Early Season Forecasting of Fire Activity in Alaska

Paul A. Duffy (UAF - Forest Sciences)

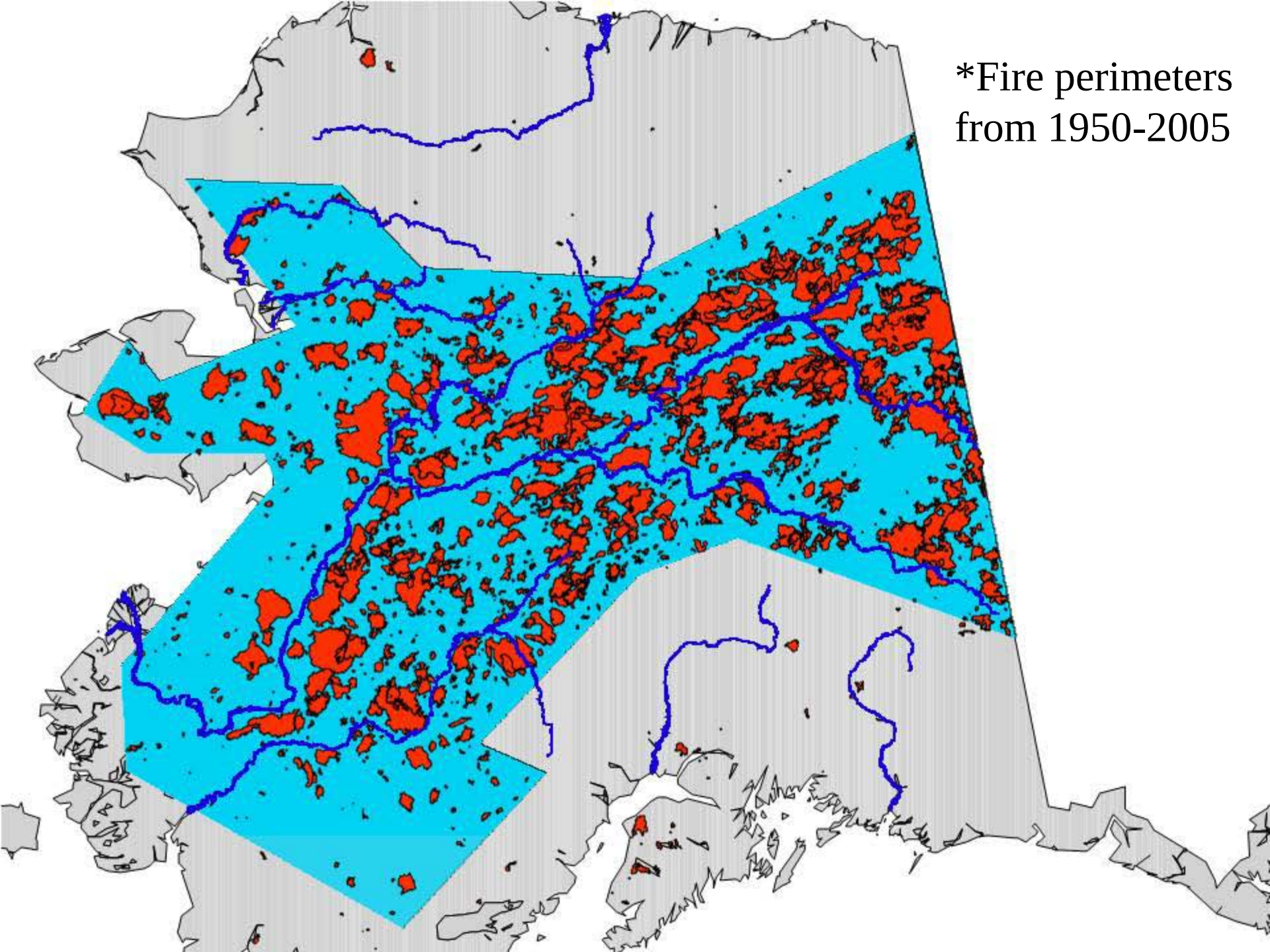
Why is Fire Important in Alaska?

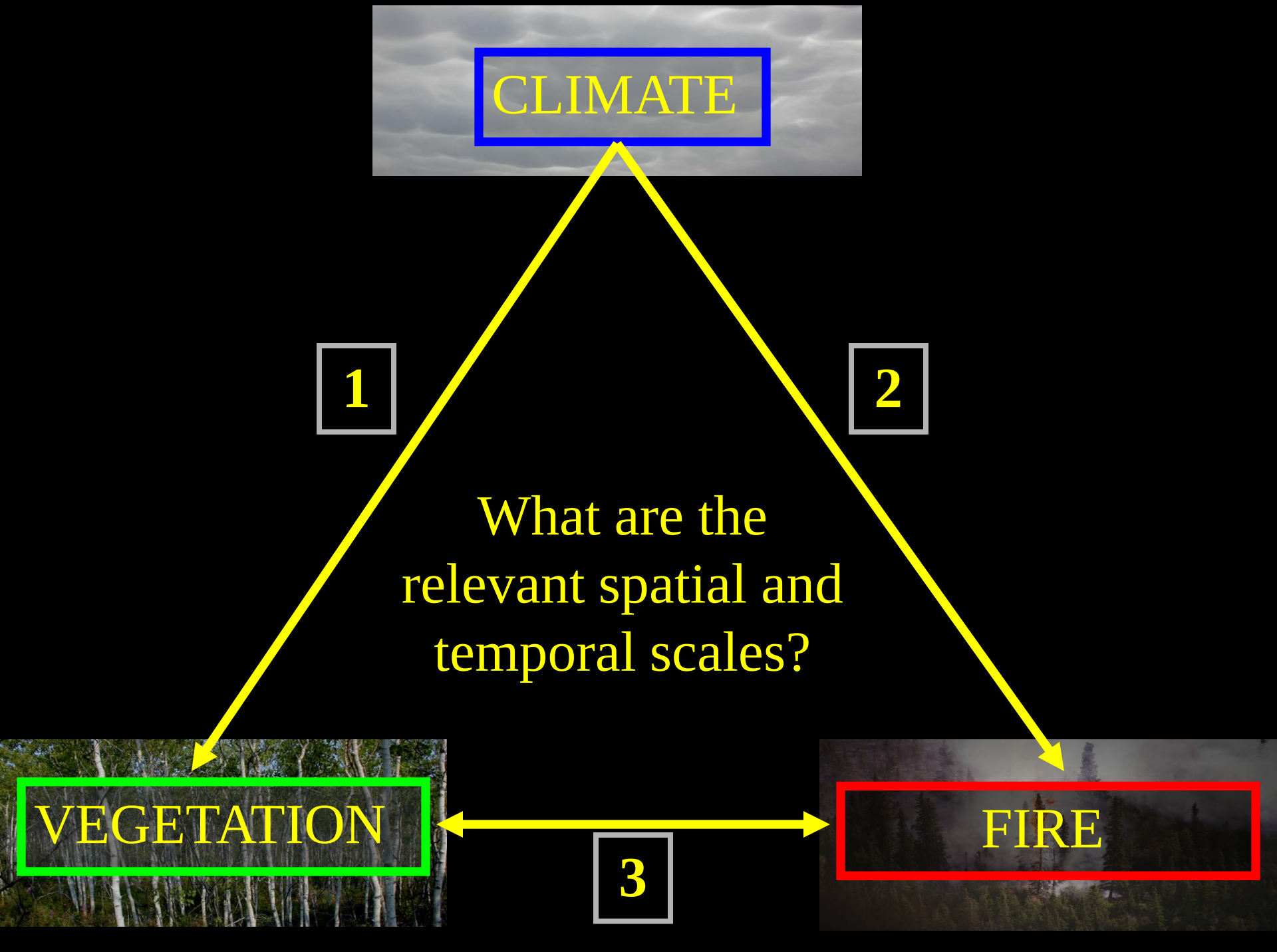
- Dominates the disturbance regime
- Succession modifies forest structure

