Carbon Dynamics Working Group

Carbon Synthesis Activity

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(on behalf of the entire ABoVE Carbon Synthesis Activity group)

Carbon Synthesis Activity Group

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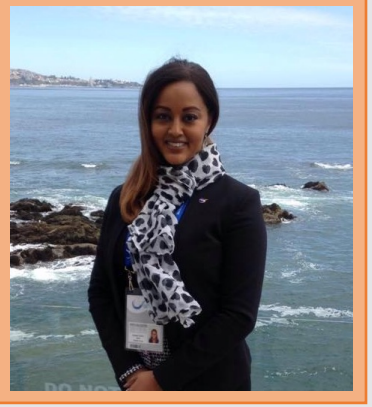

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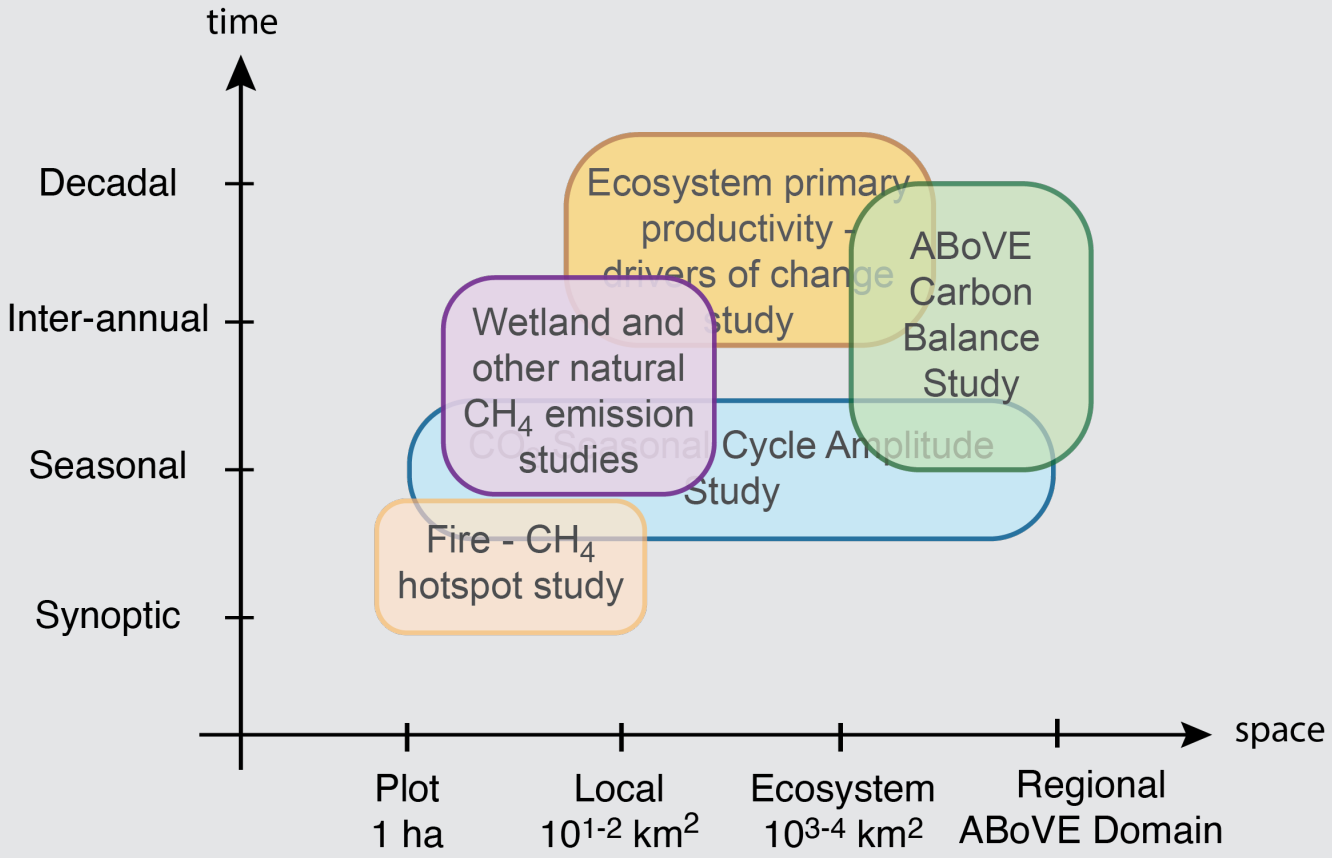
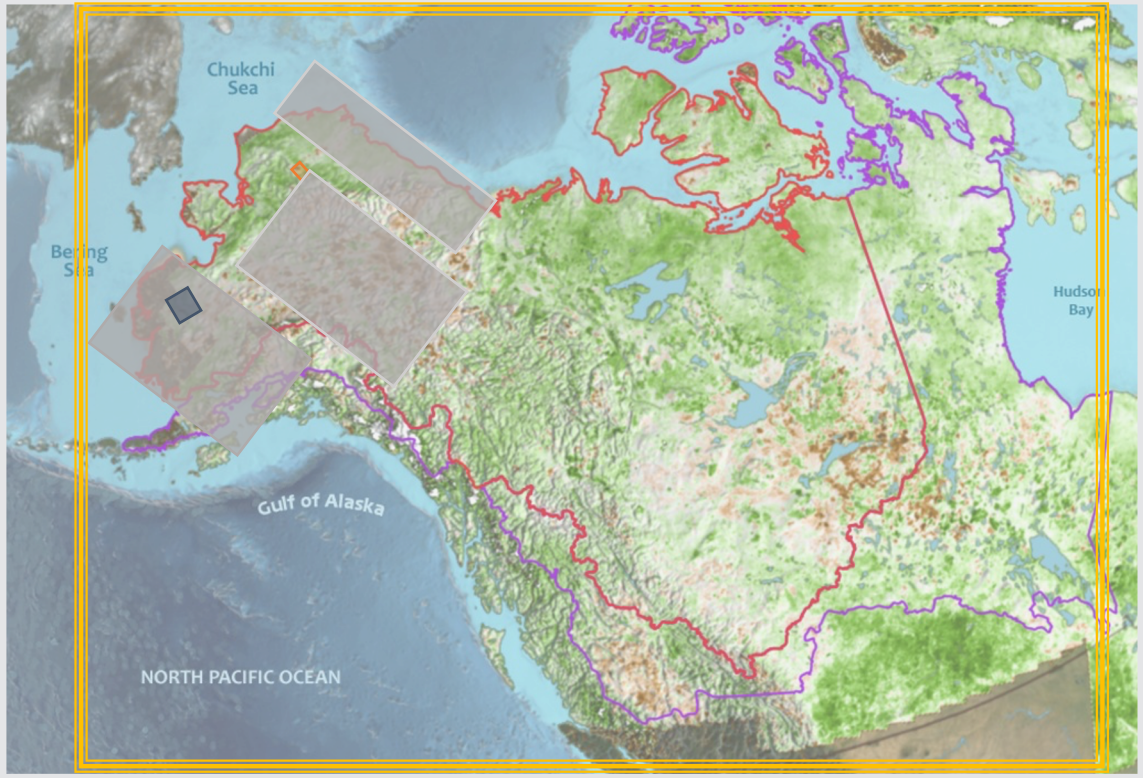
Ongoing Carbon Synthesis Topics



