The impact of snowmelt timing on the predictability of the early wildfire season in Alaska

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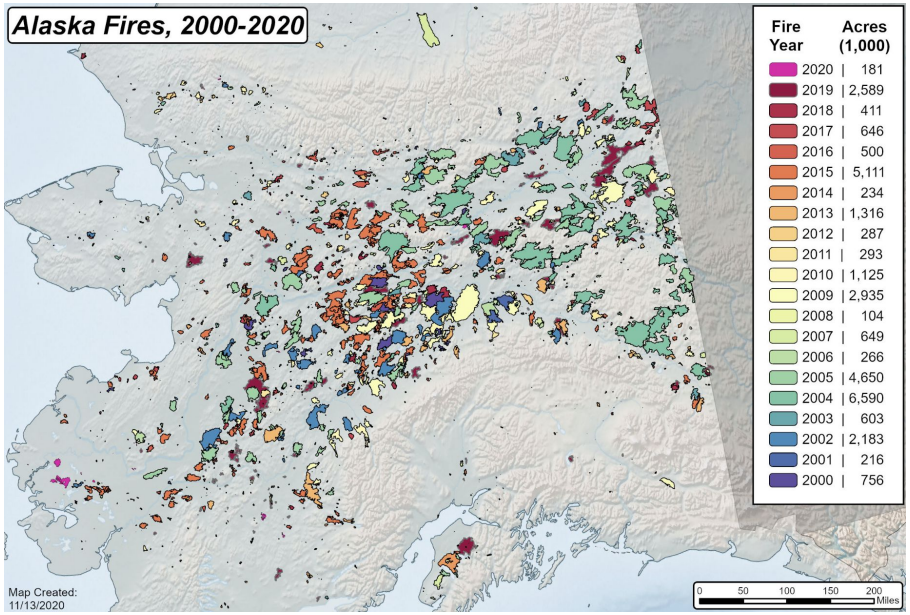
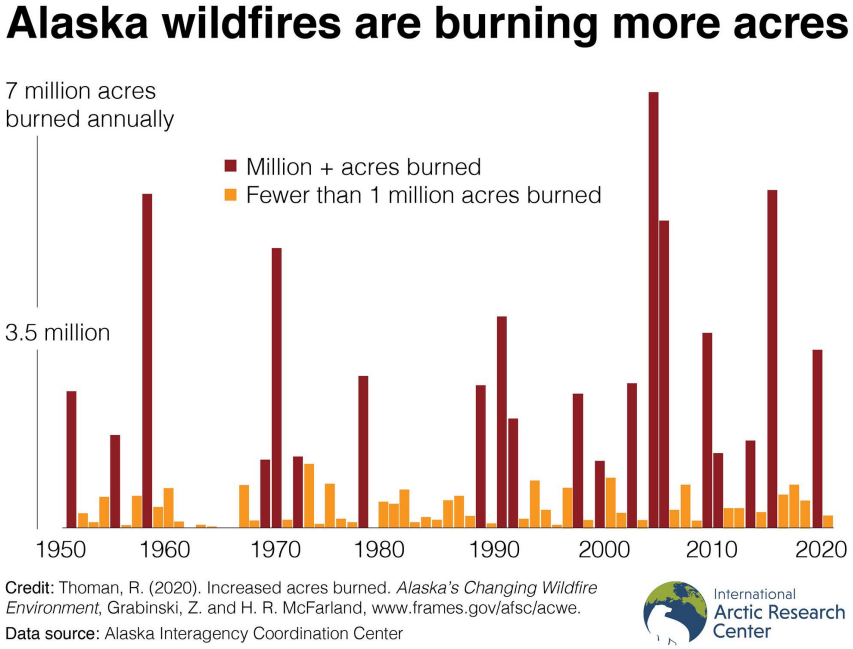
Summer wildfire season in Interior Alaska