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

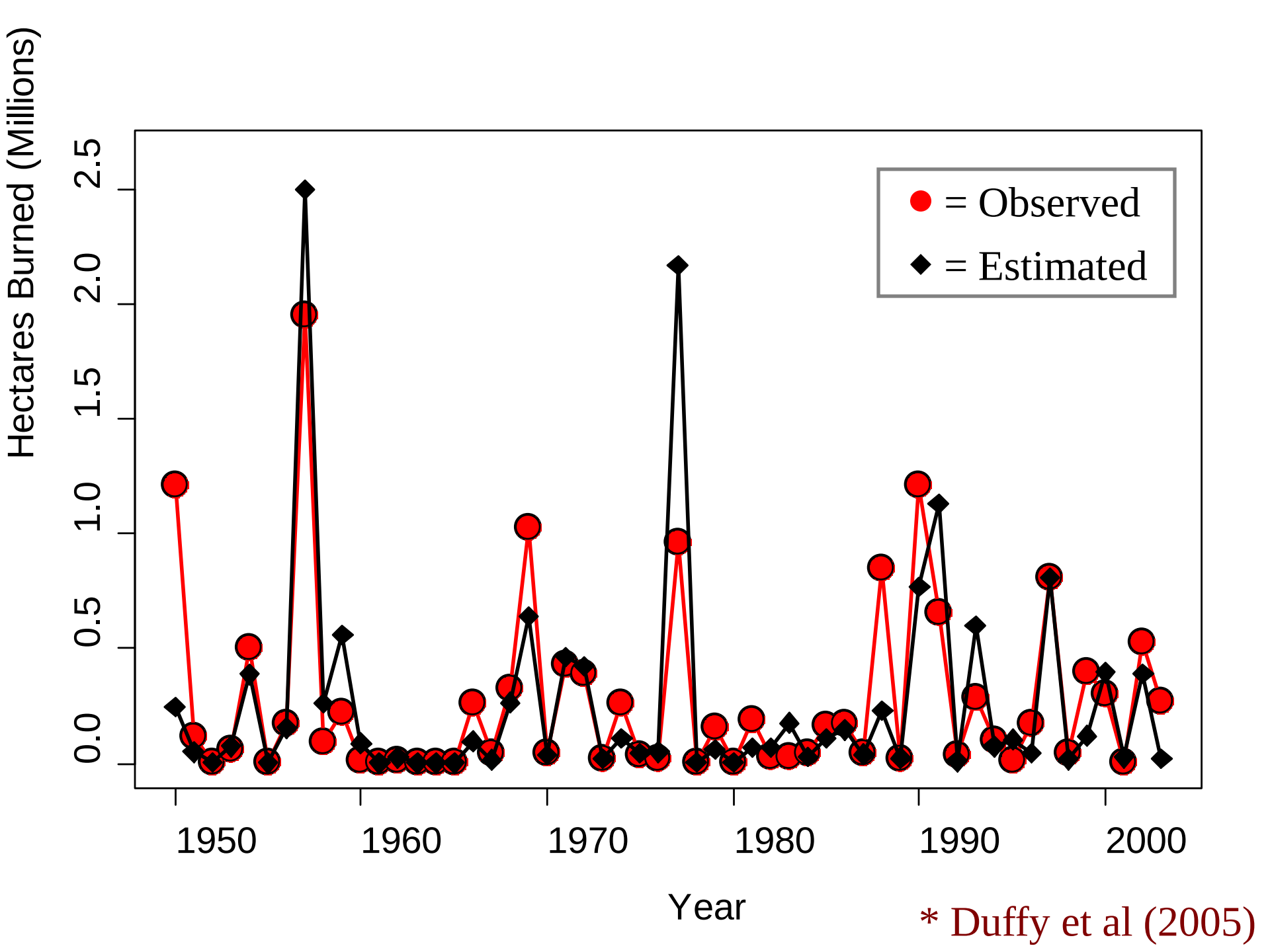
Spatial and temporal scales of interest…. not so obvious

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



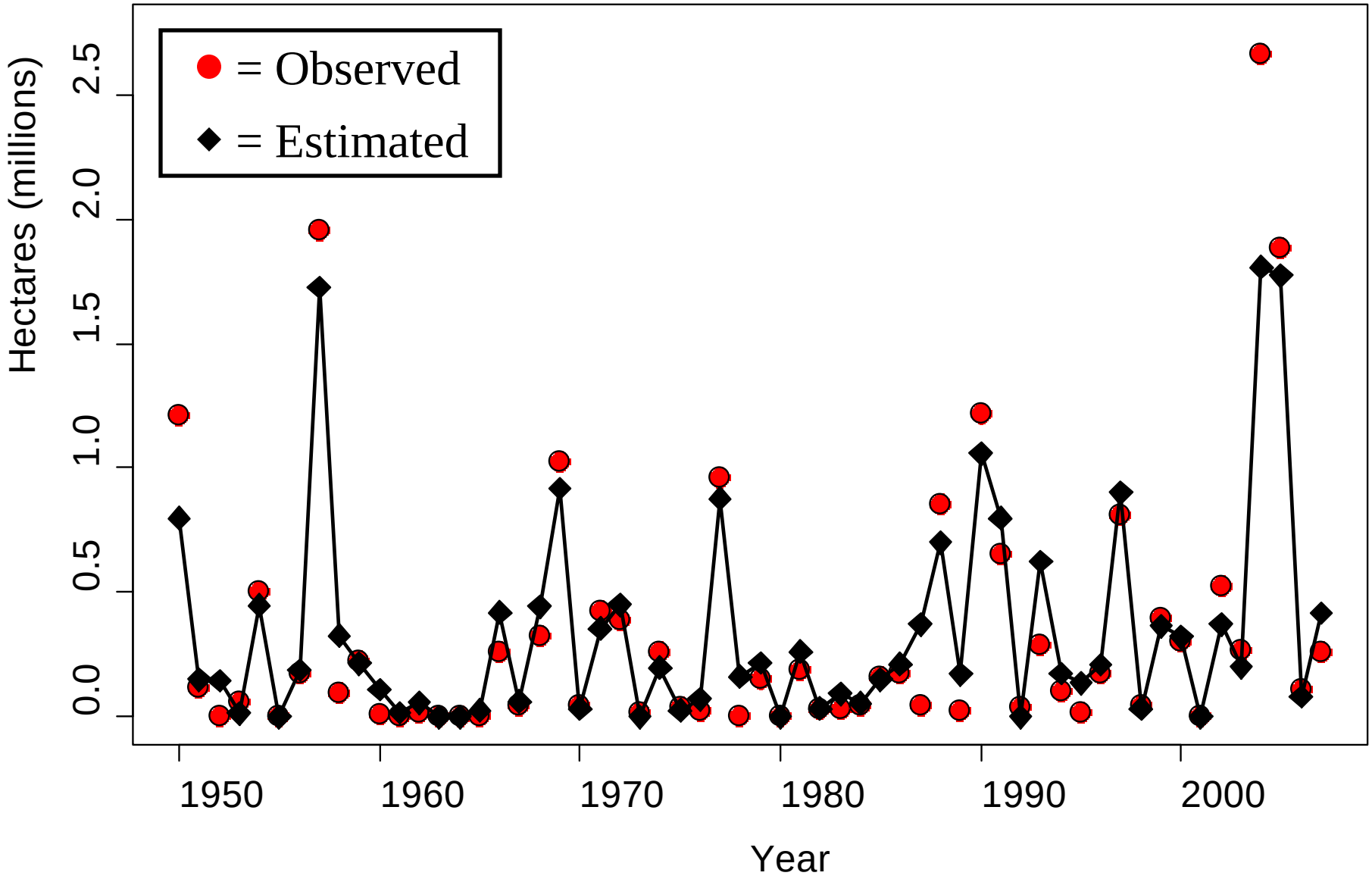
* Duffy et al (2005)