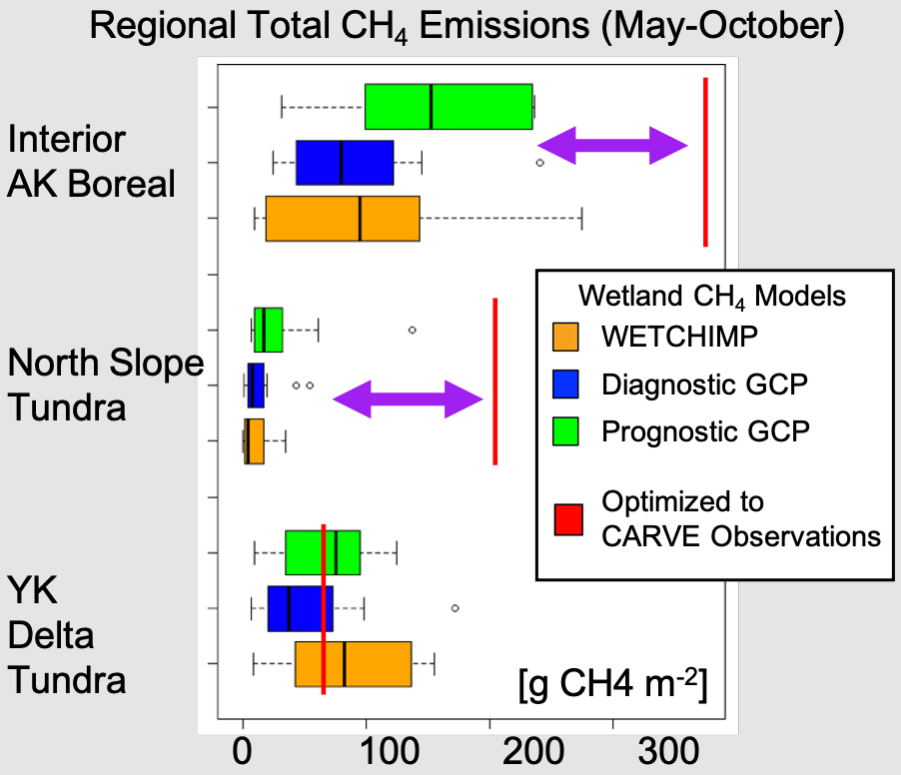


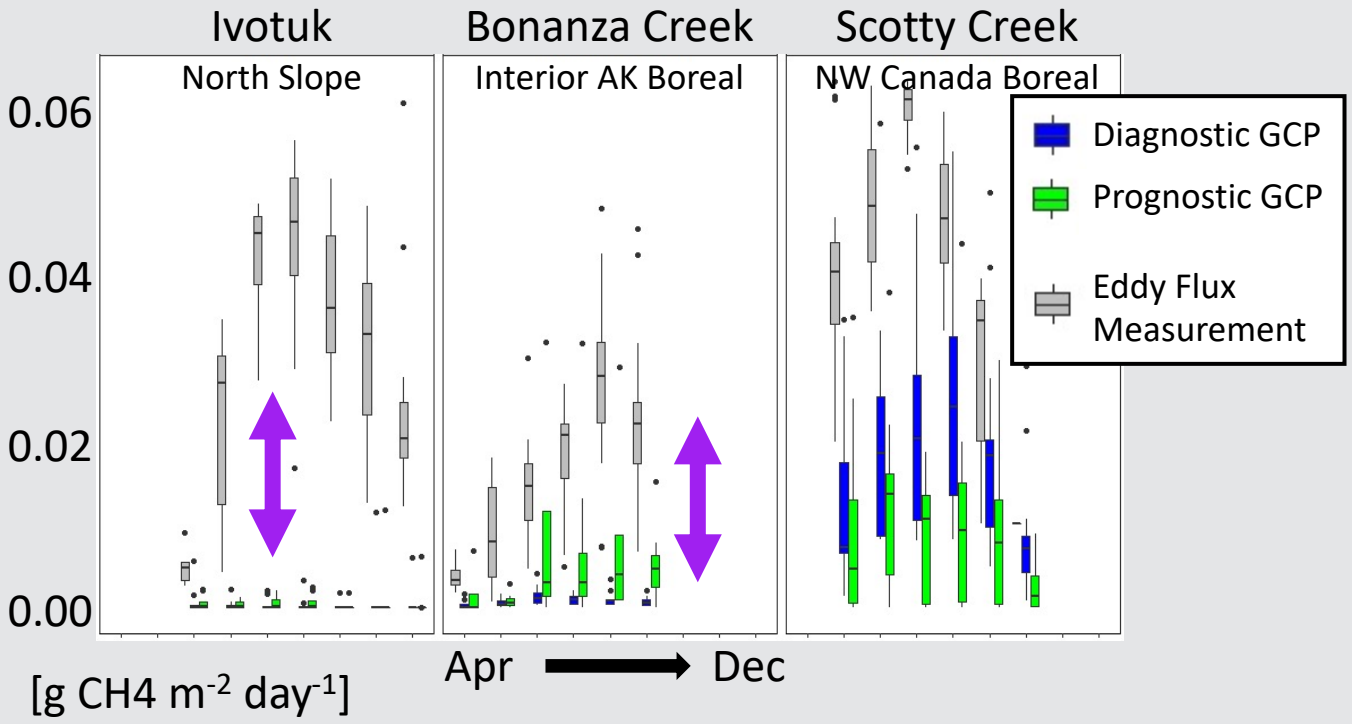
FOCUS REGIONS		
Yukon-Kuskokwim Delta North Slope	Yukon Flats Alaska	Level II EPA Ecoregions ABoVE Study Domain

What do we know about tundra wetland CH_4 emissions?

Schiferl, Commane, Watts, Reault, Webb, Hoy et al.

multiple papers in prep.





