



Early Season Forecasting of Fire Activity in Alaska

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Why is Fire Important in Alaska?

A photograph of a forest fire. A large, tall evergreen tree in the center is engulfed in bright orange and yellow flames, with thick white and grey smoke rising from it. The surrounding forest consists of many other evergreen trees, some of which are partially obscured by the smoke. The overall scene is dramatic and illustrates the impact of fire on a forest.

- Dominates the disturbance regime

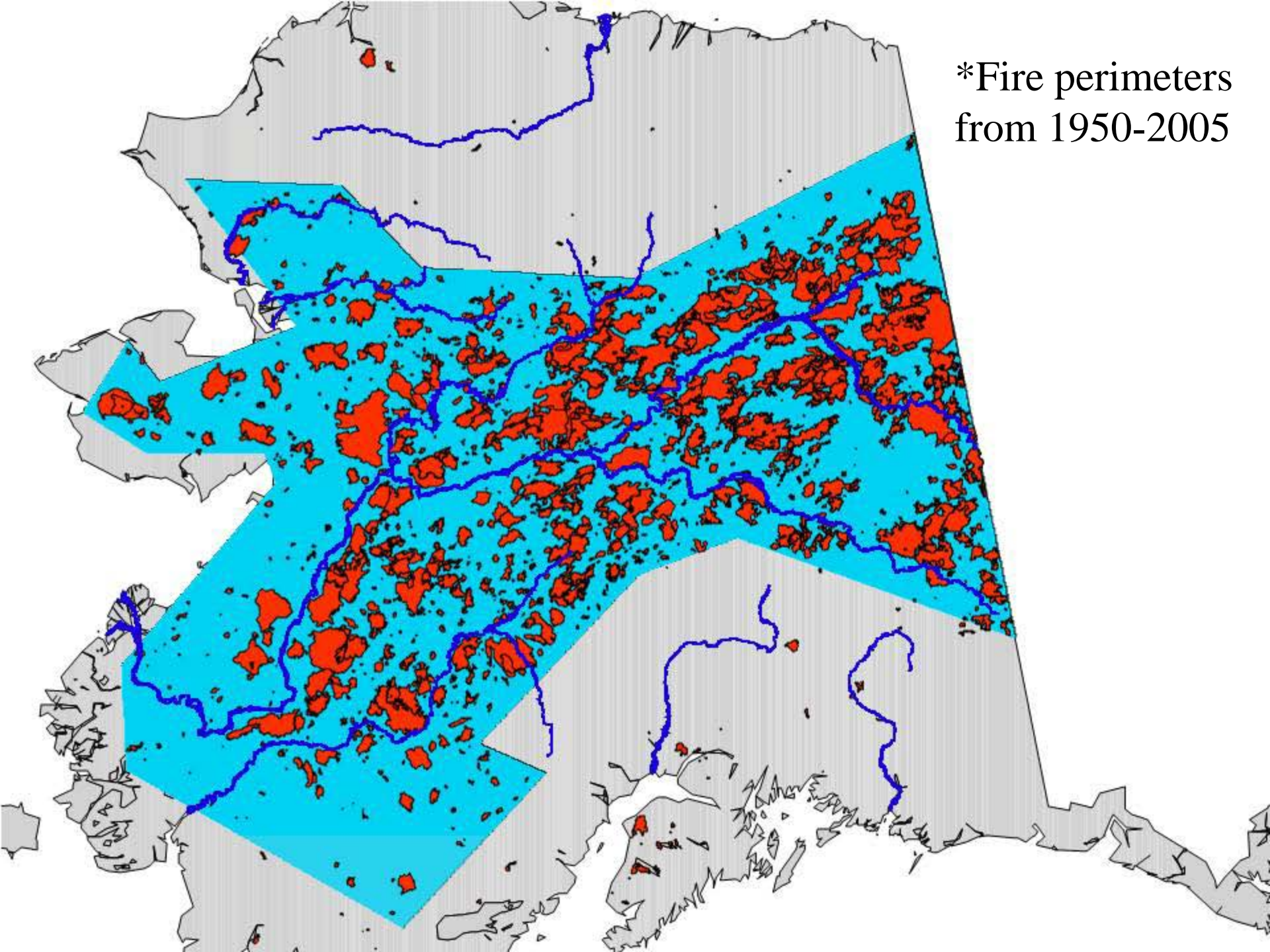
- Succession modifies forest structure



Why is Fire Important in Alaska?

- Interior Alaska contains 150 million burnable acres (approx. equal to MT and ID combined)
- Average annual area burned is 840,000 acres, Median is 334,000 acres
- Largest year burned 6.4 million acres

*Fire perimeters
from 1950-2005



CLIMATE

1

2

What are the
relevant spatial and
temporal scales?

VEGETATION

3

FIRE



CLIMATE

2

Obvious link between
climate/weather and
fire

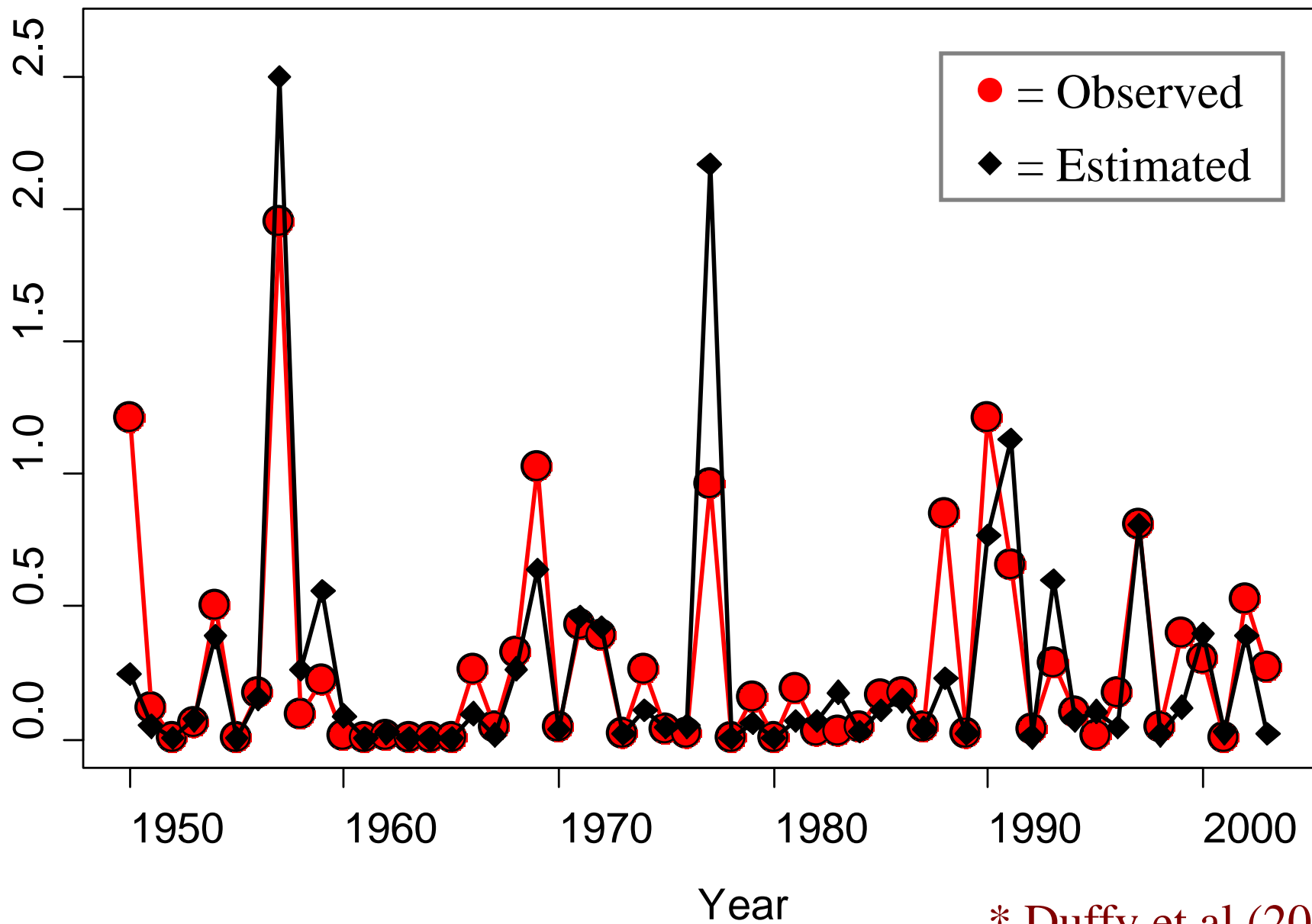
Spatial and temporal
scales of interest....
not so obvious

