RAD What?

Climate-driven regional and landscape trajectories in Alaska

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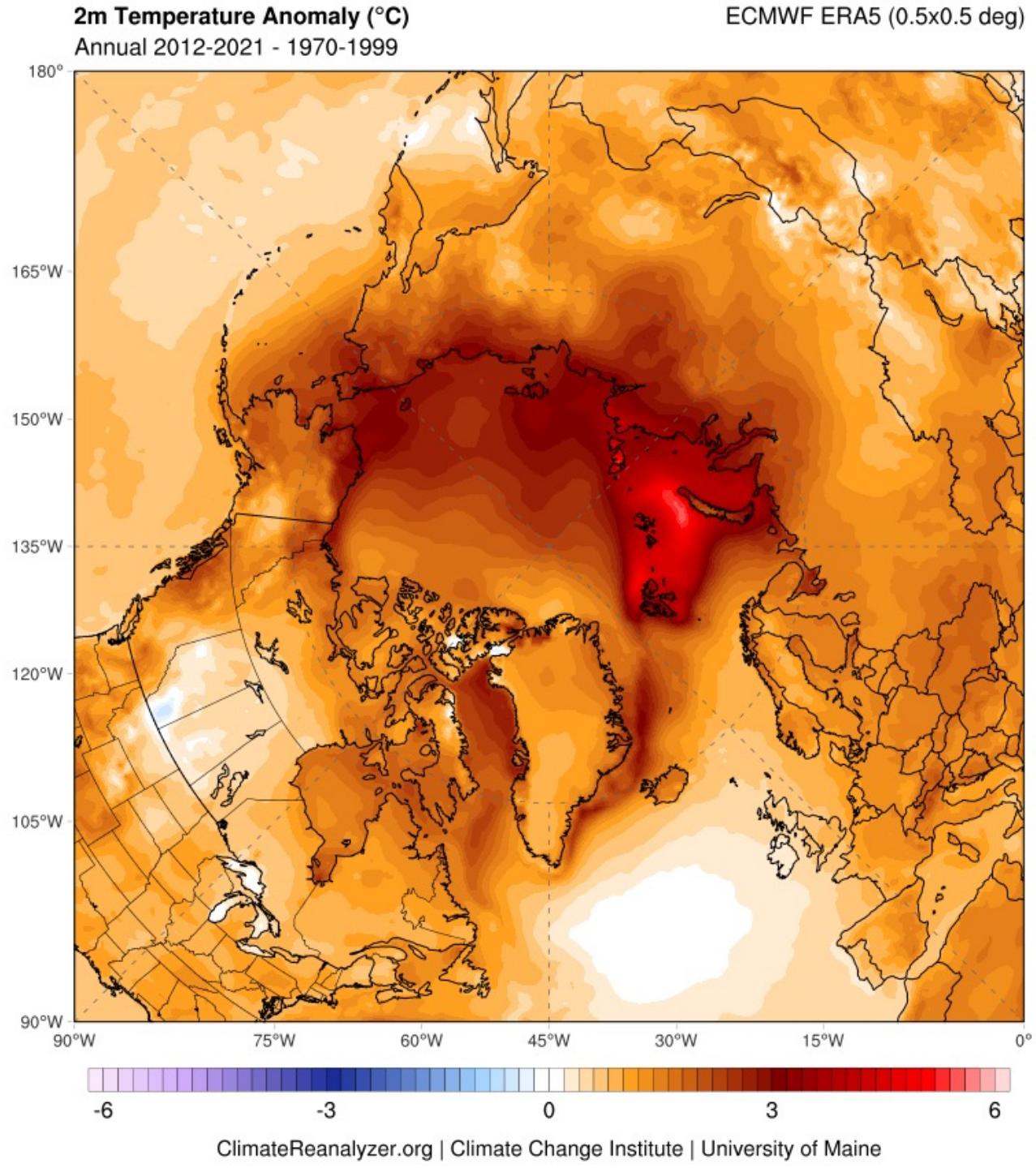

This story often starts like this…..

This is a map of the Arctic that shows how much warmer the last 10 years have been compared to 1970-1999.

In most of Alaska, between 1.5 and 3.0 ºC, or ***~ 3 to ~ 6 ºF warmer****!*

The Arctic is warming 2-3 times faster than the rest of the Earth.

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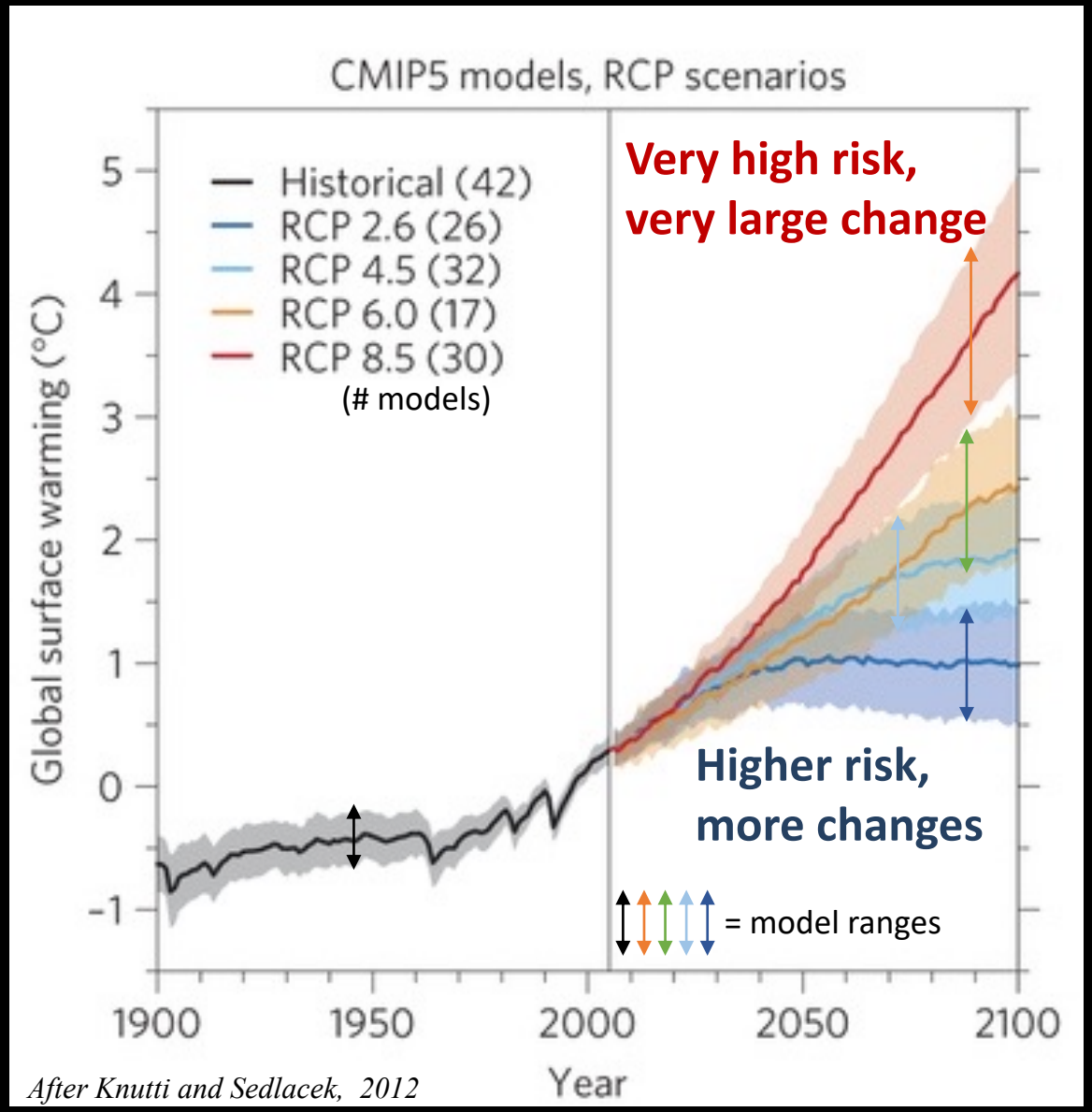
Tomorrow's risks depend on what happens today



After Knutti and Sedlacek, 2012

Future climate depends on greenhouse gas emissions.

