GC11F-1079 Drivers and implications of recent large fire years in boreal North America

Sander Veraverbeke, J.T. Randerson, E.B. Wiggins (UC Irvine), R. Jandt (Alaska Fire Science Consortium), C.E. Miller, M. Tosca (Jet Propulsion Laboratory), D. Worthy, D. Chan, E. Chan (Environment Canada), J. Henderson (Atmospheric and Environmental Research)

sander.veraverbeke@uci.edu *Department of Earth System Science* *University of California, Irvine*

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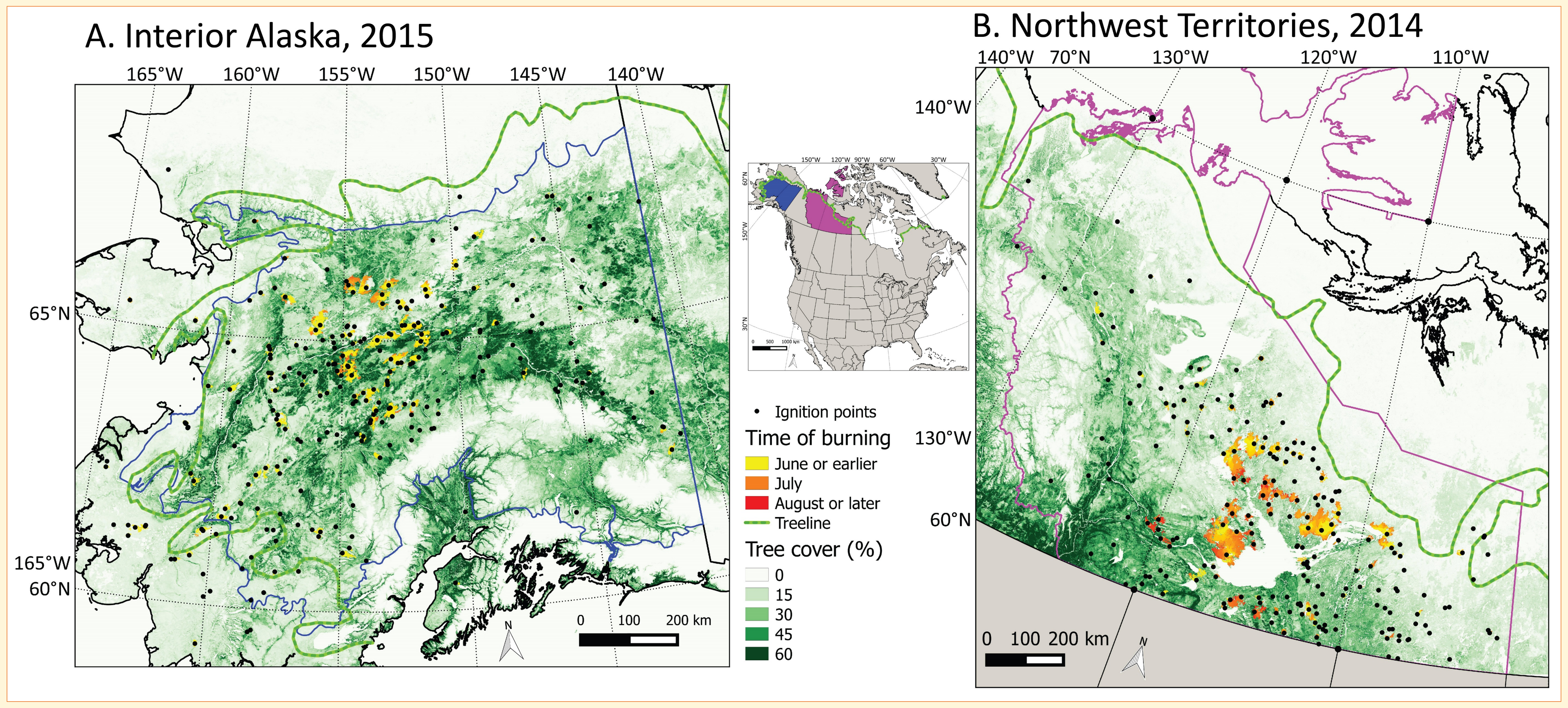
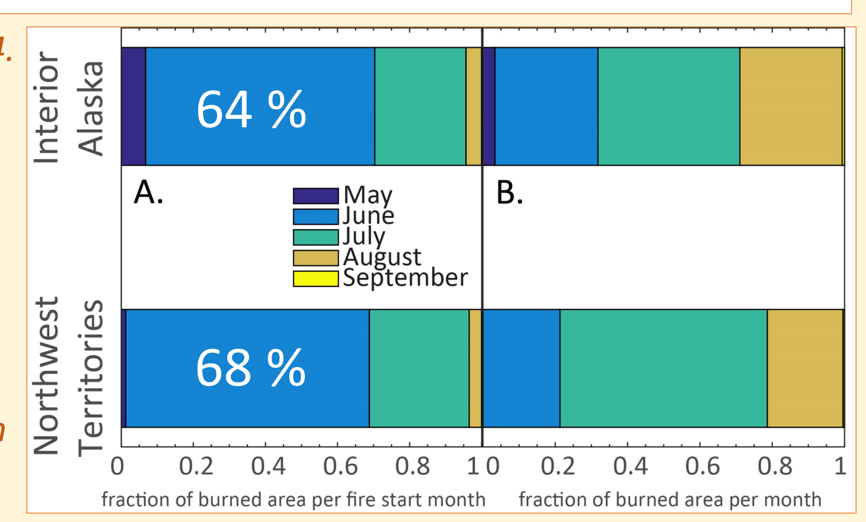
1. Recent large fire years in boreal North America