FIRE

Statistical Model Development

- Response: $\log(\text{Annual Area Burned})$
- 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

Hectares Burned (Millions)



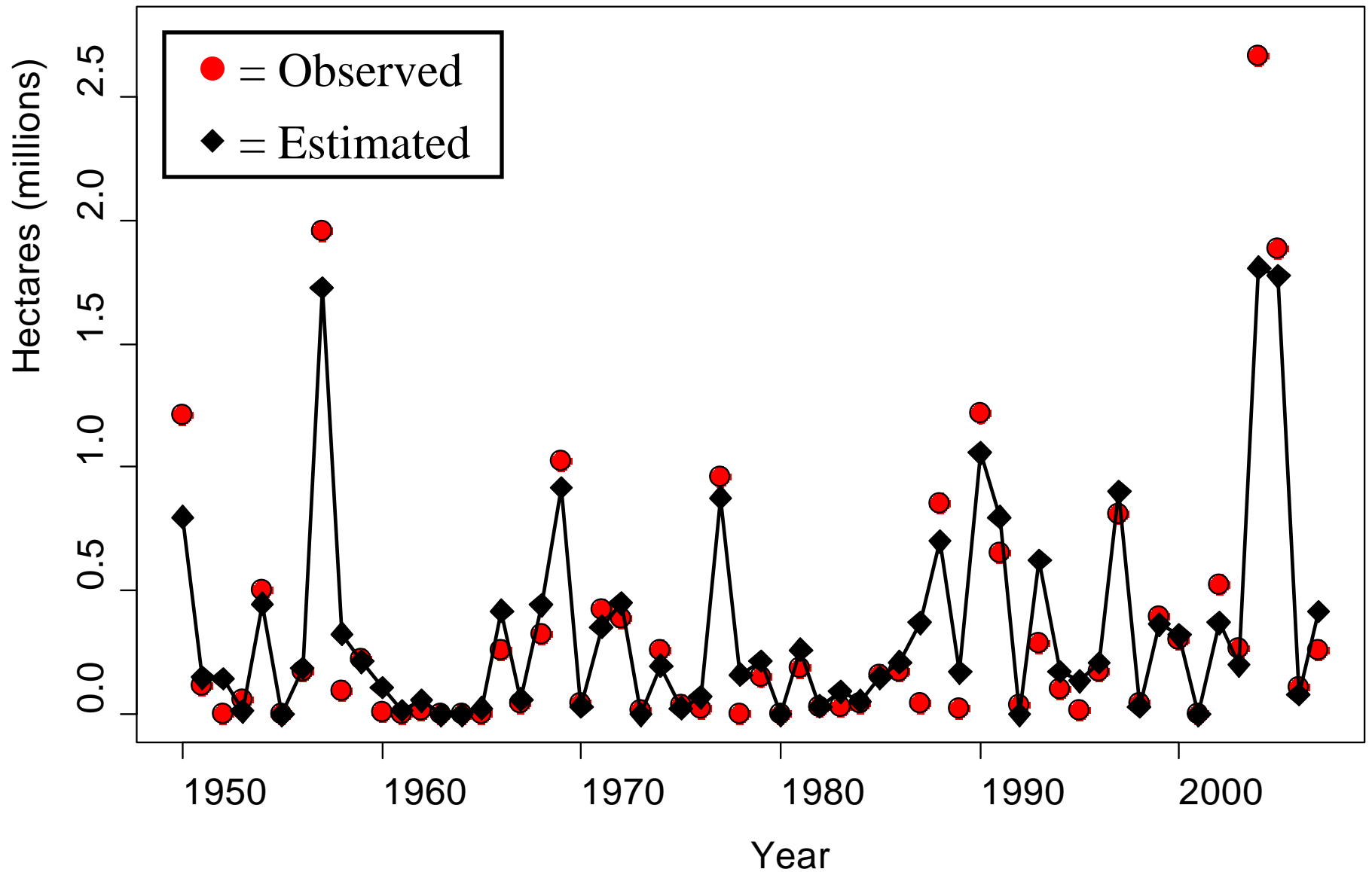
* Duffy et al (2005)

Gradient Boosting Models

- Stochastic regression tree algorithm used in machine-learning
- Similar in concept to regression, but more computationally intensive