Preparing for the high end is called **"risk averse"**; it means trying to prepare for larger impacts.

Preparing for the low end is **"risk tolerant"**; it means accepting the increased risk – and cost - that comes with warming.

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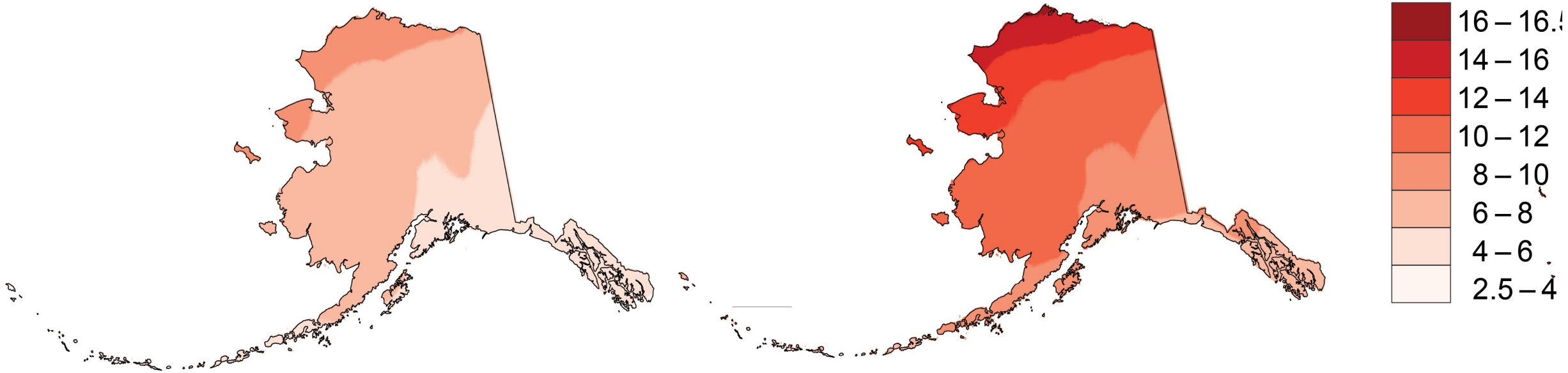
The rate of change in climate and ecosystems is sufficient that emerging systems don't much resemble those we have experience with.

Yet our models and management are based on that experience...and only as good as our questions.

A tale of two risks? With 3 or 5 subplots?

Moderate warming
(RCP 4.5, 2070-2099)

Higher warming
(RCP 8.5, 2070-2099)



CMIP 5, RCP 4.5, 8.5

Change in annual average temperature compared to 1970-1999. Average of 5 climate models, moderate emissions (left) and higher emissions (right). NCA4 Ch. 26, 2018. *Slide: J. Littell, AKCASC*

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Look around….

Now, and the plausible future, are more complicated.

We RAD impacts, not +7 ºC.

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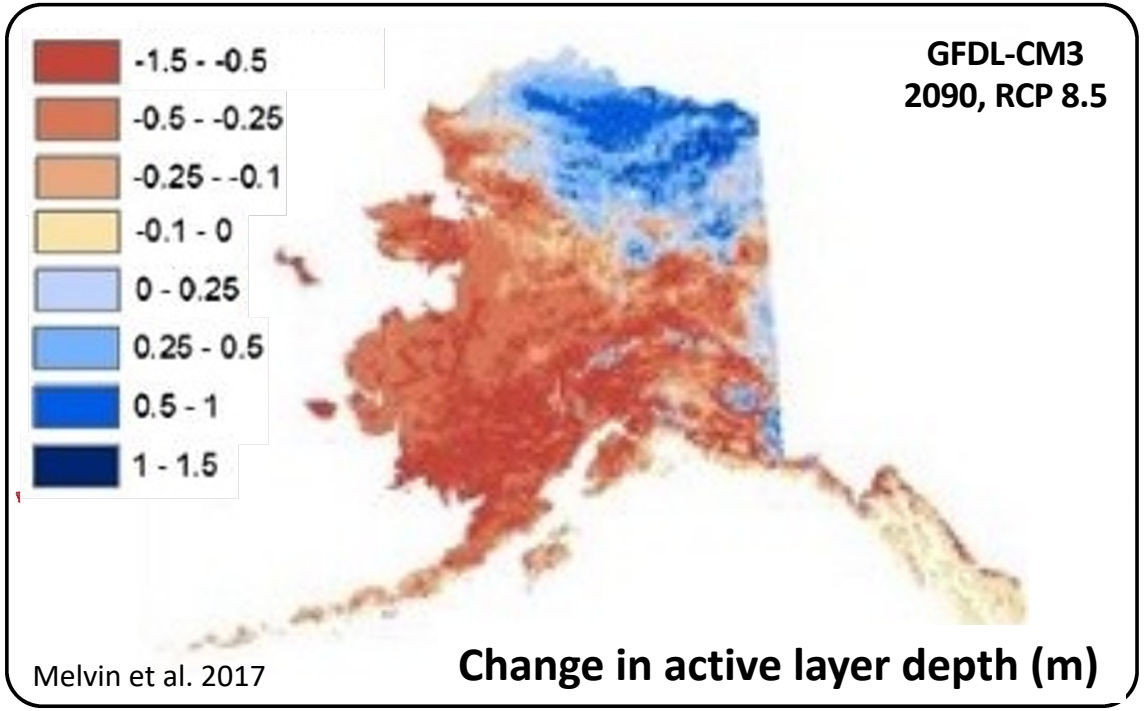