- **1.77 Mha burned** in Interior **Alaska** (AK) in **2015**, resulting in **59 ± 13 Tg carbon emissions** *(F1A)*
- **3.42 Mha burned** in the **Northwest Territories** (NT) in **2014**, resulting in **157 ± 27 Tg carbon emissions** *(F1B)*
- These years represent some of the largest fire seasons on record for both regions
- Most of the annual burned area is the result from **ignitions in June**



F1 Ignitions and burned area in (A) Alaska in 2015, and (B) Northwest Territories in 2014.



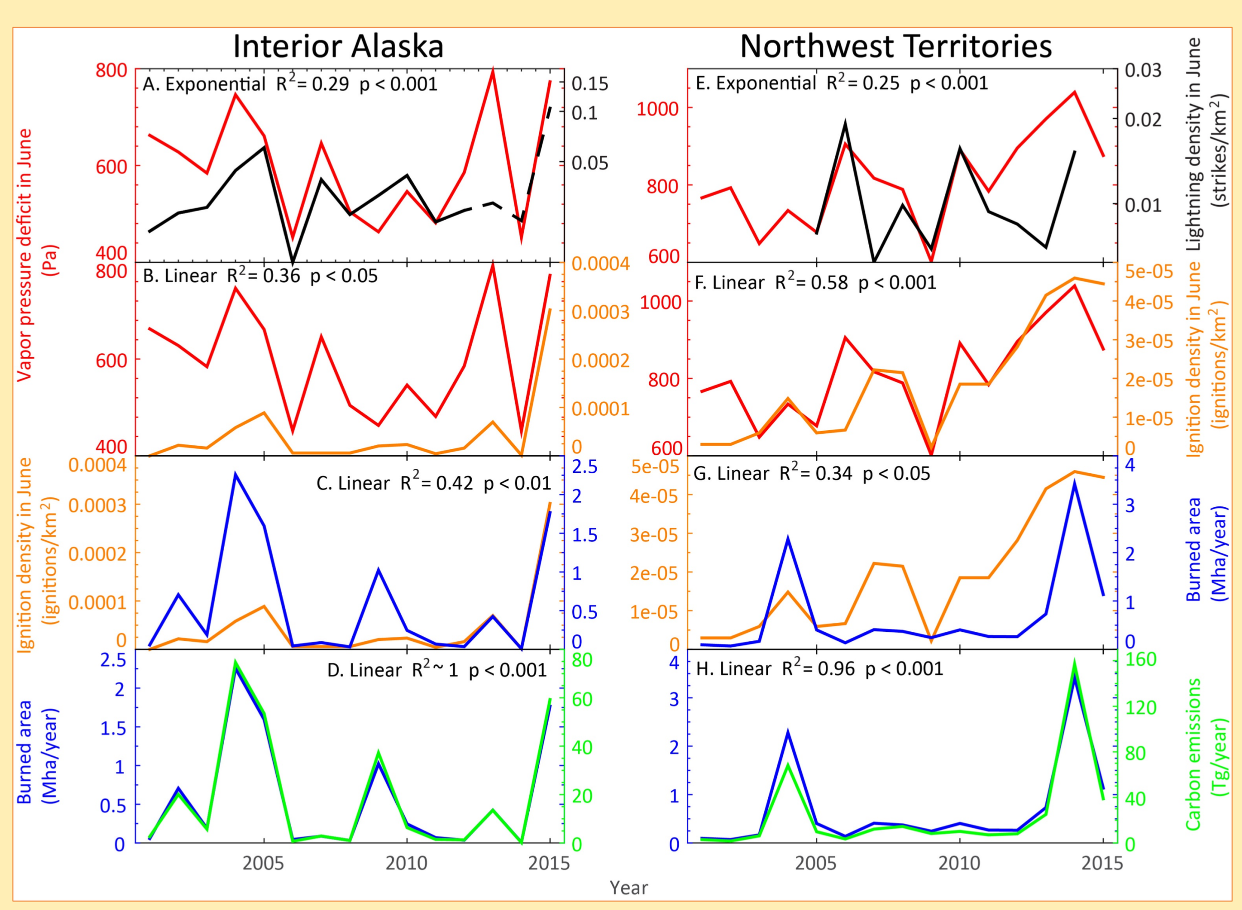
F2. Burned area (A) per fire start month and (B) per month for Interior AK and NT.

