



In 2008 NASA requested proposals for scoping studies

“...to identify the scientific questions and develop the initial study design and implementation concept for a new NASA Terrestrial Ecology field campaign..”

ABoVE was one of two selected. We focused on the impacts of climate change in High Northern Latitude regions (Kasischke, Goetz, Kimball, Mack)

ABoVE was scoped to focus on *processes, feedbacks and interactions* that are regulated by climate and influence the *vulnerability and resilience* of Arctic and Boreal ecosystems and landscapes.

We placed particular focus on the roles of and interactions between disturbance, permafrost, and surface hydrology – processes that are key to HNL biomes.

Why an Arctic – Boreal Focus?

Recent changes in climate are causing significant and novel changes to arctic/boreal ecosystems over large areas

Complex interactions are the norm, with many critical feedbacks to regional and global climate

- *How rapidly will permafrost warm?*
- *What are the impacts of permafrost warming?*
 - *Is there a methane tipping point?*
- *What controls burning of organic soils in tundra, forests & peatlands?*

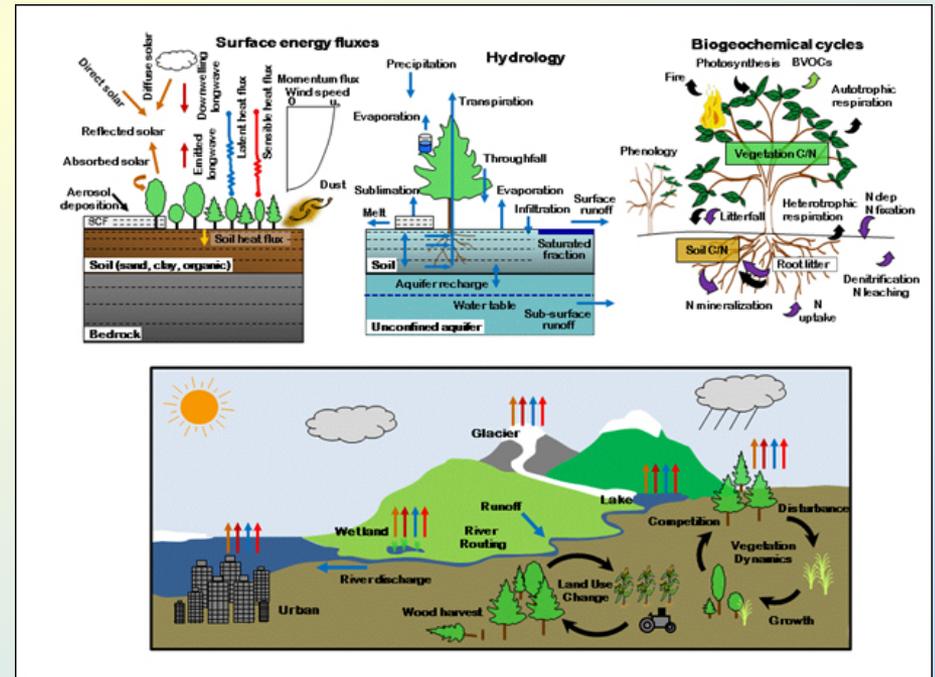
Remote sensing data are essential for addressing uncertainties and informing and assessing models

Models of key arctic/boreal processes do not adequately explain current impacts nor can they project future impacts

