A photograph of a forest fire in a coniferous forest. A single tree in the center is engulfed in bright orange and yellow flames, with thick white smoke rising from it. The surrounding trees are dark green and appear to be unaffected by the fire. The background is a hazy, greyish-blue sky.

Projected Vegetation and Fire Regime Response to Future Climate Change in Alaska

Scott Rupp

University of Alaska Fairbanks

Department of Forest Sciences

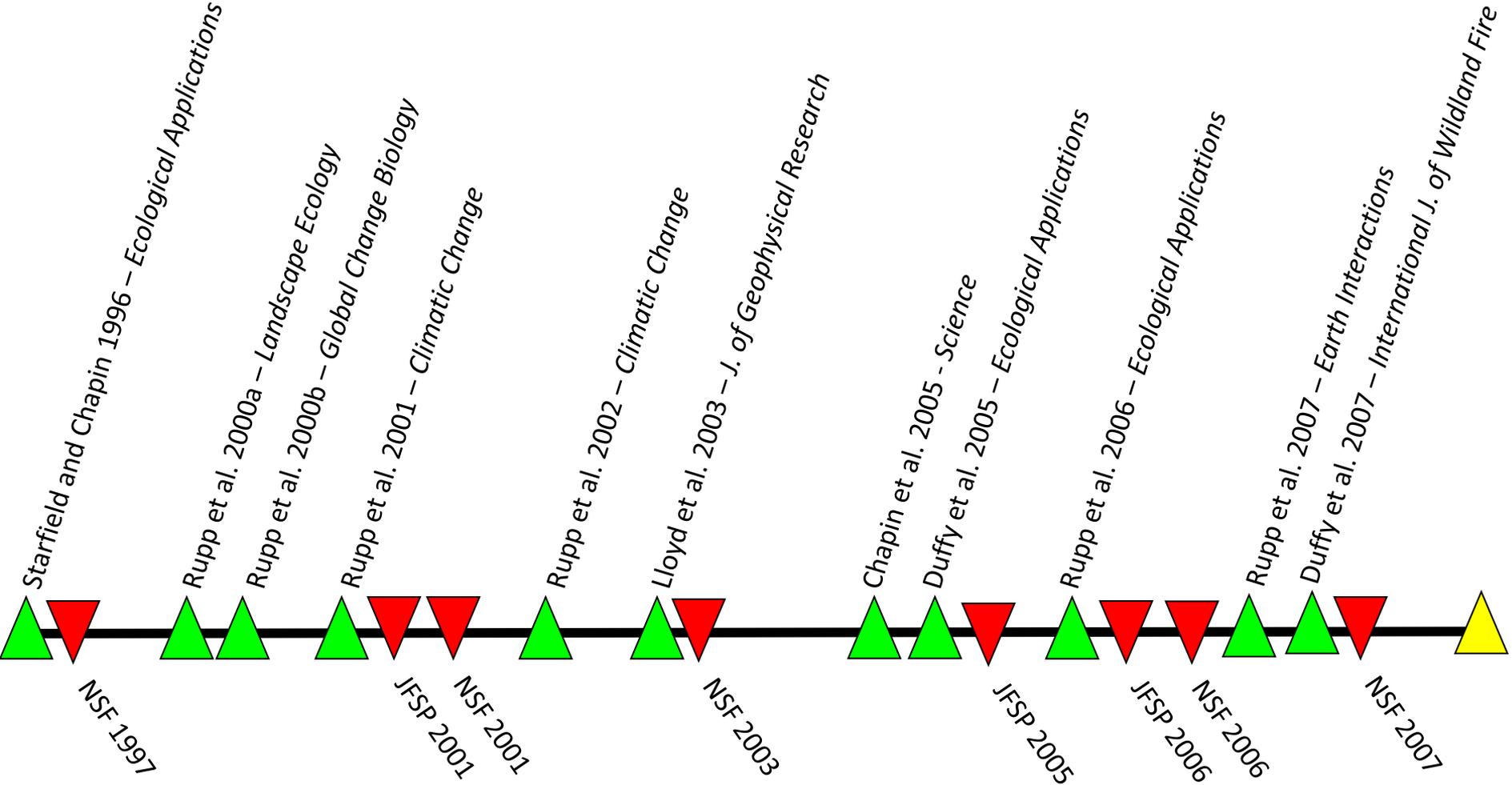
Project Investigators and Collaborators

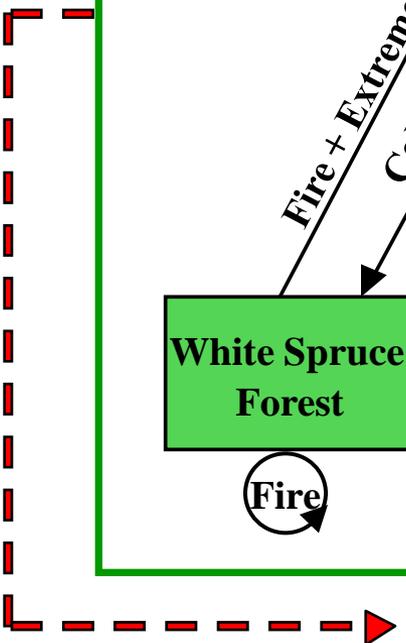
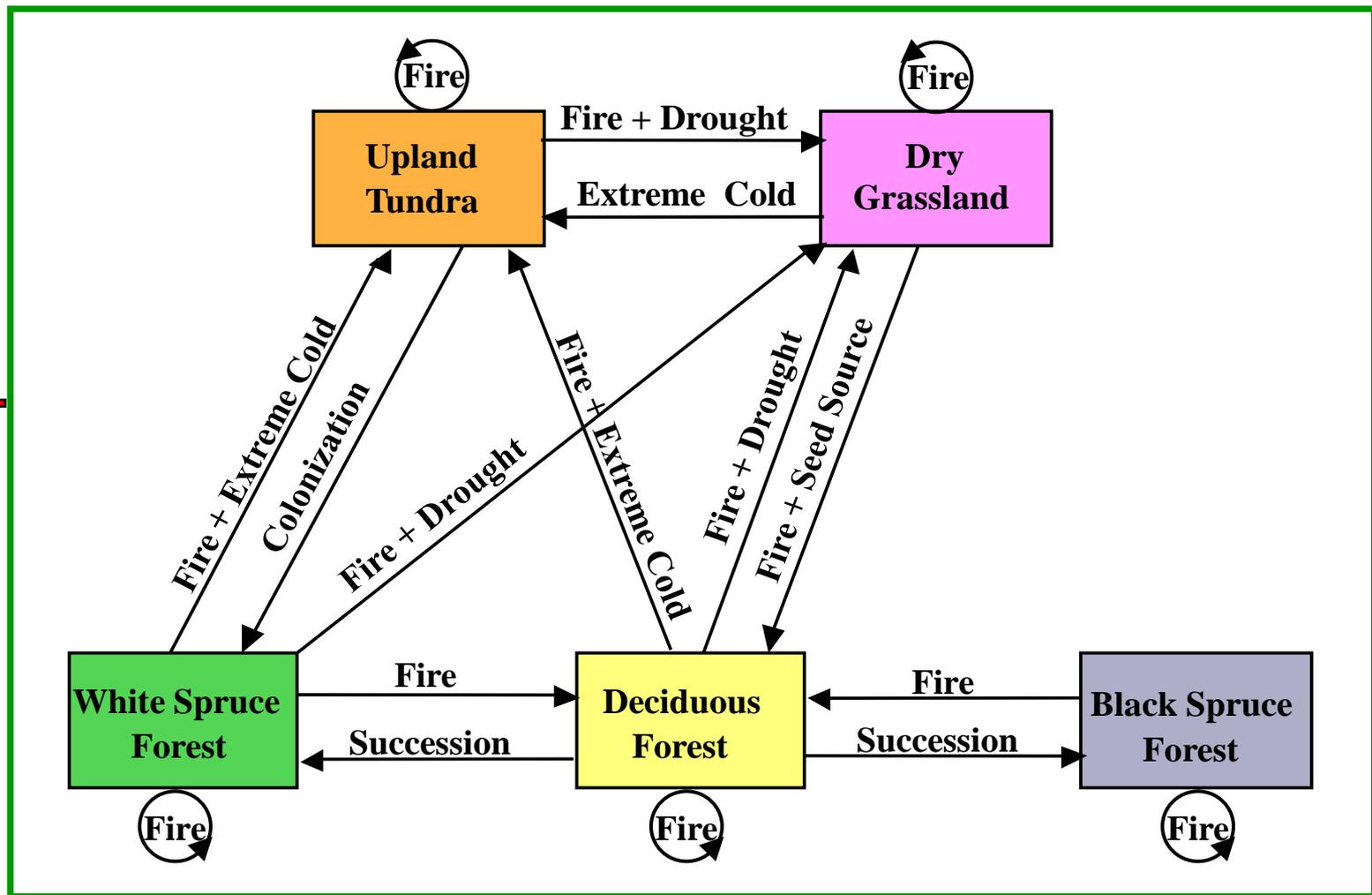
- Paul Duffy, *Department of Forest Sciences, Univ. of Alaska*
- Mark Olson, *Scenarios Network for Alaska & Arctic Planning, Univ. of Alaska*
- Tim Glaser, *Scenarios Network for Alaska & Arctic Planning, Univ. of Alaska*
- Daniel Mann, *Geography Department, Univ. of Alaska*
- Karen Murphy, *US Fish and Wildlife Service*
- Randi Jandt, *Alaska Fire Service, BLM*
- Jennifer Barnes, *National Park Service*
- Layne Adams, *USGS – Alaska Science Center*
- Bruce Dale, *Alaska Department of Fish and Game*
- Anna Springsteen, *Scenarios Network for Alaska & Arctic Planning, Univ. of Alaska*
- Skip Theisen, *BLM*