Science questions

- What drives large fire years in boreal North America?
- How will climate change alter fire regimes in boreal North America?
- Are the recent large fire years a harbinger of future change?

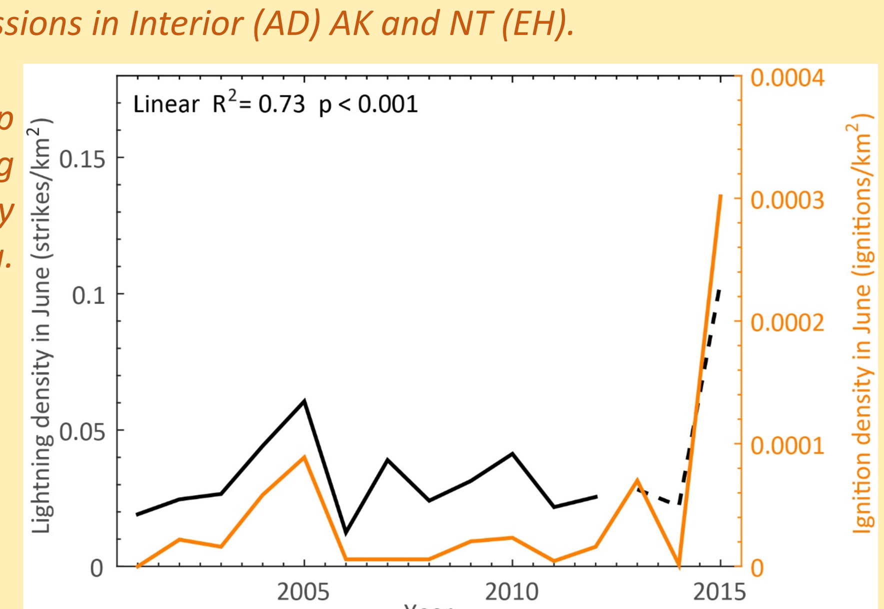
2. Climate, lightning, ignitions, burned area and carbon emissions