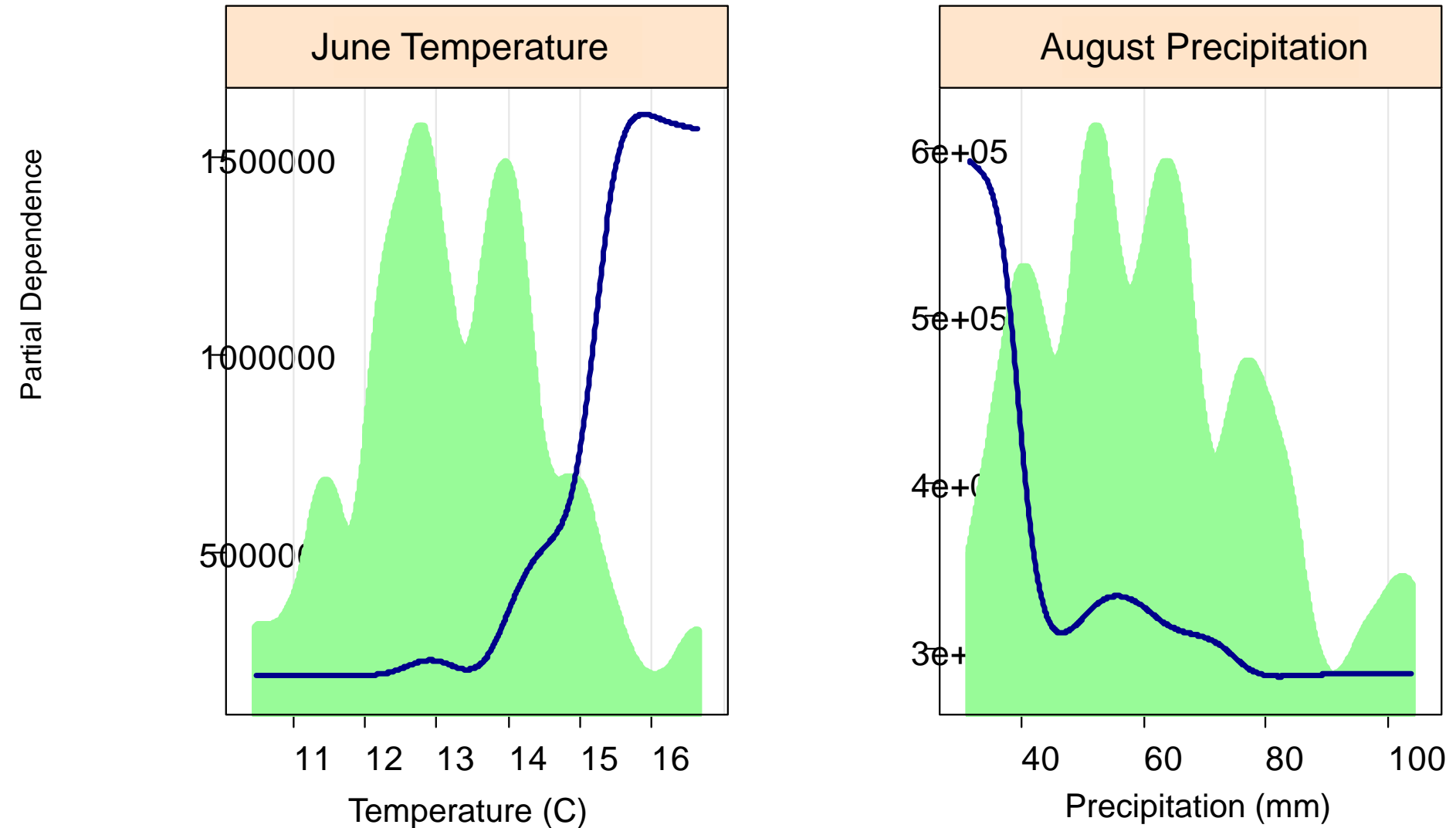
* Used the 'gbm' library in R stat software

Observed vs. GBM estimated Area Burned in Alaska



* Gradient Boosting Model (GBM) Friedman (2001)

Partial Dependence Plots for GBM model



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

Building Predictive Models

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

Building Predictive Models

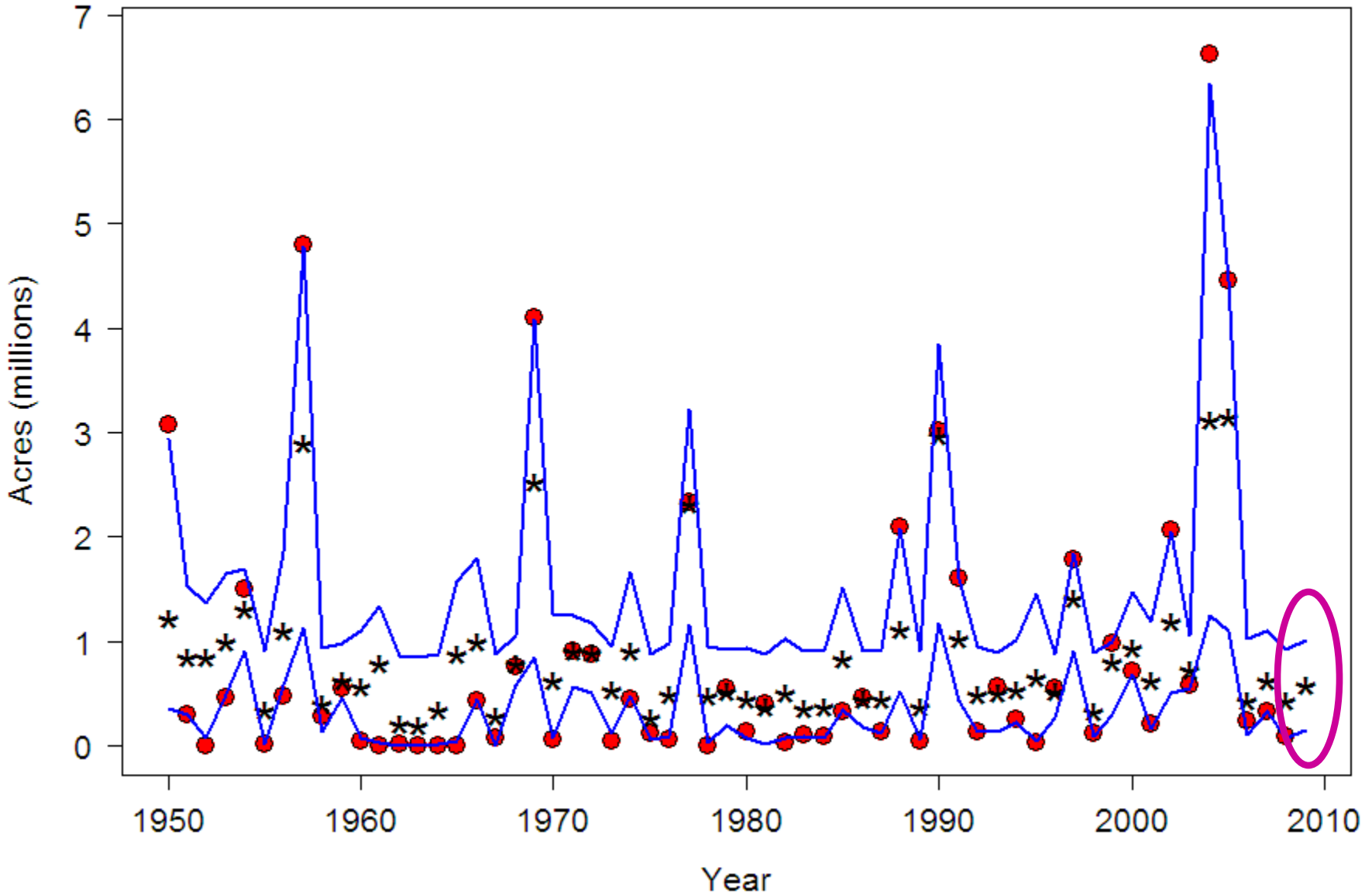
- Use a stepwise cross-validation procedure to select the teleconnections and monthly weather to be used for explanatory variables
- Currently, this process is performed monthly for March through June
- Data are available at the end of each month