ALFRESCO

- State-transition type vegetation succession model
- Focuses on system interactions and feedbacks
- User-defined spatial resolution (currently operational at 1 km pixels)
- User-defined temporal resolution (currently operational on annual time step w/ monthly fire-climate relationship)
- Pixels are randomly “ignited” and fire “spreads” as a function of climate and vegetation state

ALFRESCO Timeline





Disturbance

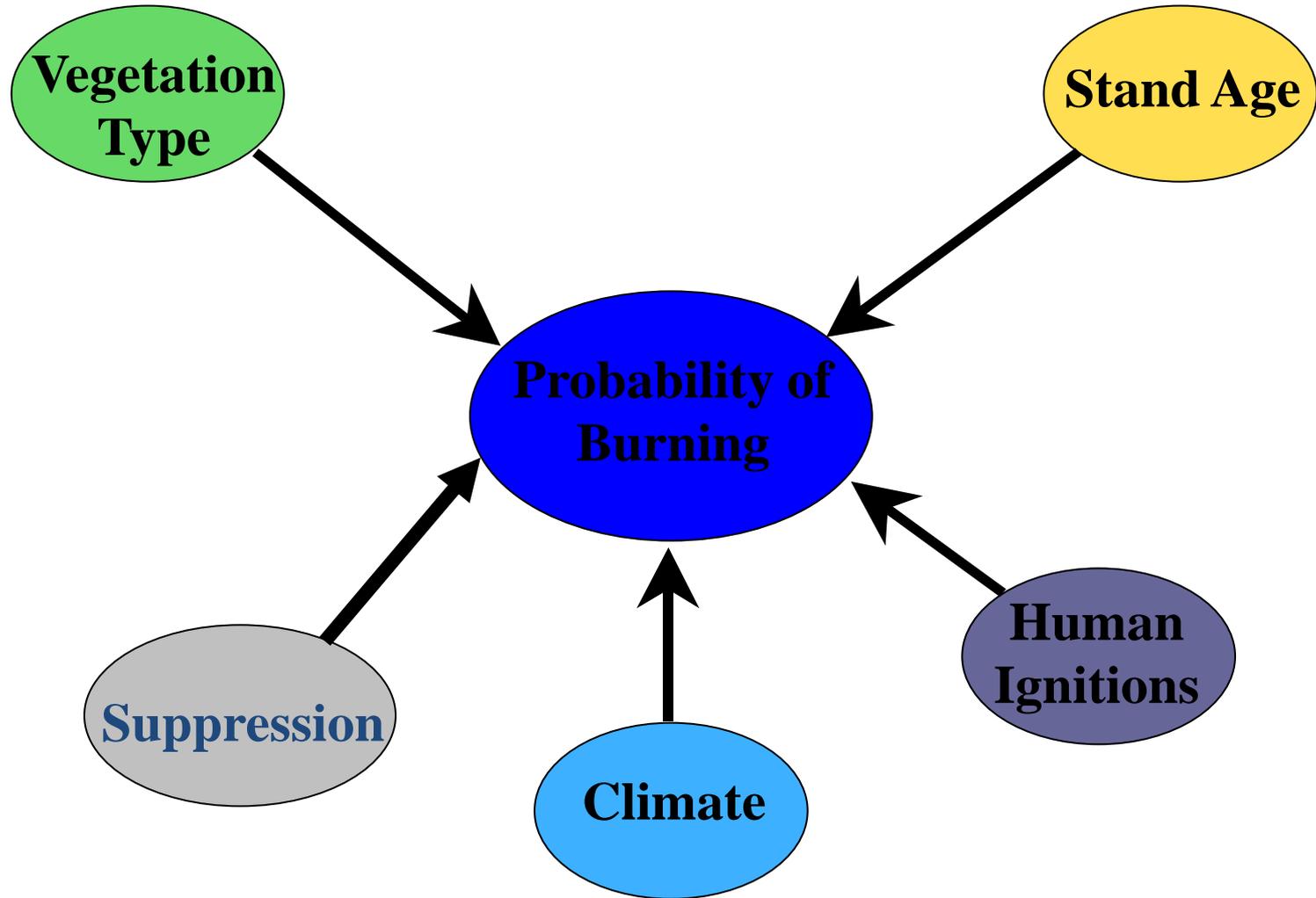
- Fire
- Insects
- Browsing



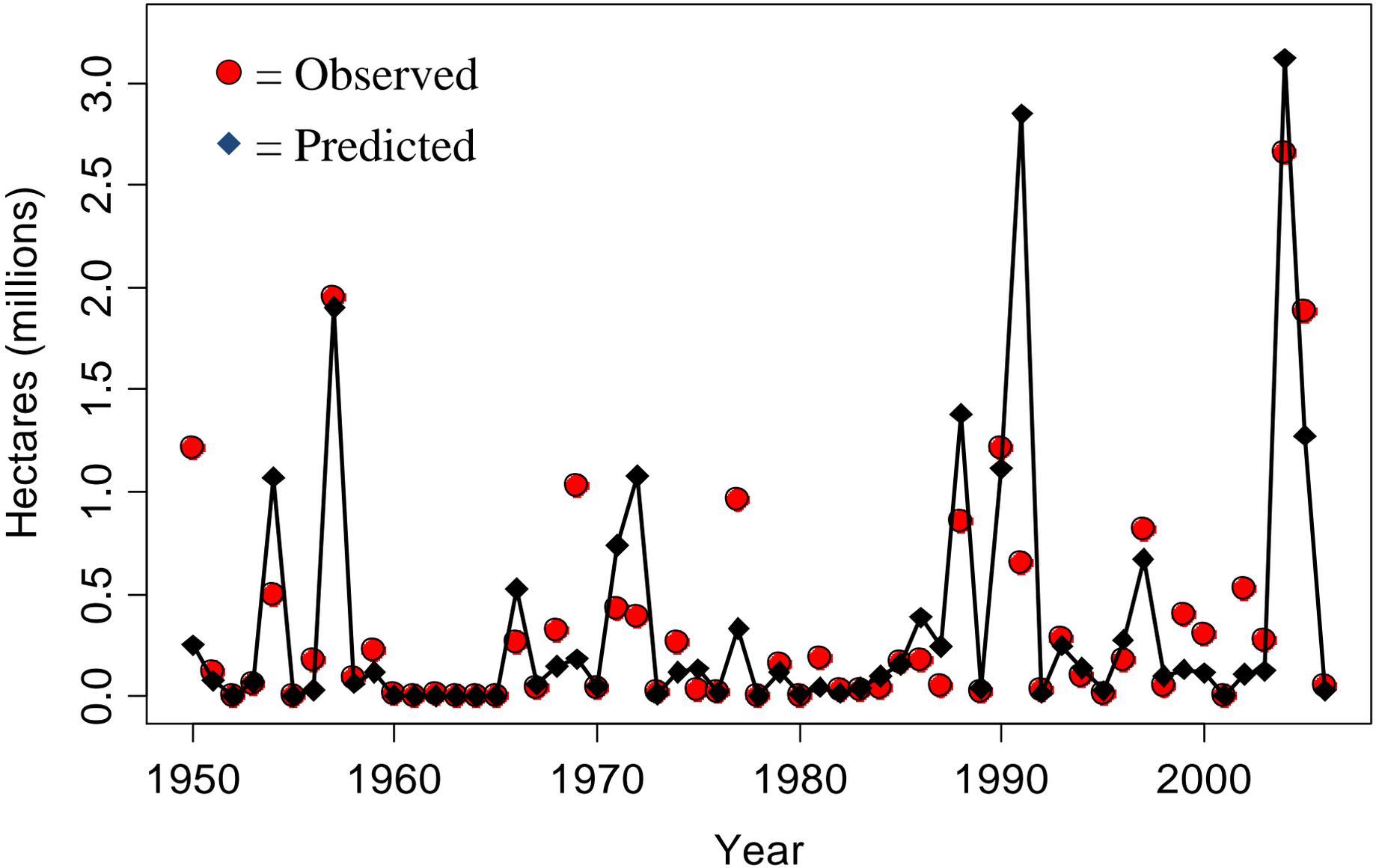
Climate

- GS Temp.
- GS Precip.
- Drought

Individual Cell Flammability

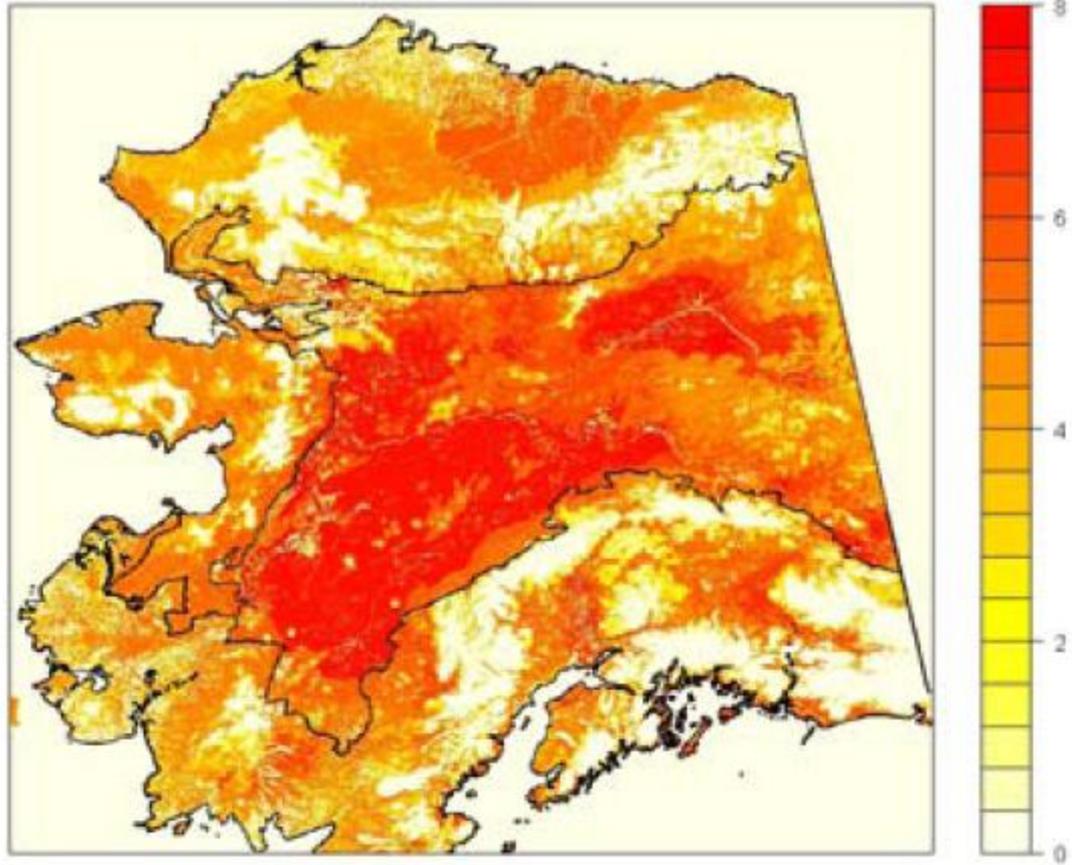


Observed vs. Predicted Area Burned in Alaska (1950-2006)



* Regression Model from Duffy et al (2005)

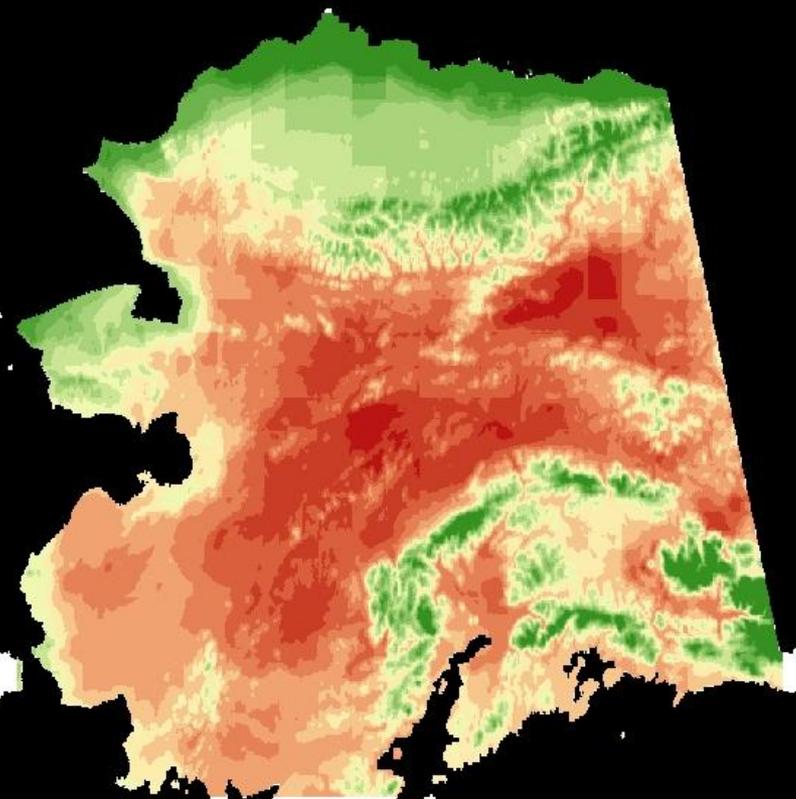
GBM Climate Flamm. Year 1957