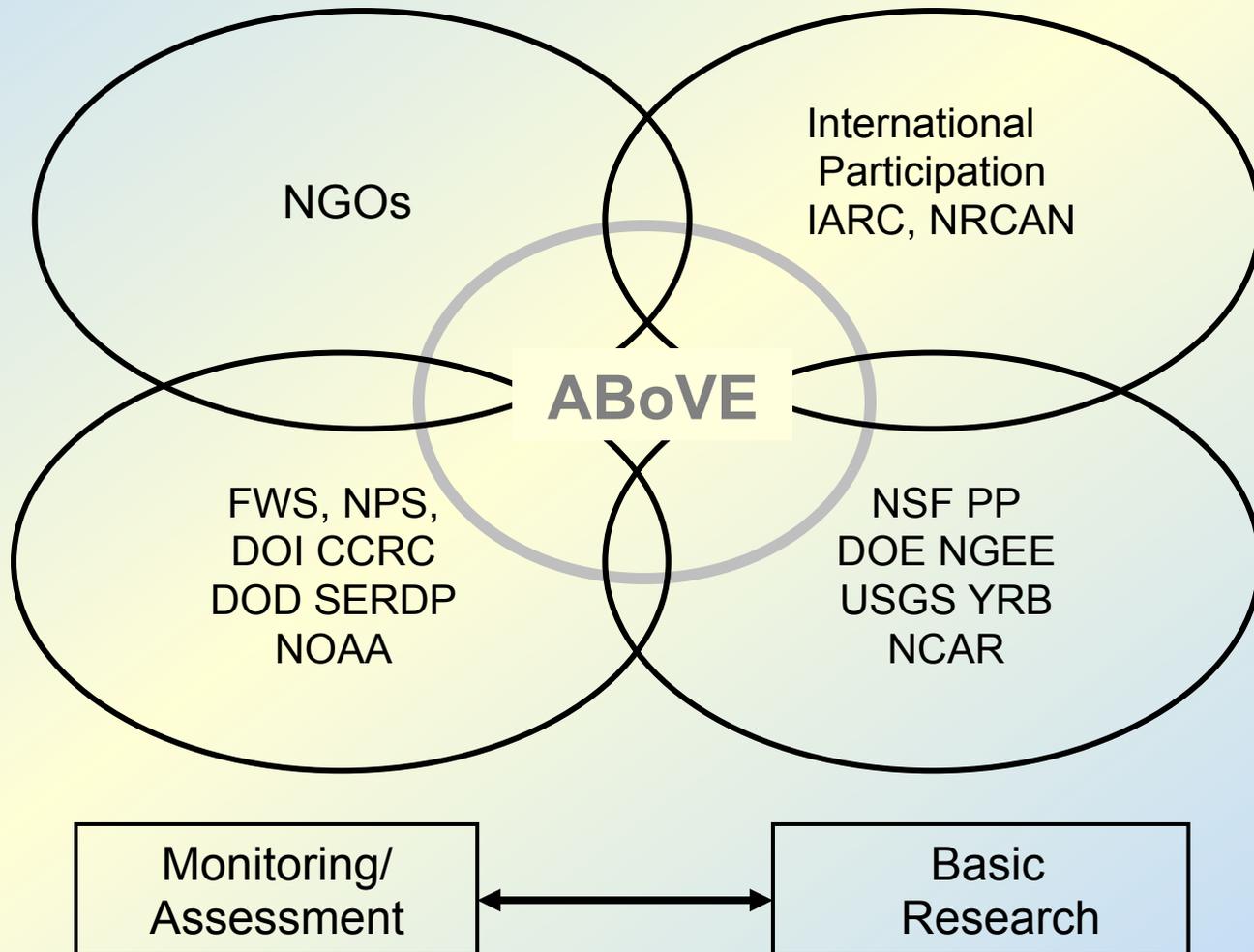
- Additional research is needed to
 - Address known areas of uncertainty (the “known unknowns”; e.g. ground-layer processes & permafrost)
 - Identify novel and new patterns of landscape change and ecosystem reorganization (the “unknown unknowns”; e.g. tipping points)

- Crucial data sets are needed to drive and independently to assess models

- An integrated modeling approach is needed



ABoVE provides a means to coordinate northern high latitude research conducted by a broad coalition of national & international organizations



