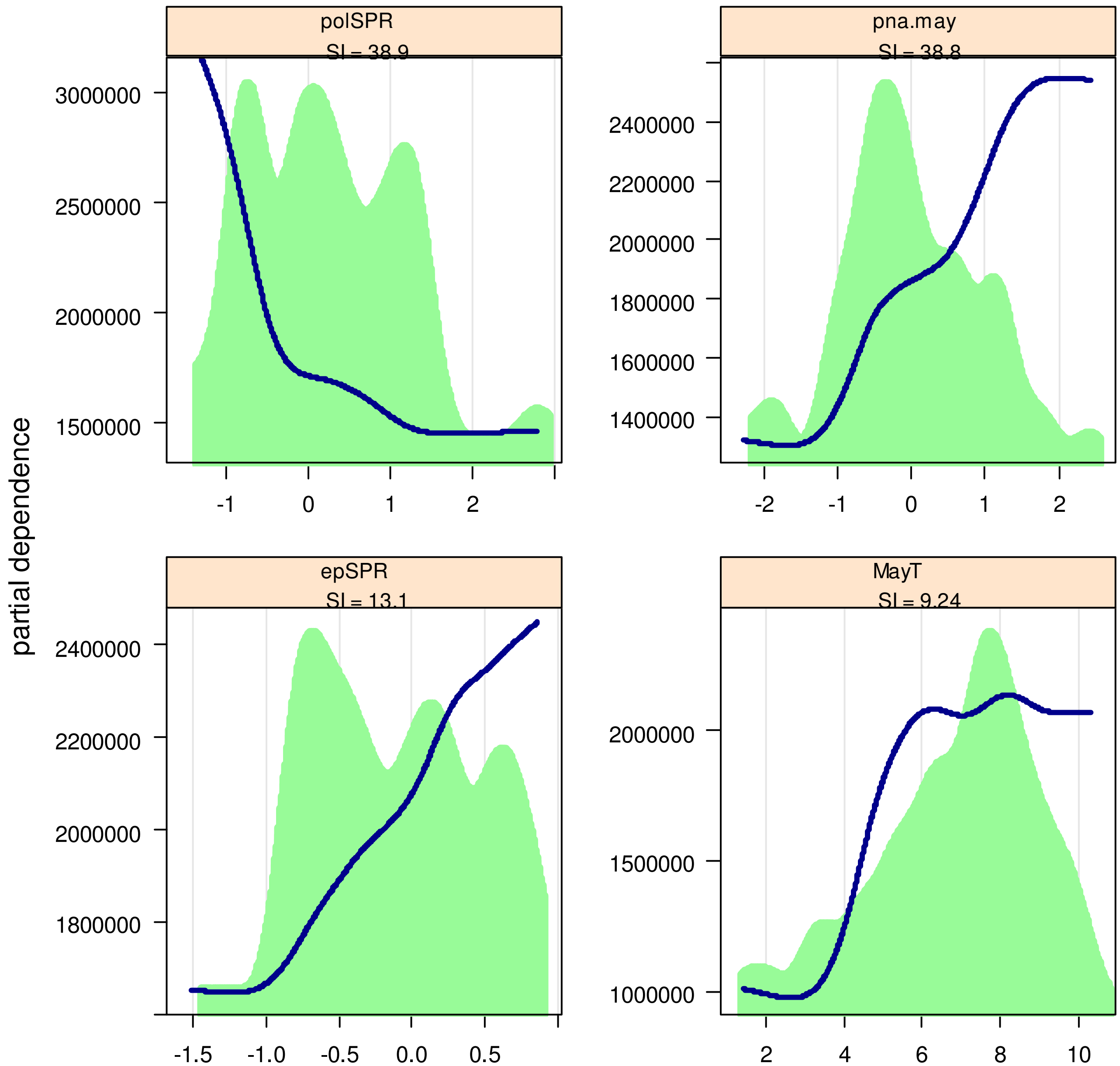
- Stochastic regression tree algorithm used in machine-learning
- Cross-validated model building
- Distribution of forecasts allows for the quantification of uncertainty

