Carbon Dynamics Working Group

Carbon Synthesis Activity

Carbon budgets, methane attribution and carbon-climate feedbacks

Abhishek Chatterjee, Jennifer Watts, Nick Parazoo, Róisín Commane,
Nima Madani, Jon Wang, Luke Schiferl, Mary Farina, Elizabeth Hoy, Megan Mcgroddy,
Peter Griffith, Charles Miller, Scott Goetz
ADAPT team - Mary Aronne, Mark Carroll
Introducing summer interns - Jeralyn Poe, Shannon Reault, Elsa Yoseph

Introduction

- **Background**
  - need for integration and synthesis of results from multiple carbon cycle studies as we enter the midway point of ABoVE (Year 5)
  - suite of ABoVE Phase 1, 1b and 2 projects are finally maturing
- **Synthesis focus areas**
  - carbon budget for the ABoVE domain
  - methane fluxes, model-data mismatch and knowledge gaps
  - carbon-climate feedbacks and carbon cycle response to disturbances
- **Spatial and temporal scope**
  - Core and extended domain, time period dependent on individual studies
- **Timeline of activity**
  - ongoing - individual studies at various stages of completion, from 10% to 50%

Data providers …

Burns, Carroll, Farina, Henderson, Hugelius, Larson, Madani, McNicol, Natali, Saatchi, Sonnentag, Wang, Watts, Westerman

Land cover, fire history, carbon stocks, environmental drivers, flux tower measurements, model output of fluxes and/or concentrations, remote-sensing, airborne or other in situ measurements of atmospheric concentrations.

abhishek.chatterjee@nasa.gov

SP1: Carbon budget for the ABoVE domain

Study Leads: **Abhishek Chatterjee** and **Jon Wang**

Co-authors: Dave McGuire, Chip Miller, Erik Larson, Nima Madani, Mary Farina, John Kimball, Liz Hoy, Nick Parazoo, Frederic Chevallier, Andy Jacobson, Christian Rödenbeck, Eugenie Euskirchen, Oliver Sonnetag, Jen Watts, Róisín Commane, Brendan Rogers, Peter Griffith, TRENDY modelers, and others.

- ✓ What is the carbon balance of the ABoVE domain?
- ✓ How well can we reconcile carbon flux estimates from multiple approaches?
- ✓ What insights do we gain regarding the response of carbon dynamics to environmental changes?

- ❑ Assess the carbon budget through synthesis of 3 types of flux estimates -
  - **data-driven**: scaled up from direct observations of carbon exchange with the atmosphere,
  - **bottom-up**: process-based models,
  - **top-down**: atmospheric inversion models
- ❑ Tailor to ABoVE specific needs, spatially - over 13 biomes (or EPA Level II Ecoregions), temporally - growing season vs. annual for the period 2009-2018.

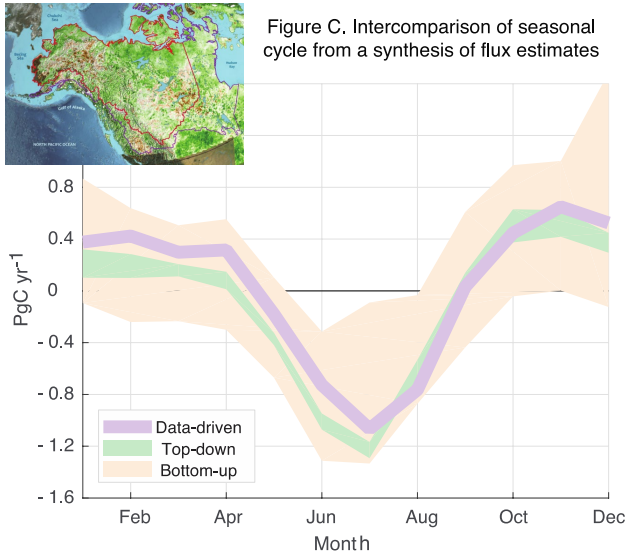
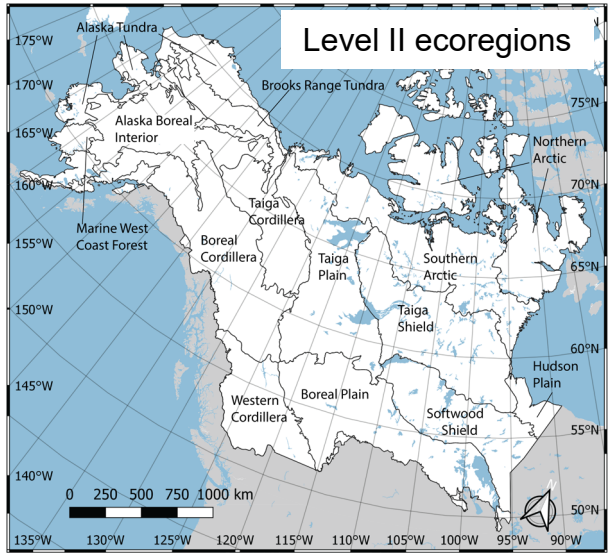


Figure C. Intercomparison of seasonal cycle from a synthesis of flux estimates



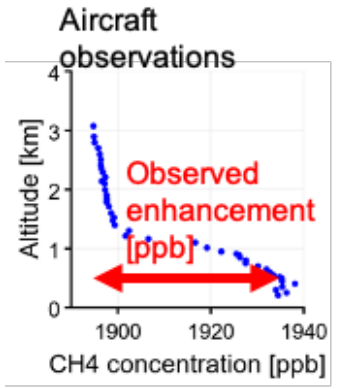
SP2: Methane fluxes, model-data mismatch and knowledge gaps