Building Predictive Models

- Explanatory variables used
 - Polar (Jan, Feb avg)
 - East Pacific/North Pacific (Apr, Feb difference)
 - Pacific North American (Jan)
 - April precipitation

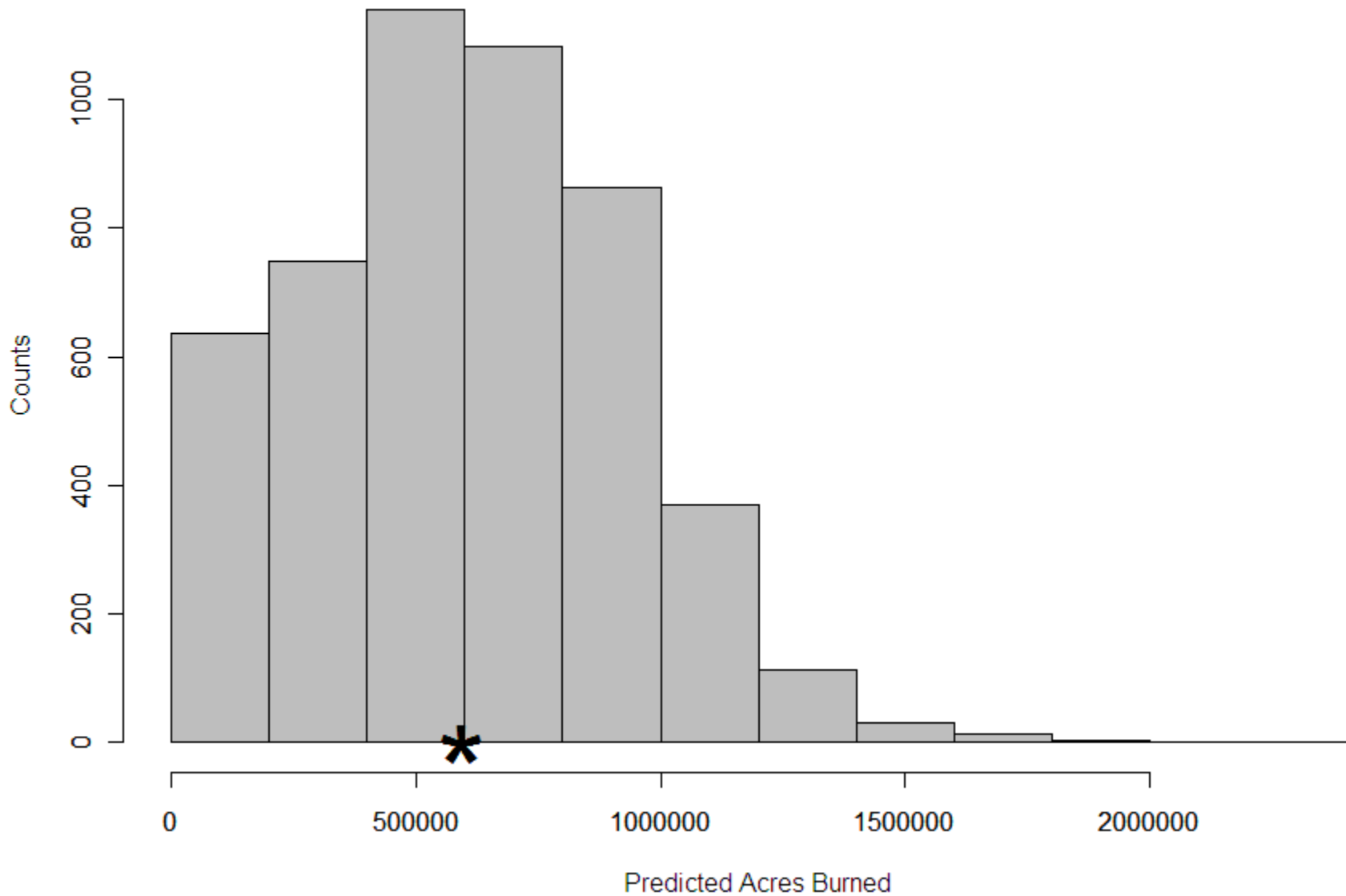
* End of April Model

80% Uncertainty Intervals of Cross-Validated Predictions

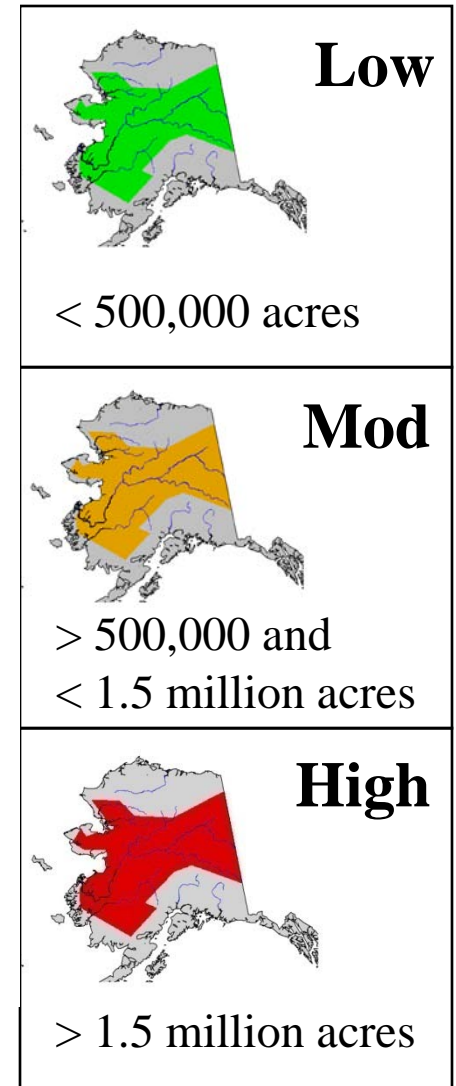
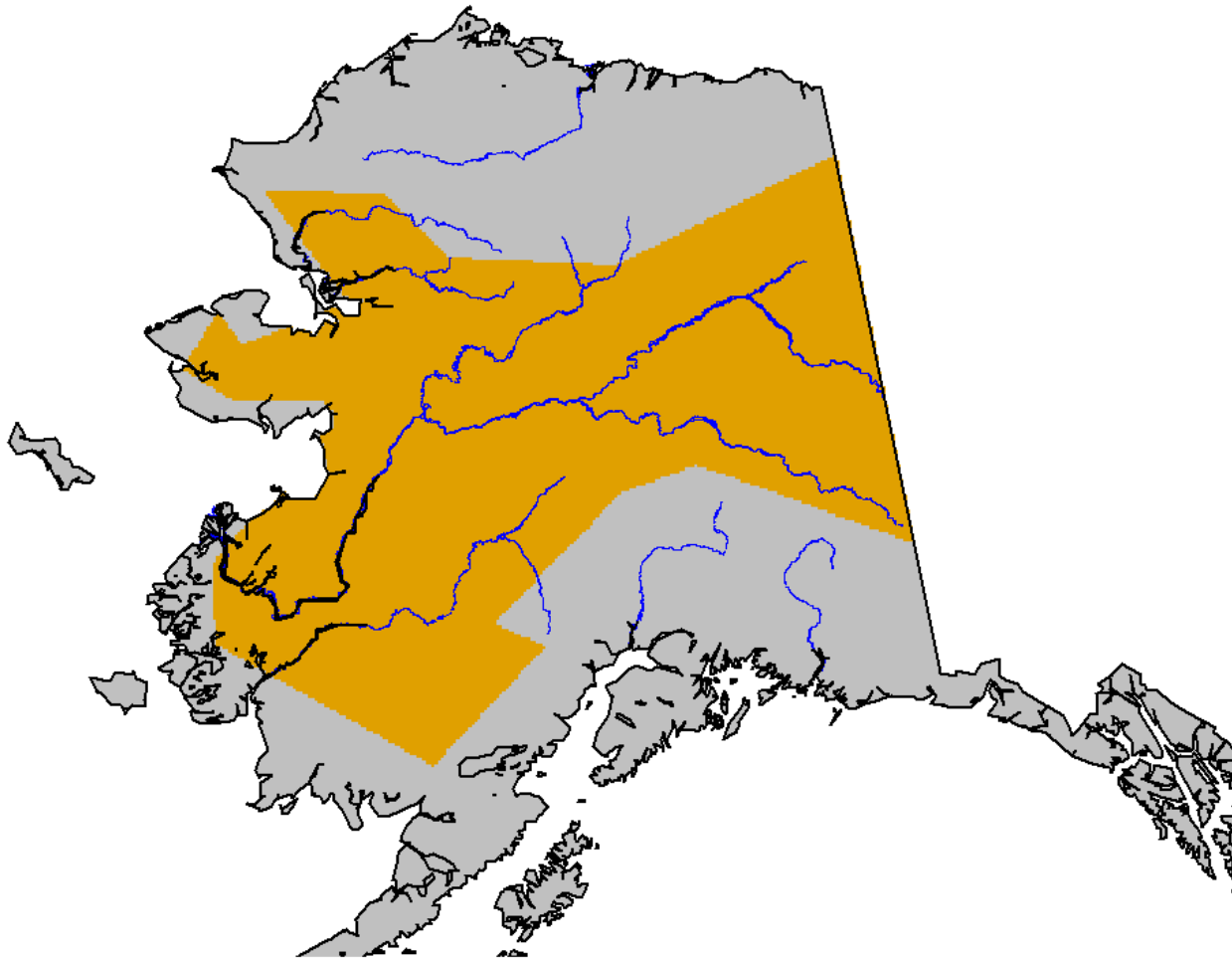