Overall Rank	Model	Alaska temperature	60-90° N temperature	20-90° N temperature	Alaska precipitation	60-90° N precipitation	20-90° N precipitation	Alaska sea level pressure	60-90° N sea level pressure	20-90° N sea level pressure	Integrated Rank Index
1	MPI ECHAM5	13	1	1	5	3	3	1	1	1	29
2	GFDL CM2.1	6	3	5	2	1	2	5	4	2	30
3	MIROC 3.2	2	4	3	7	6	8	10	3	5	48
4	UKMO HADCM3	11	8	6	3	2	9	4	6	7	56
5	CCCMA 3.1	12	11	10	4	8	2	8	2	4	61
6	GFDL CM2.0	6	9	14	1	10	6	4	8	4	62
7	MRI CGM2.3.2A	11	13	7	6	5	4	2	11	6	65
8	CNRM CM3	1	5	5	12	12	13	7	12	11	78
9	NCAR CCSM3	8	2	2	9	8	7	15	15	13	79
10	INMC 3.0	7	6	10	10	13	12	9	7	9	83
11	NCAR PCM1	14	13	14	8	5	10	6	5	12	87
12	CSIRO MK3.0	6	14	12	11	11	5	11	9	9	88
13	IPSL CM4	11	7	12	13	9	11	14	11	15	103
14	GISS E R	6	10	10	14	14	15	13	14	14	110
15	IAP_FGOALS1_0_G	15	15	15	15	15	14	12	13	10	124