Gradient Boosting Models

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

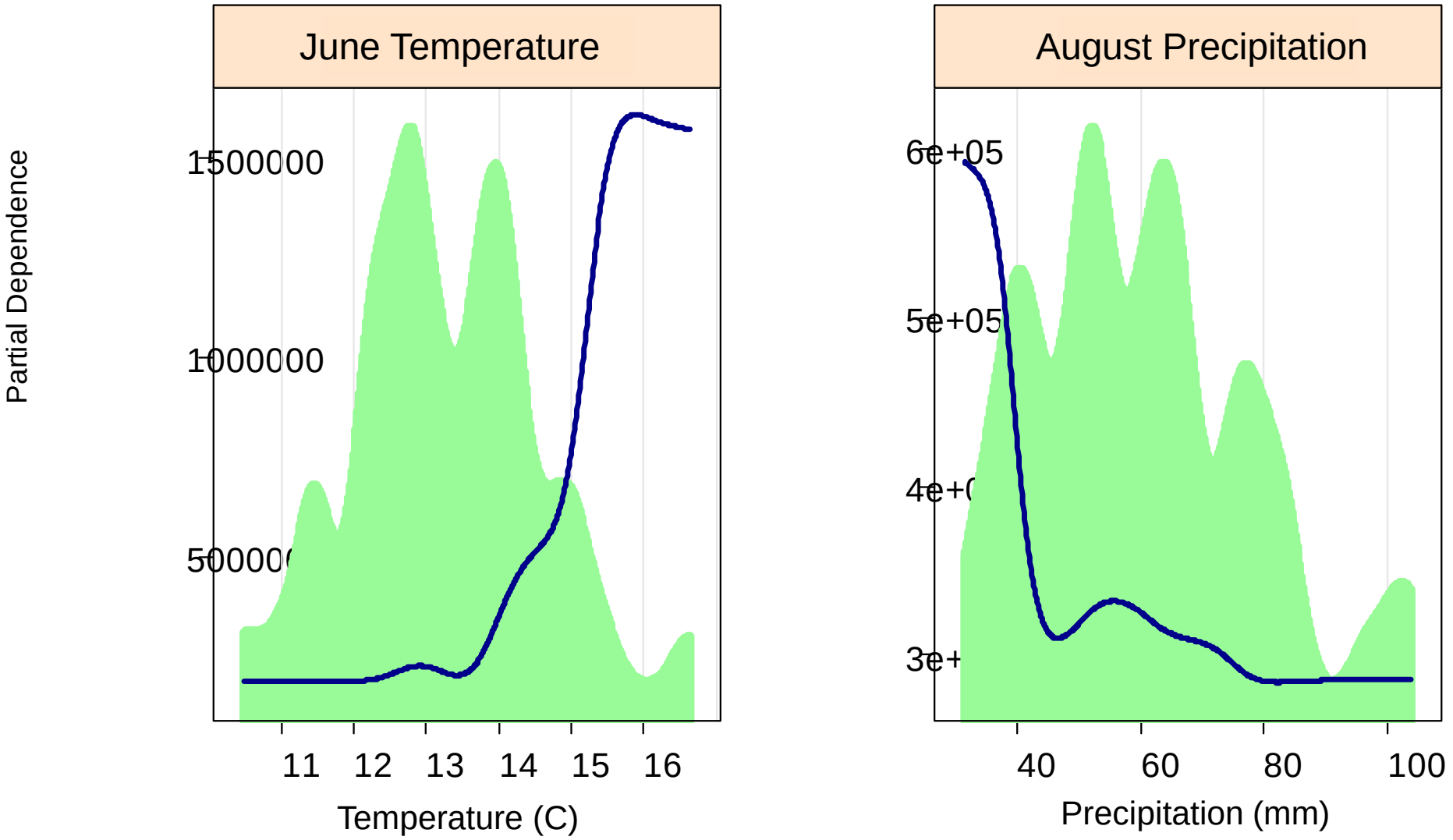
* Used the ‘gbm’ library in R stat software