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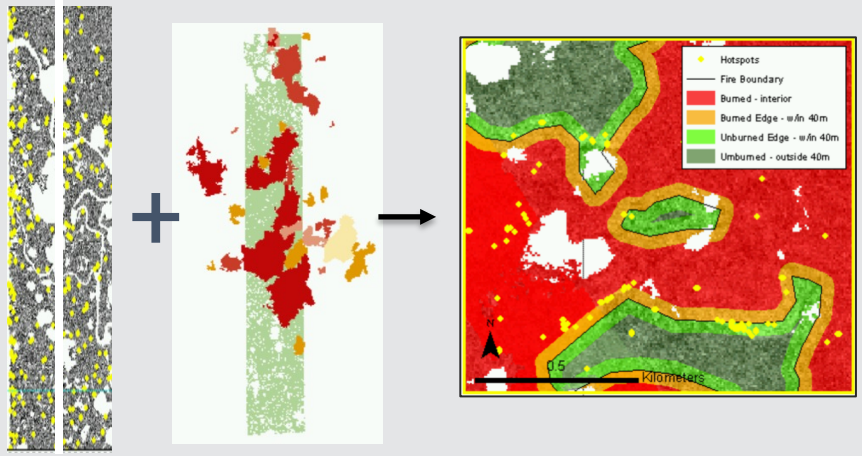
How do fire disturbances influence methane hotspots?

Yoseph, Elder, Hoy et al.

Yoseph et al. in prep.

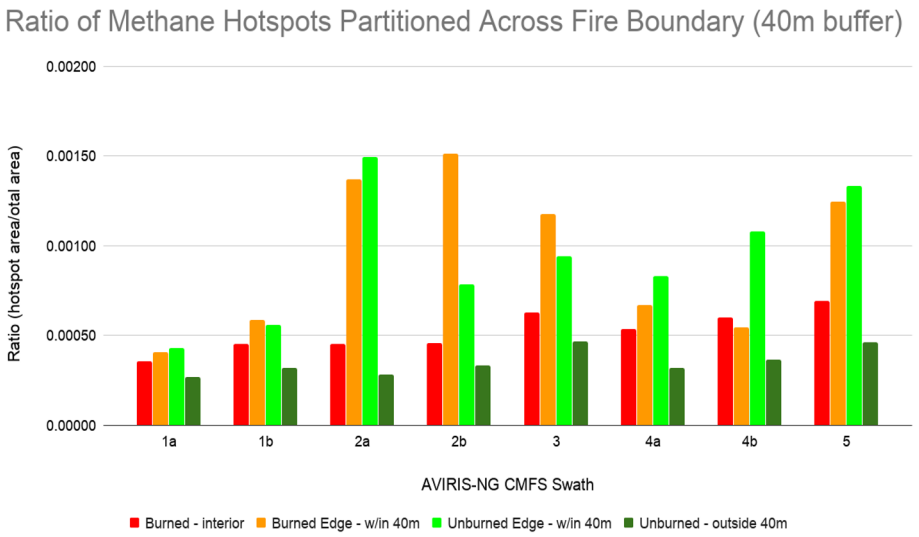
- Process-level and local scale analyses of fire - carbon relationship
- Study area - Yukon-Kuskokwim Delta, Alaska - one of the more active tundra fire regimes
- AVIRIS-NG flights from August 2018 and Alaska Large Fire Database 1940-2019
- Burn scar edges exert the greatest influence



Methane hotspots derived from AVIRIS-NG

Fire history

Analysis of methane hotspots in YK Delta



- **Increased ratio of hotspots in burned areas**
- **CH_4 hotspots were on average:**
  - **47% more likely in burned areas**
  - **125% more likely in burn scar edges**