CRU – 0.5 x 0.5 degrees

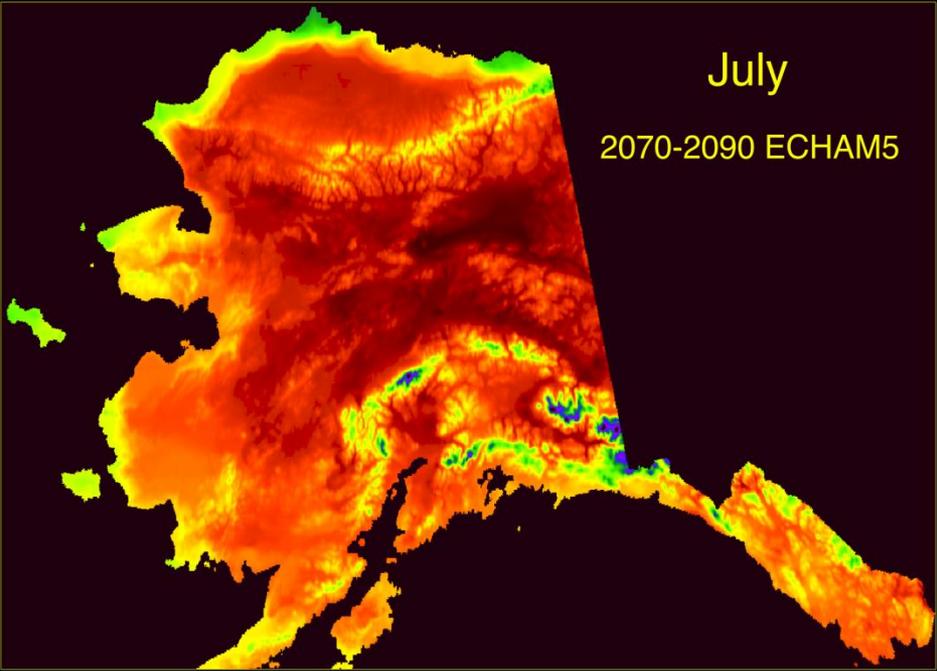
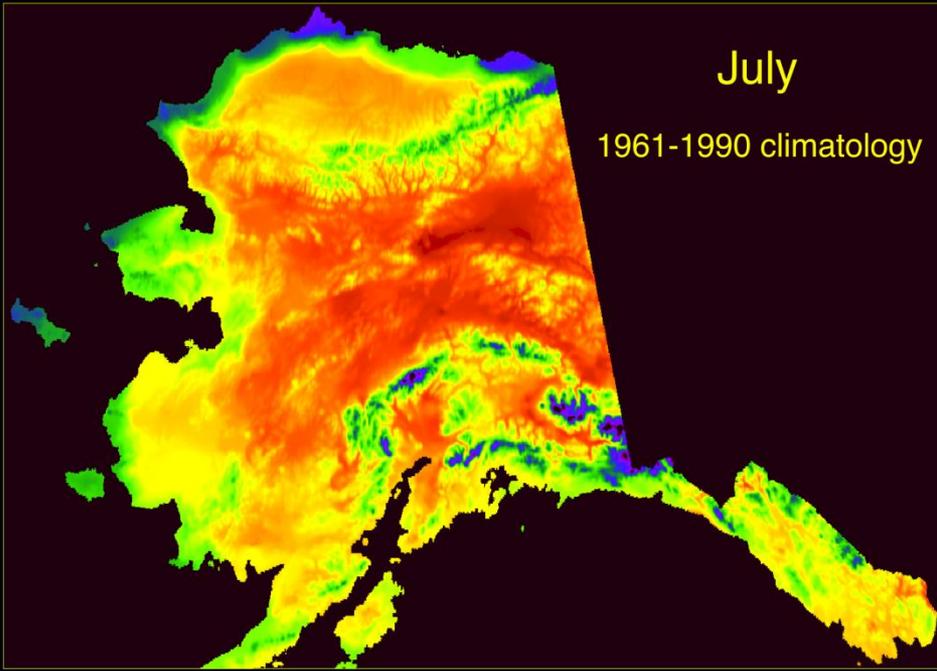


Downscaled CRU – 2 x 2 km

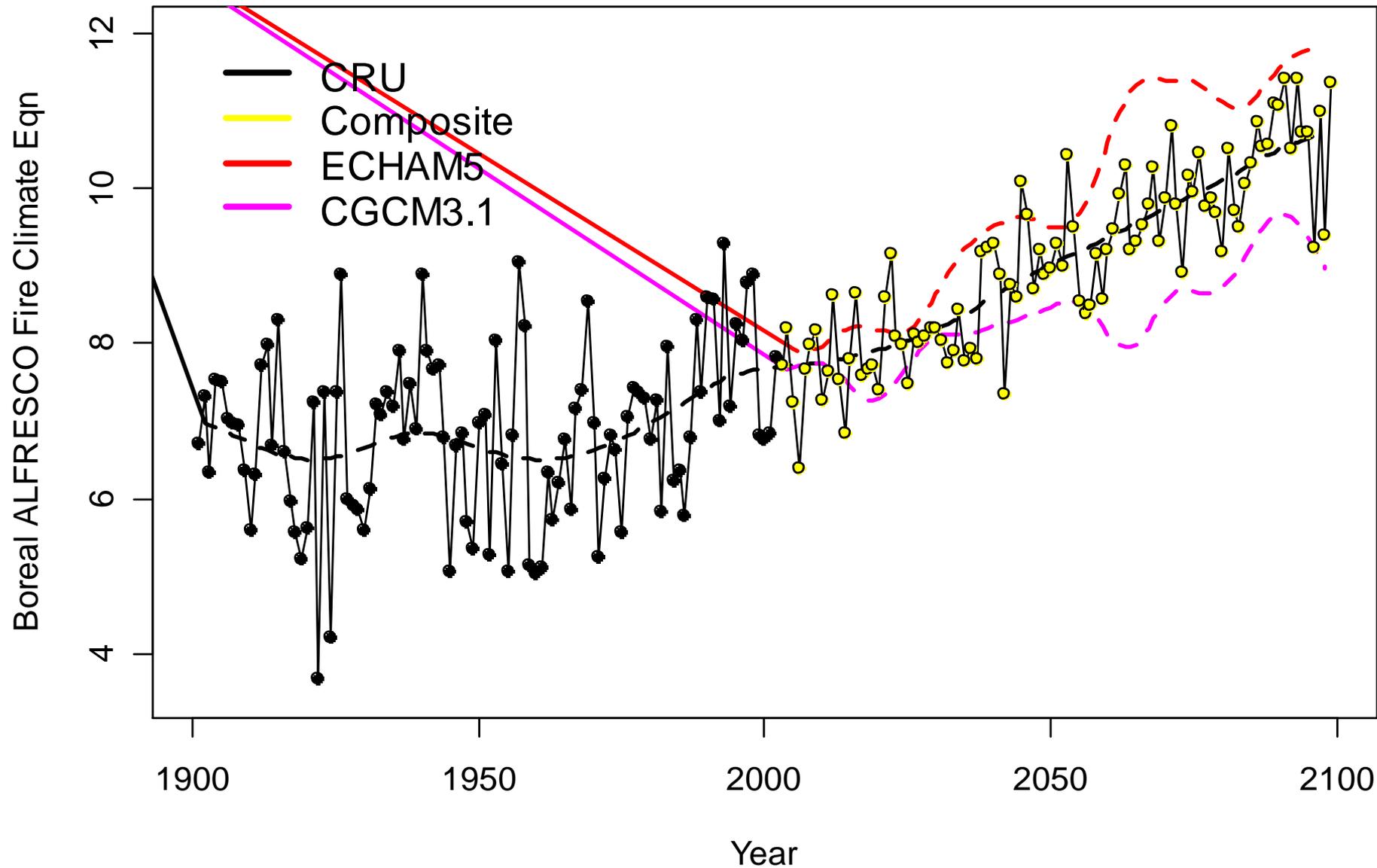
July temperatures

1961-1990 (PRISM climatology)