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

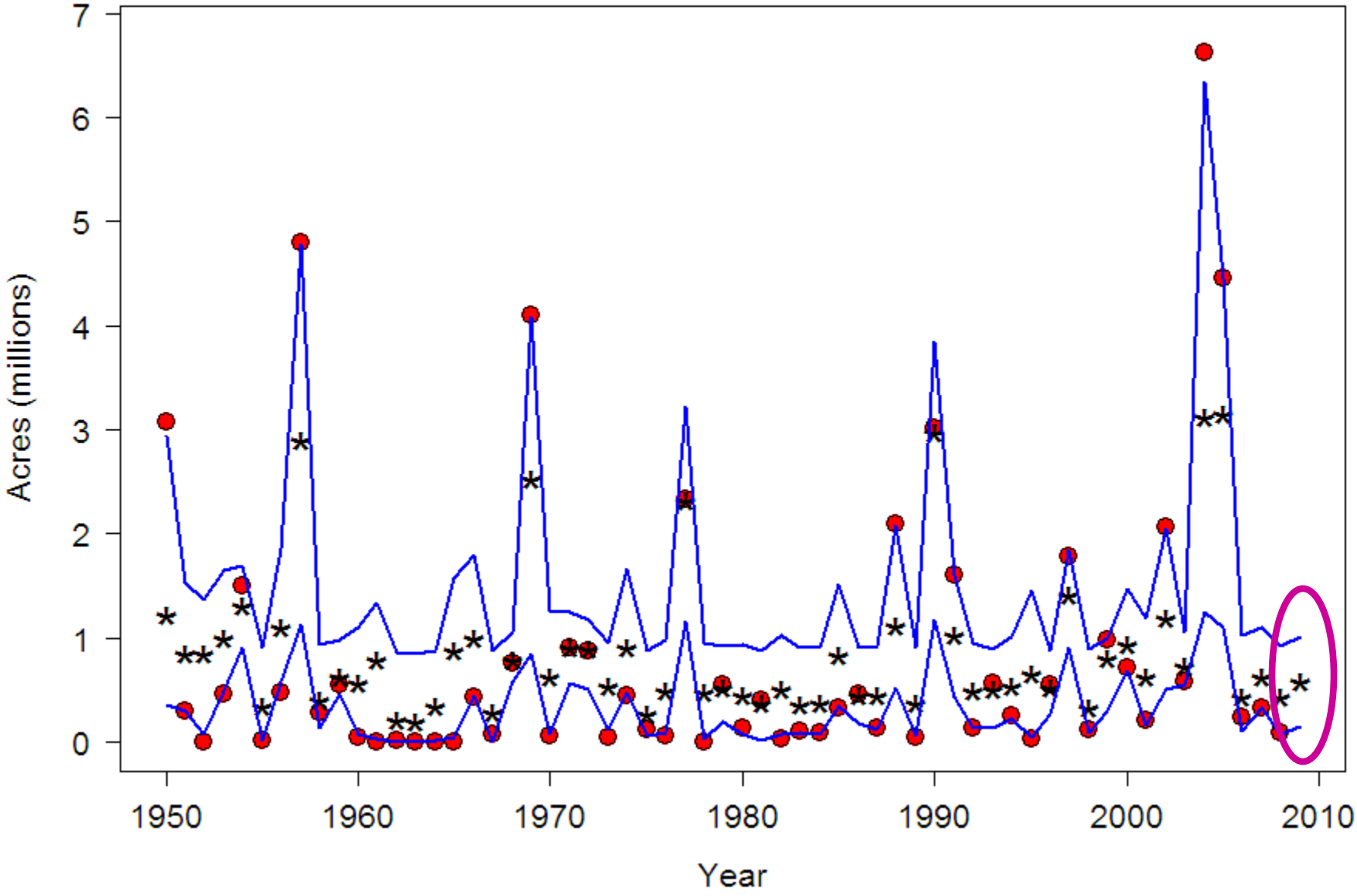
- Use a stepwise cross-validation procedure to select the teleconnections and monthly weather to be used for explanatory variables
- Currently, this process is performed monthly for March through June
- Data are available at the end of each month