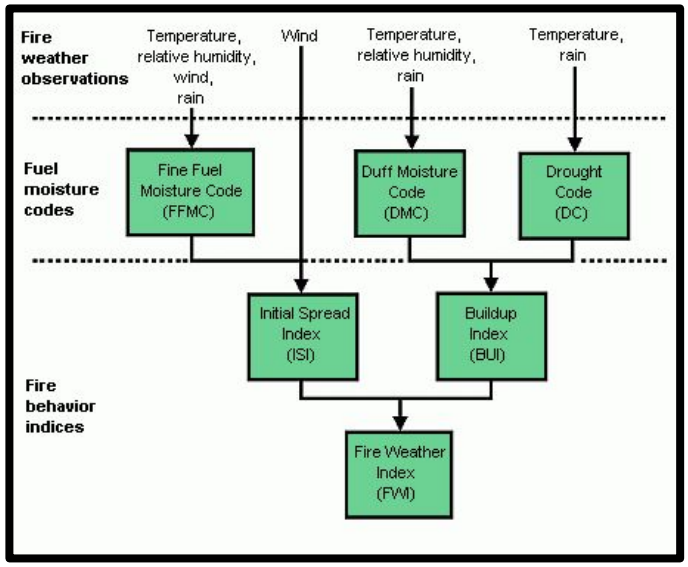
https://fire.ak.blm.gov/



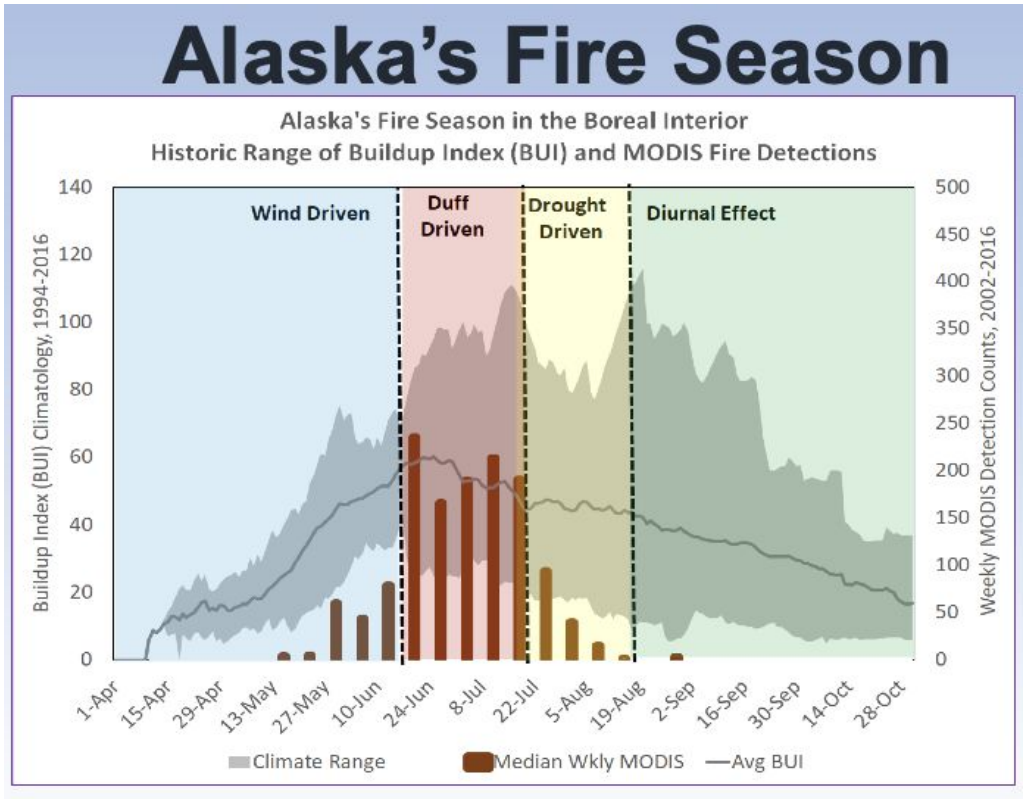
- Most wildfires occur in Boreal forests in Interior Alaska
- Largest fires started by lightning (~80-90% of area burned)
- Extreme years burn more than 1 million acres

Start of the wildfire season after the snow melts

Canadian FWI System



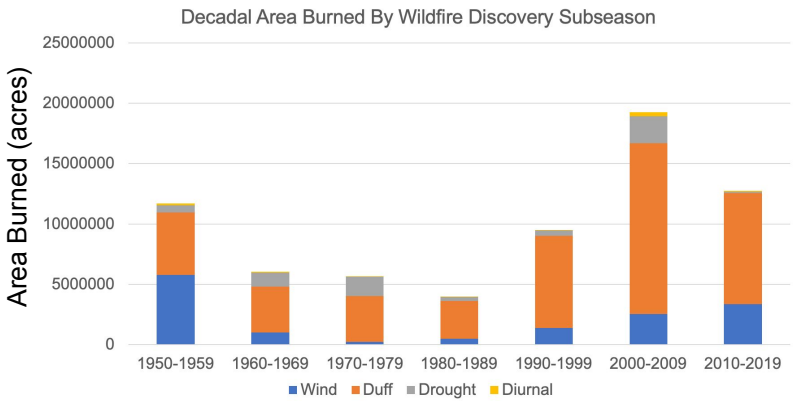
https://cwfis.cfs.nrcan.gc.ca/background/summary/fwi