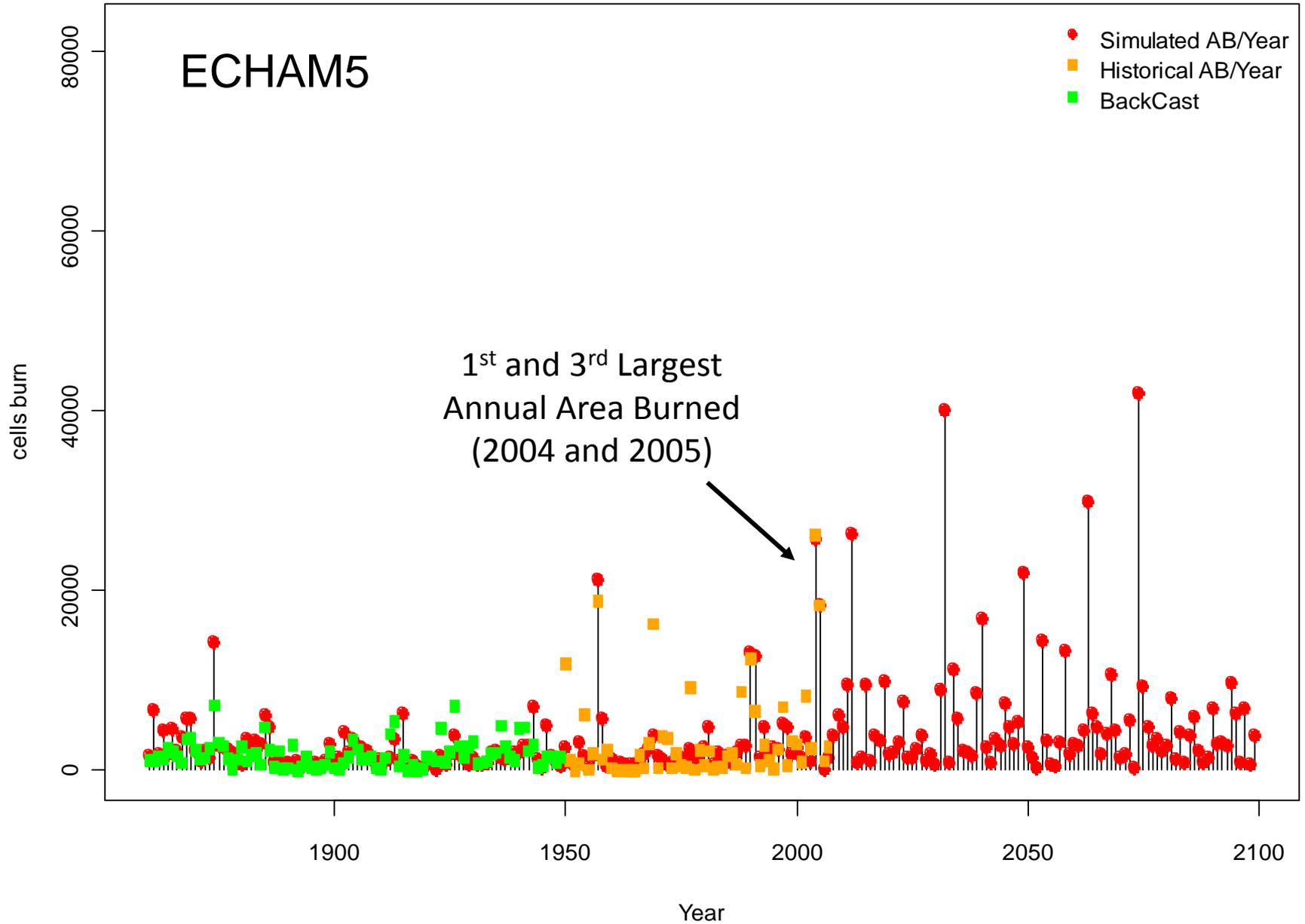
2070-2090 (ECHAM5)



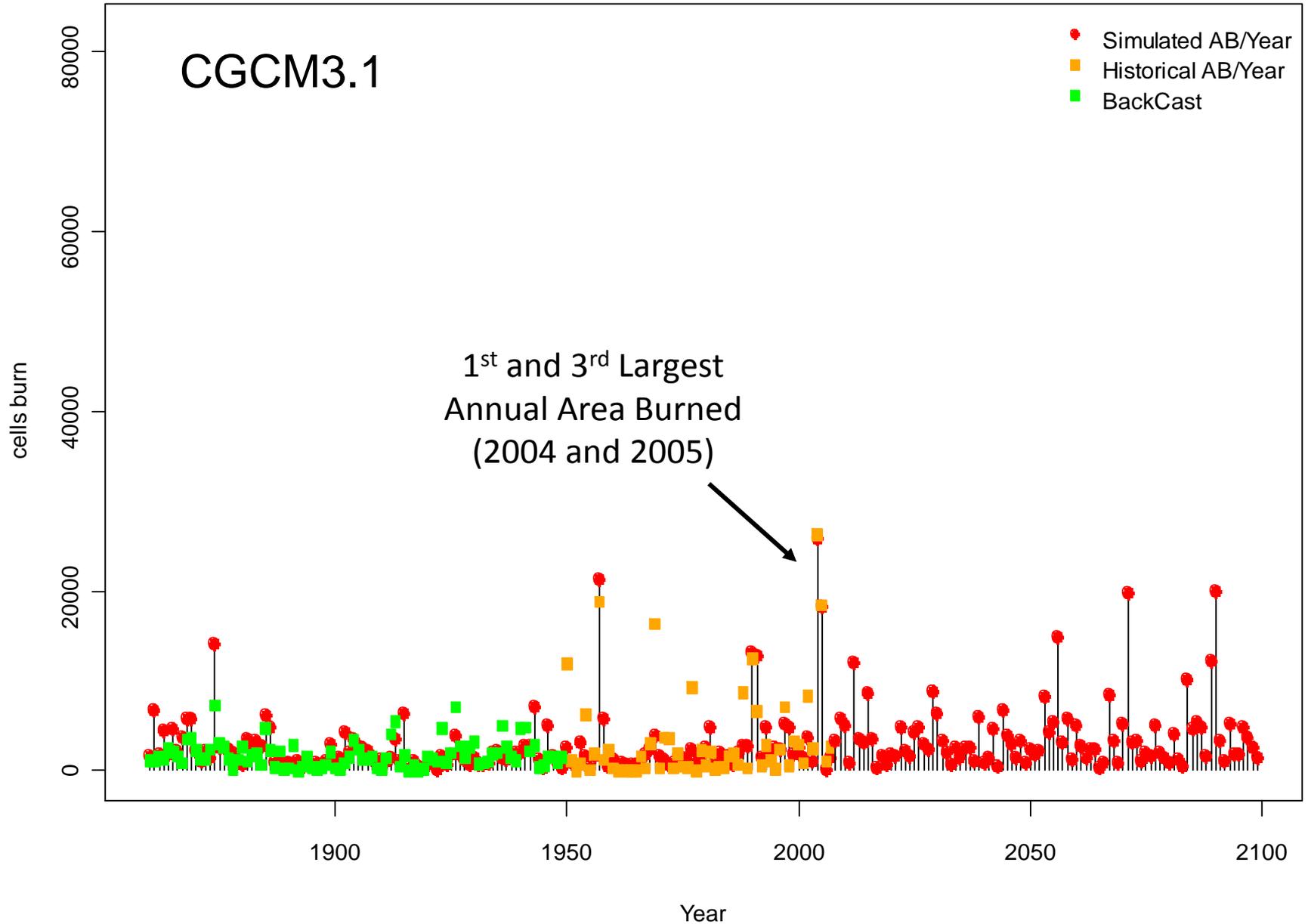
Boreal ALFRESCO FireClimate Relationship