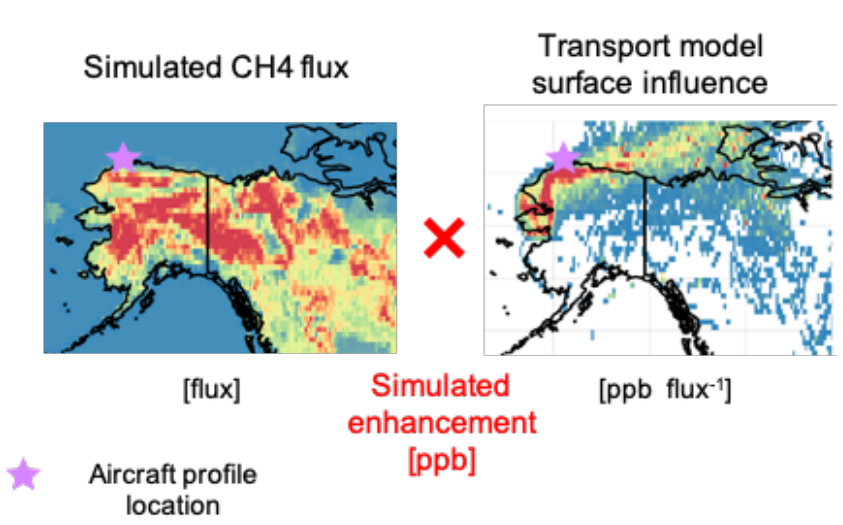
Study Leads: **Róisín Commane** and **Jennifer Watts**

Co-authors: Luke Schiferl, Scot Miller, Ben Poulter, Abhishek Chatterjee, Charles Miller, Mary Farina, Colm Sweeney, Kathryn McKain, Sebastian Biraud, John Henderson, and others.

- ✓ Multi-model comparison & diagnostics - where, when and why do model results agree or disagree?
- ✓ Methane emission budget analysis - identify key regions of emissions, uptake, changes in seasonal cycle and annual budgets
- ✓ Provide recommendations for future studies

- ❑ Evaluate modeled methane fluxes vs atmospheric observations via atmospheric transport models, over the ABoVE domain.
- ❑ Investigate where, when (and possibly why) models do not match the observations and where they need to focus their improvements.
- ❑ Provide resulting code and observations in a nice, open-source package so anyone can use this framework to evaluate their models.





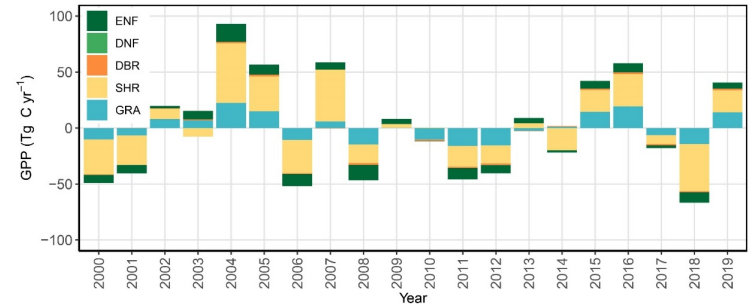
SP3: Carbon-climate feedbacks, carbon cycle response to disturbances

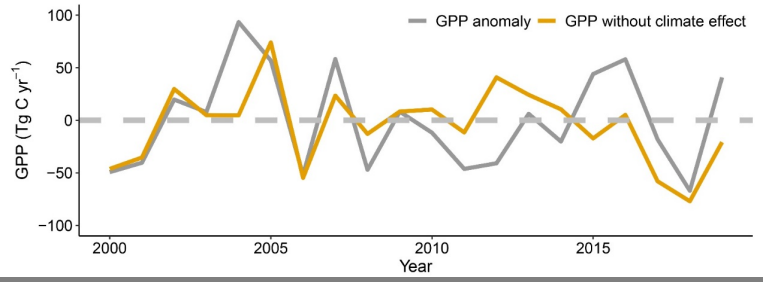
Study Leads: Nick Parazoo and Nima Madani

Co-authors: John Kimball, Abhishek Chatterjee, Jen Watts, Ashley Ballantyne, Sassan Saatchi, Zhihua Liu, Torbern Tagesson, Chip Miller, and others.

- ✓ Identify trends in carbon fluxes and disentangle the impact of disturbance effect vs. climate and CO_2 fertilization effect on GPP
- ✓ Evaluate plant post-fire recovery in Arctic and boreal forests of Alaska - what processes drive the GPP recovery time and signal?

- ❑ Assess the response of forests to wildfires by looking at a synthesis of carbon cycle and environmental drivers - GPP, VOD, biomass
- ❑ Identify significant fire events (burn area > 40k acres) and for individual fire years disentangle the impact of climate vs. fire on GPP, subsequent recovery signal and time





If interested and if you want to participate …

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

SP1
Carbon budget

abhishek.chatterjee@nasa.gov

jon.wang@uci.edu

SP2
Methane data and knowledge gaps

jwatts@whrc.org

r.commane@columbia.edu

SP3
Carbon-climate feedbacks

nima.madani@jpl.nasa.gov

nicholas.c.parazoo@jpl.nasa.gov

Suggested (future?) CDWG synthesis activity topics

- Changes in seasonal amplitude of CO_2 concentrations
- Partitioning of net ecosystem exchange components using COS and SIF
- (with Hydrology and Permafrost WG) Synthesis of carbon fluxes in permafrost ecosystems; local > regional > high-latitude scales
- (with Hydrology and Permafrost WG) Freeze-thaw dynamics and timing, impact on CO_2 and CH_4 fluxes
- (with Modeling WG) Scaling, merging fine scale datasets with larger scale (spaceborne) data
- (with Modeling WG) Characterization of model uncertainty
- (with Veg Dynamics WG) Greening/browning trends, ABZ productivity and drivers