Melvin et al. 2017

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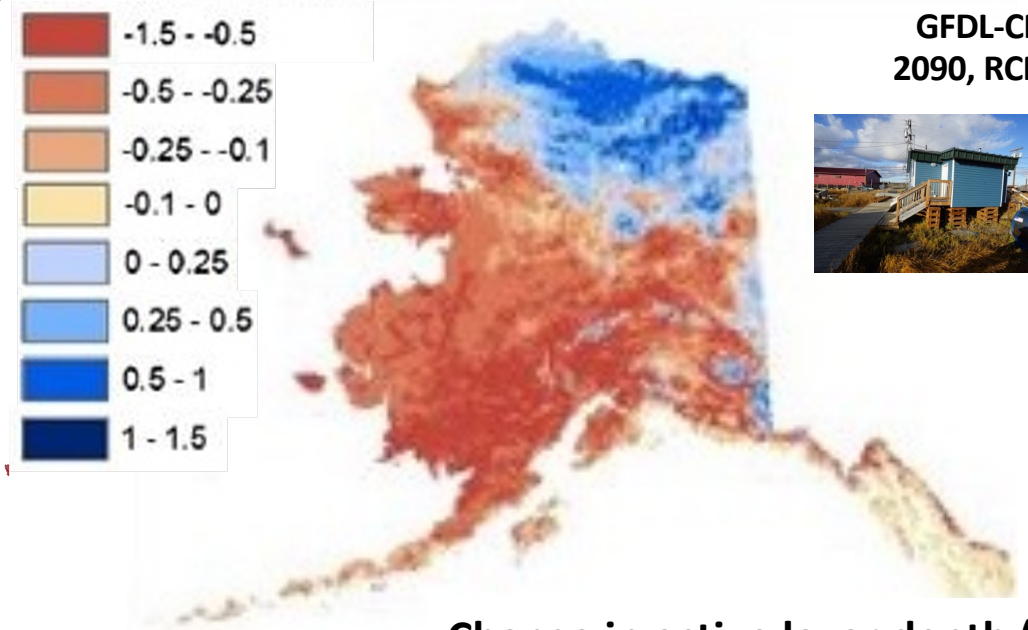
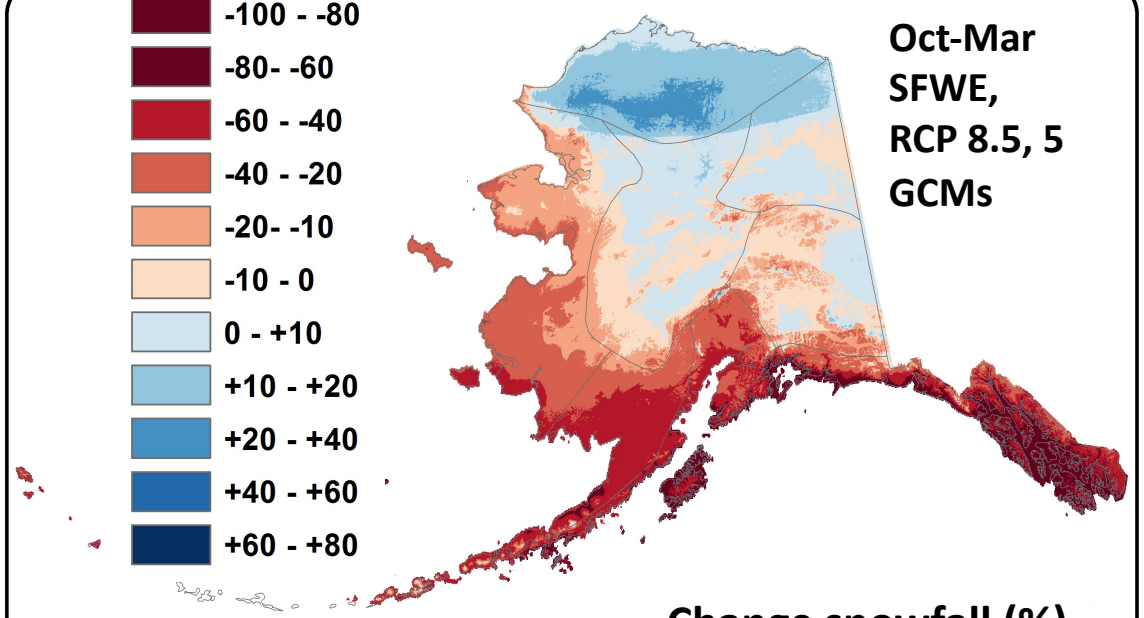


Melvin et al. 2017

Change in active layer depth (m)



Littell et al. 2016

Change snowfall (%)

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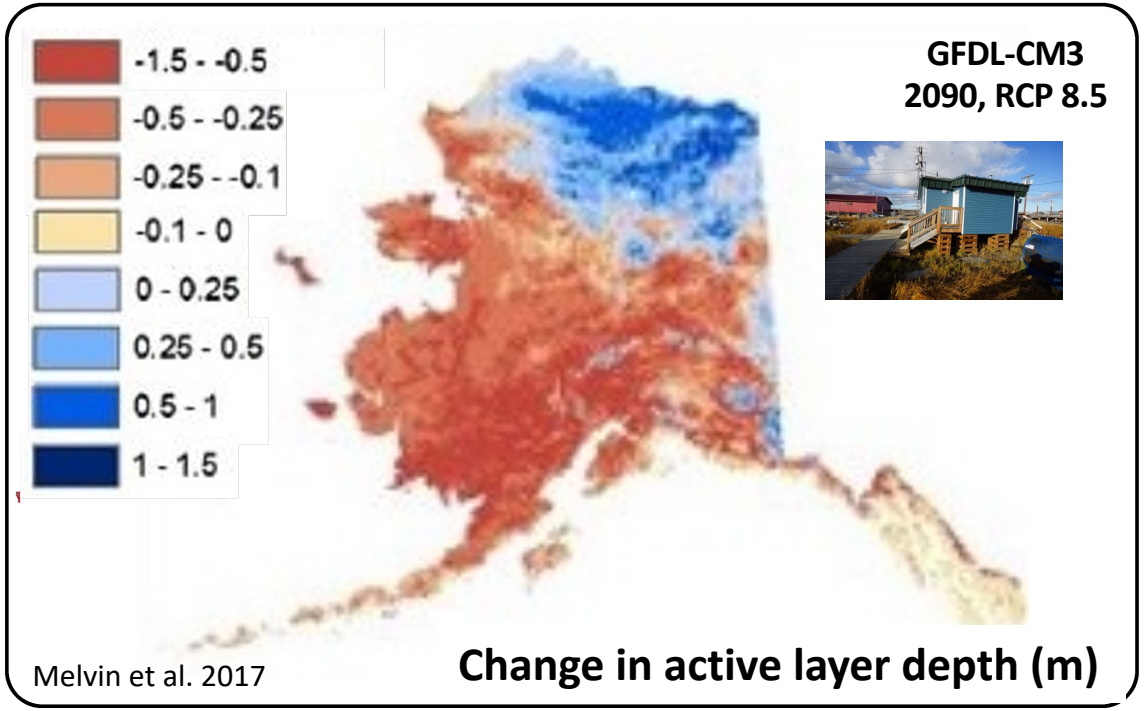