*Cross-Validation performed by re-fitting the model 5000 times, each time eliminating 20 years of data

Prediction(s) for the 2009 Season (April data)

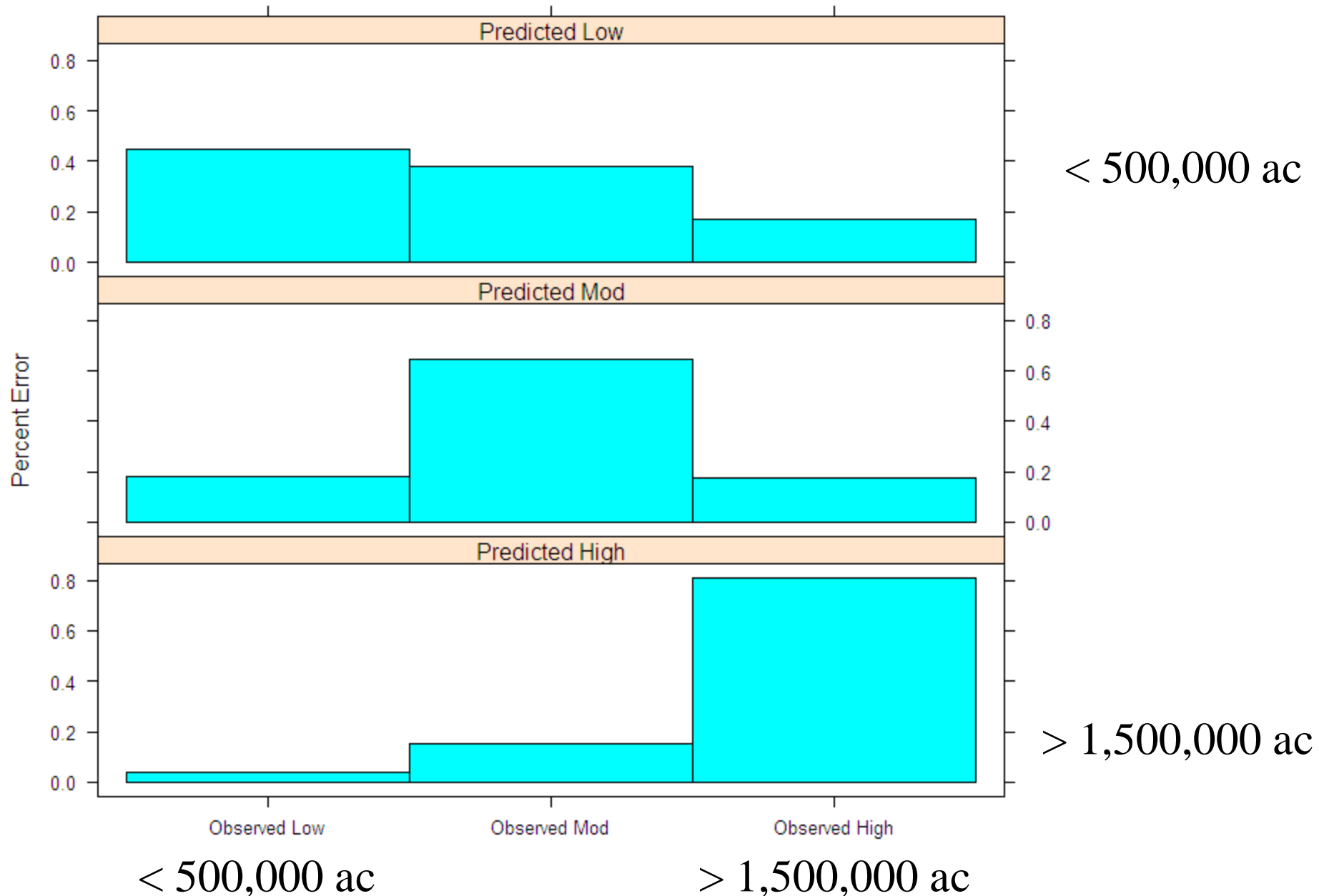


Forecast of Area Burned in 2009 Based on April Data



Median April prediction is 595,674 acres

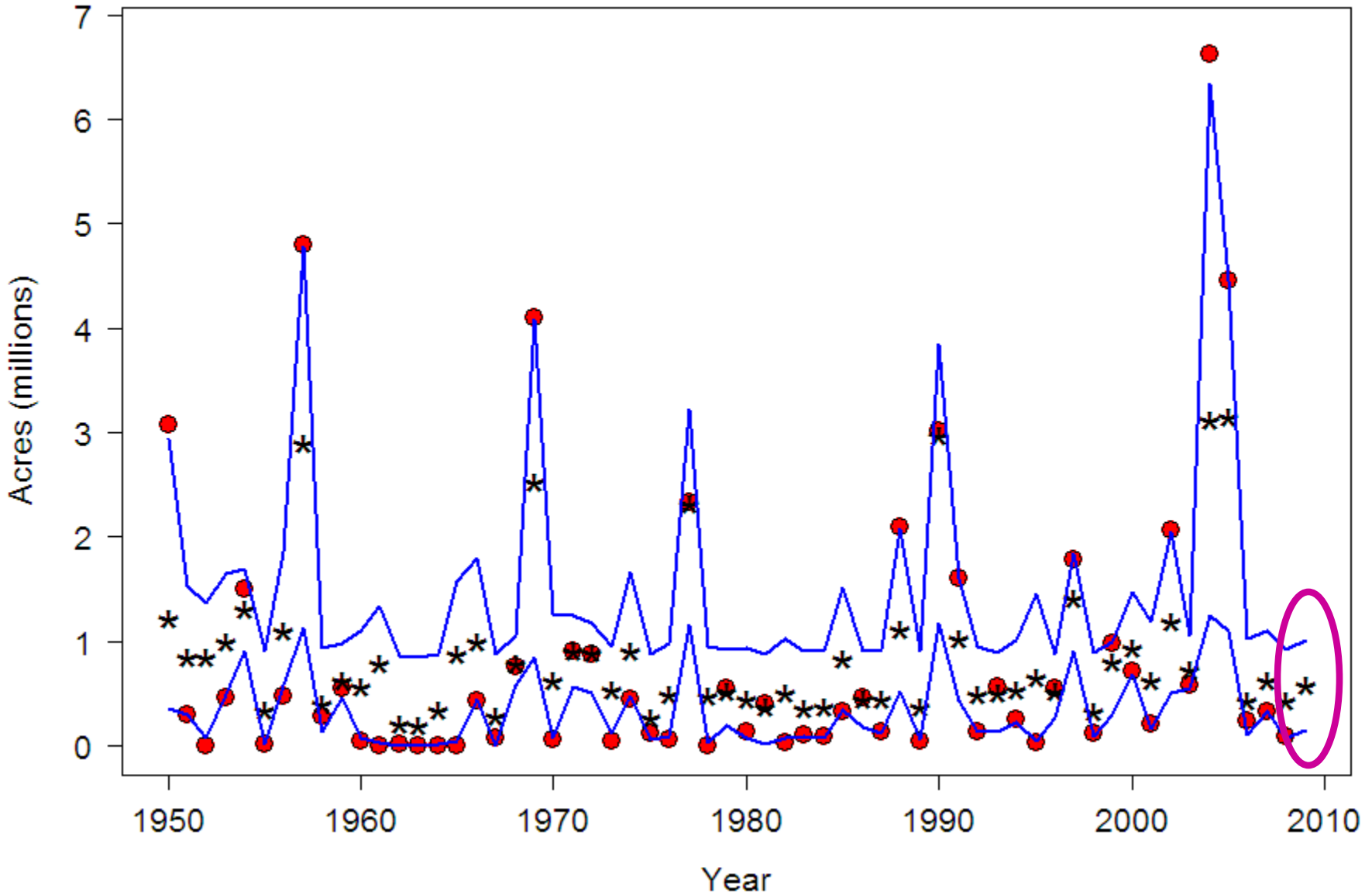
Error Table for Predictions Based on April Data



Variability of Median Forecast

- Variability of median forecasts is lower than variability of annual area burned