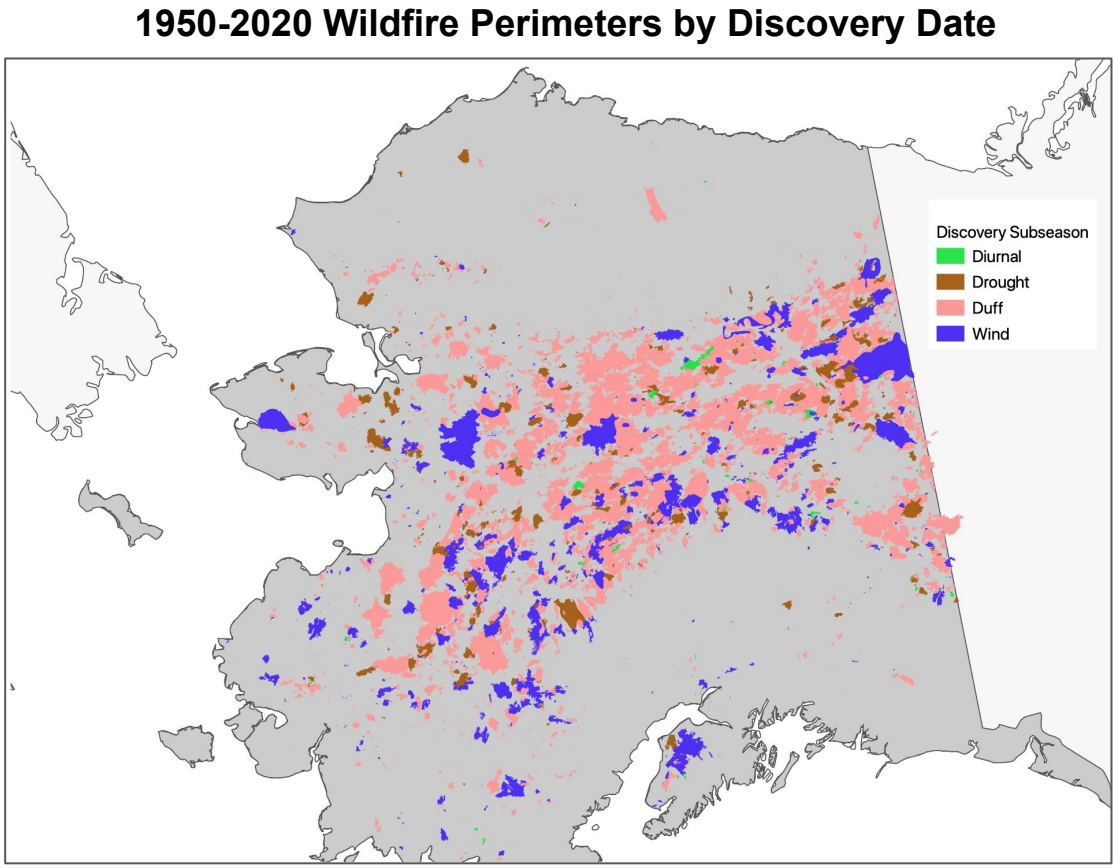


Borries-Strigle et al. (in prep)

- Four subseasons - most active during Duff season mid June-mid July
- Wildfire danger in Alaska monitored using the Canada Fire Weather Index system
- How does the timing of snowmelt impact wildfires and fire danger?