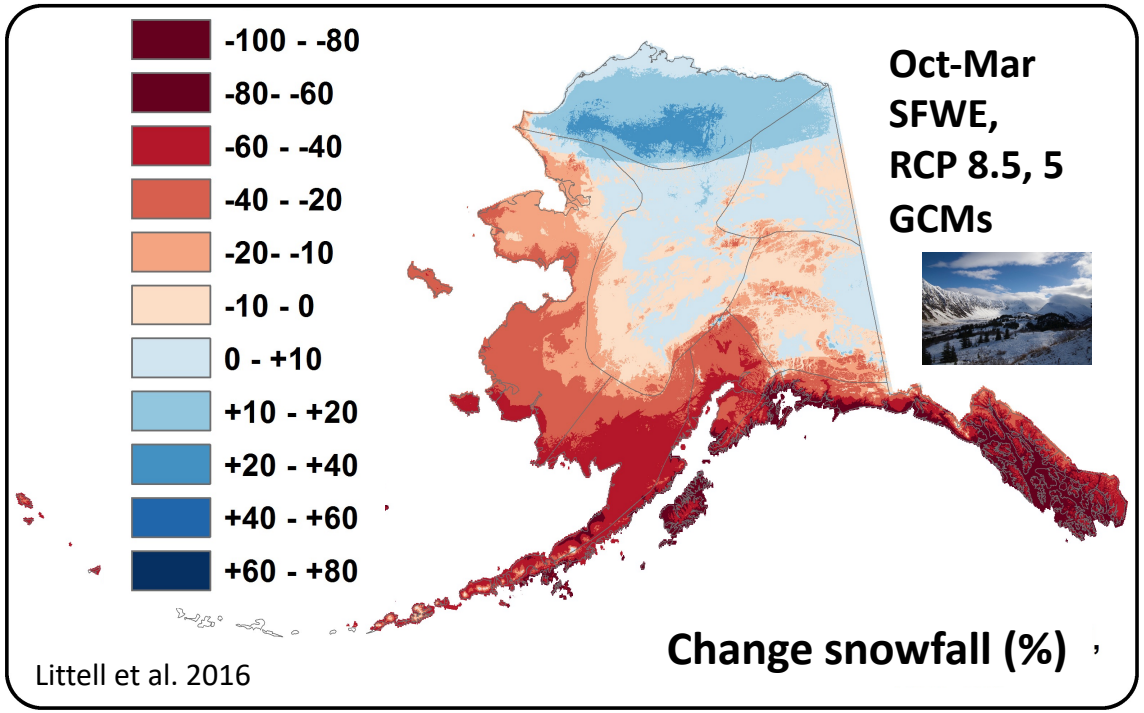

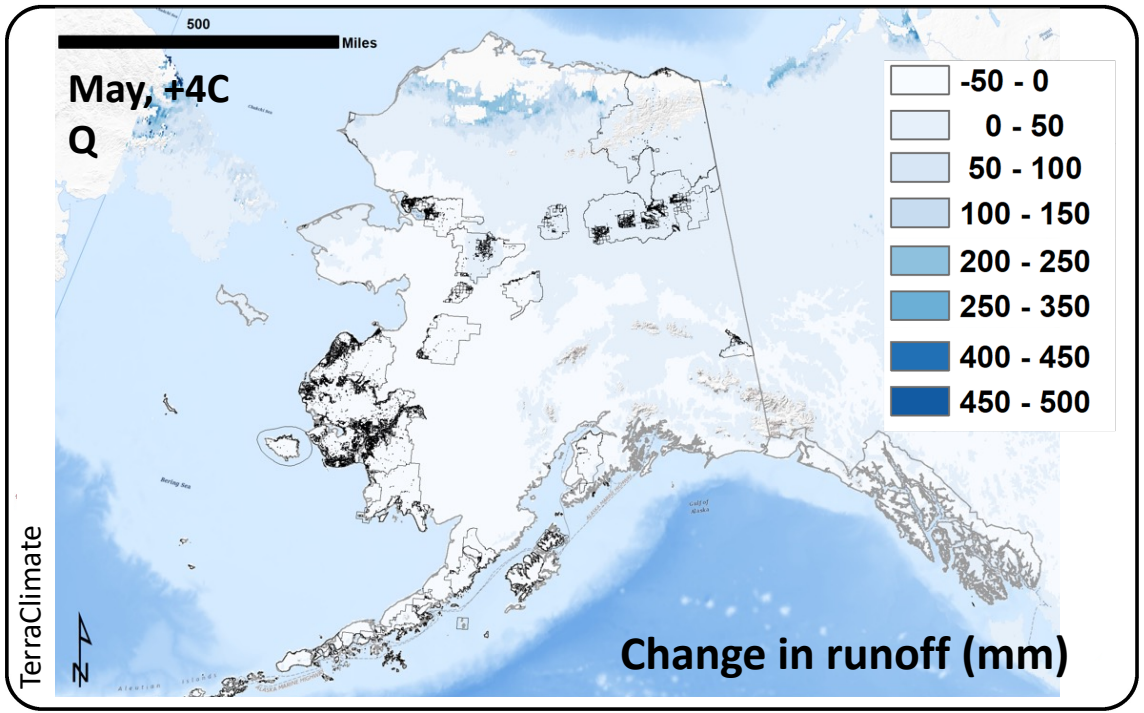

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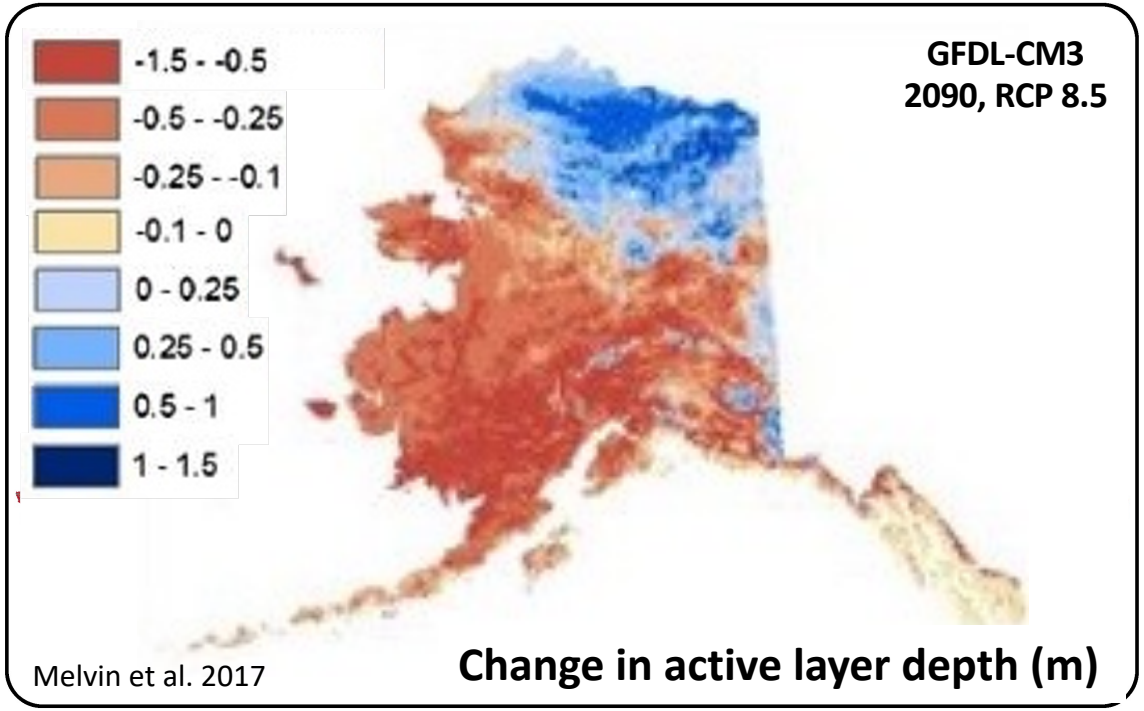
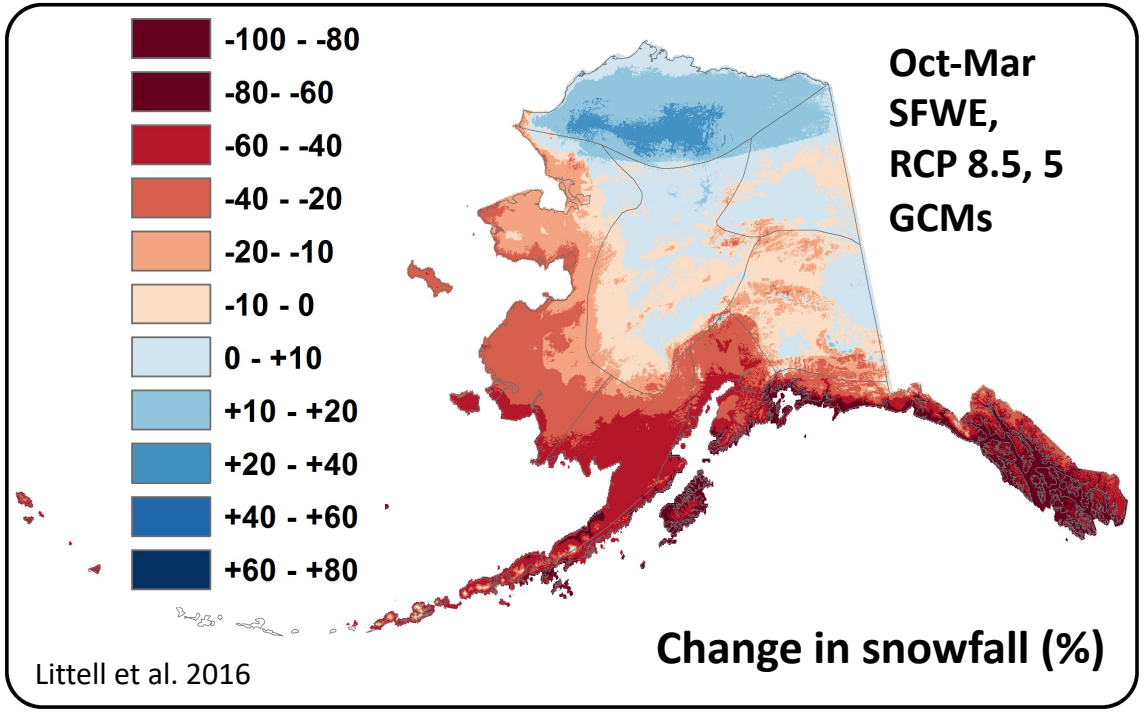
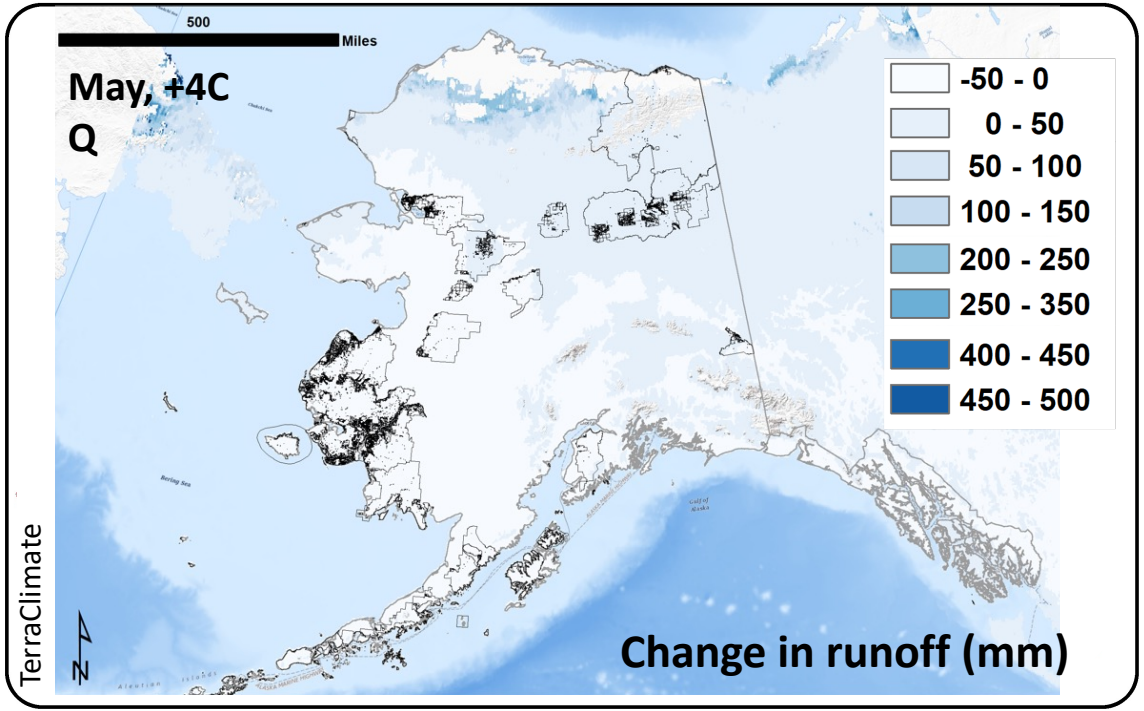
