Climatic Controls of Wildfire in the Boreal Forest and Arctic Tundra Biomes Across Multiple Spatial and Temporal Scales

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Motivation

LETTER

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Carbon loss from an unprecedented Arctic tundra wildfire

Michelle C. Mack[1], M. Syndonia Bret-Harte
& David L. Verbyla[6]

nature geoscience

LETTERS

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Recent acceleration of biomass burning and carbon losses in Alaskan forests and peatlands

Merritt R. Turetsky[1]*, Evan S. Kane[2], Jennifer W. Harden[3], Roger D. Ottmar[4], Kristen L. Manies[3],

Global Change Biology (2009) **15**, 1491–1510, doi: 10.1111/j.1365-2486.2009.01877.x

Vulnerability of carbon storage in North American boreal forests to wildfires during the 21st century

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and J. MELILLO¶

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Research questions

- What controlled past variability in fire activity?
- What is the nature of these controls?
- What does this imply about responses to future climate change?

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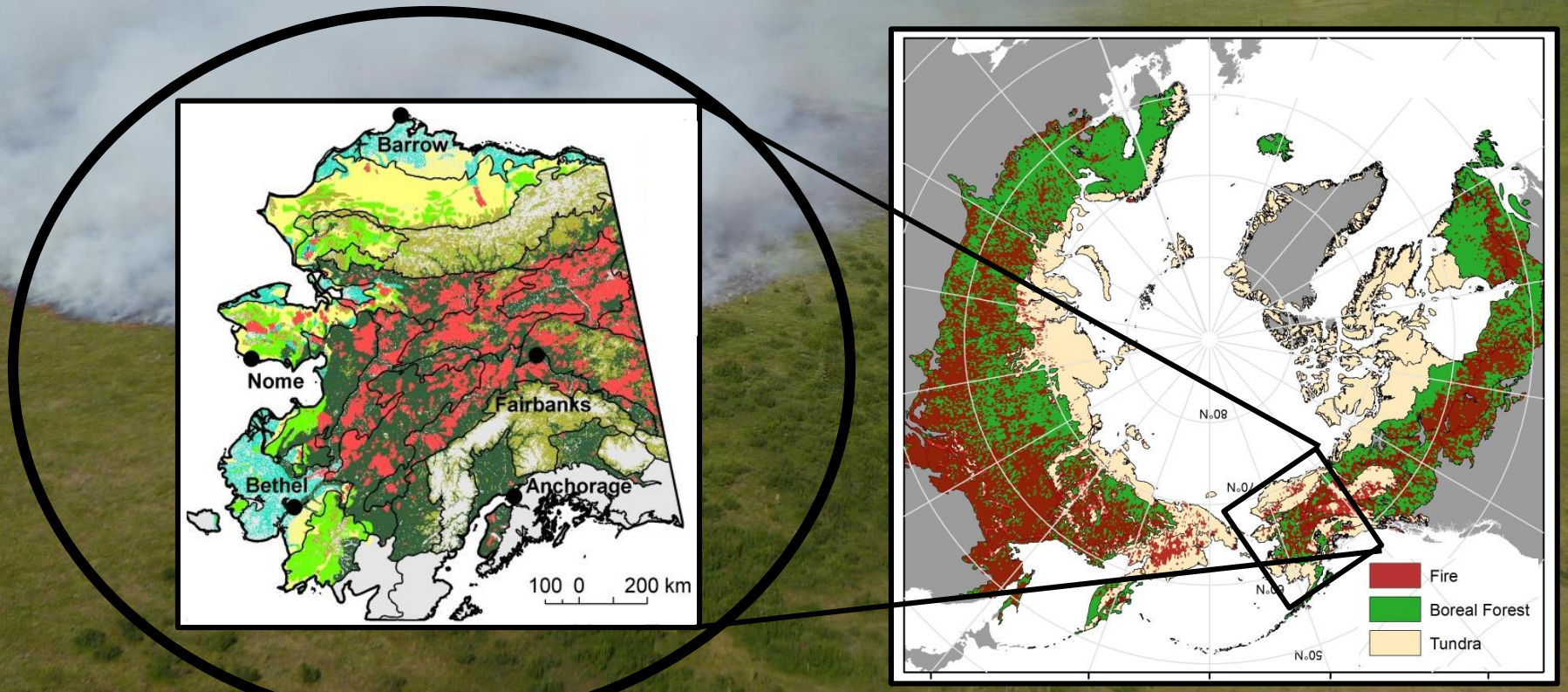
Research questions