* Used the ‘gbm’ library in R stat software

Histogram of Forecasts Based on May Data

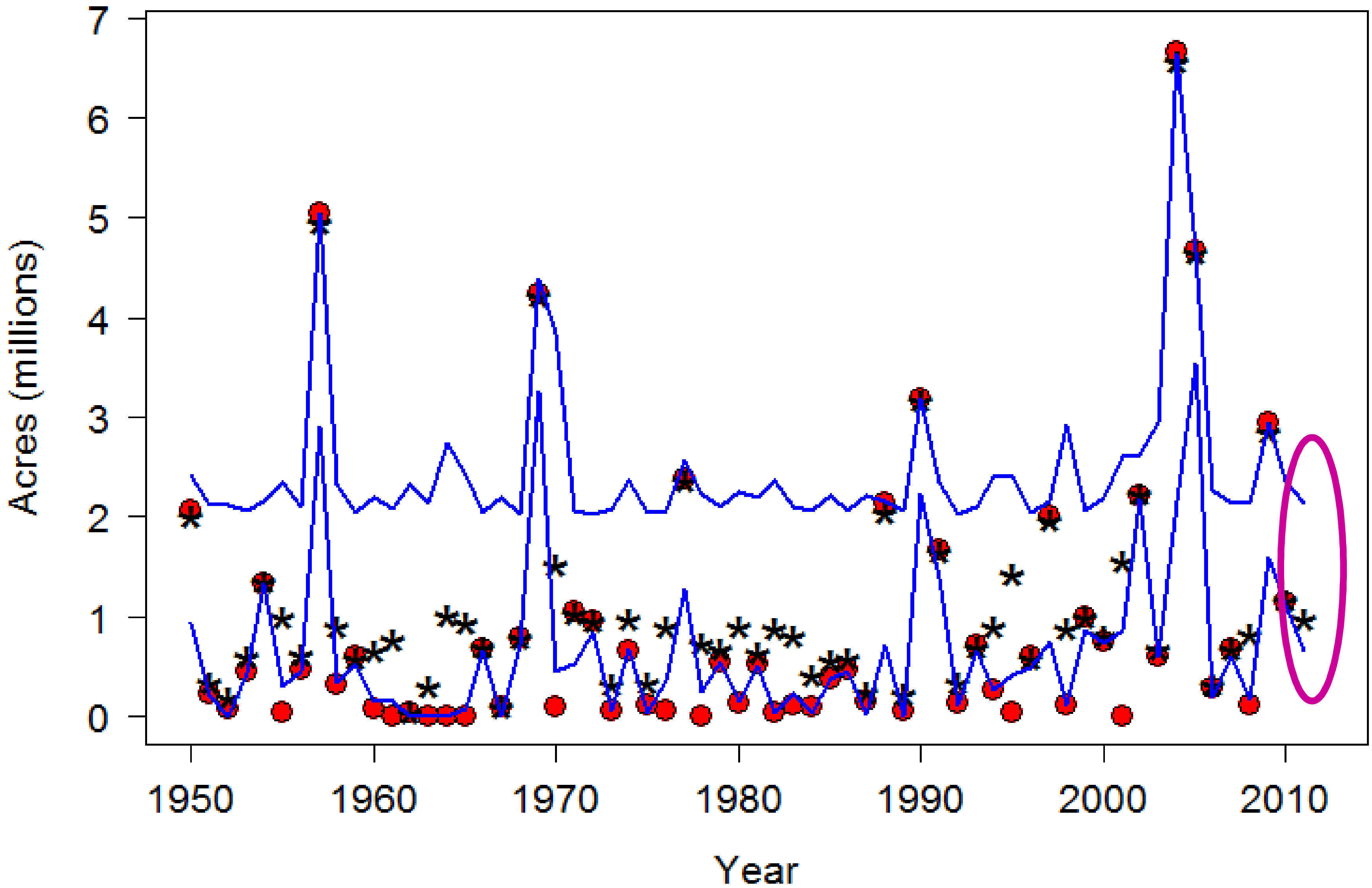


Partial Dependence Plots for GBM model



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

Distributions of Cross-Validated Predictions



xRISA - Mozilla Firefox

File Edit View History Bookmarks Tools Help

snap.uaf.edu/fire_prediction_tool/

xRISA Neptune

xRISA

Experimental Forecast of Area Burned for Interior Alaska

Forecast | Methodology | 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:

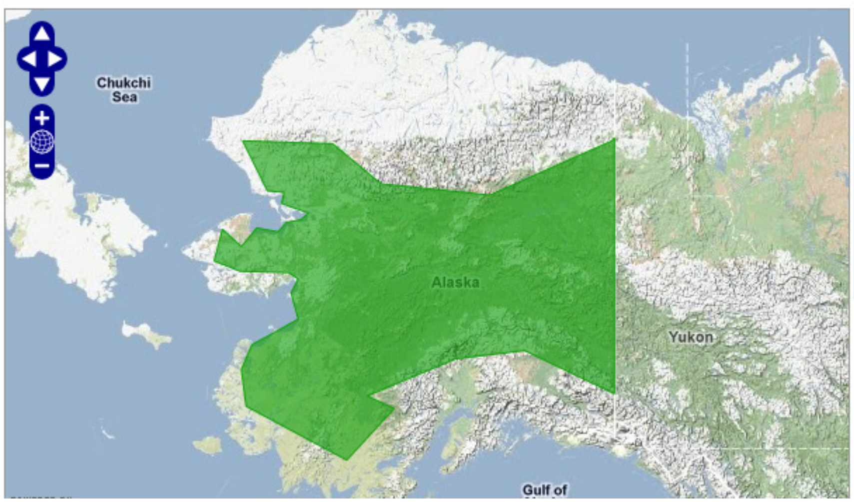
- **Low** (less than 500,000 acres)
- **Moderate** (between 500,000 and 1,500,000 acres)
- **High** (greater than 1,500,000 acres)

Median Forecast for the 2011 season is 450,000 acres (Low) as of the end of July.

292,440 acres have burned as of August 15th

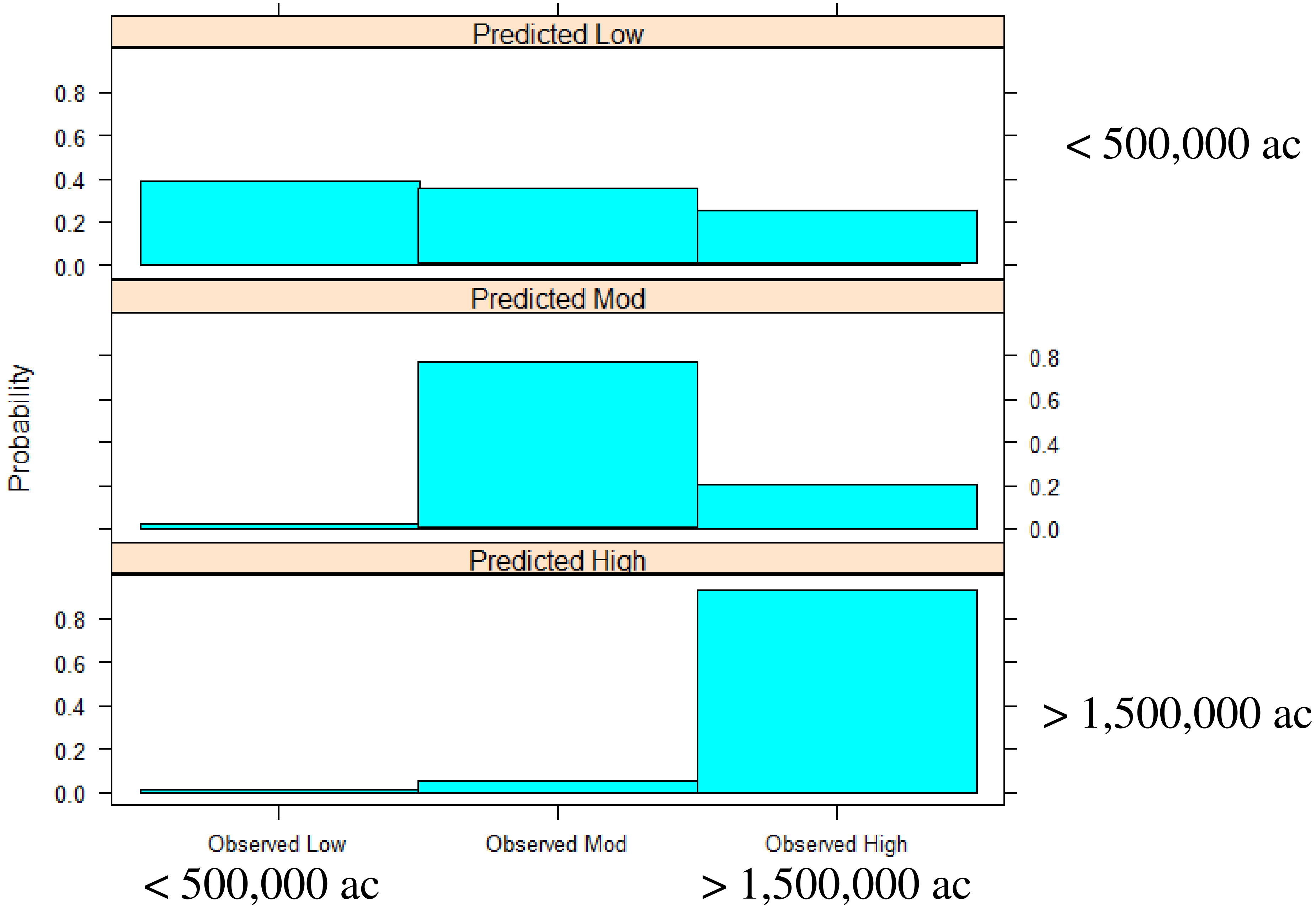
http://fire.ak.blm.gov/content/sitreport/current.pdf

- There is a 61% chance that less than 500,000 acres will burn.
- There is a 39% chance that between 500,000 and 1,500,000 acres will burn.
- There is a 0% chance that more than 1,500,000 acres will burn.