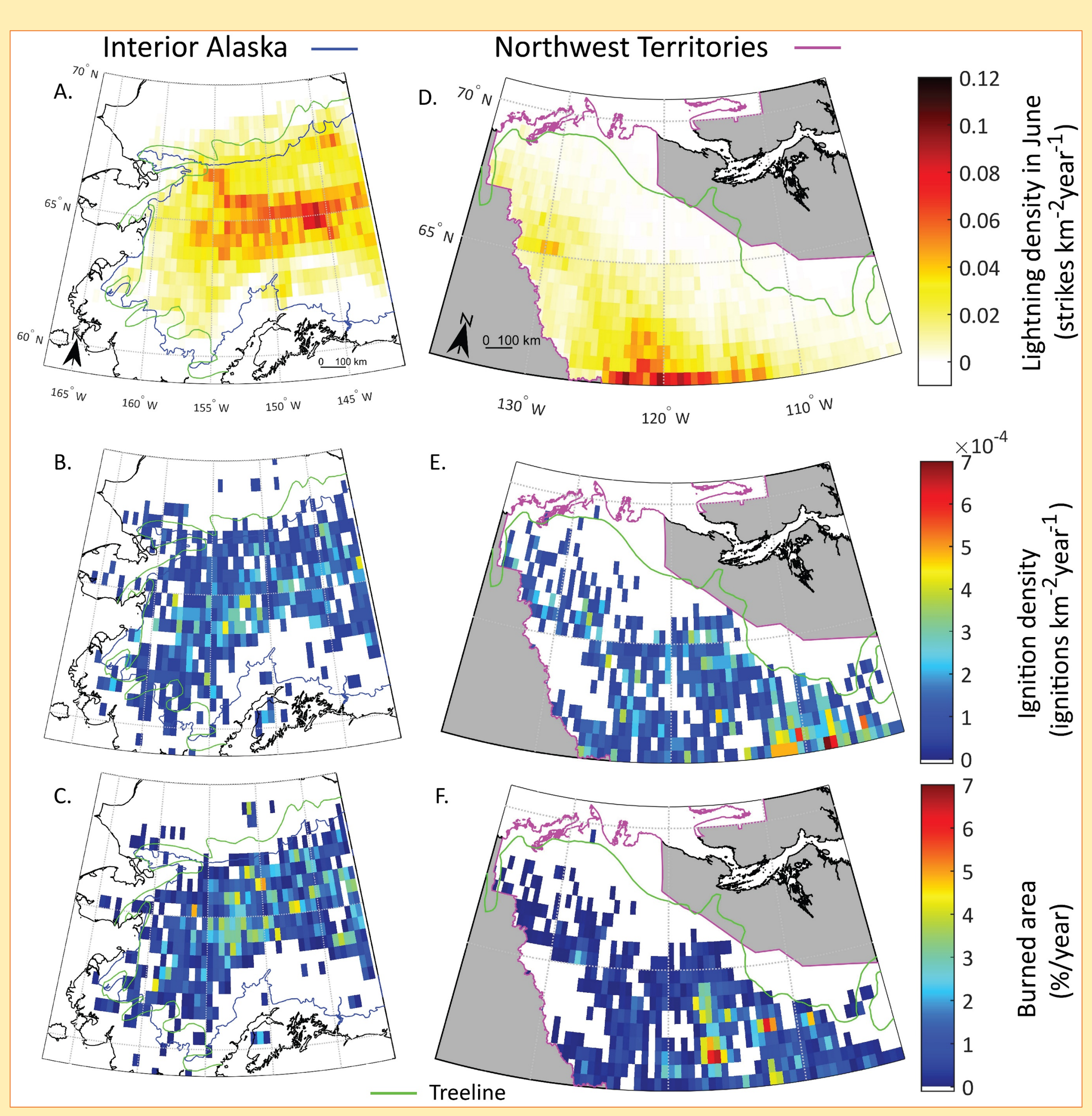
- **Vapor pressure deficit** anomalies drive **lightning** and **ignition** density *(F3ABEF-4)*
- The number of **ignitions** explain a significant part of the variability in annual **burned area** and **carbon emissions** *(F3CDGH)*
- **Vapor pressure deficit** anomalies also drive **fire size**
- Spatial variability in lightning, ignitions and burned area covaries *(F6)*



F3. Relationships between vapor pressure deficit, lightning, ignitions, burned area and carbon emissions in Interior (AD) AK and NT (EH).

F4. Relationship between lightning and ignition density in Interior Alaska.