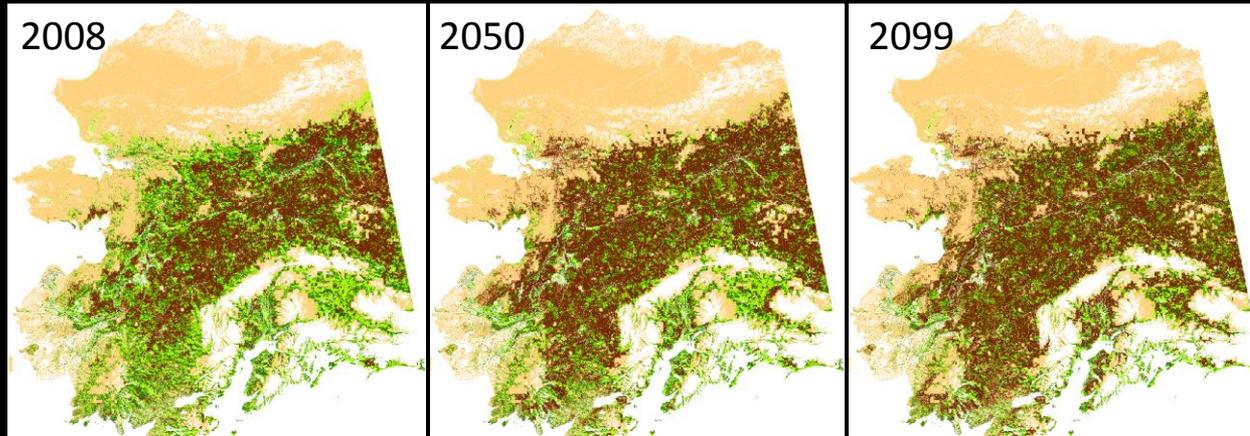
Simulated Annual Area Burned



Simulated Annual Area Burned



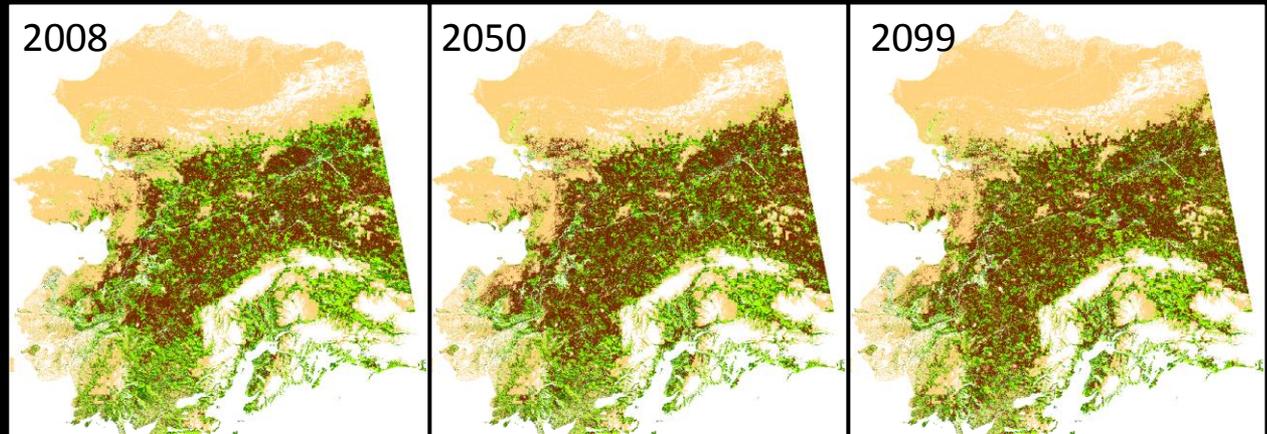
Simulated Vegetation Distribution



EHCAM5

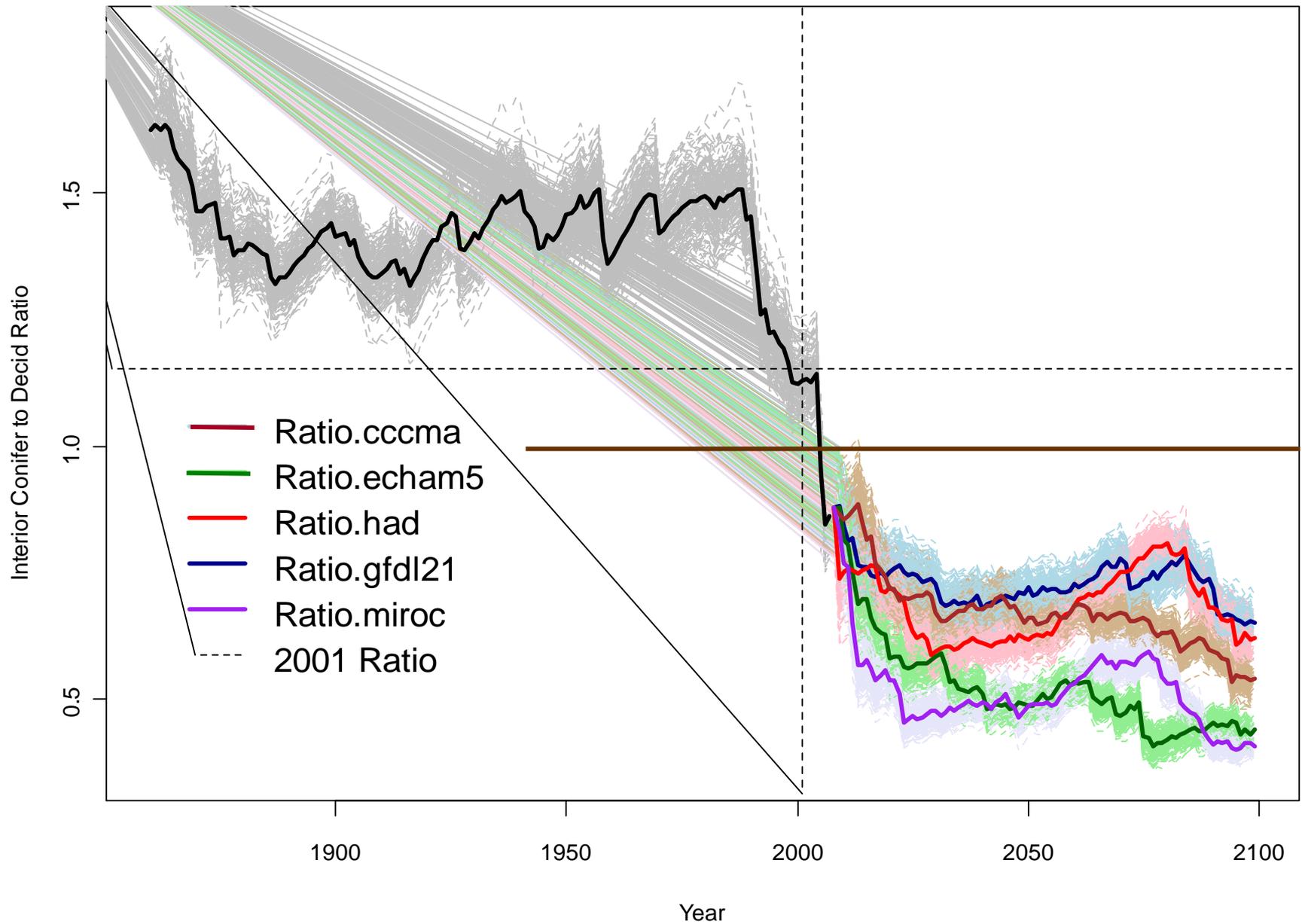
CGCM3.1

Legend



*Results from single replicate simulation

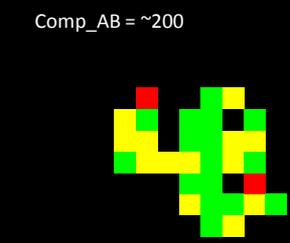
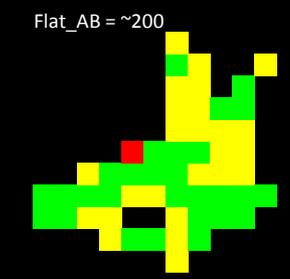
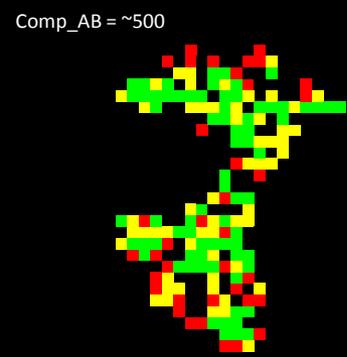
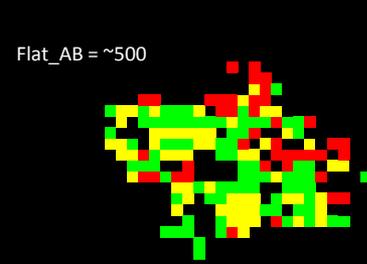