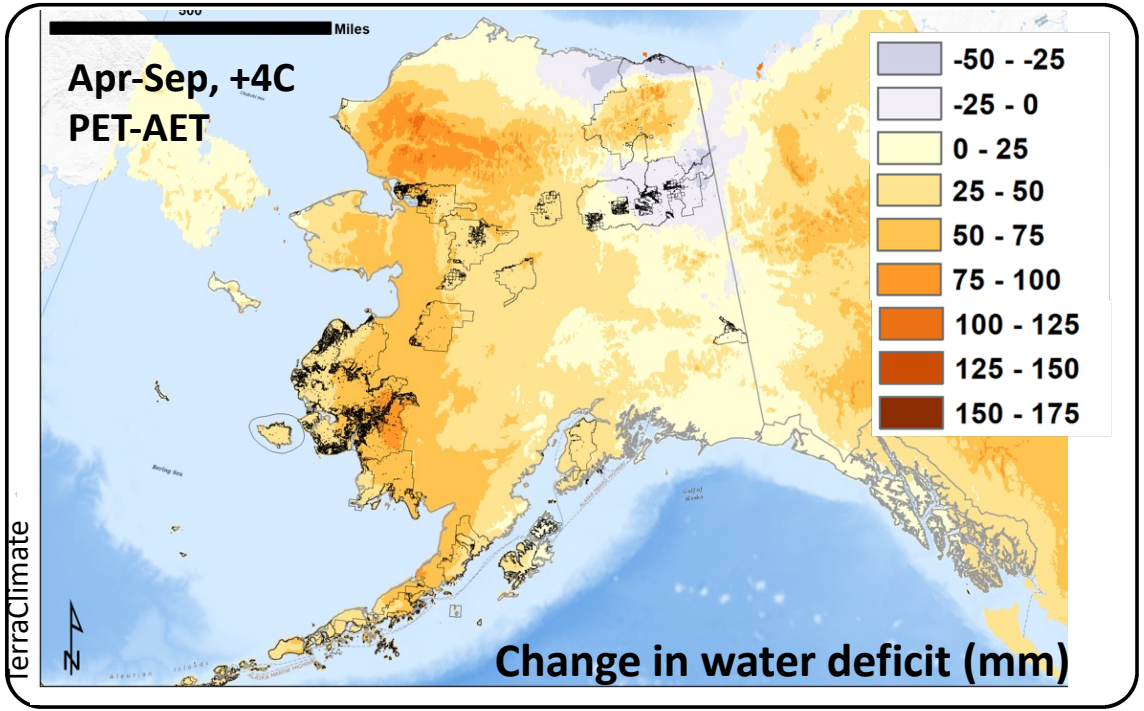


Melvin et al. 2017



Littell et al. 2016





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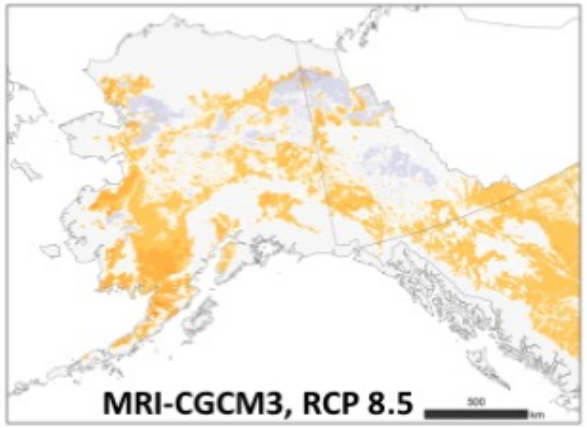
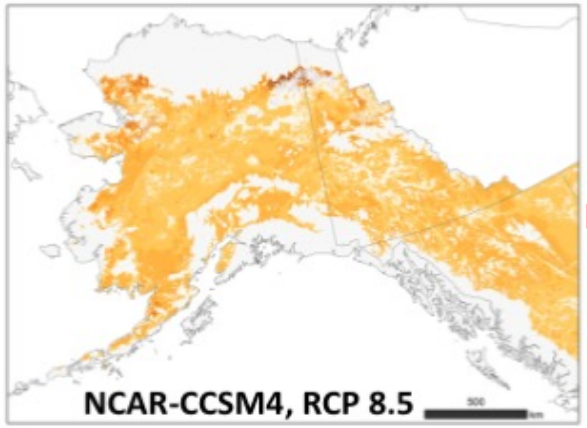
More than just "more fire"