- Consequently, median forecast tends to overestimate small fire years and underestimate large fire years

80% Uncertainty Intervals of Cross-Validated Predictions



*Cross-Validation performed by re-fitting the model 5000 times, each time eliminating 20 years of data

Variability of Median Forecast

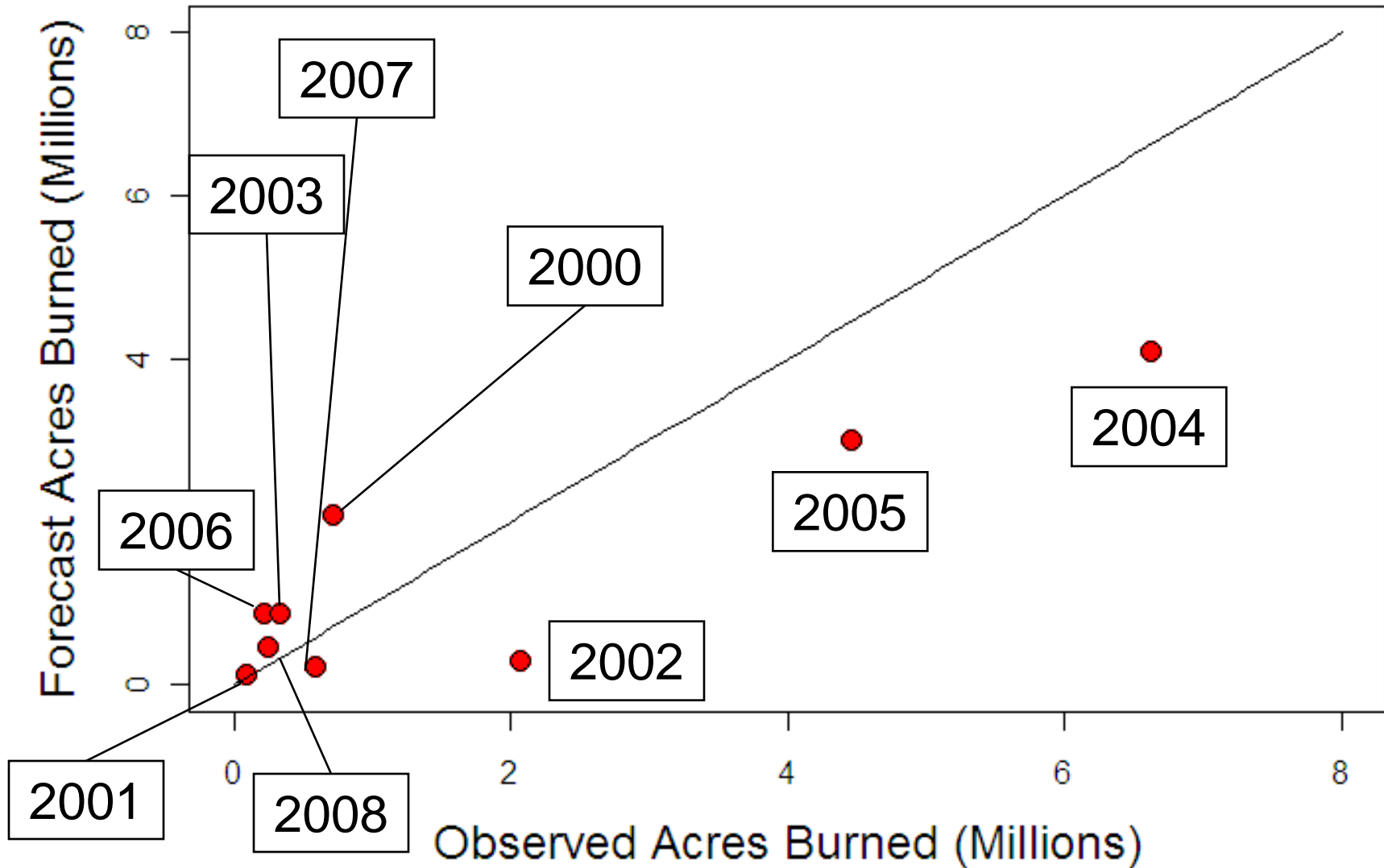
- One way to adjust these forecasts is to rank both the annual area burned data and the median forecasts
- Then “map” the median forecast to the annual area burned with the corresponding rank