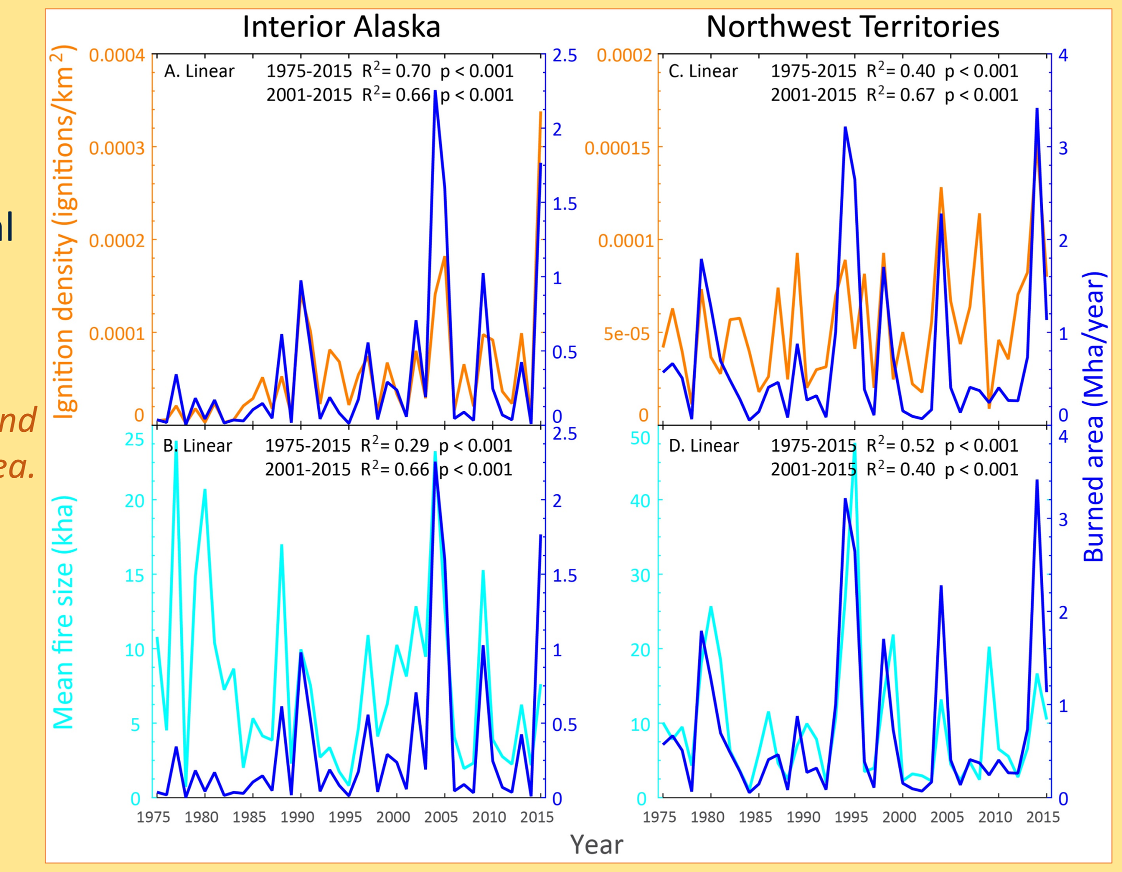




F5. Lightning and ignition density, and burned area in (ABC) Alaska and (DEF) Northwest Territories.

3. Ignitions versus fire size

- *Annual burned area = number of ignitions X mean fire size*
- Both ignitions and fire size explain significant portions of the annual burned area *(F6, T1)*
- The number of ignitions is at least an equally important driver of annual burned area than fire size *(F6, T1)*



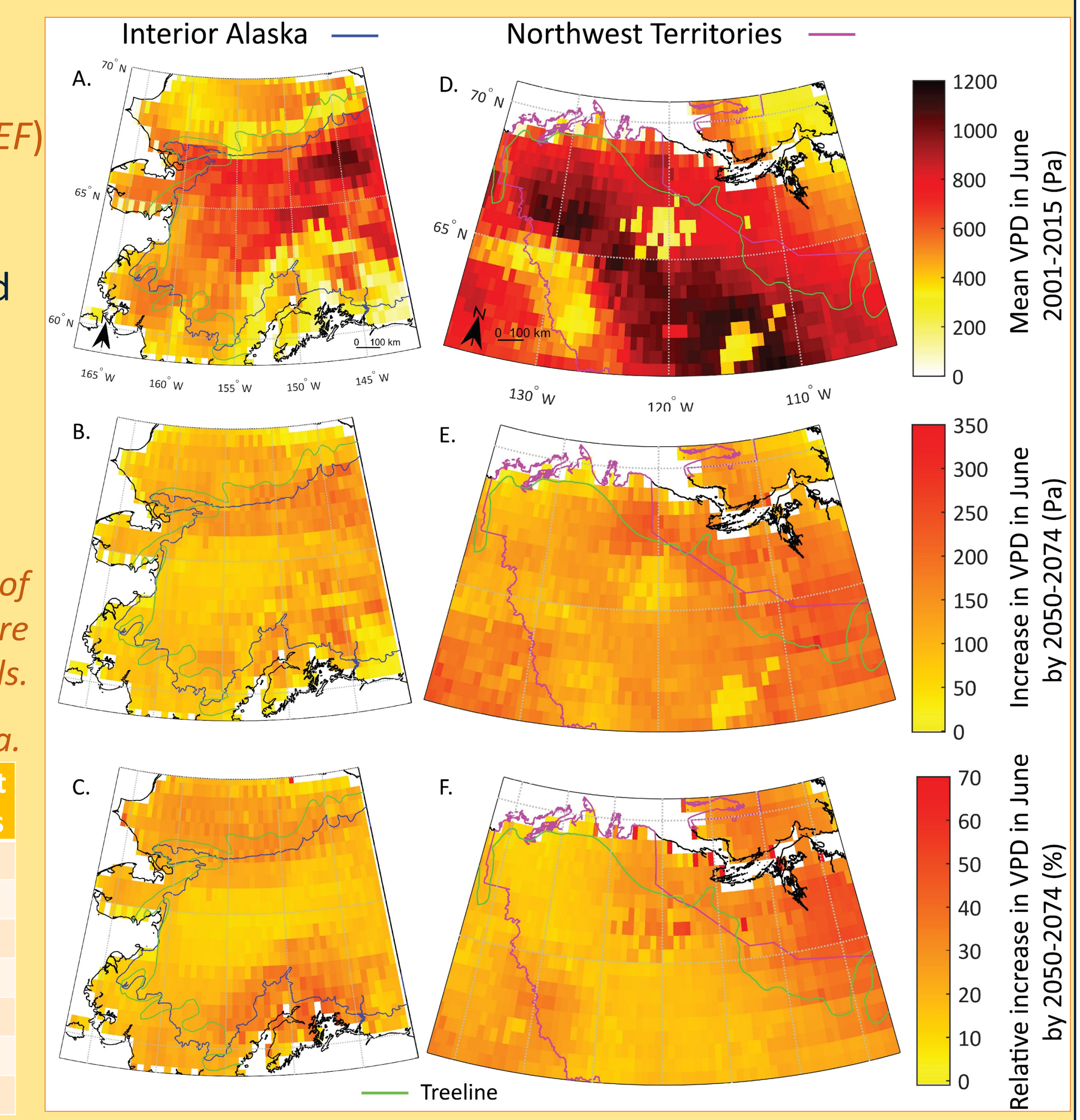
F6 Time series of ignition density and mean fire size versus burned area.