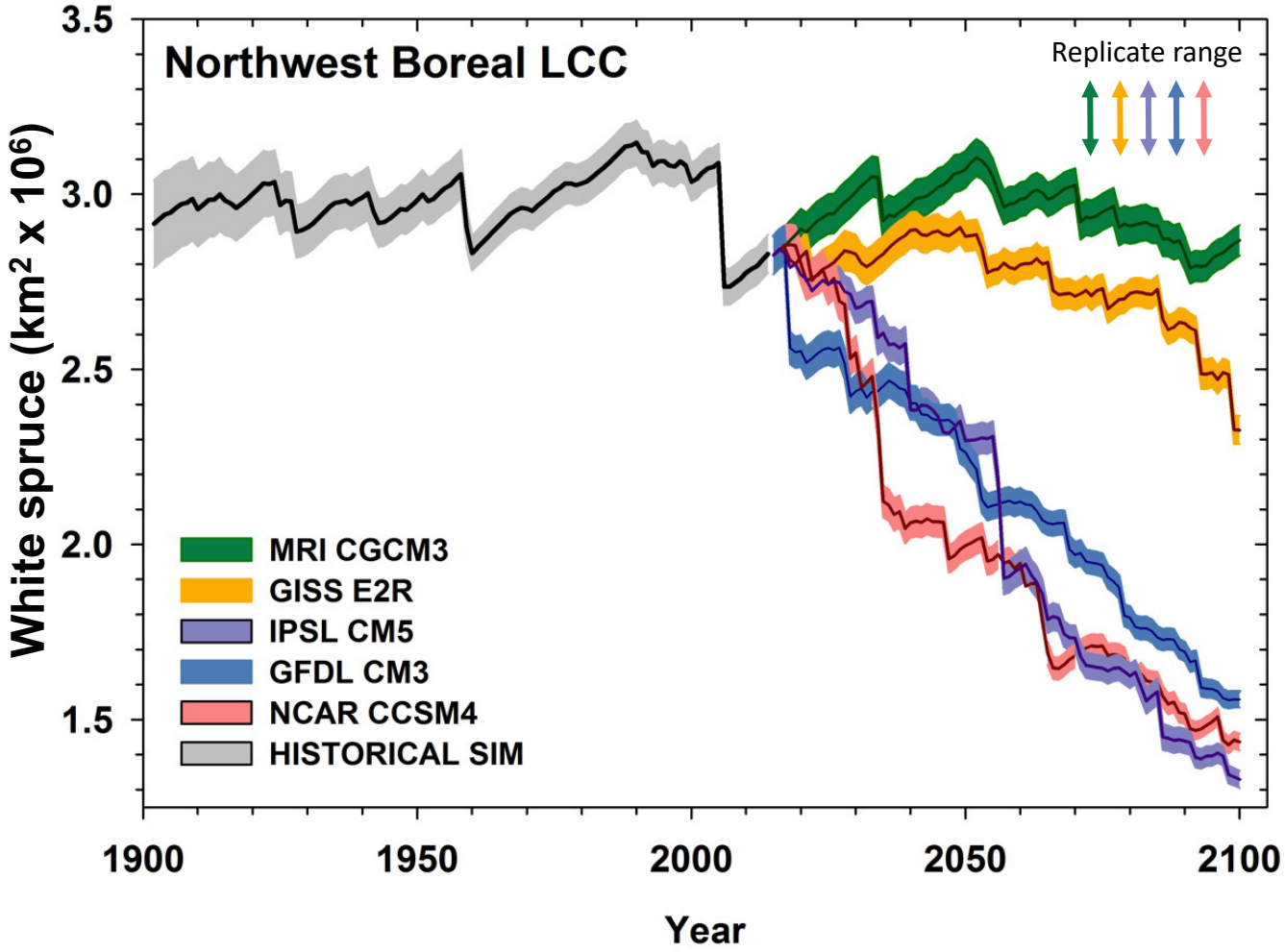




Change in fires / cen

-1.5 - -1.0	0 - 0.5	1.5 - 2.0	3.5 - 4.0
- 1.0 - -0.5	0.5 - 1.0	2.0 - 2.5	4.0 - 4.5
-0.5 - 0	1.0 - 1.5	2.5 - 3.0	4.5 - 5.0
0			

2000-2100 vs 1900-2000



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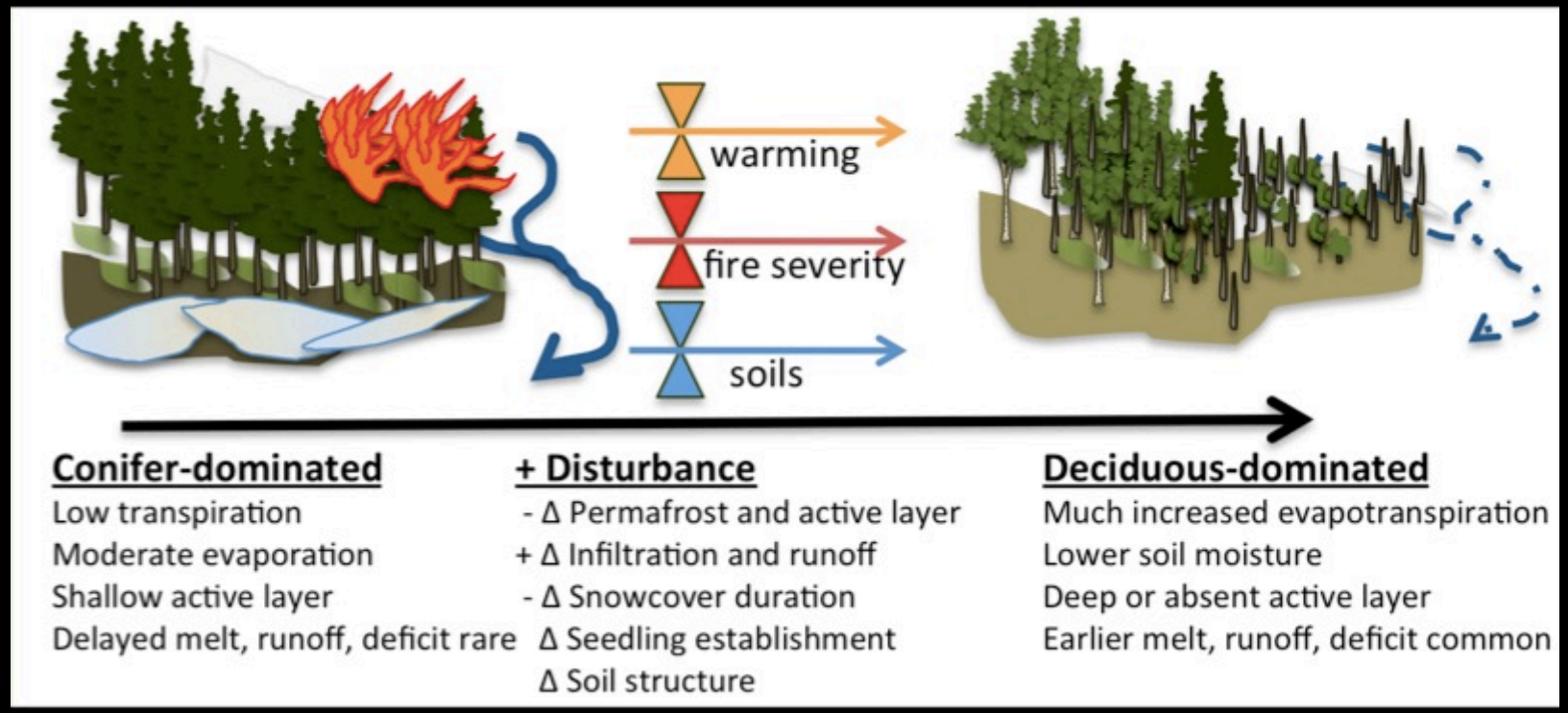
More than just "spruce to deciduous"…