Building Predictive Models

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

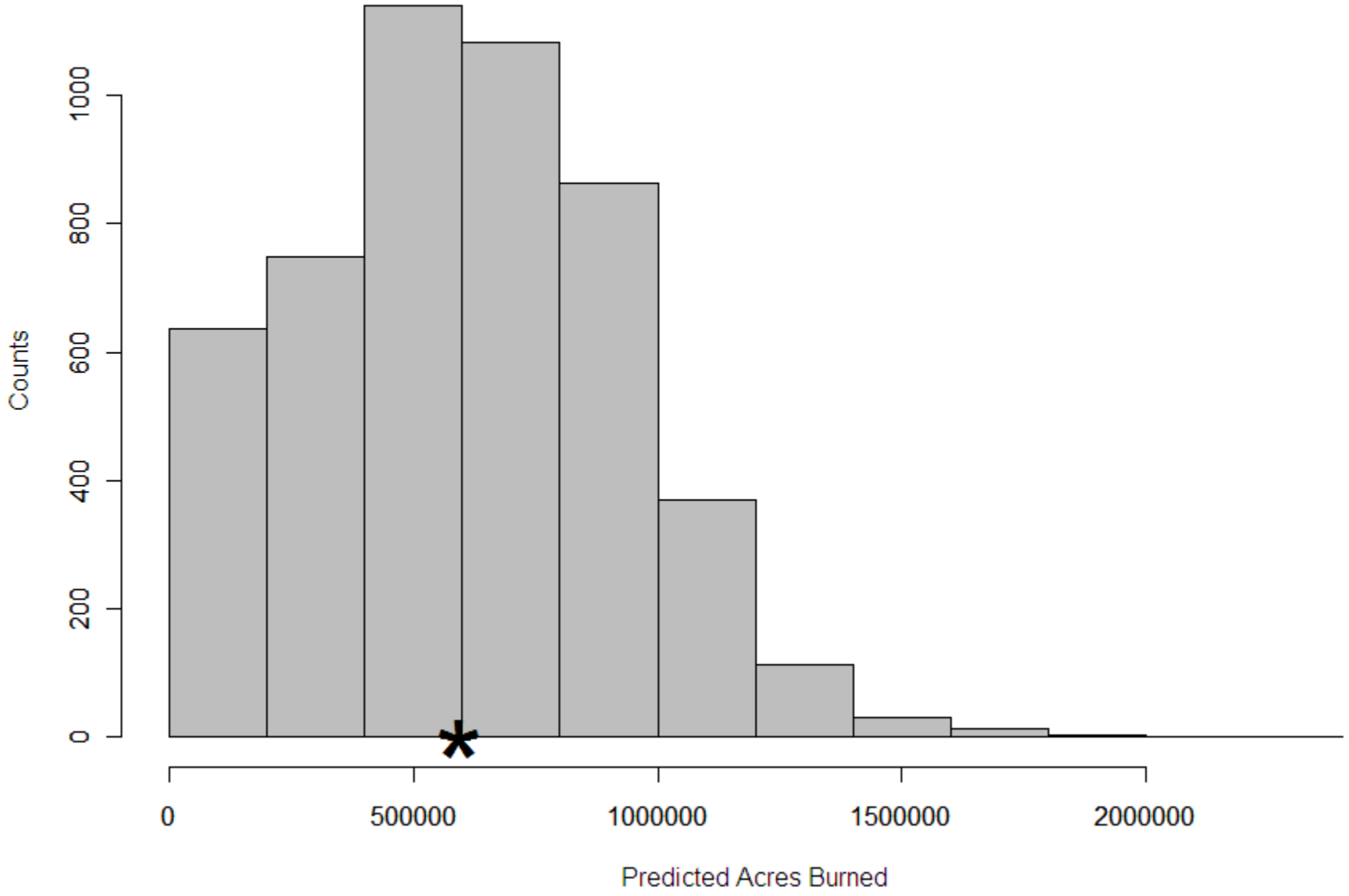
* End of April Model

80% Uncertainty Intervals of Cross-Validated Predictions

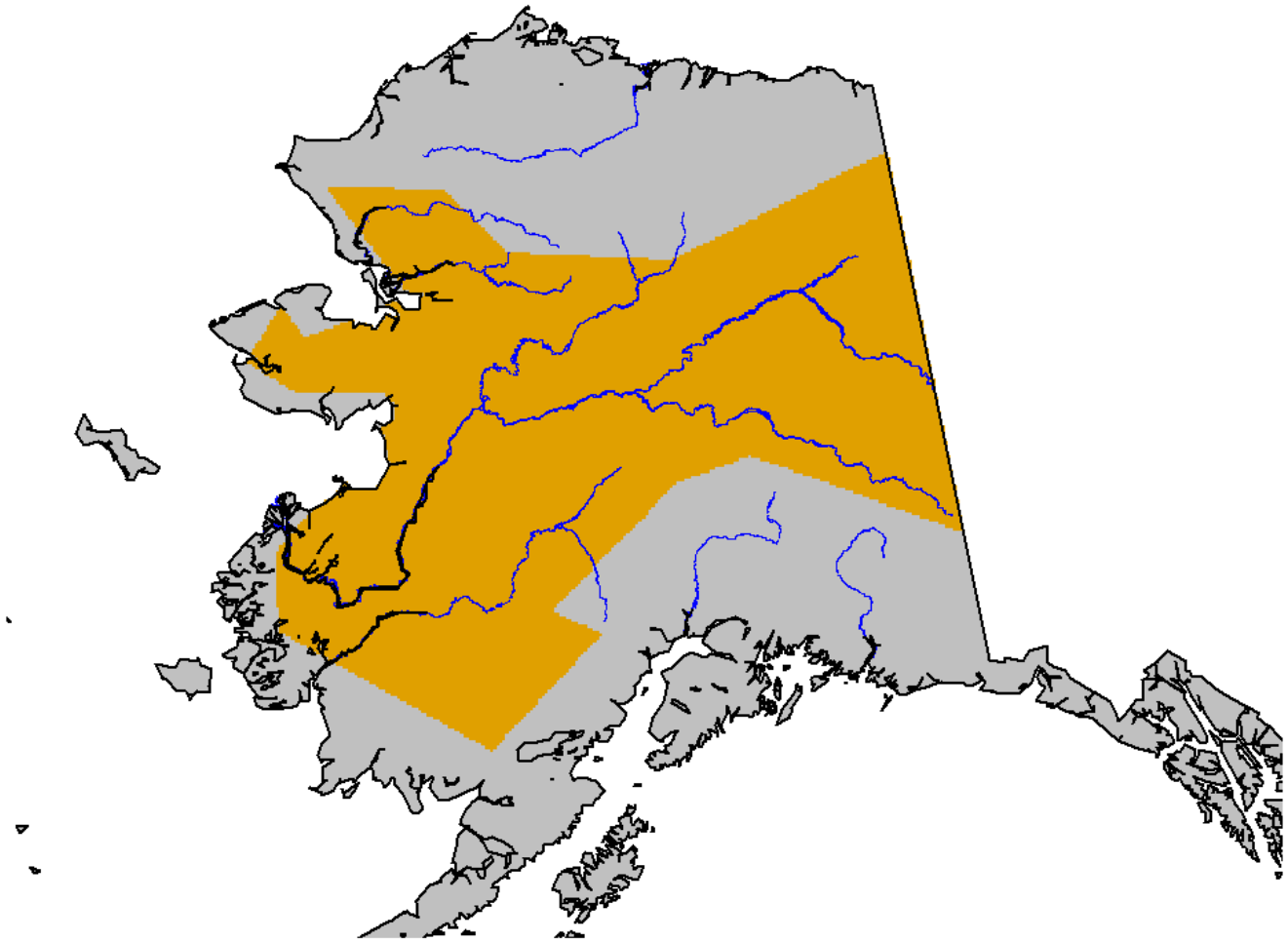


*Cross-Validation performed by re-fitting the model 5000 times, each time eliminating 20 years of data