- Base Layers
- 2011 Forecasts
  - July [Low]
  - June [Moderate]
  - May [Moderate]
  - April [High]
  - March [Moderate]
- 2010 Forecasts
- 2009 Forecasts
- Other Layers

Error Table for Predictions Based on May Data



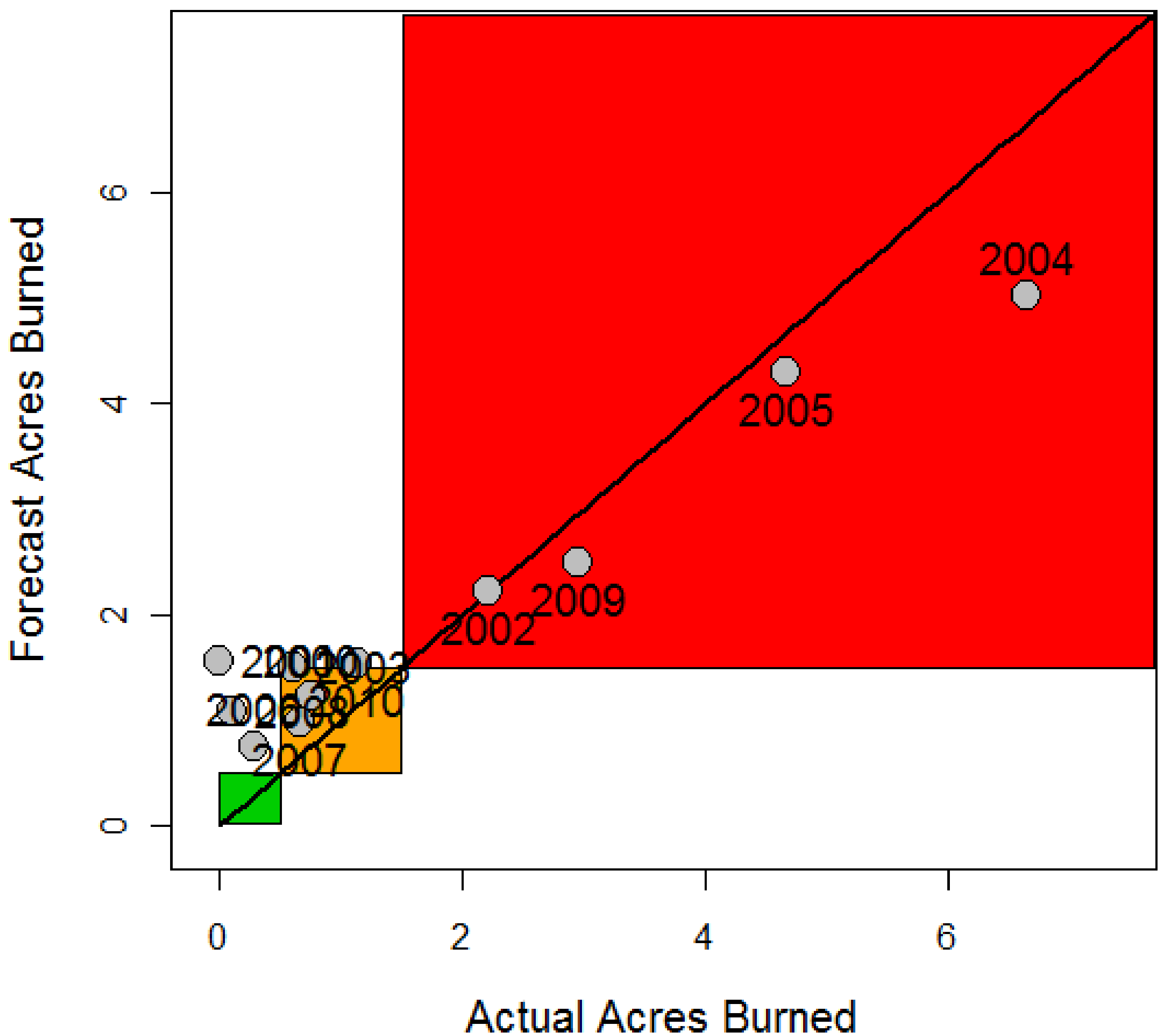
Historical Performance

- Imagine it is May 2000….