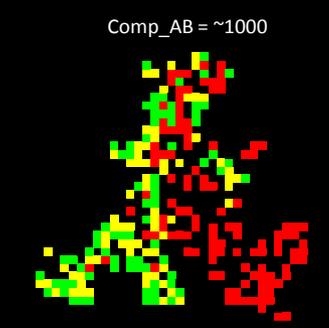
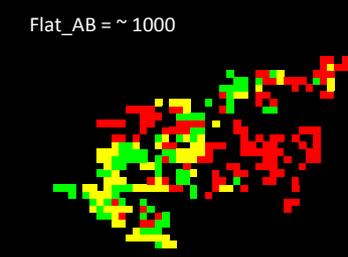
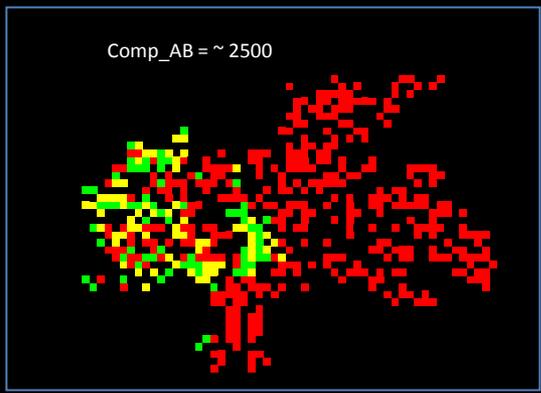
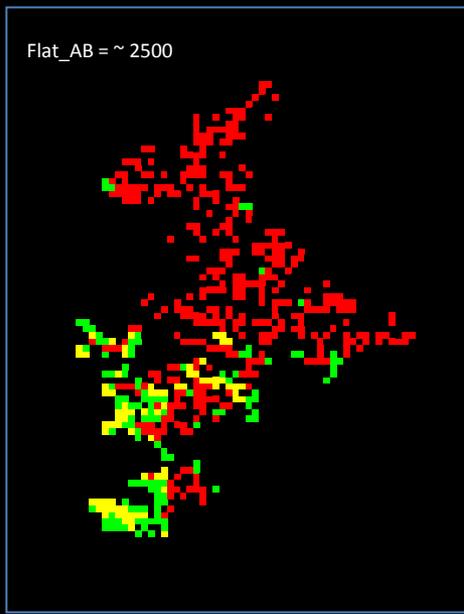
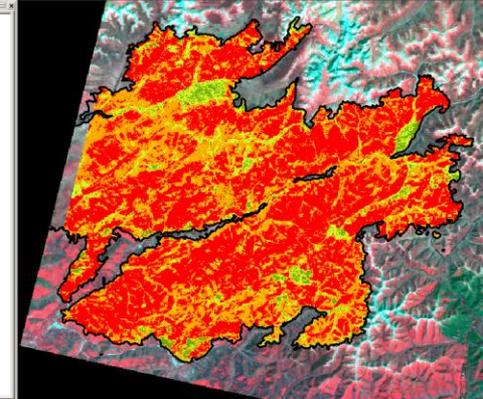
Simulated Conifer to Deciduous Ratio



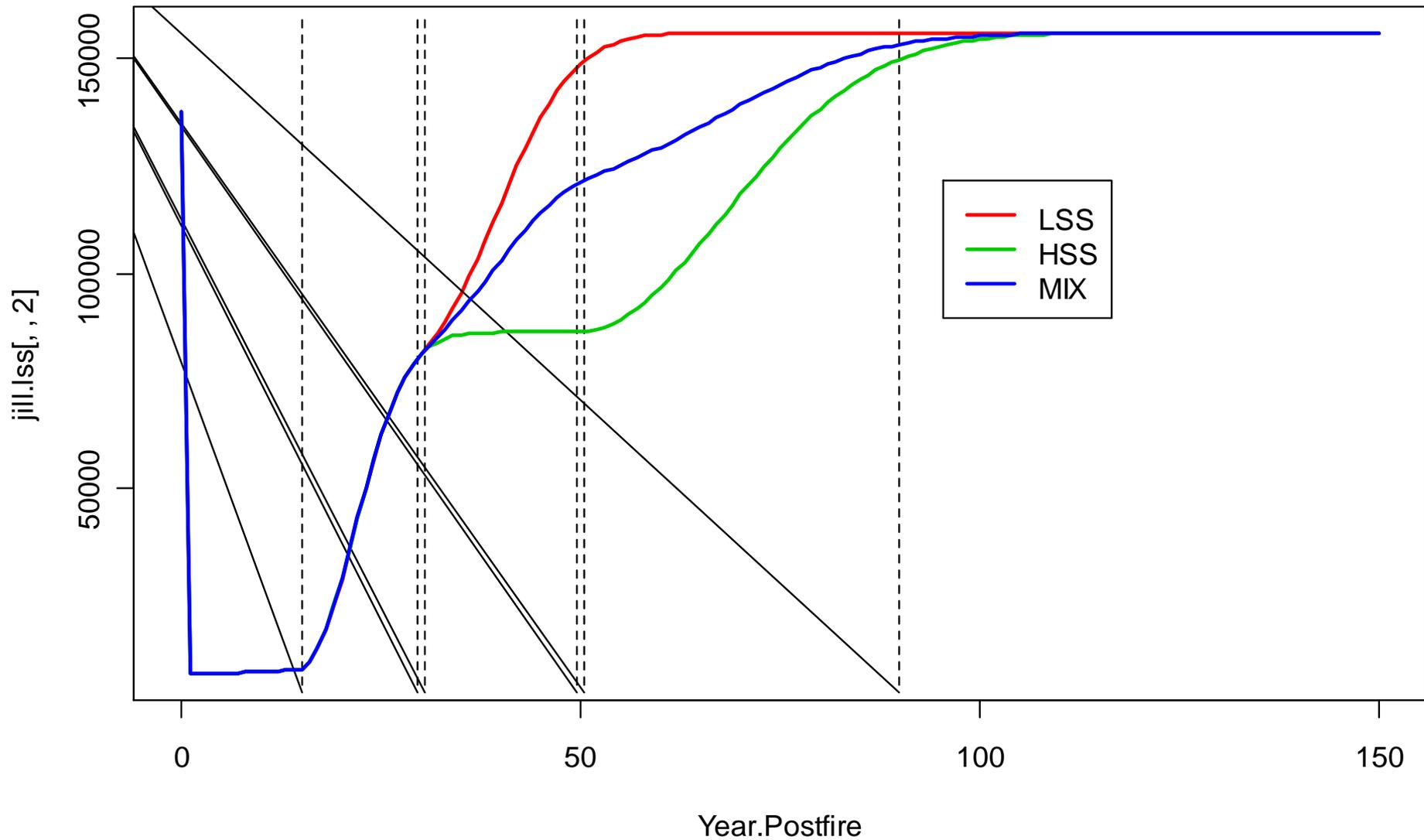
ALFRESCO Fire Severity Patterns

Boundary Burn

- Boundary_perimeter
- burn_severity.img
 - Class
 - High Severity
 - Low Severity
 - Moderate Severity
 - Unburned
- TM_18July2003