Ranked Forecast Acres	Ranked Observed Acres	Year for Observed	Ranking of Observed Acres
669,156.50	410,020	1981	28
637,886.00	334,932	2007	29
633,459.40	328,263	1985	30
629,703.60	298,129	1951	31
627,917.10	292,448	1958	32
595,674.70	275,034	? 2009 ?	
575,877.70	257,621	1994	33
545,192.00	248,729	2006	34
542,395.50	216,372	2001	35
534,817.80	140,296	1987	36
527,730.80	133,627	1992	37

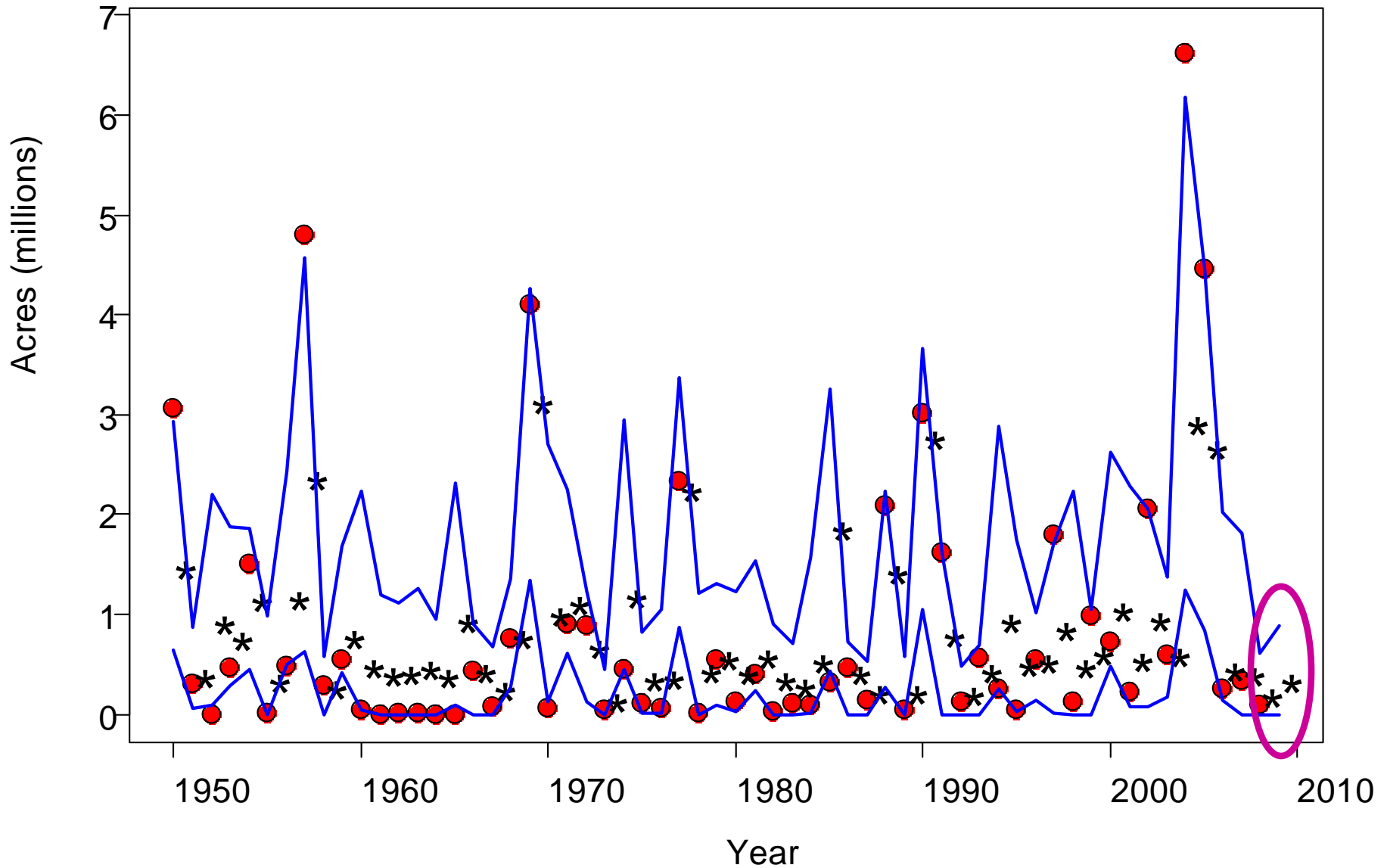
Historical Performance

- Imagine it is April 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 Application of Predictions from April Model