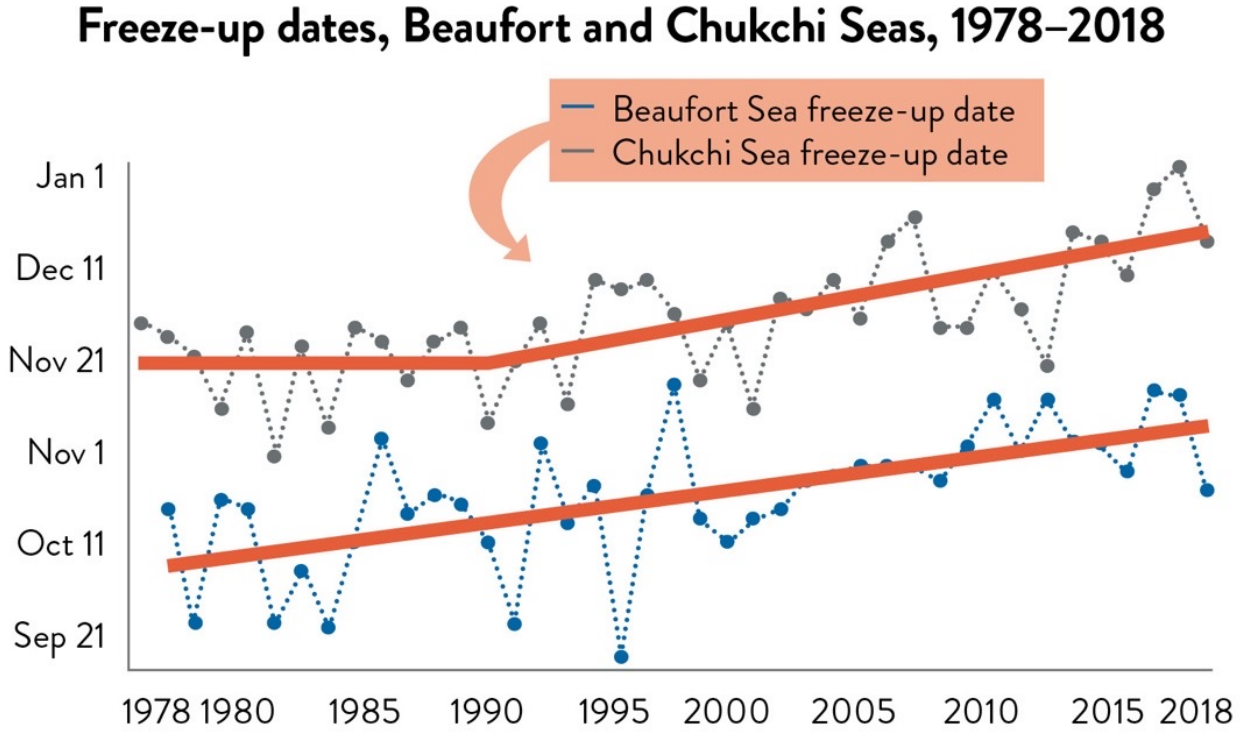


- Resulting increases in shrubs and decreases in lichens → ungulates
- Changes in wetland stability → changes in migratory bird habitat
- Changes in fire hazard → fire management

More than just "ice-free season"

Ice-free conditions in the Bering, Chukchi, and Beaufort seas are projected to increase one week per decade south of latitude 60N and about ***two weeks per decade*** north of latitude 65N.

This would result in longer ice-free seasons, during which storms (usually fall and winter) of even historical magnitude would be more likely to cause erosion and flooding events.



Credit: Rick Thoman, Alaska Center for Climate Assessment and Policy.

Data source: NSIDC Sea Ice Index, V3

IARC International Arctic Research Center University of Alaska Fairbanks

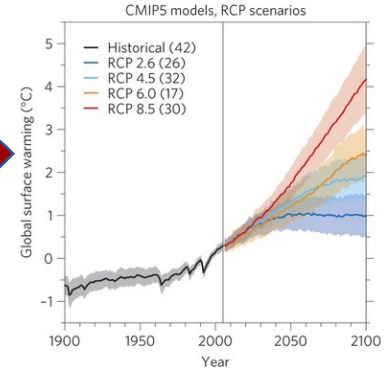
The future will be a bumpy ride!!

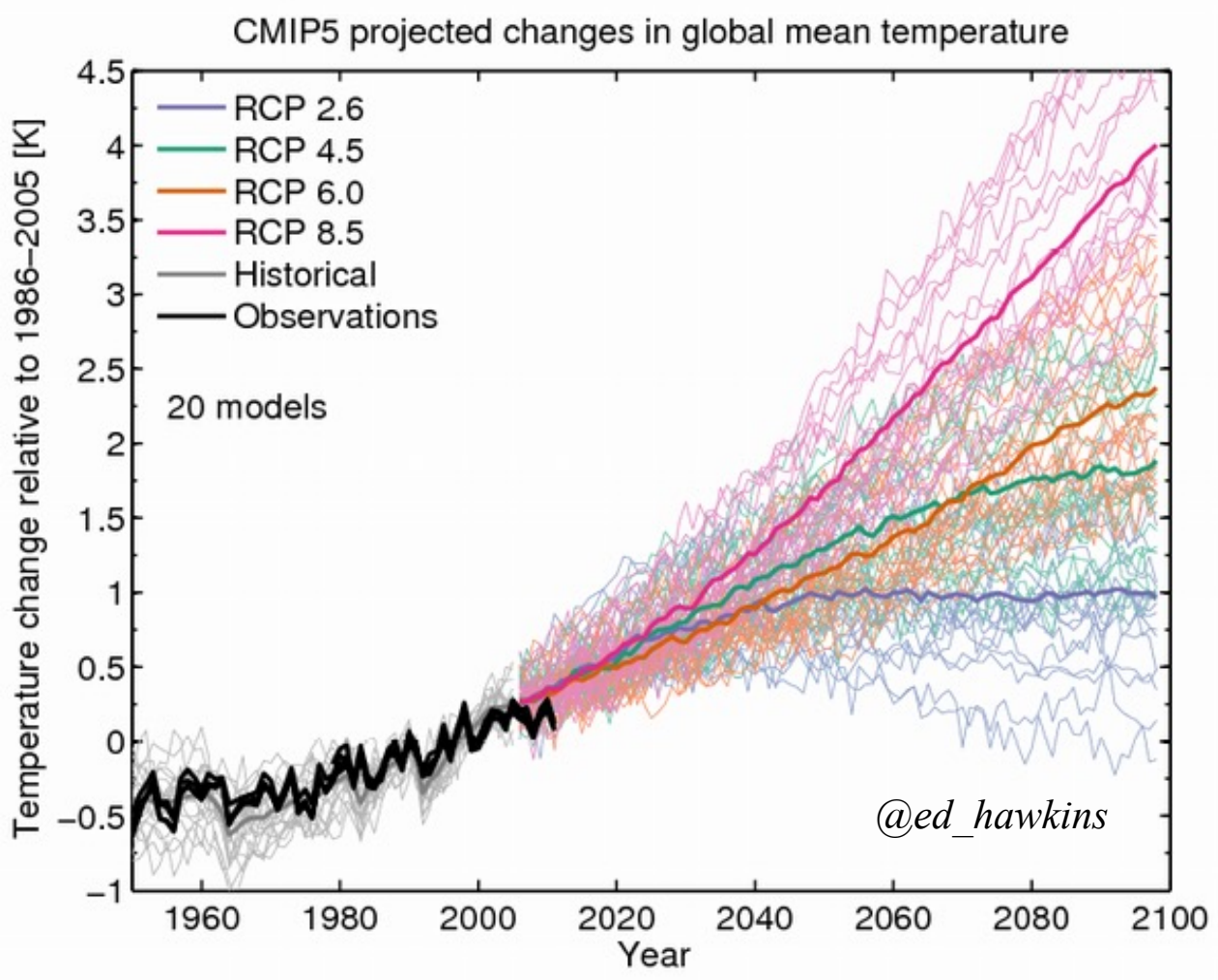
We get used to smooth lines and maps.