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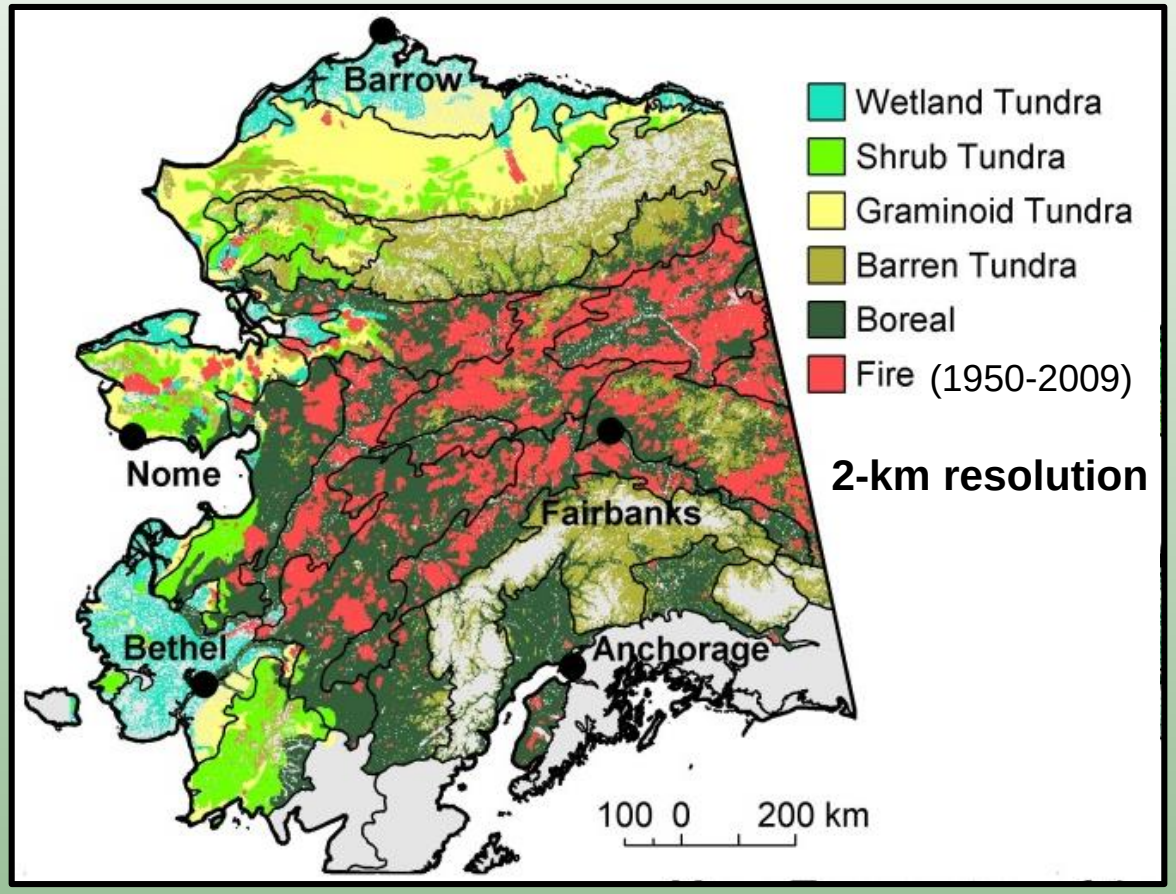
Study area

Spatial variation in fire activity

Presence/absence approach

Modeled P(fire) at 30-yr timescales



Statistical models

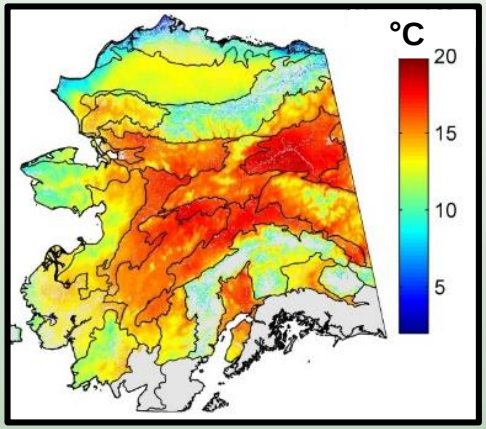
Boosted Regression Trees (BRTs)

Two models: boreal forest and tundra

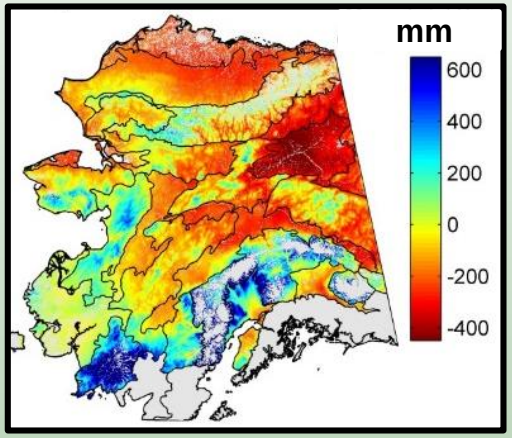
100 BRTs each

Explanatory Variables

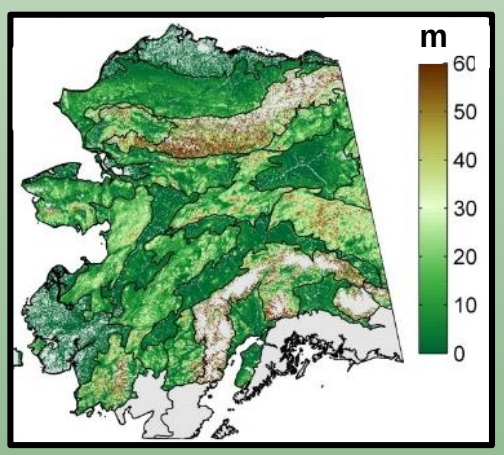
Summer Temp.



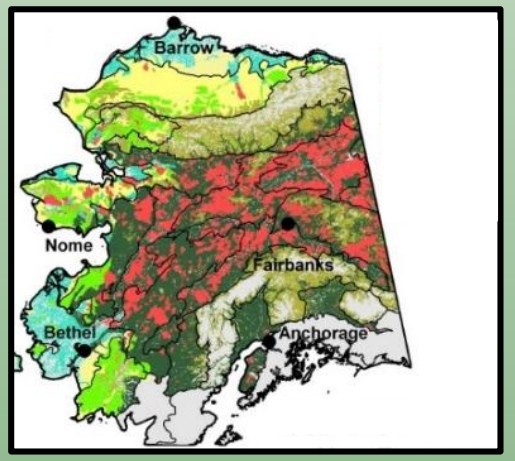
Ann. Moisture Avail.



