ABoVE Cross-Cutting Breakout: Permafrost-Carbon-Hydrology

ASTM-4
Seattle, WA
26 January 2018

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
• 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