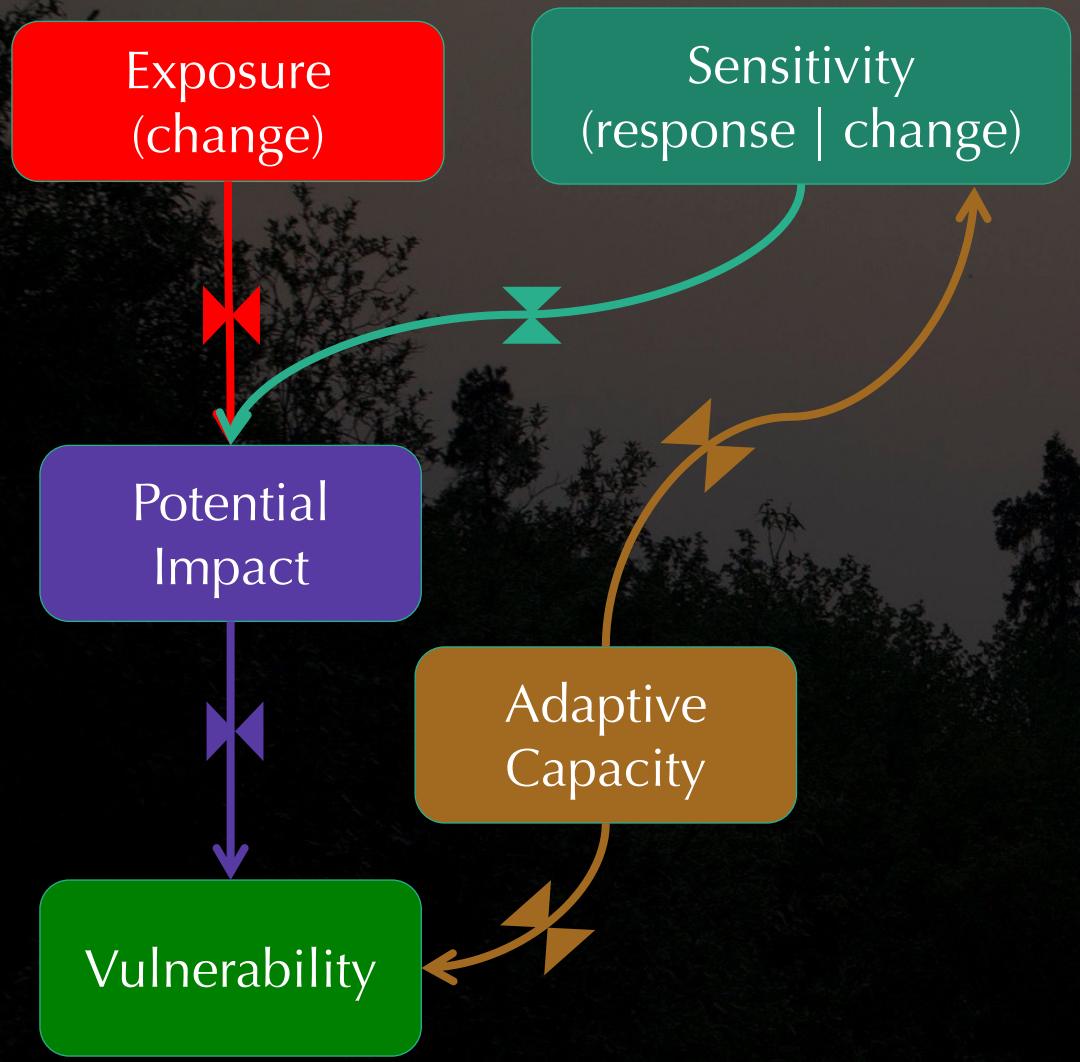
In model world and the real world, they're "bumpier"- variability is high.

We should prepare for (at least) the variability we know to occur, and for new extremes on top of that.

Today's extremes become tomorrow's ordinary in most of these futures….when?







For a decade (two?), we have focused on **exposure and sensitivity**, perhaps at the expense of adaptive capacity.

We're ready to move past "2-3 times" everybody else's temperature change. We need to be trying on the plausible futures in all their complexity.

What actions are workable – R, A, D, or something else - depends on which Alaska impacts geography we work within.

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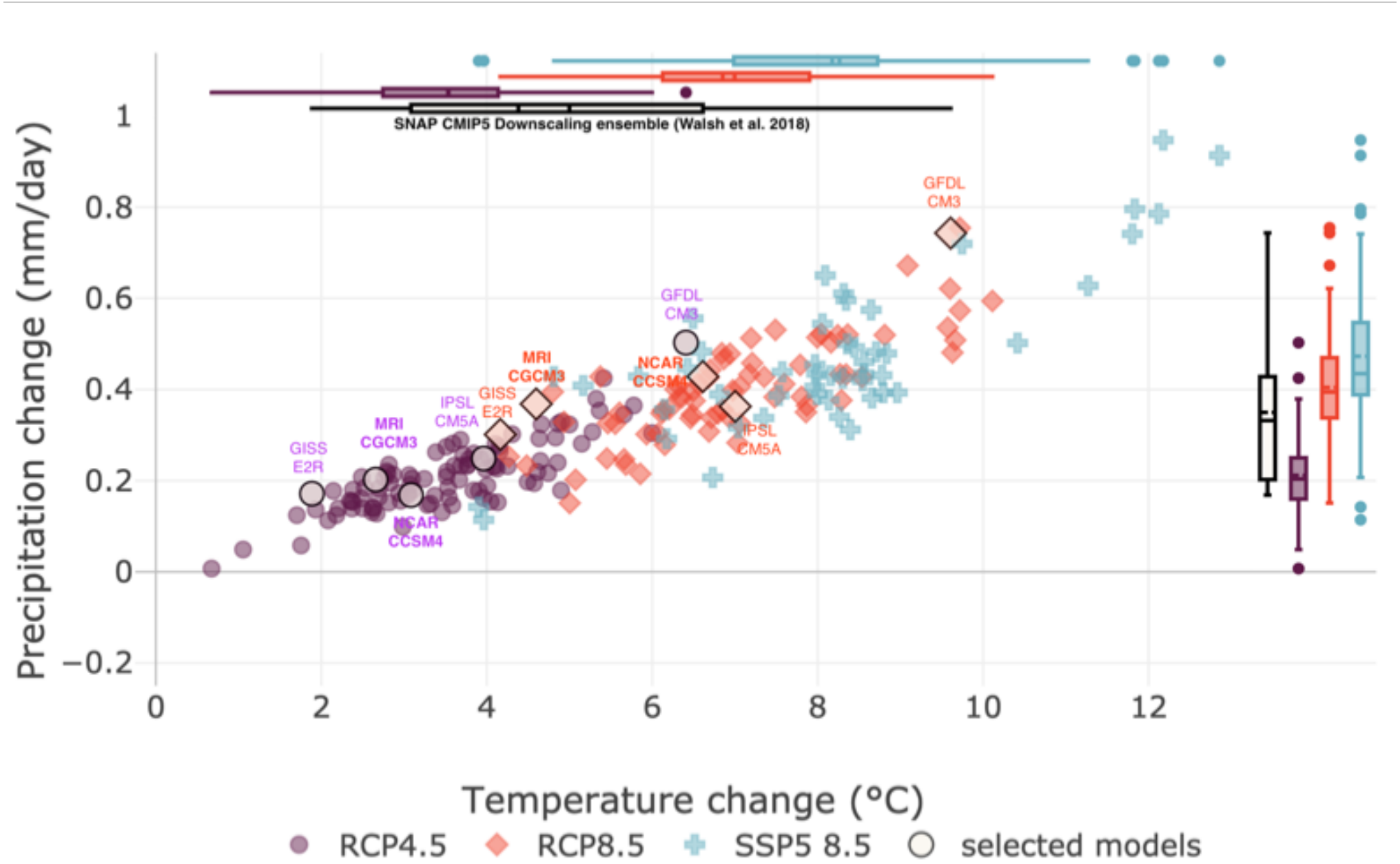

The next round of GCMs (for IPCC AR6/CMIP6) seems to be warmer on average. SNAP models (dark outlined symbols) CMIP5 RCP 8.5 mean is cooler by ~ 1.5+ C than the SSP5 8.5 scenario ensemble mean, but ensemble mean precipitation is similar.