Topography



Veg. Type

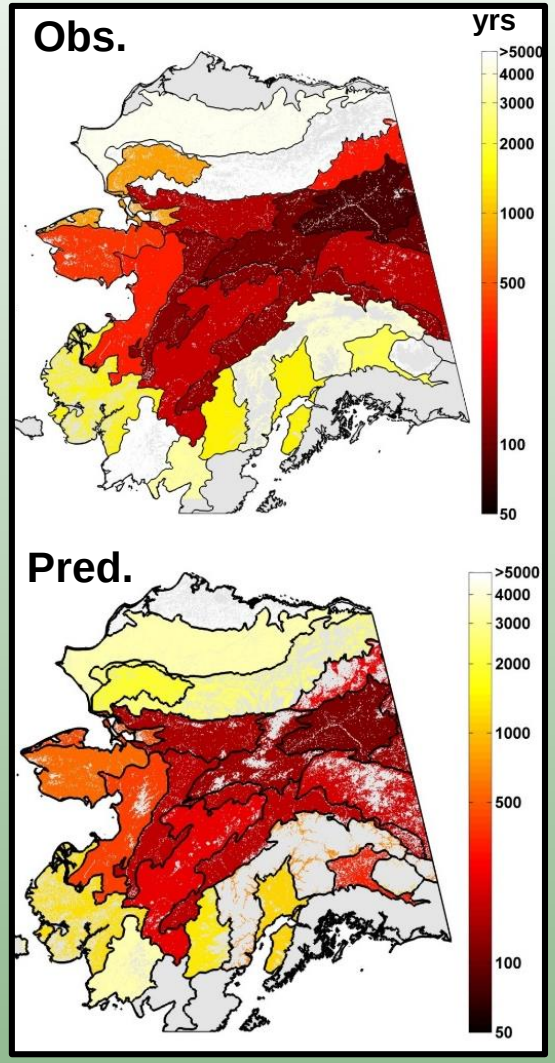


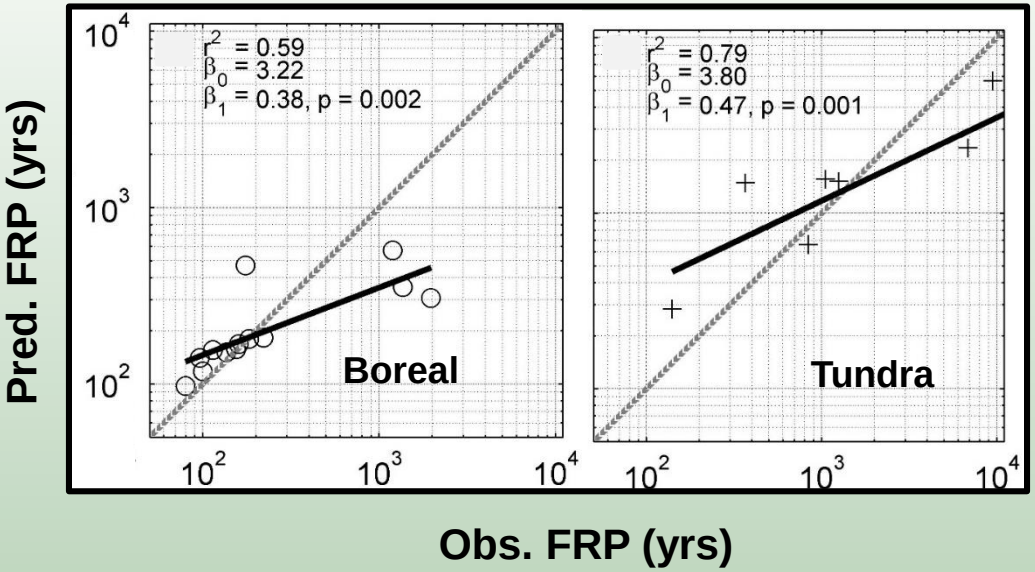
Fire Data: Alaska Large Fire Database (fire.ak.blm.gov)

Veg. Data: Circumpolar Arctic Veg. Map (www.geobotany.uaf.edu/cavm)

Climate Data: Scenarios Network for Alaska and Arctic Planning (www.snap.uaf.edu)

