ABoVE Cross-Cutting Breakout: Permafrost-Carbon-Hydrology

ASTM-4

Seattle, WA

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WGs represented:

Carbon Dynamics, Hydrology & Permafrost, Airborne, Wildlife & Ecosystem Services, Fire Disturbance, Modeling

Enhancing Synthesis Activities That Can Answer *"what did we learn"*

- Focus on shoulder seasons, especially in the Fall zero curtain: what is really happening to the carbon fluxes, esp. respiration, during these times?
  - Quantify carbon fluxes, thaw depth, unfrozen water content in soil, snow effects, duration of zero curtain before phase change; are we accessing older Carbon?
- What is the relationship between methane production and pond edges?
  - What are the distributions of small streams and ponds, and what is the CH4 production mechanism?
  - Quantify relationship between permafrost thaw at pond/lake edges and methane production
- What are cross-scale feedbacks involving carbon fluxes and hydrology?
  - Quantify 3D (vertical + lateral) soil moisture effects in thermokarsting by looking at scales from tens of meters to tens of kilometers
  - Understand subsurface connectivity
- Carbon models and hydrology models exit mostly in isolation; need unified models
  - Each side may make gross simplifying assumptions about the other side's physics
  - Incompatible interfaces, including those for ingesting remote sensing products

Scaling Considerations

- How do we upscale products and synthesis results from plot to airborne to regional scales?
  - Need geospatial data layers that span these scales; plot and remote sensing data used as training data sets for multivariate/nonlinear/machine learning regressions
  - Data layers include: DEM, landcover, soil composition, precipitation
  - Landcover identified as an issue, especially in Canada: need high-res and more highly resolved species classes specific to boreal/arctic
  - Soils maps, including organic content, exist from PCN and may be of sufficiently high quality; to be investigated
  - Validation is key: need independent data sets, ground and airborne, for validation

Data & Knowledge Gaps

- Shoulder season dynamics:
  - Need biweekly observations of active layer thaw depth from end of summer to well past start of snowfall over various gradients
  - Need continuous-time, spatially representative, simultaneous ground observations of carbon emissions, soil (temperature, dielectric constant and electrical conductivity, hydrology, soil composition), snow, vegetation

- Some perceived data gaps are actually gaps in knowledge about existence of data
  - Example: DOC, DIC, soil organic matter, root biomass, fine roots: various data sets exist from Northern Circumpolar Database, borehole sites, LTER, Permafrost Carbon Network , NGEE-Arctic
  - Perennial problem: how do we locate, collate, and harmonize the relevant data sets, both from ABoVE and non-ABoVE sources?

Future Airborne Campaigns to Address These Questions

- Shoulder season observations identified among highest priorities
  - Biweekly radar (for soil moisture and ALT) and hyperspectral (for veg dynamics and methane); can we correlate soil moisture with methane hot spots?
  - Cover a number of north-south transects: need to sample gradients of temperature, topography, vegetation, soil

- Need to develop metrics for optimal design of spatial and temporal sampling frequency for remote sensing observations

Near-Term Activities

- Modeling workshop: need a heavy push towards unifying Carbon and hydrology models
  - Focused on boreal/arctic and ABoVE domain, but doesn't have to be limited to the ABoVE project; joint TE/THP; can invite non-NASA investigators as well
- Data search/discovery/harmonization task force
  - Representatives needed from each WG: generate wish list
  - Search, discover, assemble data and data sources, assess adequacy and quality
  - Learn from successful examples of data harmonization, such as PCN and various datasets on ORNL-DAAC
  - Data QA/QC support from ABoVE project
- Spell out clear data use and co-authorship policy
  - Archiving data sets with DOI could address the problem