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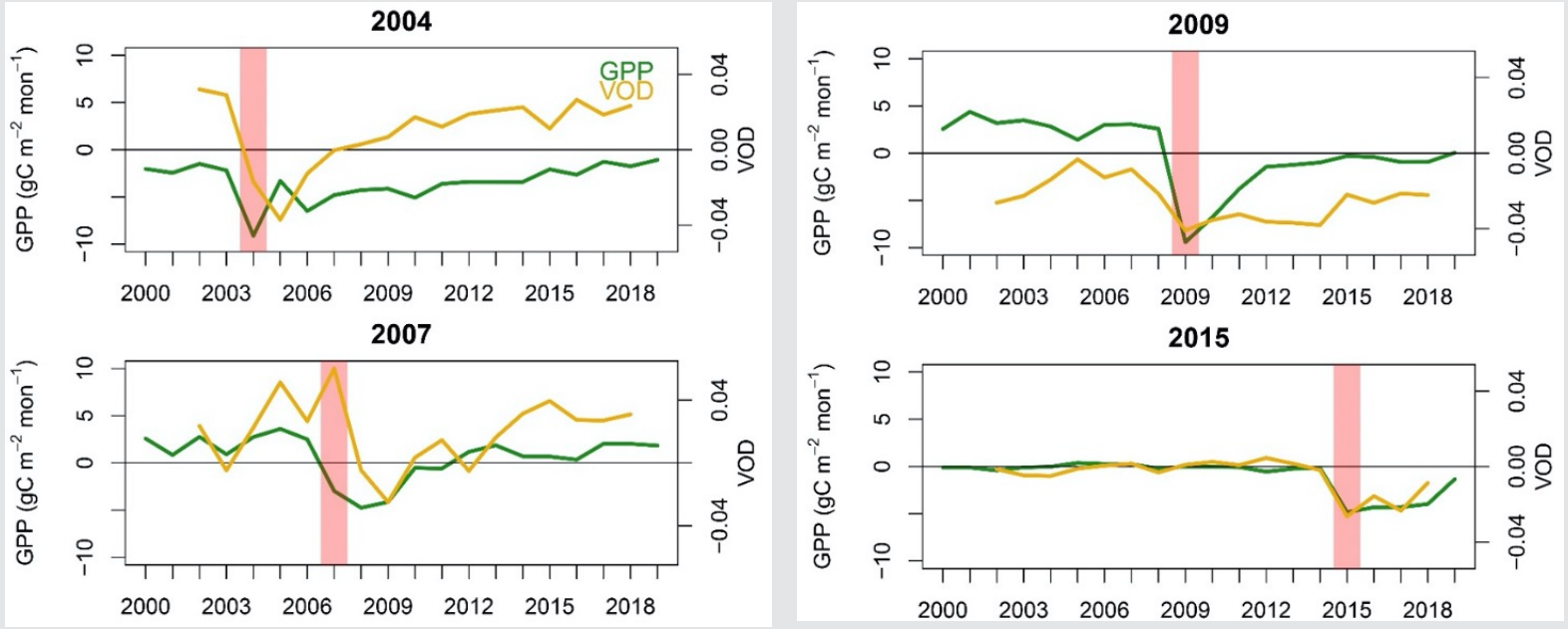
How do fires impact ecosystem gross primary productivity?

Madani, Parazoo, Kimball et al.

*Madani et al. **in press**, JGR-Biogeosciences*

- Uses satellite vegetation observations and environmental data with a diagnostic GPP model to analyze recovery from large fires in Alaska over the period 2000-2019
- Higher temperatures increase the risk of wildfire occurrence leading to direct carbon loss over a period of 1-3 years
- While mortality related to severe wildfires reduce ecosystem productivity, post-fire productivity in moderately burned areas shows a significant positive trend



Difference between burned and surrounding unburned pixels (burned minus unburned) for GPP (green) and VOD (brown) for the month of September and selected large fire years (represented by the pink vertical bars).

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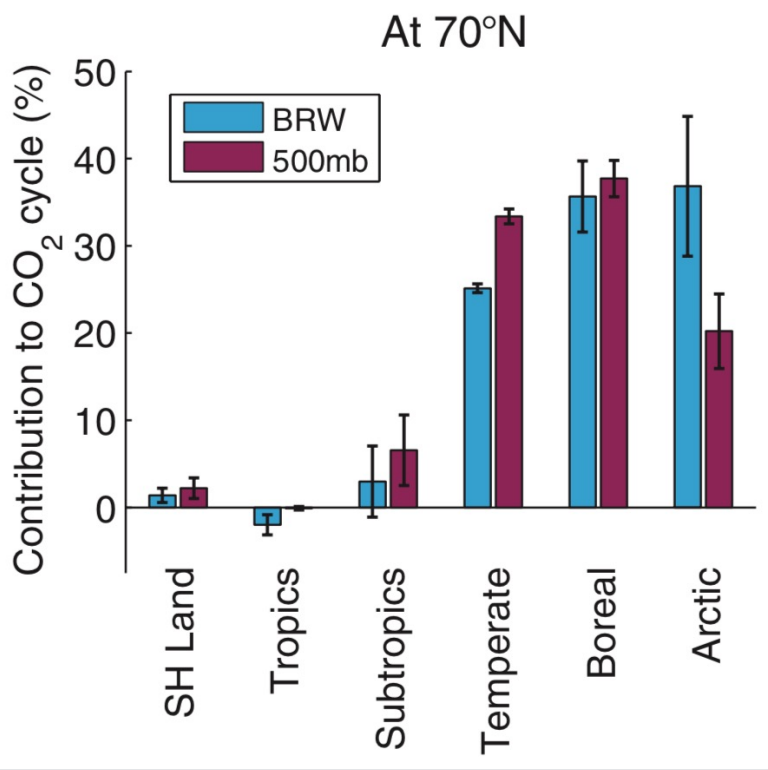
What are the causes and implications of the increasing seasonal cycle amplitude?