Model performance



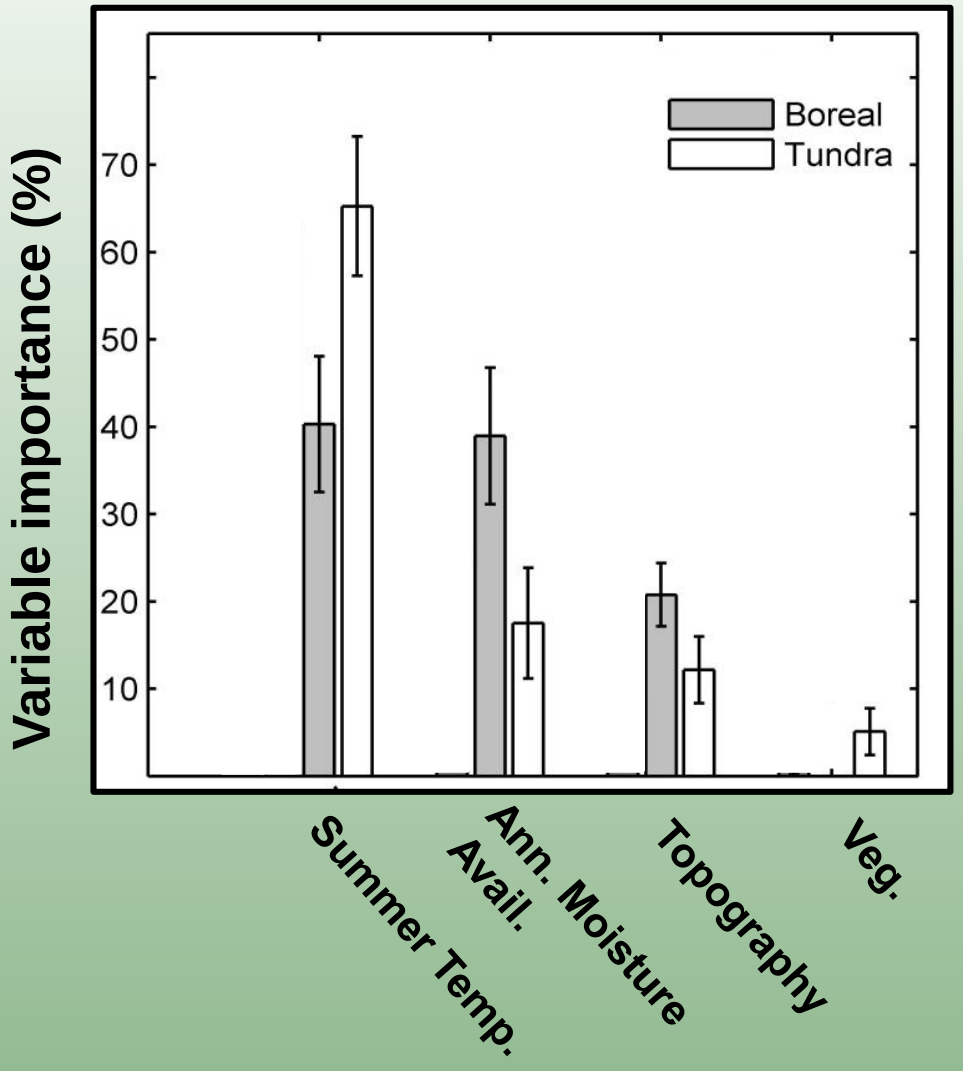


***Models explain significant variability in fire occurrence**

AUC (boreal) = 0.63

AUC (tundra) = 0.74

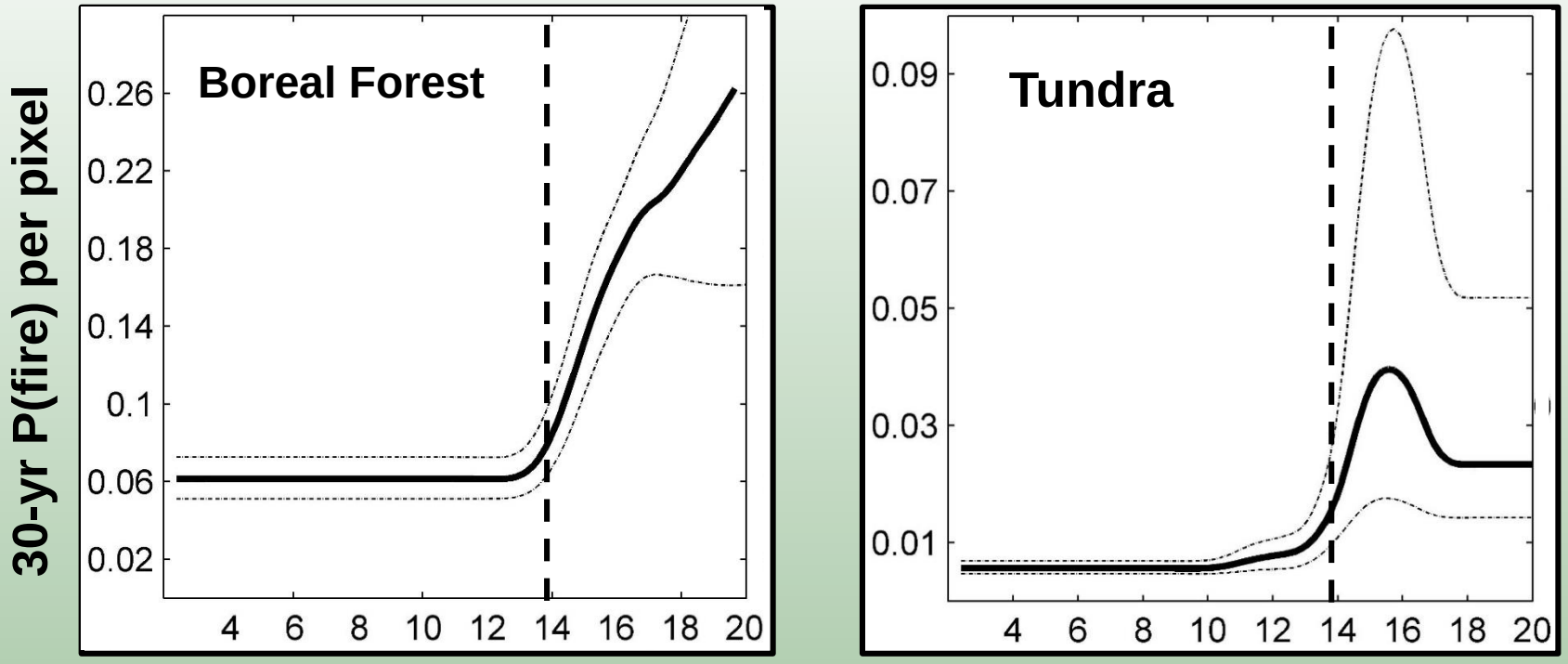
Variable importance



***Climate is most influential**

***Influence differs between boreal forest and tundra**

Fire-climate relationships



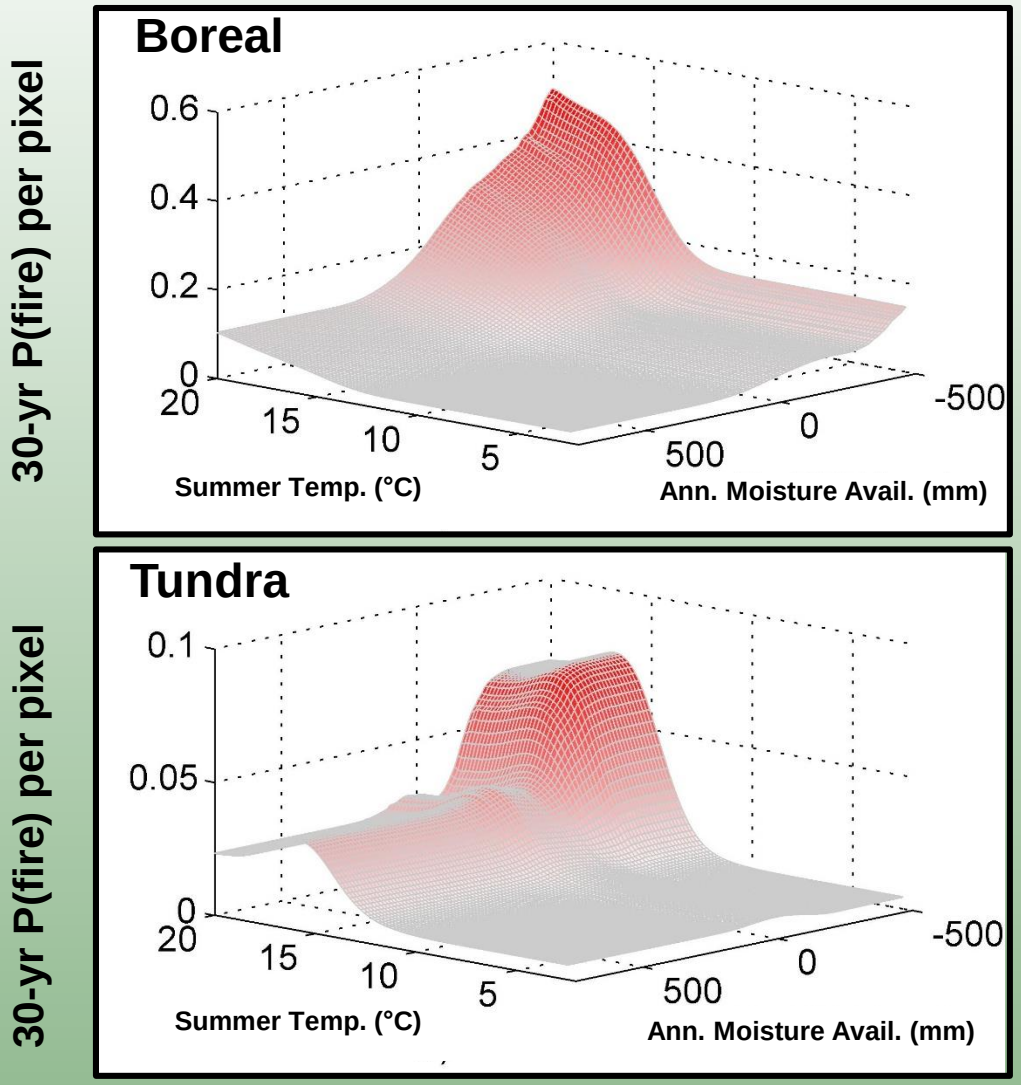