80% Uncertainty Intervals of Cross-Validated Predictions

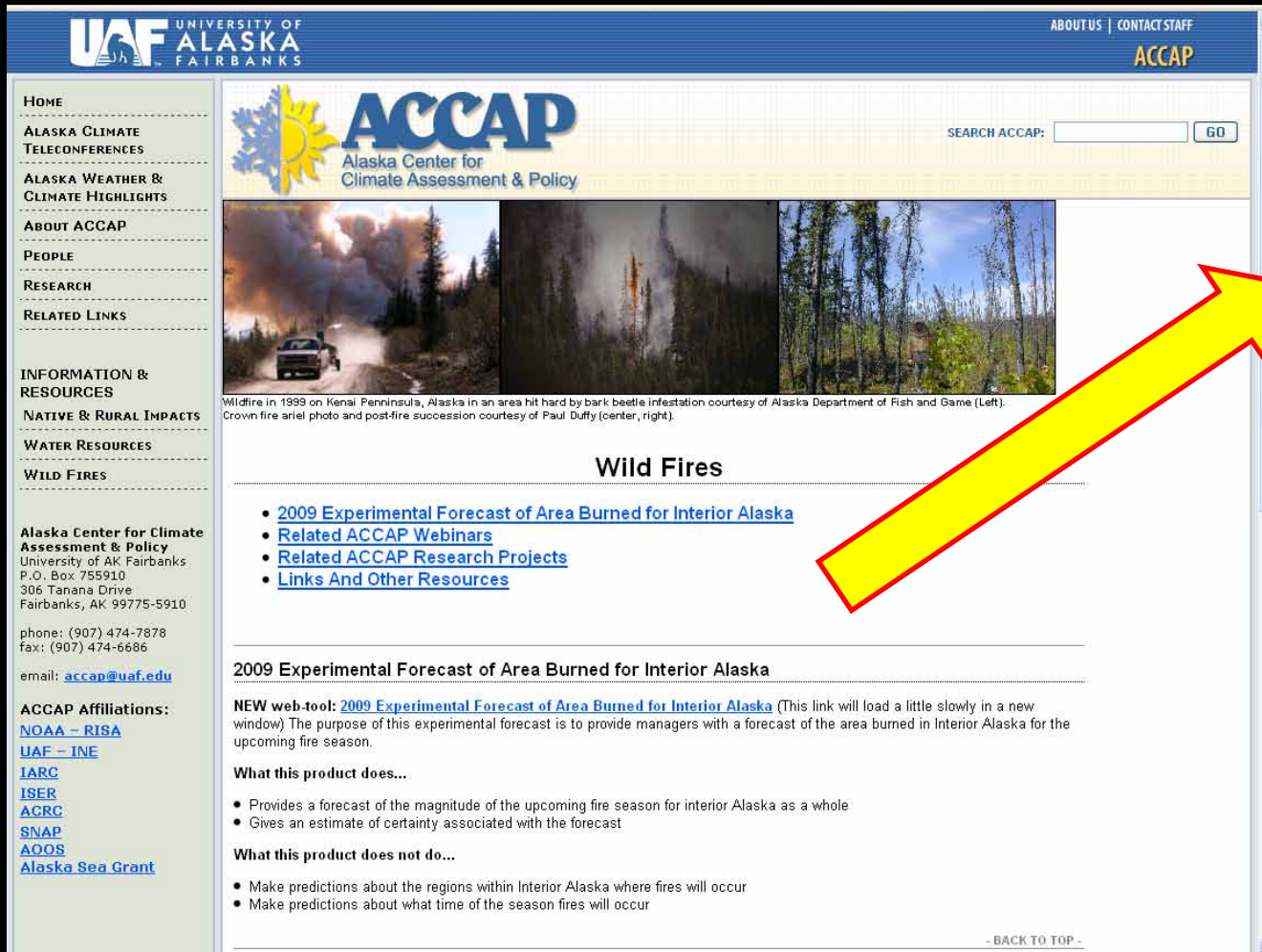


*Cross-Validation performed by re-fitting the model 5000 times, each time eliminating 20 years of data

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://zeus.neptuneinc.org/xRISA/index.html>

Access the Web-Tool from the ACCAP Wildfires Page: http://www.uaf.edu/accap/wild_fires.html



The screenshot shows the ACCAP website interface. At the top, there is a navigation bar with 'UAF UNIVERSITY OF ALASKA FAIRBANKS' on the left and 'ABOUT US | CONTACT STAFF' on the right. Below this is the ACCAP logo and a search bar. The main content area features a large image of a wildfire with a car on a dirt road, and a list of links under the heading 'Wild Fires'. A yellow arrow with a red outline points to the link '2009 Experimental Forecast of Area Burned for Interior Alaska'.

UAF UNIVERSITY OF ALASKA FAIRBANKS

ACCAP
Alaska Center for Climate Assessment & Policy

SEARCH ACCAP:

Wild Fires

- [2009 Experimental Forecast of Area Burned for Interior Alaska](#)
- [Related ACCAP Webinars](#)
- [Related ACCAP Research Projects](#)
- [Links And Other Resources](#)

2009 Experimental Forecast of Area Burned for Interior Alaska

NEW web-tool: [2009 Experimental Forecast of Area Burned for Interior Alaska](#) (This link will load a little slowly in a new window) 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.

What this product does...

- Provides a forecast of the magnitude of the upcoming fire season for interior Alaska as a whole
- Gives an estimate of certainty associated with the forecast

What this product does not do...

- Make predictions about the regions within Interior Alaska where fires will occur
- Make predictions about what time of the season fires will occur

[- BACK TO TOP -](#)

- Link to the web-tool
- Related ACCAP webinars: podcast, summary, and slides
- In-depth information about ACCAP's projects
- Wildfire-related links and resources

Interactive Web-Tool

Experimental Forecast of Area Burned for Interior Alaska

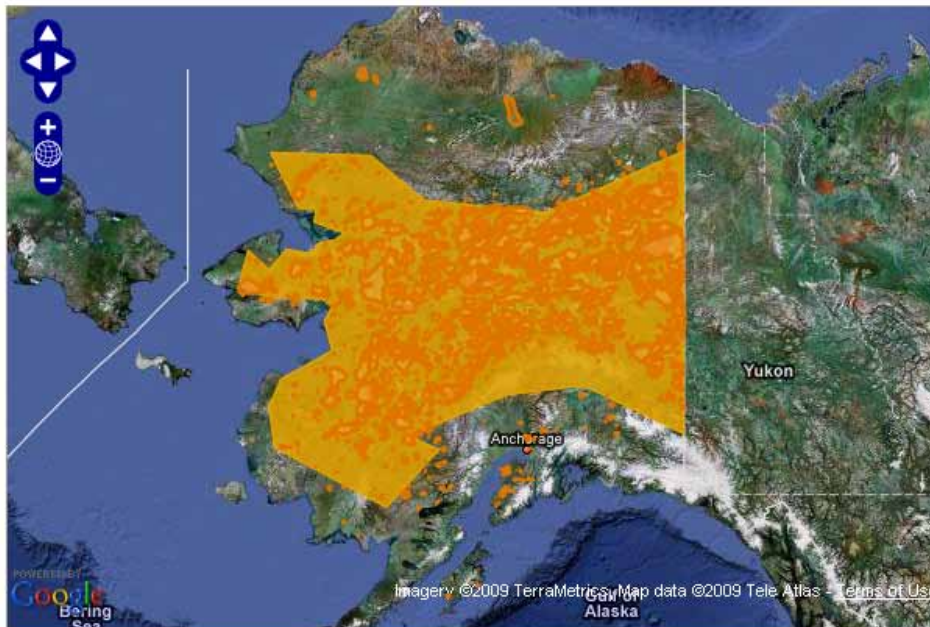
Forecast | Methodology | Analog Analysis | About

The purpose of this experimental forecast is to provide managers with a forecast of the area burned in Interior Alaska for the upcoming fire seasons in the following categories:

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

Current Forecast for the 2009 season is XXXXX as of the end of March. This falls in the Moderate category

The next 2009 forecast will be available in early April



- Base Layers
 - Google Physical
 - Google Hybrid
- 2009 Forecasts
 - March [Moderate]
 - April [Moderate]
- Misc Layers
 - Fire History 1942-2007

Choose to add monthly Fire Forecasts and other layers that are currently in development, including Fire History and Management Options

Applications

- This information can be used by land managers to inform decisions about initial attack
- Resource allocation can be informed using this information

Future Work

- Develop regionalized versions of this forecast
- Better understand how land managers can use this information

Acknowledgements

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