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



Forecast of Area Burned in 2009 Based on April Data



Low

< 500,000 acres

Mod

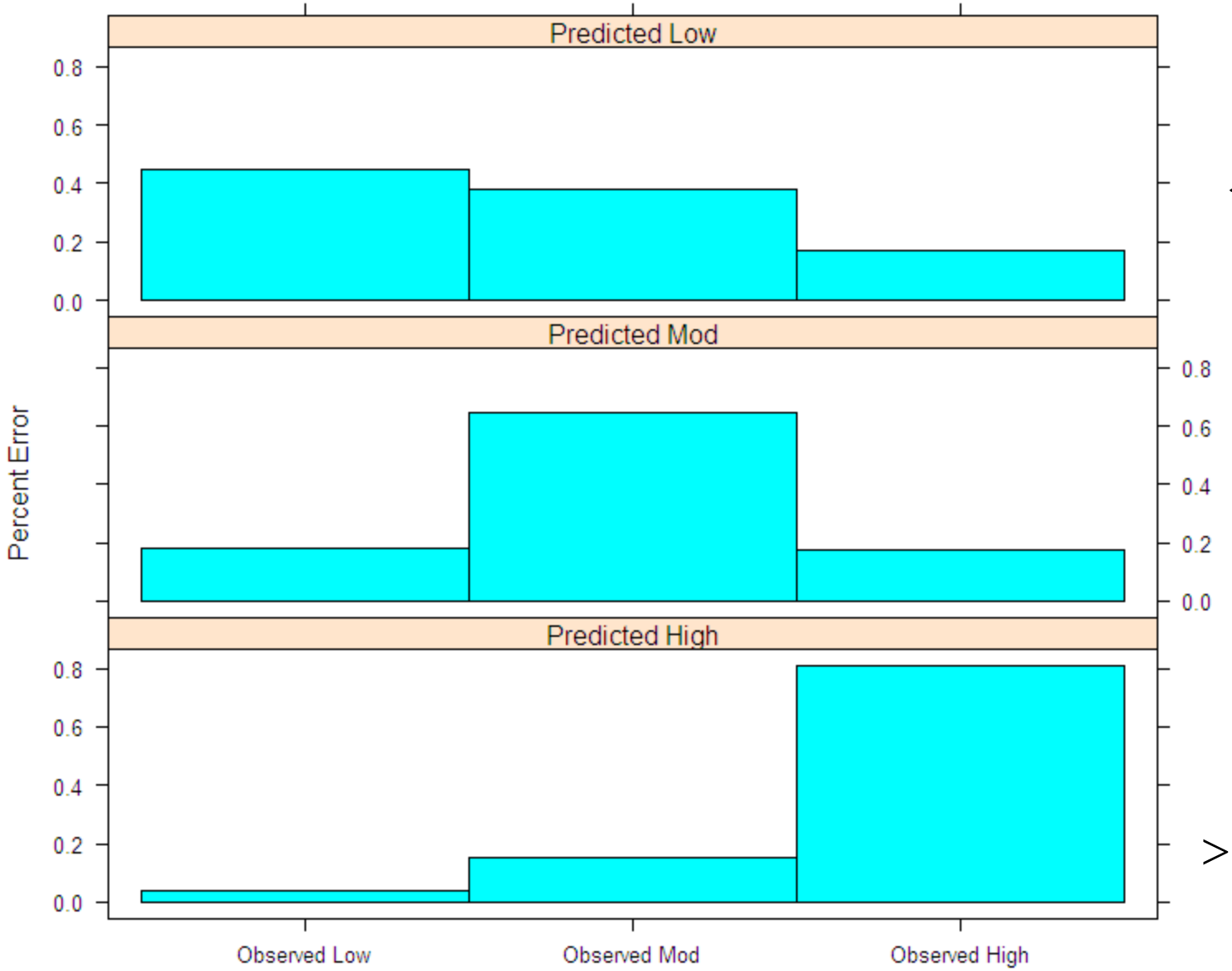
> 500,000 and
< 1.5 million acres

High

> 1.5 million acres

Median April prediction is 595,674 acres

Error Table for Predictions Based on April Data



< 500,000 ac

> 1,500,000 ac

< 500,000 ac

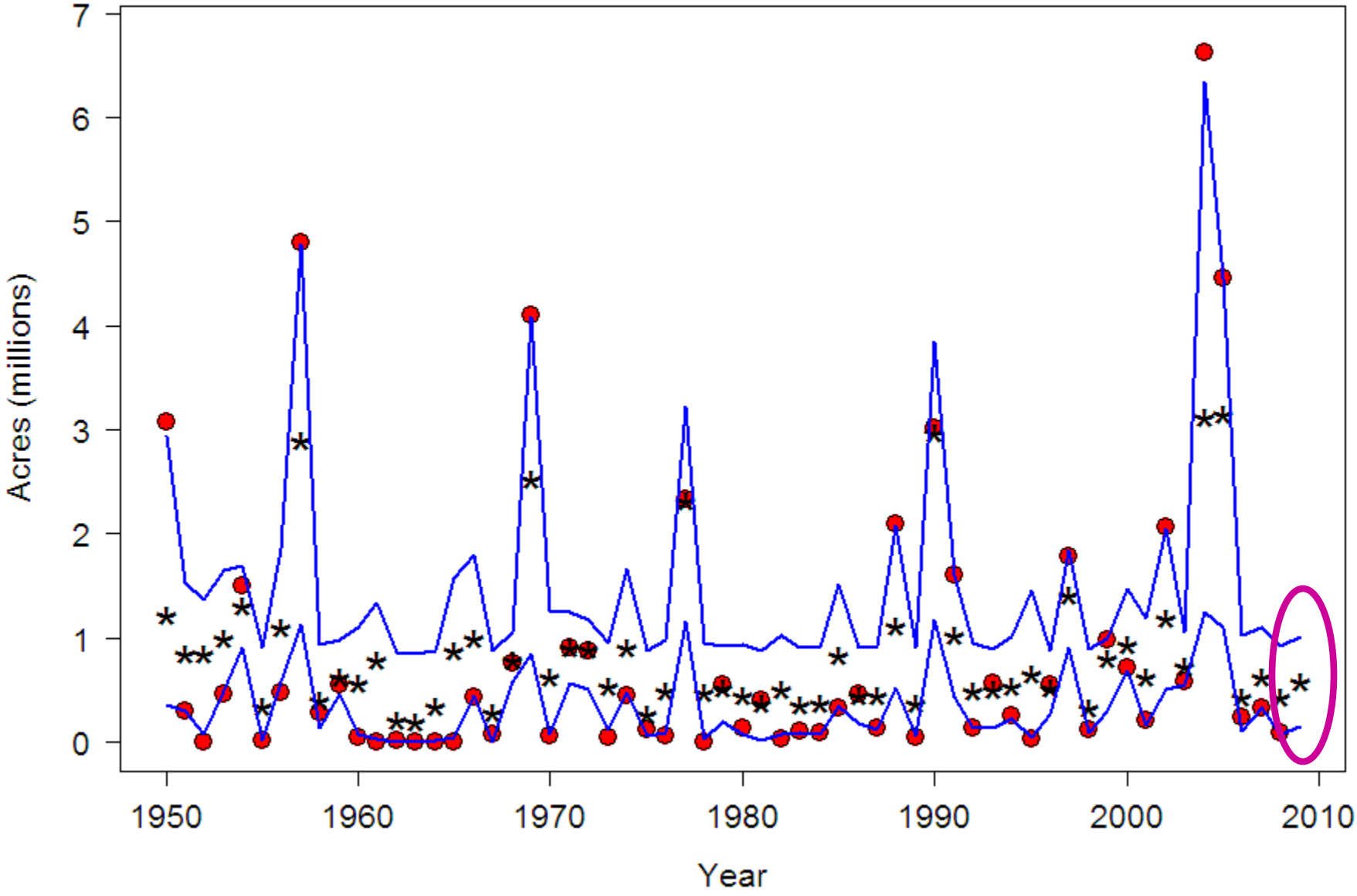
> 1,500,000 ac

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



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Variability of Median Forecast

- One way to adjust these forecasts is to rank both the annual area burned data and the median forecasts