***Non-linear fire-climate relationships reveal thresholds**

***Small climatic changes may result in large fire regime changes**

Temperature and moisture interact

Warm, dry regions most susceptible to burning

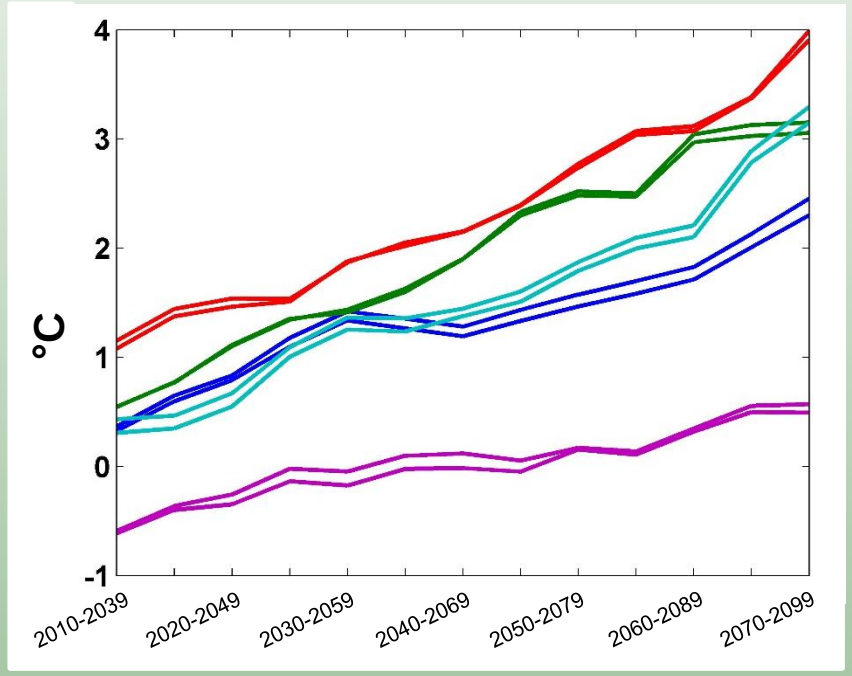
***Interactions suggest spatial variability in responses to climate**



GCM projected climate changes

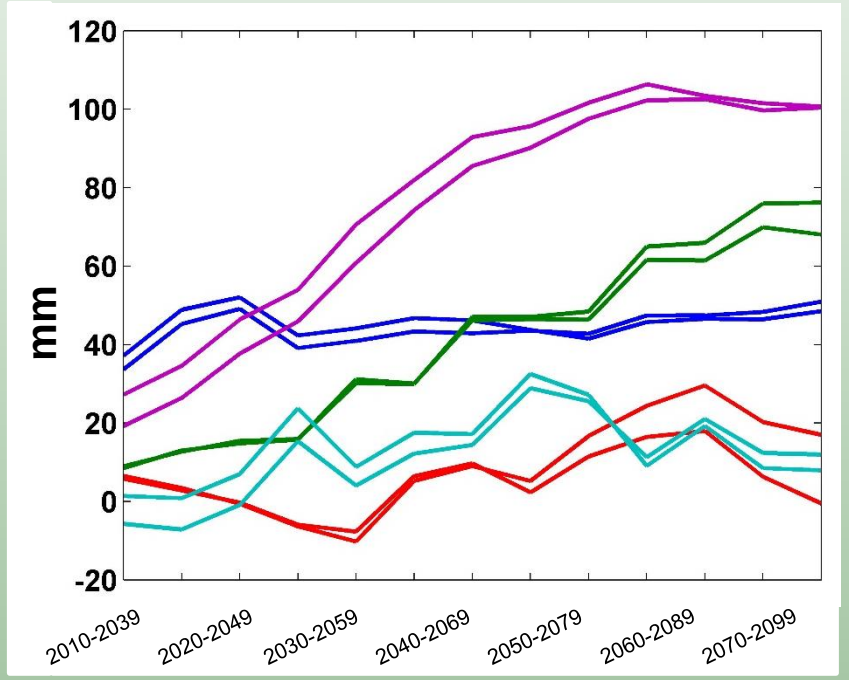
Change from 1950-2009 average

Summer temp.