T1 Relative importance of ignitions and fire size as drivers of burned area. The numbers represent the explained variability in annual burned area (calculated as the R^2 from linear regressions).

	Time period	Number of ignitions	Mean fire size
Interior Alaska	1975-2015	0.70	0.29
	2001-2015	0.66	0.66
Northwest Terrritories	1975-2015	0.40	0.52
	2001-2015	0.67	0.40

4. Future change

- **Increases in vapor pressure deficit** are expected **by 2050-2074** *(F7BCEF)*
- **Increases** are relatively **larger** in areas close to latitudinal **treeline** *(F7BCEF)*
- These increases will drive **increases** in both **ignitions** and **fire size**, and thus burned area *(T1)*
- **Increases** in **burned area** driven by increases in **ignitions** will be relatively more important than increases driven by fire size *(T1)*
- The predicted change in burned area in Interior AK is 176 ± 245 %
- The predicted change in burned area in NT is 472 ± 666 %



F6 Contemporary and future predictions (2050-2074) of vapor pressure deficit in AK (AC) and NT (DF). Future climate predictions are the mean of five climate models.

T2 Future predictions of vapor pressure deficit, ignitions, fire size and burned area.

	Interior Alaska	Northwest Territories
Vapor pressure deficit increase in June (Pa)	108 ± 119	141 ± 121
Increase in ignitions in June (%)	195 ± 223	219 ± 209
Increase in annual burned area driven by increase in ignitions (%)	83 ± 55	218 ± 230
Vapor pressure deficit increase in July (Pa)	69 ± 75	115 ± 100
Increase in fire size (%)	33 ± 5	40 ± 25
Increase in annual burned area driven by increase in fire size (%)	42 ± 30	134 ± 168
Increase in total burned area (%)	176 ± 245	472 ± 666

5. Conclusions

- **Interior Alaska** (2015) and **Northwest Territories** (2014) recently experienced **large fire seasons**
- Most of the **burned area** is from fires that **ignited before July**
- Drought-induced early season (June) **lightning ignitions** were an important **driver** of these large fire years
- **Ignition density** is at least equally important in **explaining annual burned area** than fire size
- **Future climate** predictions show **increases in vapor pressure deficit** that will drive **increases in ignitions**, **fire size** and **annual burned area** by 2050-2074
- **Ignitions** and **burned area** are likely to occur **more frequently** close the latitudinal **treeline**
- This may **accelerate** the northward migration of tree species and thereby induce a **biome shift**

- The **Alaskan Fire Emissions Database (AKFED)** now available from: https://sites.google.com/a/uci.edu/sander-veraverbeke/akfed

ABoVE ARCTIC BOREAL VULNERABILITY EXPERIMENT
CARVE Carbon in Arctic Reservoirs Vulnerability Experiment
NASA

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