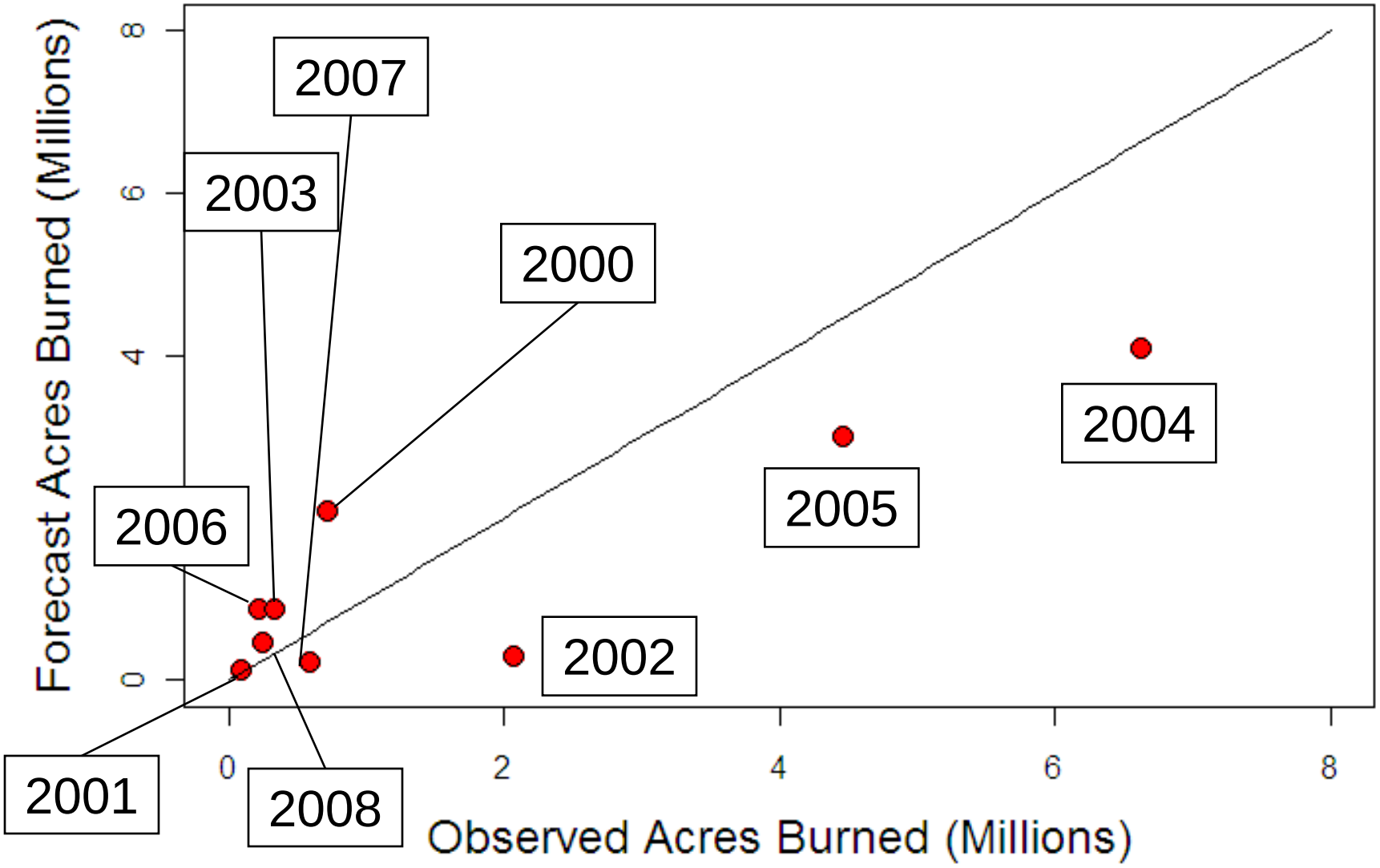
- Then “map” the median forecast to the annual area burned with the corresponding rank

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



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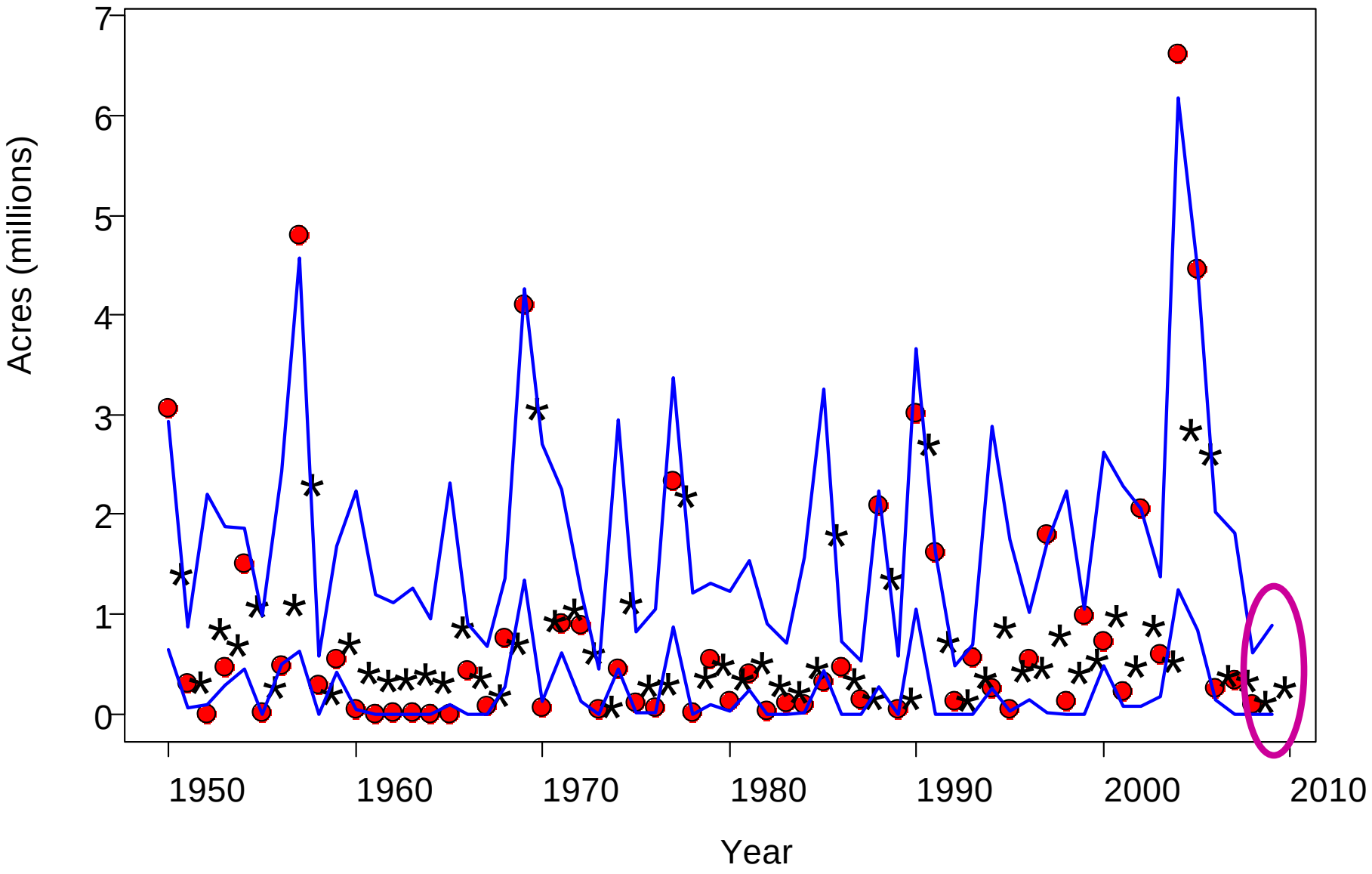