Temp. projected to increase

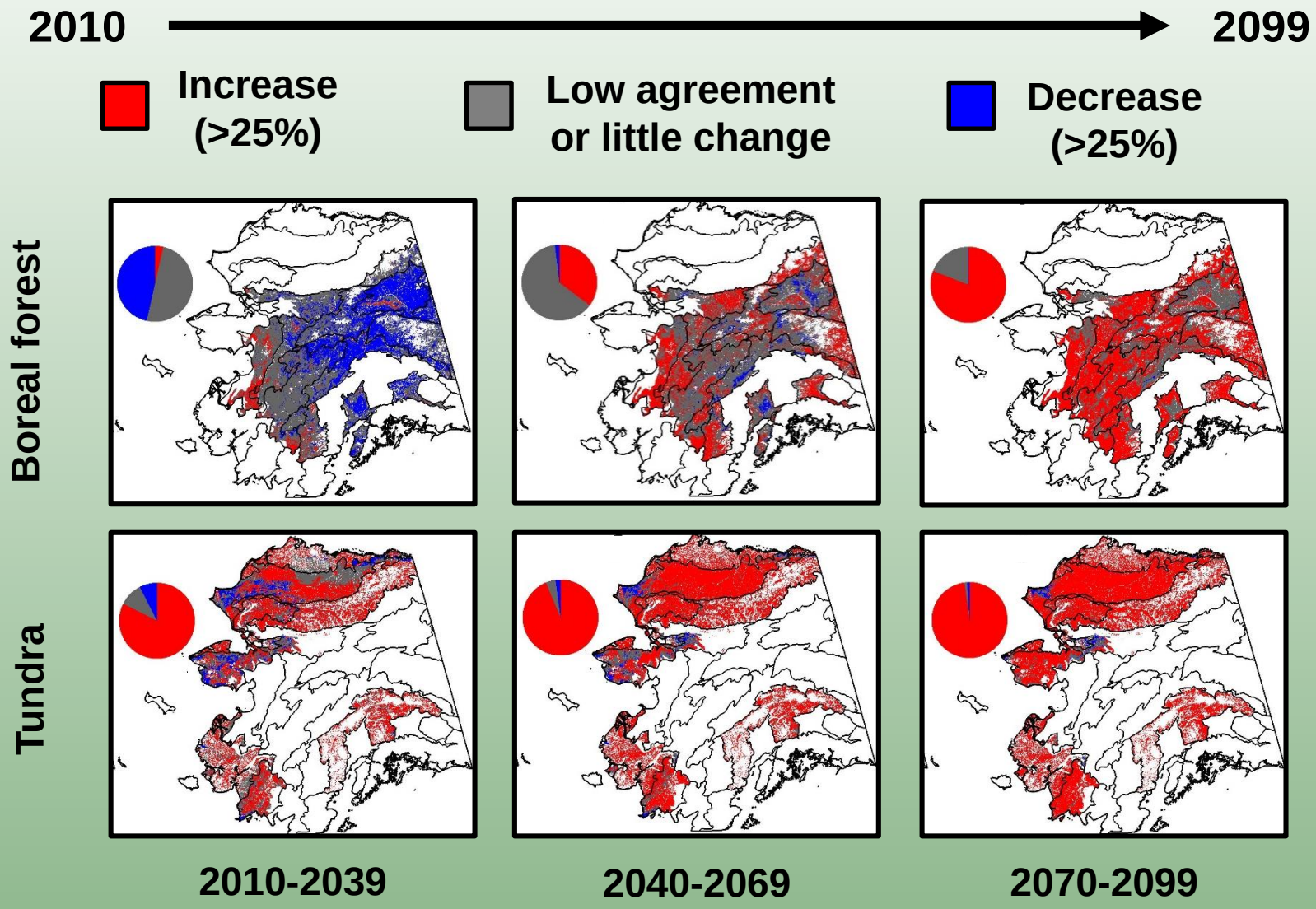
Annual moisture availability



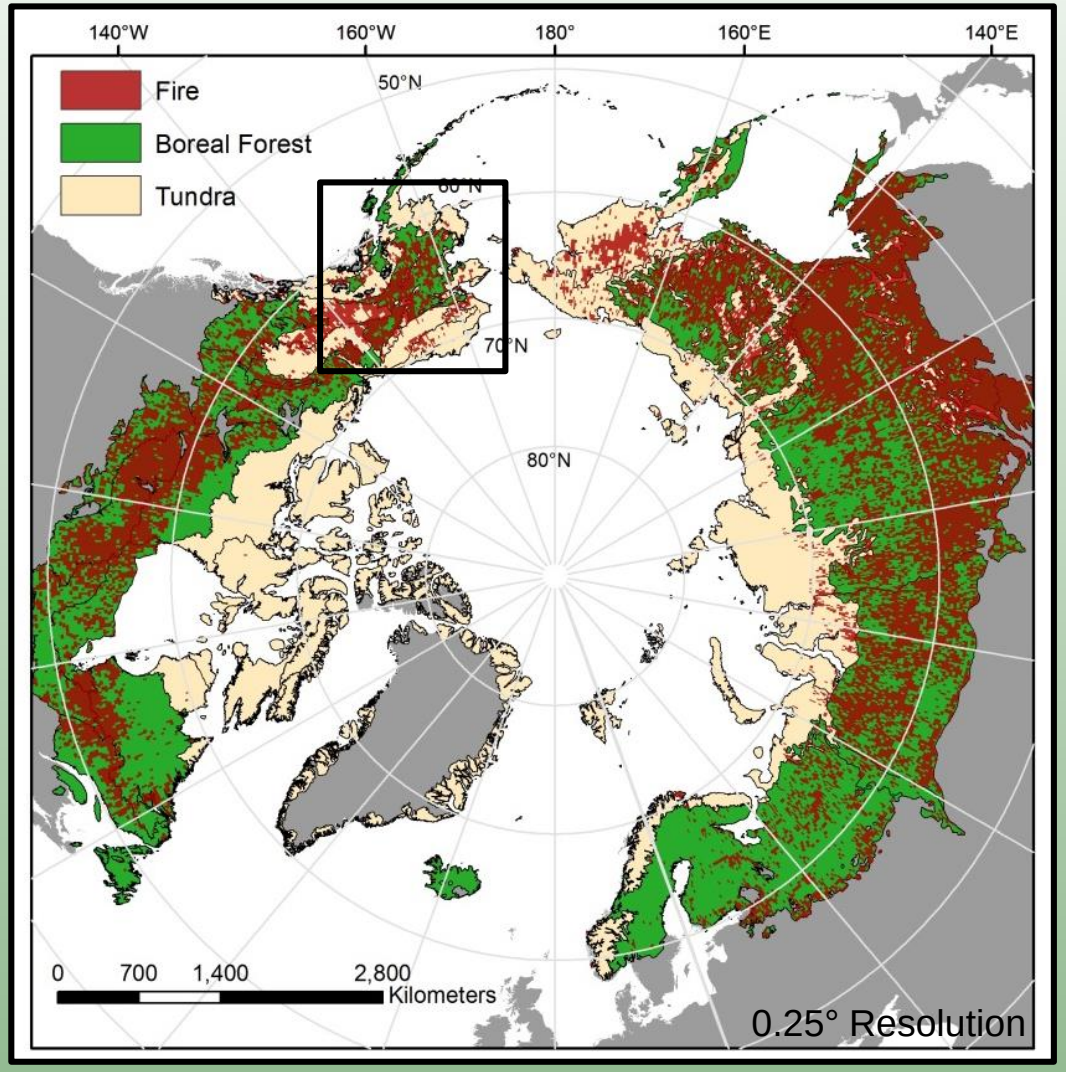
Moisture projections more variable

Climate Data: Scenarios Network for Alaska and Arctic Planning (www.snap.uaf.edu)