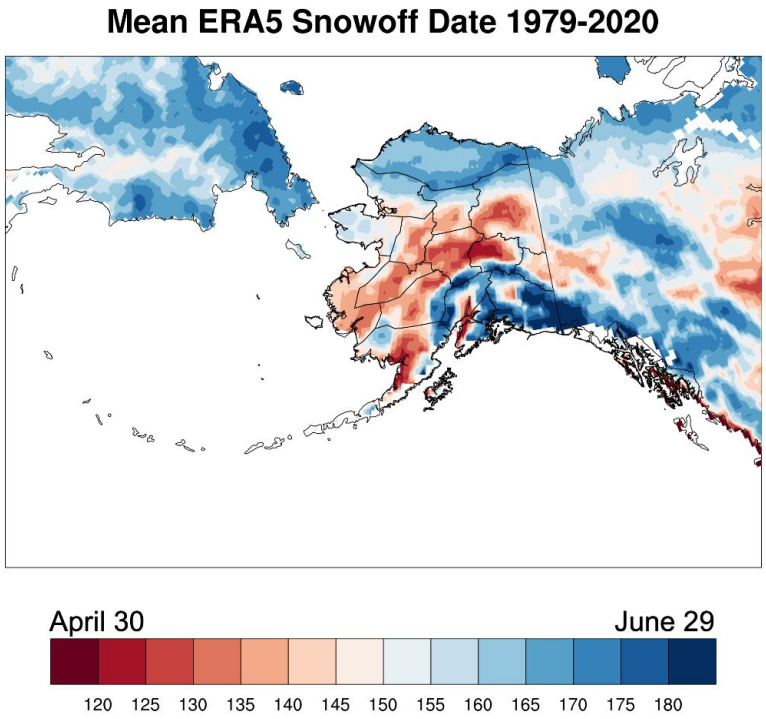
Some large fires have started in the Wind subseasom

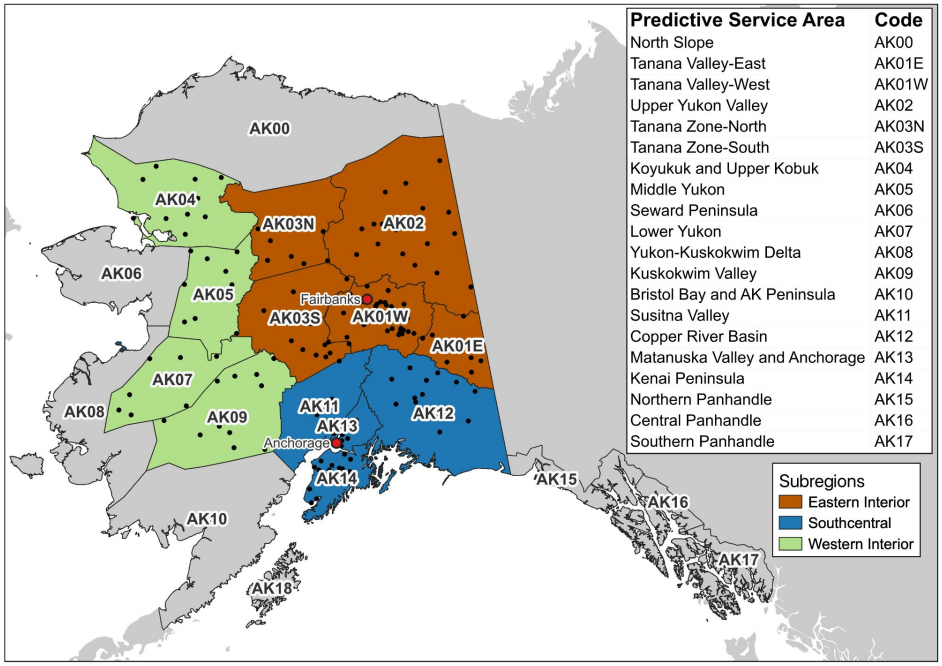




- Most fire area burned had origin in Duff subseason
- Trend to more area burned driven by Duff subseason but increase also in Wind subseason