- What type of forecast would this product obtain using only the data from 1950-1999?

- Now use this same approach for 2000-2011

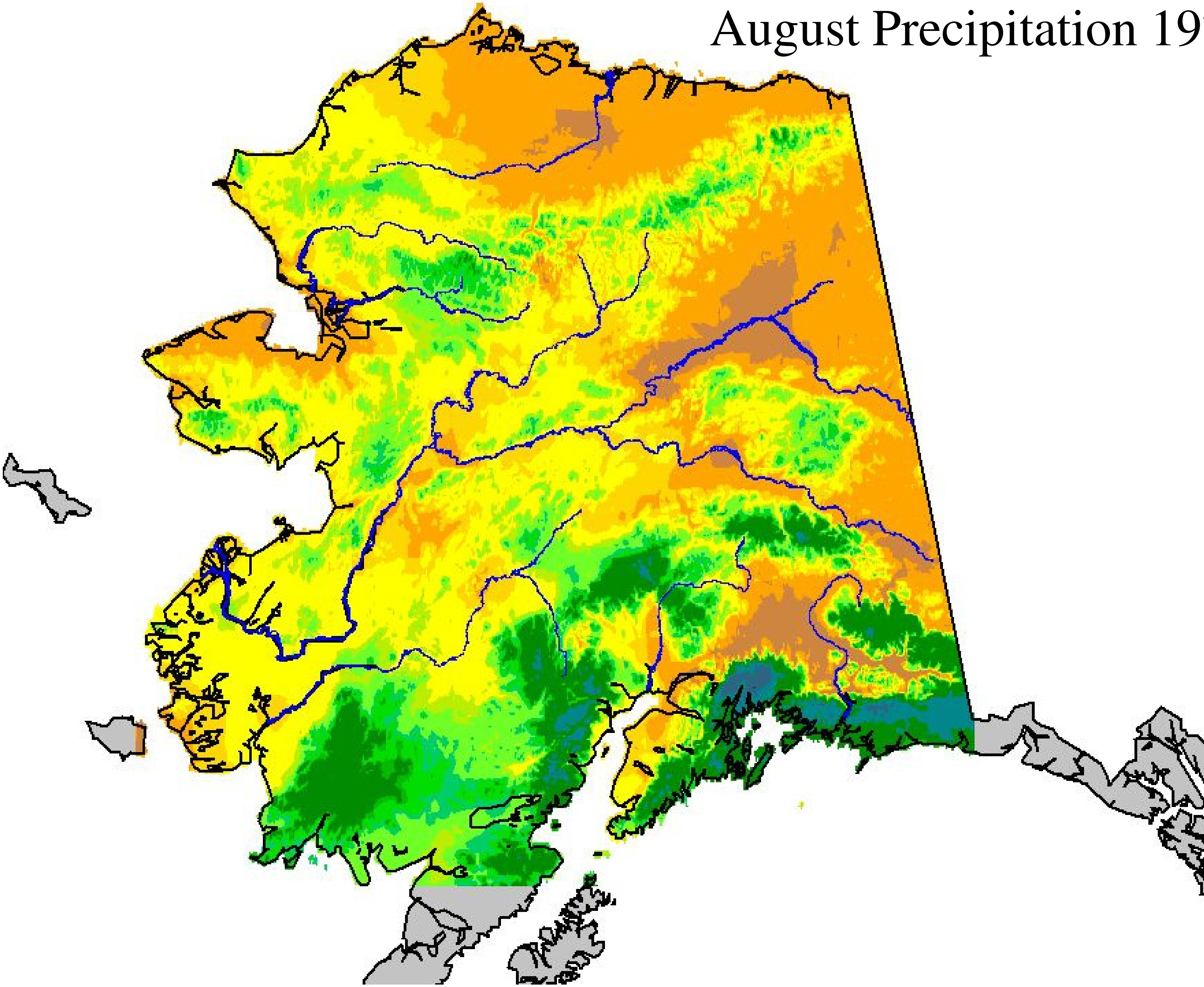
Historical Application of Predictions from May Model



Experimental Spatial Forecast

- We can also extrapolate these point models across space using spatially explicit data sets
- We have spatially explicit monthly temperature and precipitation for roughly 1920 -present

August Precipitation 1977



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