Rogers, Helbig, Keppel-Aleks, Liu et al.

Rogers et al. in prep. Review Paper

- CO_2 amplification one of the longest-standing questions/problems in Arctic-boreal carbon cycle science
- Rapidly evolving topic with evidence from different fields. Well-accepted and understood dynamics but large remaining unknowns
- 4 working groups within this one topic, defined by technique - field observations, atmospheric observations and modeling, terrestrial remote sensing and process-based modeling
- Primary goal is to use collective ABoVE expertise & research to synthesize what's known, what's not known, and highest priorities for understanding this phenomenon
- Findings will be organized by - drivers of change, seasonal and regional dynamics, major knowledge/data gaps, recommendation for future research

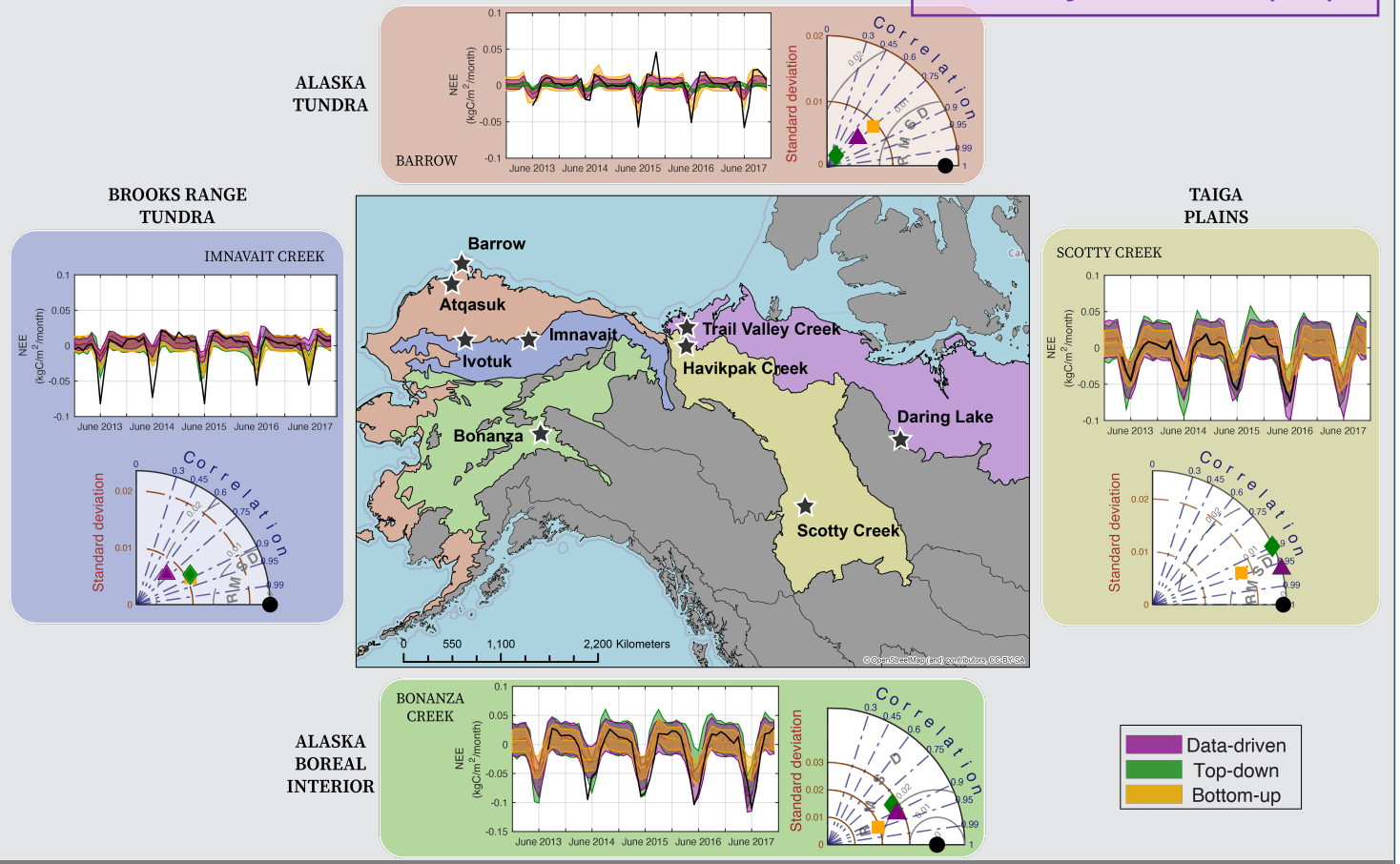


What is the carbon balance of the ABoVE domain?

Chatterjee, Wang, Poe et al.

- Reconciling carbon flux estimates (NEE and NBE) from multiple approaches - empirical, top-down and bottom-up - over the period 2009-2018
- Comparison against eddy covariance towers over representative EPA Level II ecoregions to gauge fidelity of the flux estimates
- Bringing in information about fires, harvest and wood products and lateral C export fluxes to assess the **overall** carbon balance
- Average decadal NBE (NEE + fires) over the ABoVE domain = -0.24 ± 0.35 PgC yr^{-1}, with net flux per unit NPP = 13 - 18%

Chatterjee et al. in prep.