Average snowfree date in May in Interior Alaska

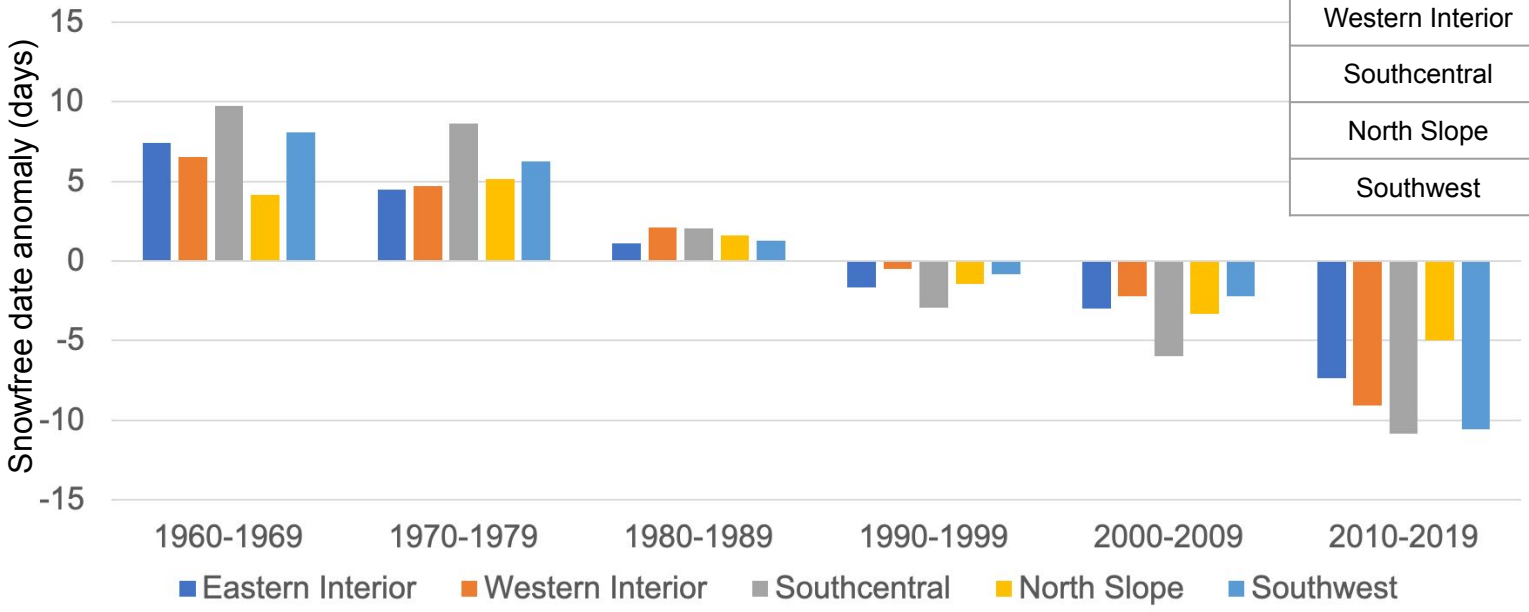




Borries-Strigle et al. (in prep)

- Use ERA5 reanalysis snow (1959-2020) and evaluate wildfire and BUI in Predictive Service Areas (PSAs)