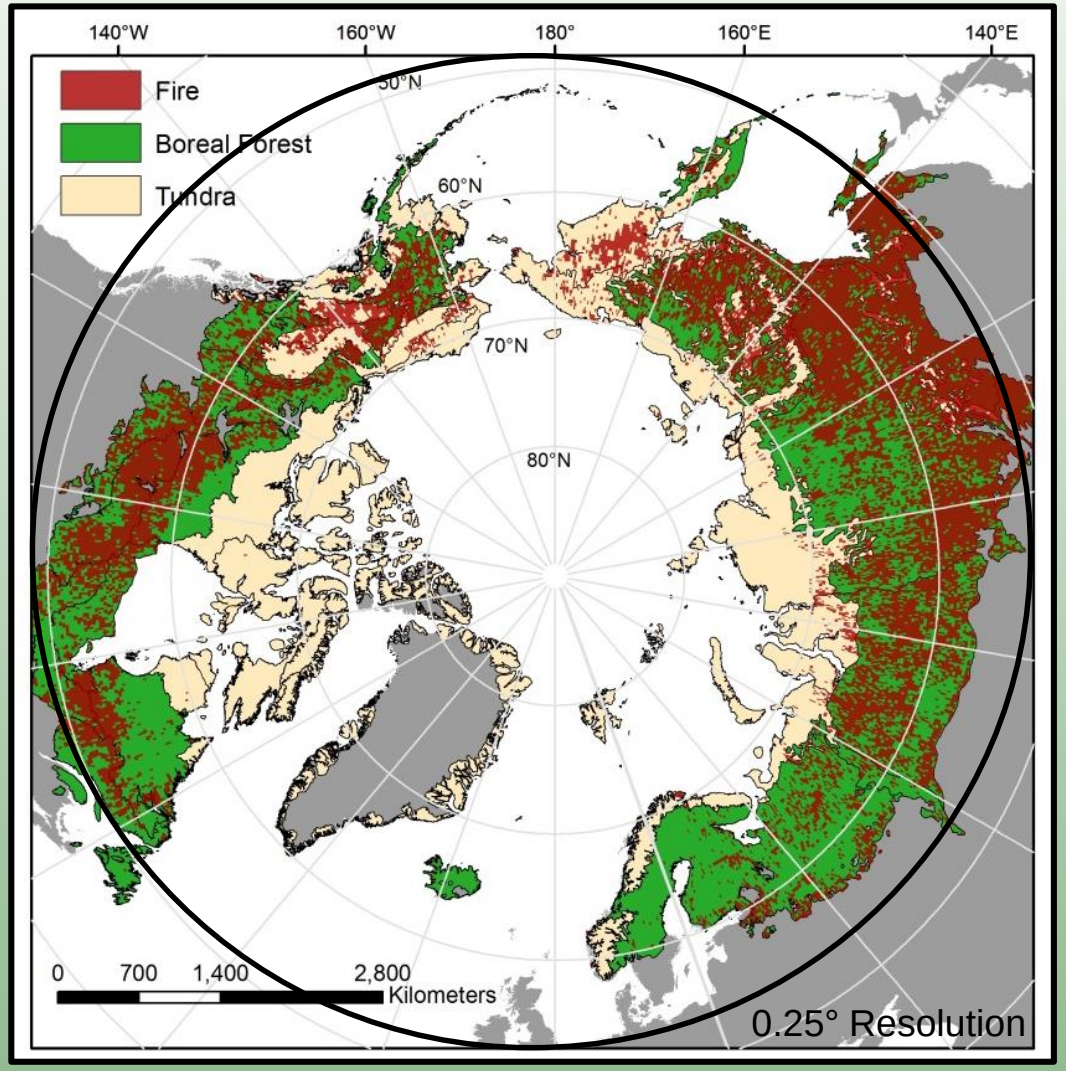
Responses to climate change



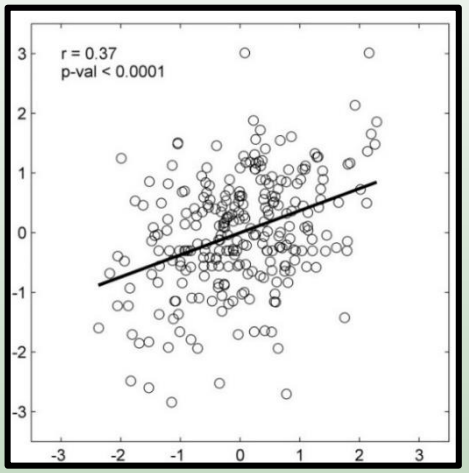
Future work


140°W
160°W
180°
160°E
140°E
50°N
Fire
Boreal Forest
Tundra
70°N
80°N
0
700
1,400
2,800
Kilometers
0.25° Resolution