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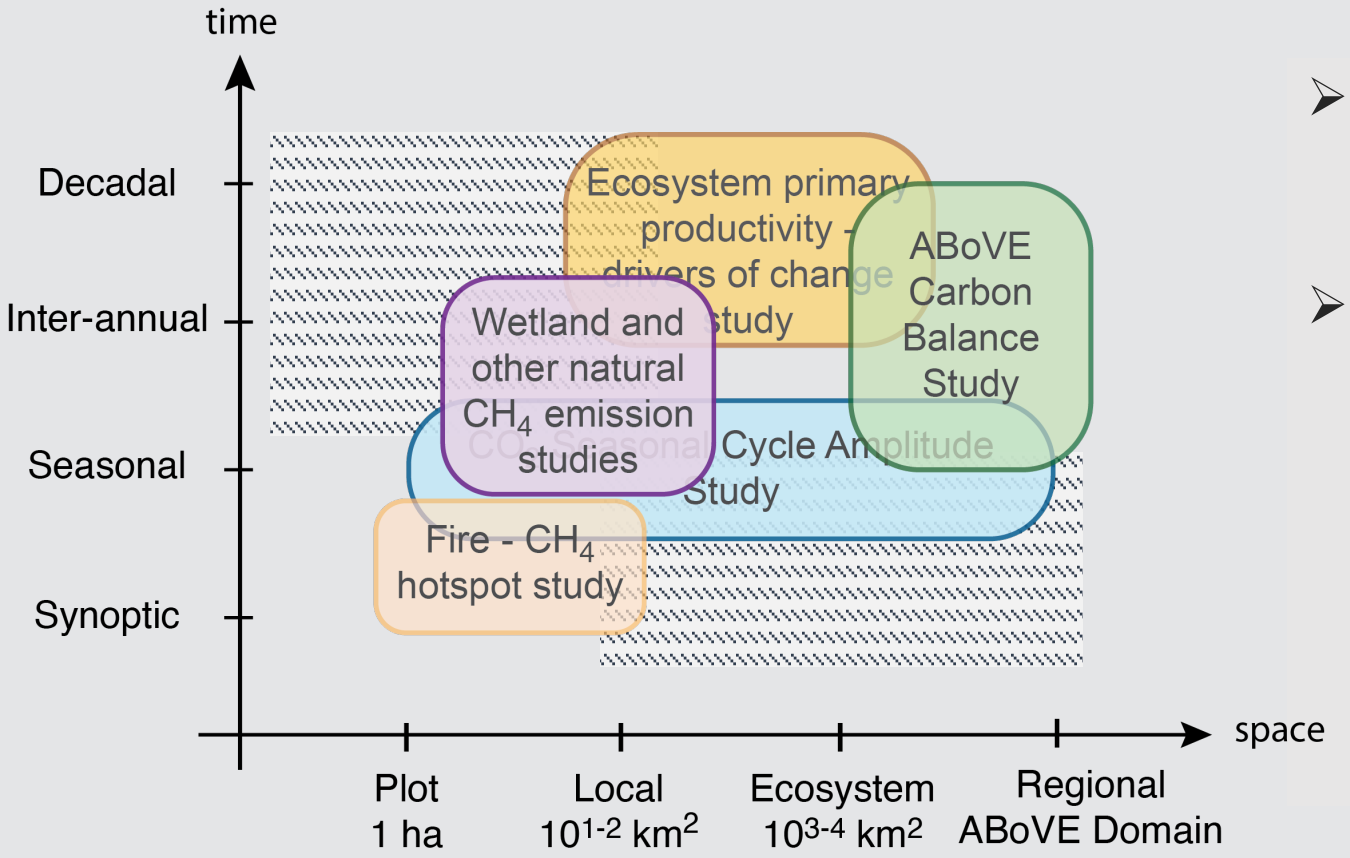
	Paper	Status	Level of completion
1	*Madani* et al., The Impacts of Climate and Wildfire on Ecosystem Gross Primary Productivity in Alaska	**In Press**, JGR - Biogeosciences	
2	*Madani* et al. Drivers Of Change in Ecosystem Productivity Trends in the Pan-Arctic Domain	In prep.	90% completed
3	*Maguire* et al. Spatial Covariation between Solar-induced Fluorescence and Vegetation Indices from Arctic—Boreal Landscapes	**In Review**, Environmental Research Letters	
4	*Reault* et al. Assessment of Methane Model Performance in Alaska: the Influence of Wetland Identification	In prep.	50% completed
5	*Yoseph* et al. Fire disturbance influences methane hotspot detection in Yukon-Kuskokwim Delta, Alaska	In prep.	50% completed
6	*Webb* et al. Spatiotemporal heterogeneity in CH4 emissions from Northern tundra and Boreal ecosystems	In prep.	25% completed
7	*Rogers* et al. CO_2 seasonal cycle amplification across the Arctic-boreal zone	In prep.	10% completed
8	*Chatterjee* et al. Decadal Carbon Budget of the North America Arctic and Boreal Ecosystems	In prep.	70% completed
9	*Wang* et al. Disturbance suppresses the aboveground carbon sink in North American boreal forests	**Published**, Nature Climate Change	
10	*Hu* et al. Evaluation of GPP from terrestrial ecosystem models using inverse modeling of COS	**In Review**, PNAS	
11	*Hashemi* et al. Seasonality buffers carbon budget variability across heterogeneous landscapes in Alaskan Arctic Tundra	**Published**, Environmental Research Letters	