Snowmelt is occurring earlier across Alaska since 1959

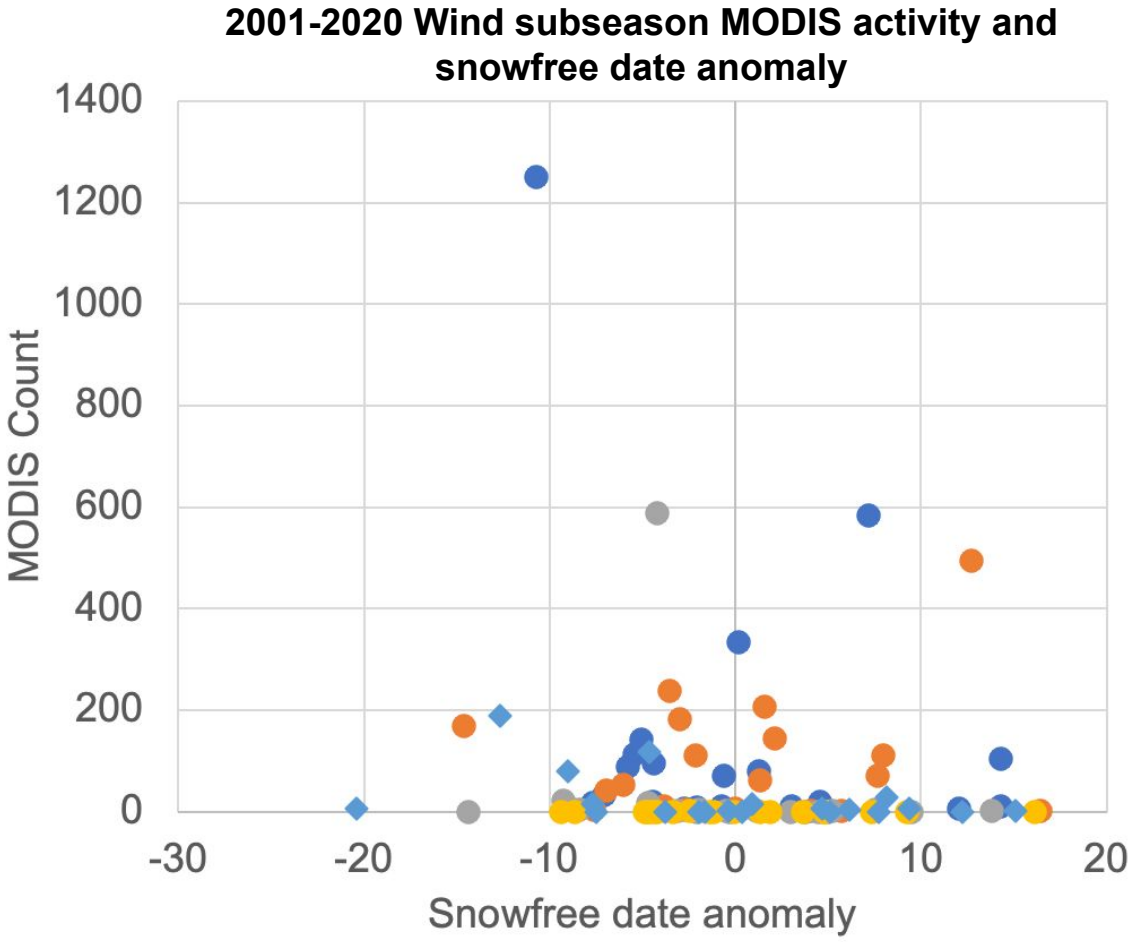


Snowfree date correlation

Region	Area Burned	# Fires
Eastern Interior	-0.20	-0.11
Western Interior	-0.12	-0.16
Southcentral	**-0.28**	-0.23
North Slope	**-0.26**	-0.11
Southwest	-0.19	-0.06

- All regions have declining trends toward earlier snowmelt
- Correlation between snowmelt timing (and end of season SWE) are generally low between annual area burned and numbers of wildfires