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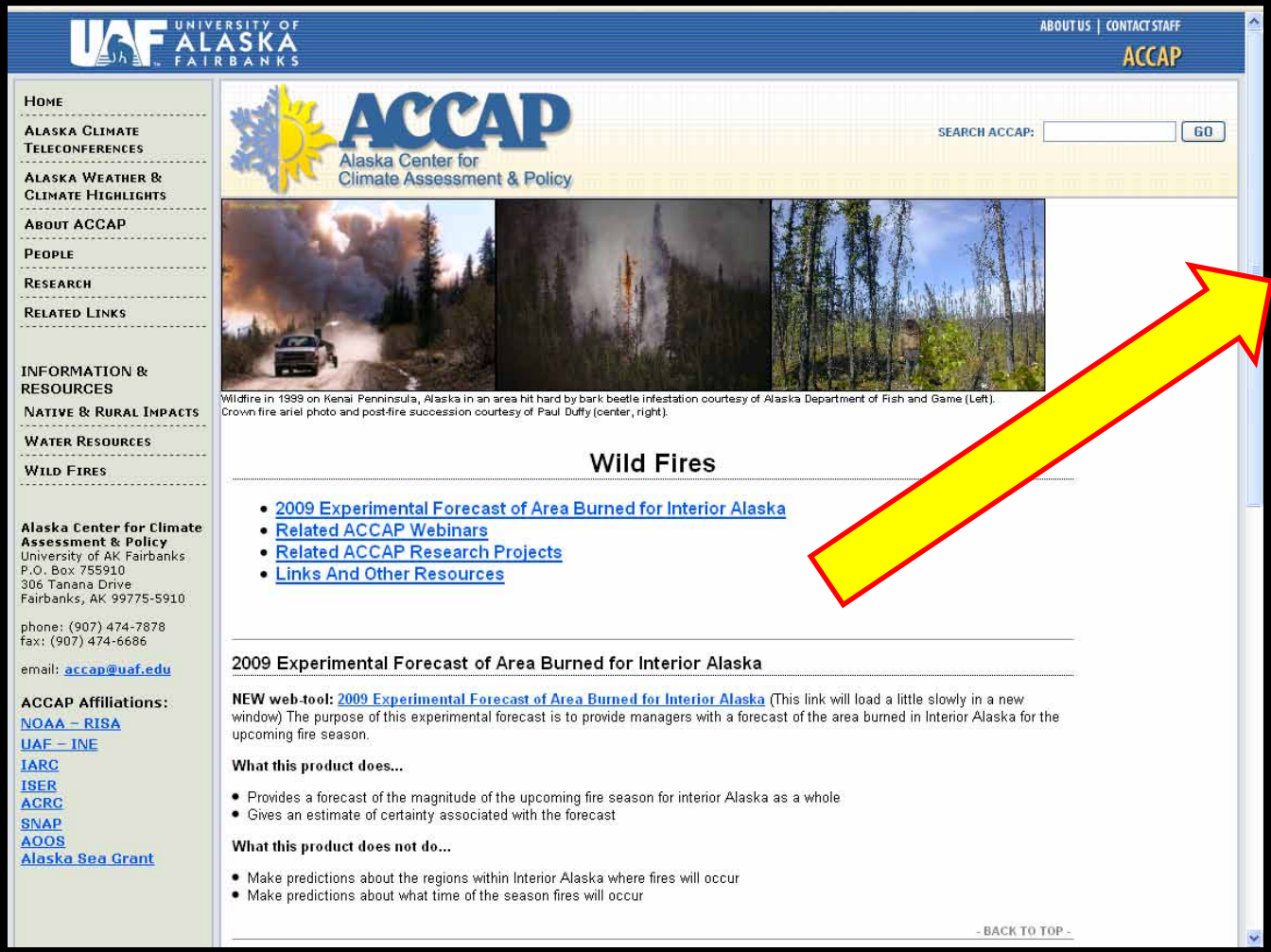
Conclusions

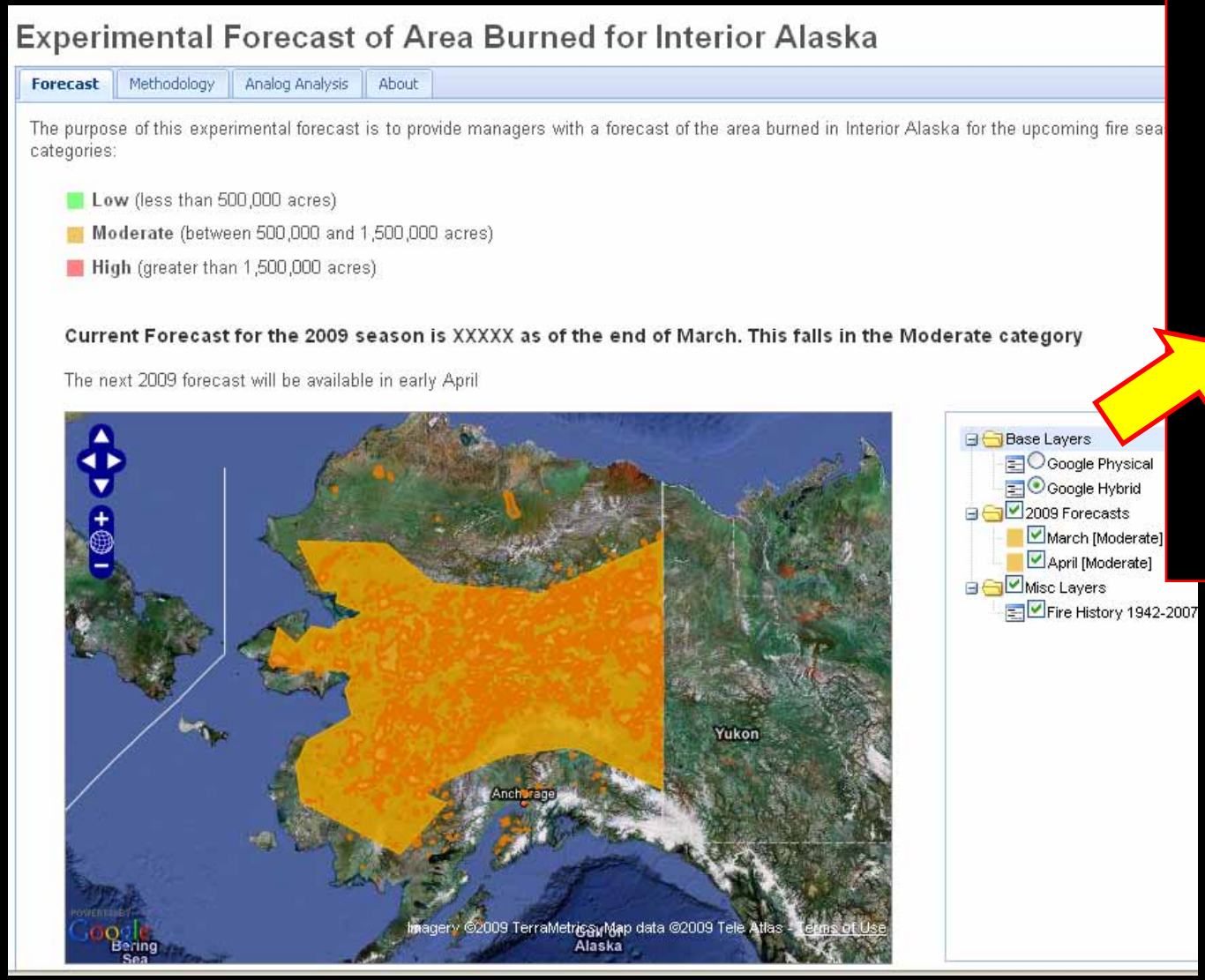
- Annual area burned in Alaska is strongly driven by climatic factors
- This link can be used to generate forecasts
- Experimental forecasts will be available monthly
- http://zeus.neptuneinc.org/xRISA/index.html

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



- **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



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
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- Alaska Center for Climate Assessment and Policy
- Scenarios Network for Alaska Planning