12	*Virkkala* et al. Statistical upscaling of ecosystem CO_2 fluxes across the terrestrial tundra and boreal domain: regional patterns and uncertainties	**Published**, Global Change Biology	

Growing body of carbon synthesis topics



- Current synthesis topics are a **precursor** to more complex synthesis studies that we will need to tackle in Phase 3.
- These studies help to -
  - link to airborne data that were collected during the 2017 AAC
  - identify gaps in our data (observations) and/or modeling studies
  - demonstrate relevant space-time scales that may not be well-covered with currently funded activities

Growing body of carbon synthesis topics

Based on discussions at ASTM5 and ASTM6

Potential Synthesis Topic / Idea	Discussions 'willingly' initiated by
Scaling, Standardization of model drivers, consistent benchmarking	Shawn Serbin, Dave Moore
Synthesis of **land surface data assimilation fluxes**	Nick Parazoo, Dave Moore, Abhishek Chatterjee
Carbon fluxes in the future	Min Chen, Erik Larson, Brendan Rogers, Abhishek Chatterjee
Synthesis of **carbon fluxes in permafrost ecosystems**, local → regional → high-latitude scales	Chip Miller, Nick Parazoo
"Aquatic" carbon fluxes - Arctic Ocean carbon, Lateral C flows - export and degassing	Abhishek Chatterjee, David Butman, Chip Miller, Kim Wickland, Nick P.

QUESTIONS?

Join the '**Carbon Synthesis Group**' at above_synthesis_carbon@cce.nasa.gov **OR**

send me an email expressing your interest …