Snowfree date and fire activity in Wind Subseason

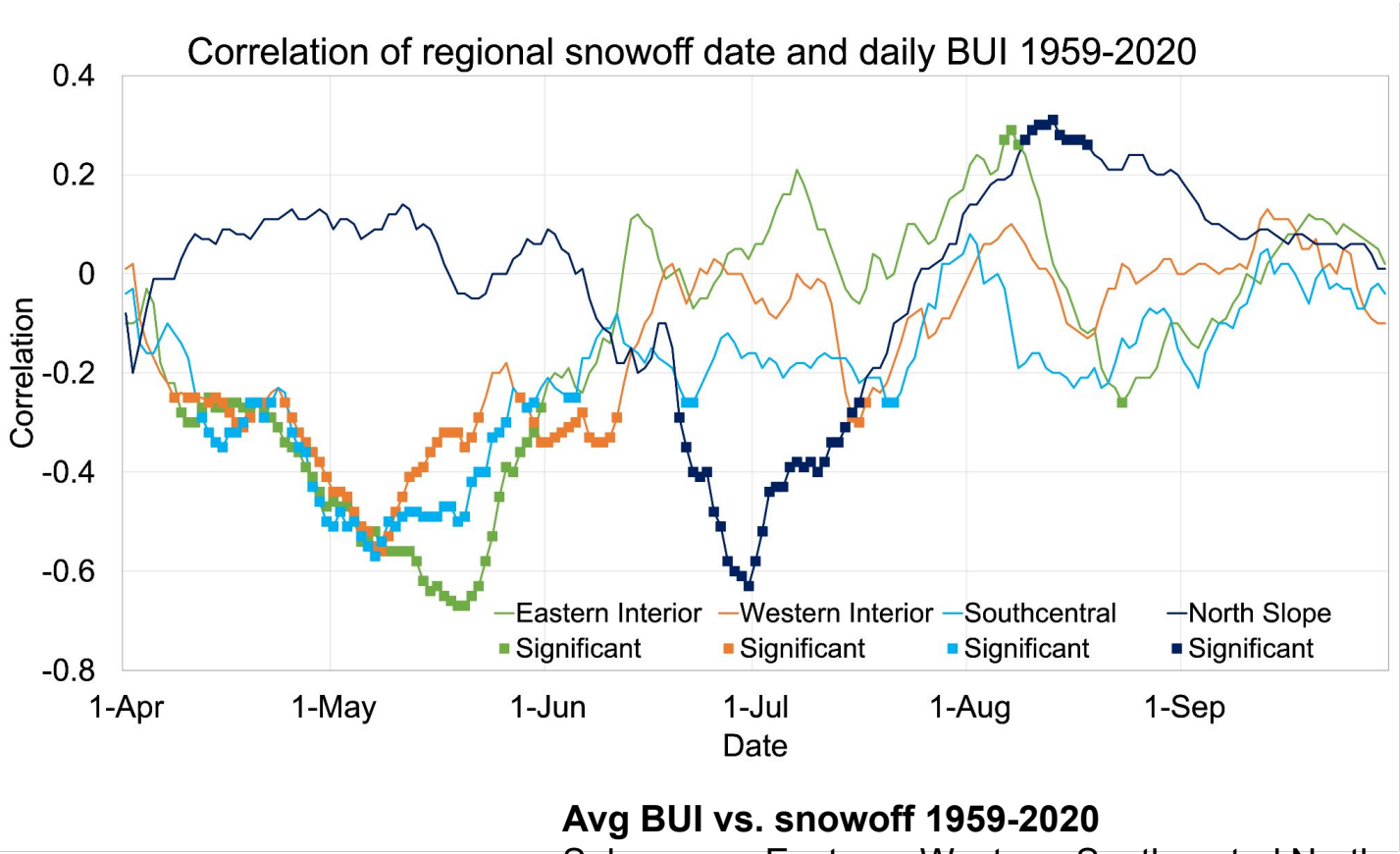


62% of MODIS activity when snowmelt was earlier in Wind subseason 2001-2020

Subseason	Eastern Interior	Western Interior	Southcentral	North Slope	Southwest
Wind	-0.31	0.17	-0.11	0.01	-0.17
Duff	*-0.39*	-0.21	-0.24	-0.22	-0.21
Drought	-0.24	-0.16	-0.23	-0.04	0.12
Diurnal	**-0.48**	-0.24	-0.02	-0.04	-0.05

- Early season wildfire activity also does not have significant correlations with snowmelt timing
- Trend in snowmelt would move 0 line to the right if compared to full record!

Snowmelt timing is significantly correlated with BUI



- Earlier snowmelt date associated with higher BUI
- Later peak correlation in North Slope
- Correlations drop off later in the season

Avg BUI vs. snowoff 1959-2020

Subseason	Eastern Interior	Western Interior	Southcentral	North Slope	Southwest
Wind	**-0.57**	**-0.47**	**-0.54**	0.05	**-0.41**
Duff	0.06	-0.13	**-0.27**	**-0.46**	-0.15
Drought	0.19	-0.03	-0.10	0.10	-0.05
Diurnal	-0.06	-0.01	-0.18	0.18	-0.11