Black Spruce Transitions



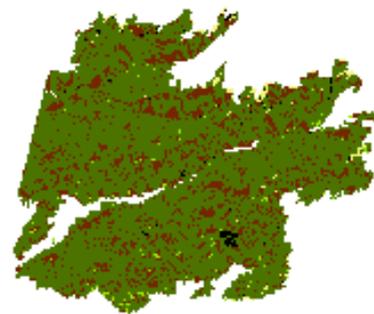
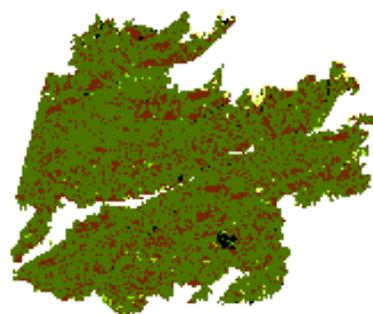
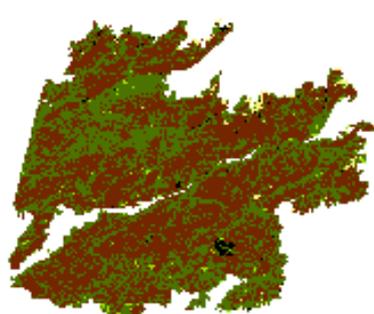
10 YPF

30 YPF

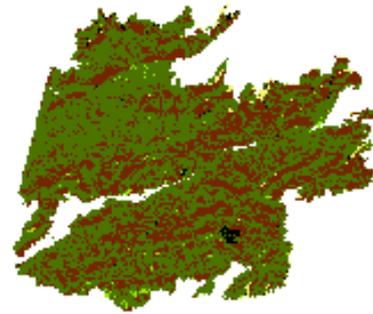
50 YPF

70 YPF

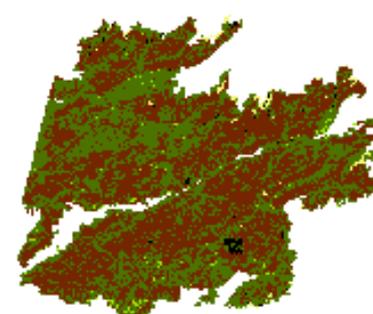
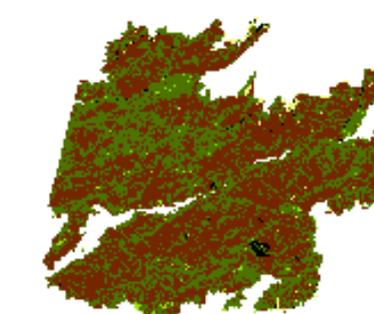
L
S
S



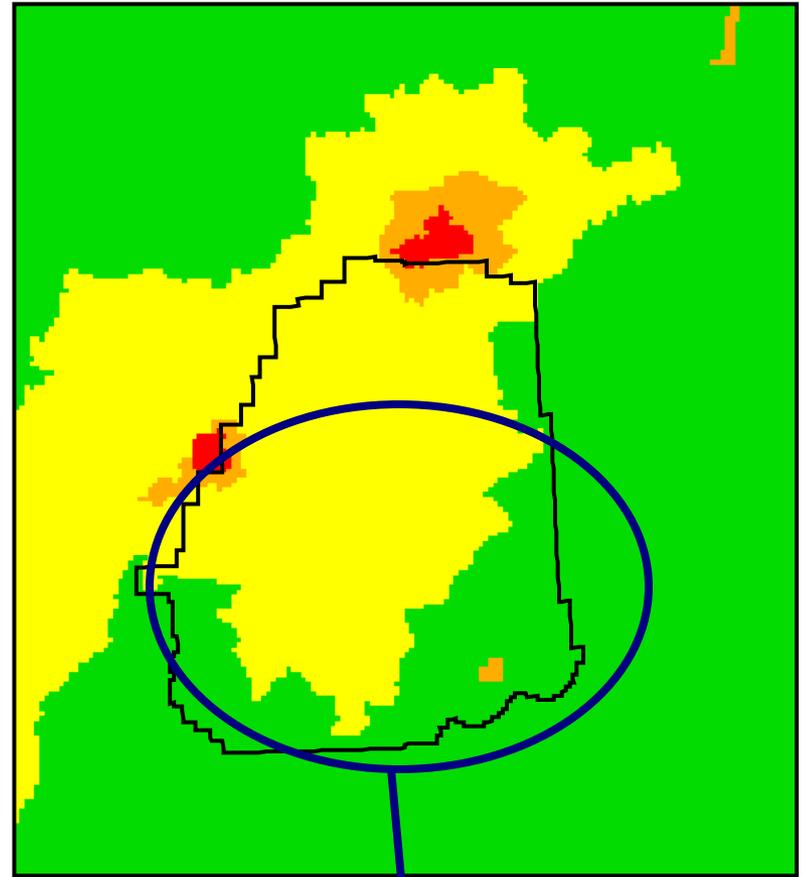
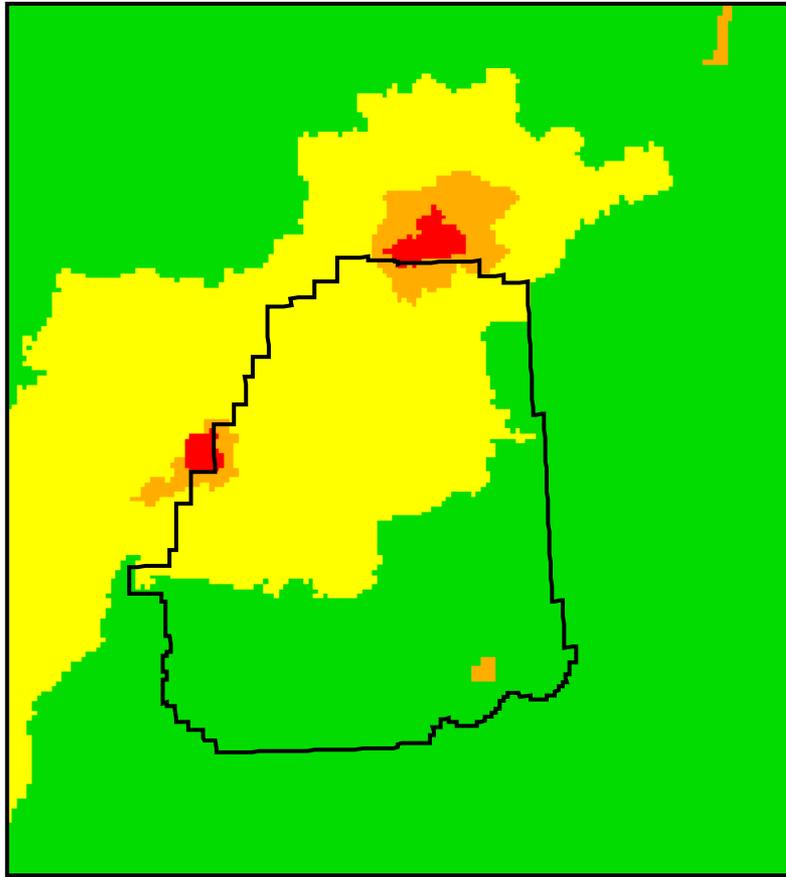
M
I
X



H
S
S



New Fire Management Options



More “Modified”

-  = Critical
-  = Full
-  = Modified
-  = Limited



Management Implications

- Alaska will likely experience substantial burning over the next 3 decades in response to projected warming and drying.
- As a result the Alaska boreal forest will likely transition to a new landscape equilibrium dominated by deciduous vegetation.
- The age structure of this new landscape will likely be considerably younger, including the remaining spruce forest cover as a result of continued frequent burning events.