Future work

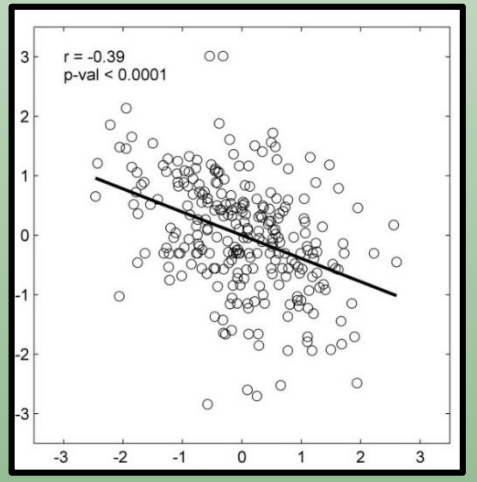


Boreal Forest



z-score avg. JJA temp.

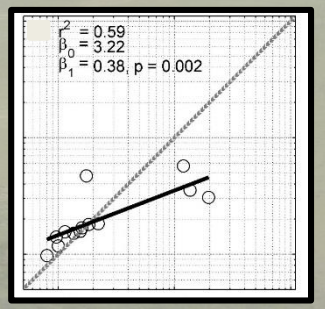
z-score log(AAB)



z-score total JJA precip.

Key results

- **Climate explains significant spatial variability in Alaskan fire occurrence**



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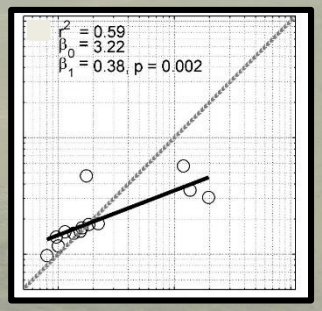
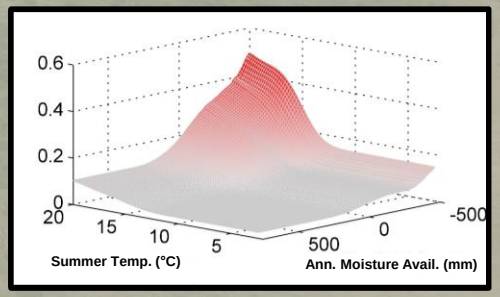
Key results

- Climate explains significant spatial variability in Alaskan fire occurrence

- Fire-climate relationships are non-linear, with interactions





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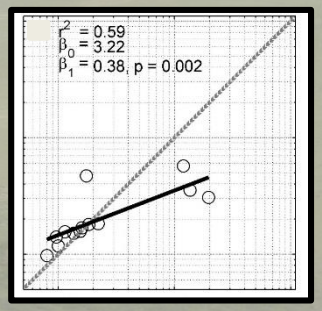

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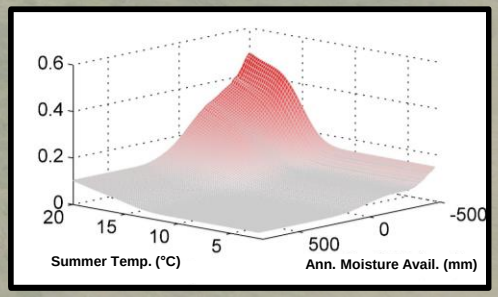
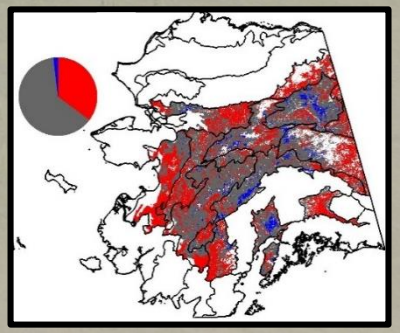


- Fire regime responses may be complex temporally and spatially



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Acknowledgements

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Award 14-3-01-7

Award NNX14AK86H

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Related work

Paul Duffy, Philip Higuera, Adam Young, Feng Sheng Hu, and Michael Dietze

B51H-0118**, Friday 8:00-12:20** in Moscone West Poster Hall

Key results

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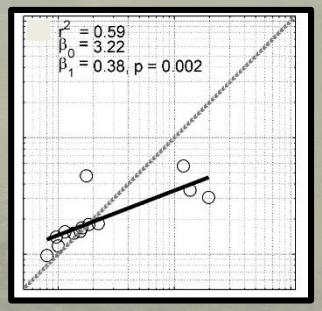

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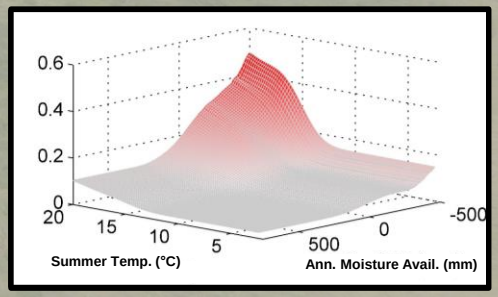

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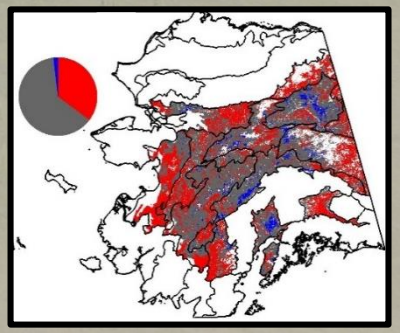

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