Snowfree date earlier with warmer temperatures during Wind subseason

Tmax vs snowoff 1959-2020

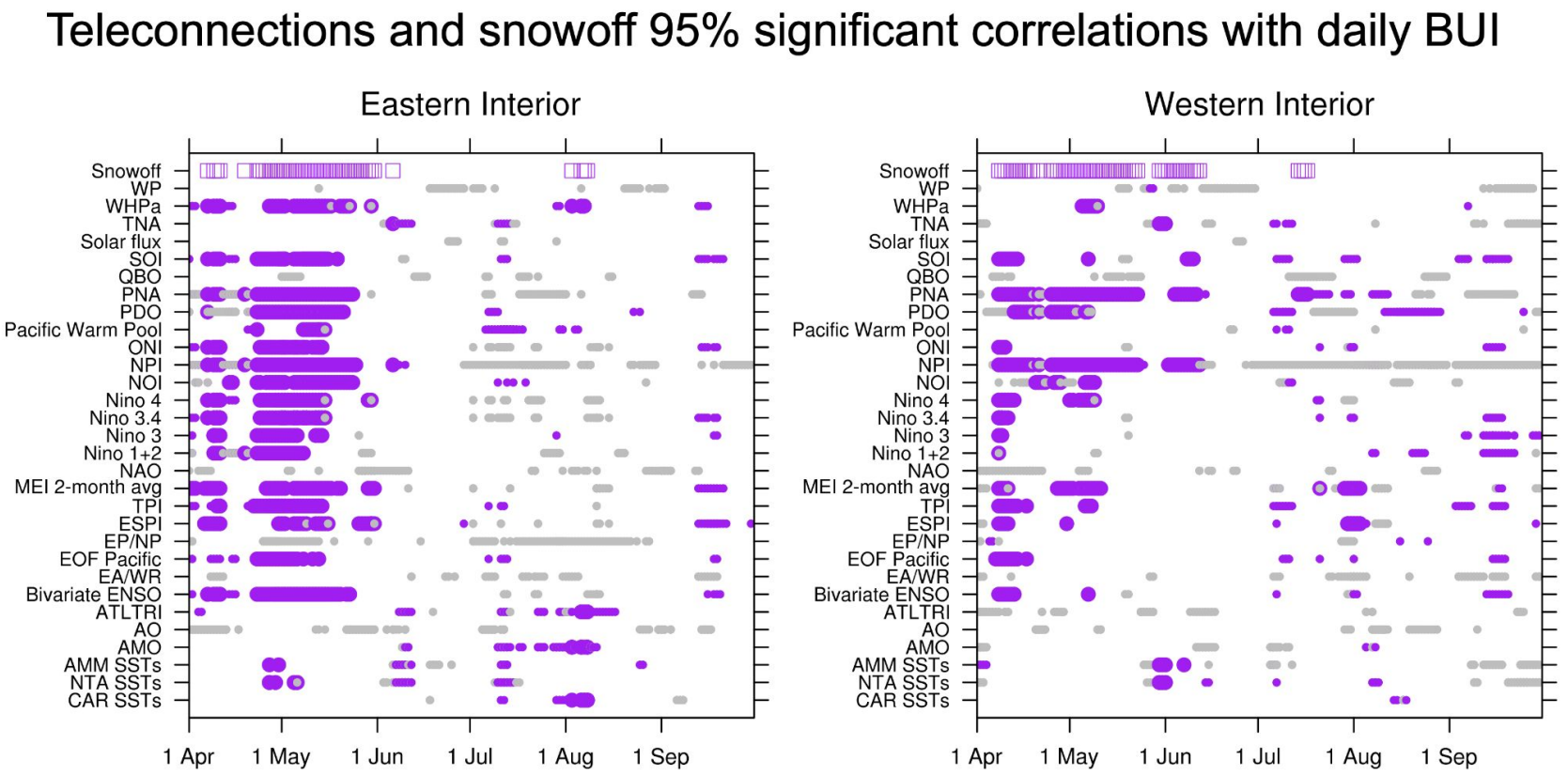
Subseason	Eastern Interior	Western Interior	Southcentral	North Slope	Southwest
Wind	**-0.73**	**-0.68**	**-0.83**	-0.08	**-0.81**
Duff	0.03	-0.15	**-0.41**	**-0.49**	*-0.23*
Drought	0.11	0.04	-0.20	*0.22*	-0.19
Diurnal	-0.05	-0.17	**-0.27**	0.10	**-0.29**

Precp vs snowoff 1959-2020

Subseason	Eastern Interior	Western Interior	Southcentral	North Slope	Southwest
Wind	0.03	0.05	*0.24*	0.04	-0.04
Duff	-0.16	-0.03	0.06	*0.23*	-0.01
Drought	**-0.28**	-0.11	-0.18	**-0.34**	-0.13
Diurnal	0.11	-0.01	-0.06	-0.01	0.09

- Strongest correlation between snowmelt timing and temperatures during early season
- Precipitation not well correlated with snowmelt timing

Snowmelt/river ice breakup timing linked with ENSO



- Several major teleconnections correlated with snowmelt and BUI in Wind subseason but drop off before the peak season
- Other teleconnections such as NPI (North Pacific Index) and EP/NP (East Pacific/North Pacific) remain significant

Conclusions

- Direct correlations between snowfree date and wildfire activity not statistically significant but physically consistent
- Snowmelt is significantly correlated with BUI in April-May
  - Shared link with temperature
- Most teleconnections are most strongly linked with BUI during the Wind subseason but may have limited applicability to the peak season
  - However, a few possibilities remain