Atmosphere/Climate

Land-Atmosphere Feedbacks

Land Surface/Subsurface

Ecosystem Dynamics

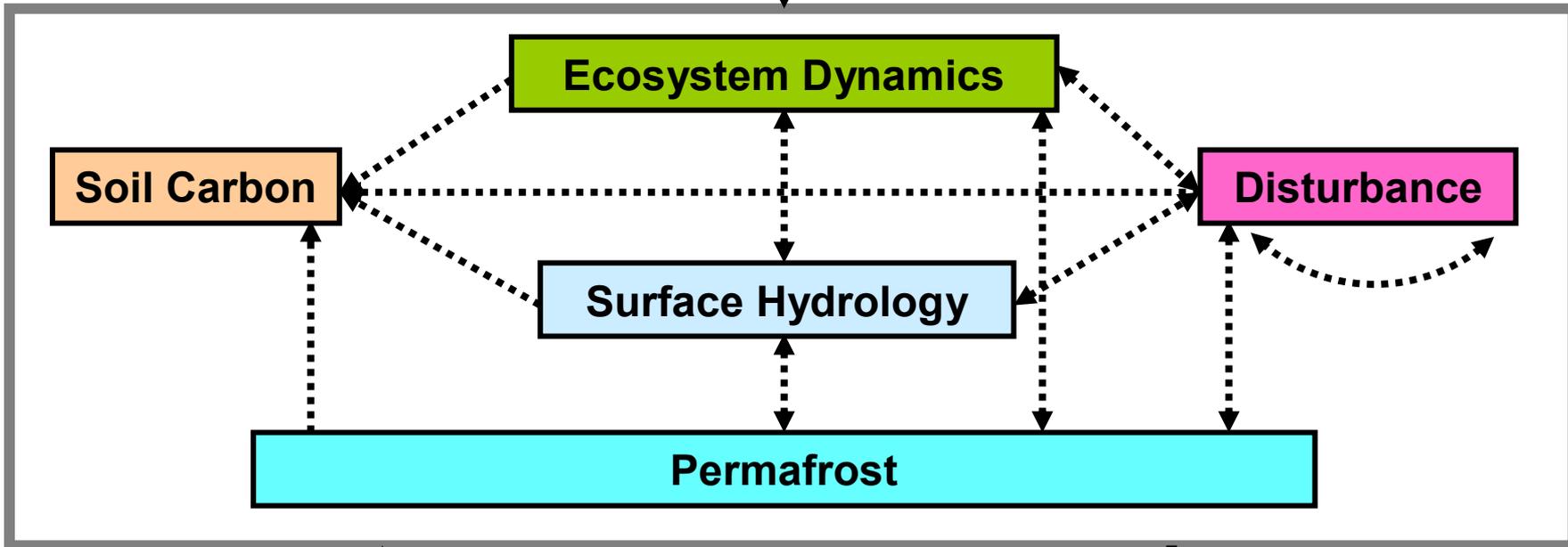
Soil Carbon

Disturbance

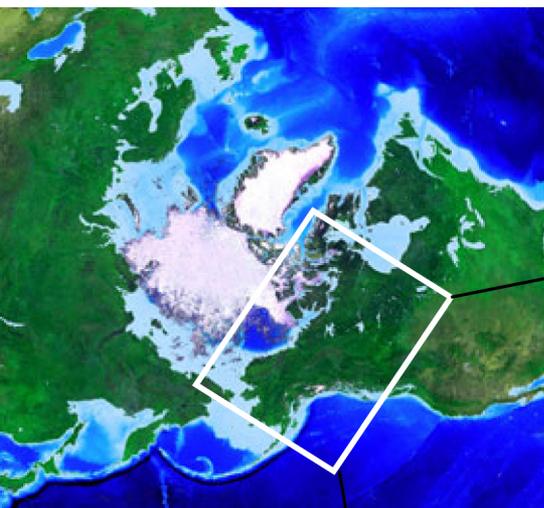
Surface Hydrology

Permafrost

Human Dimensions / Impact Assessment



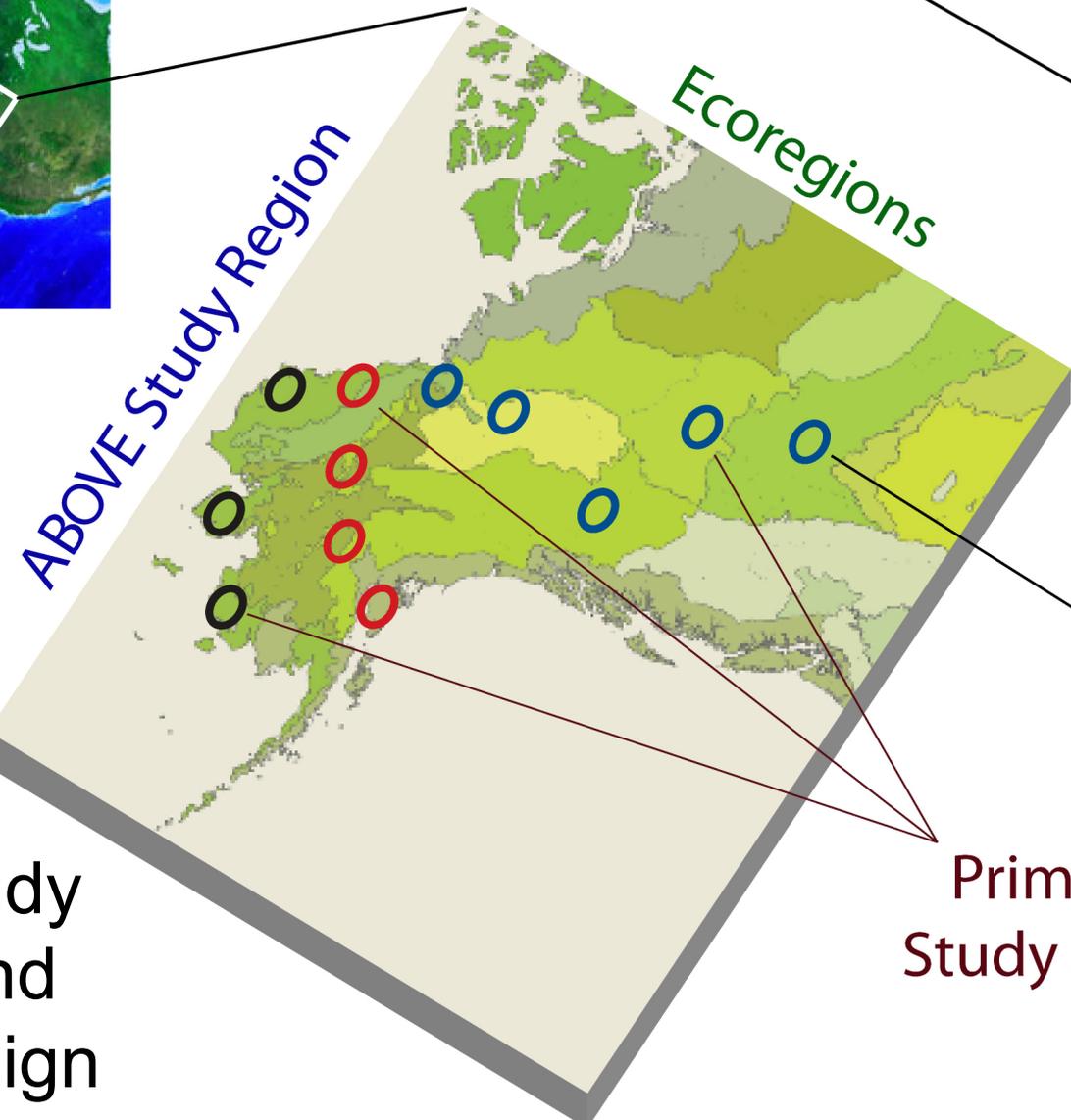
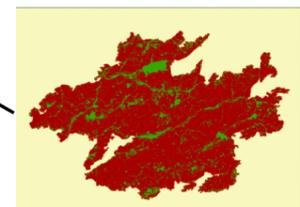
Pan Arctic-Boreal



Tower/Process/
Validation
Sites

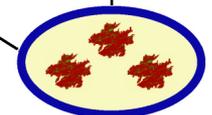


Discrete
Landscape
Unit



ABOVE Study
Domain and
Nested Design

Primary
Study Areas



The ABoVE Story (thus far)

- NASA Research Announcement (April 2008)
- Proposal submitted (Oct 2008)
- Proposal selected (Jan 2009)
- Workshop in Fairbanks with ~90 participants (Aug 2009)
- Scoping study report submitted to NASA (Oct 2010)
- Science community feedback solicited (May-Aug 2011)
http://cce.nasa.gov/terrestrial_ecology/scoping.html
- AGU Eos article published (May 2011)
- NASA external committee review (Sept 2011)
 - review, including community comments, to assess feasibility
 - scientific importance, priority of research questions
 - appropriateness of scientific implementation approach
- Presented & discussed at annual CC&E mtg (Oct 2011)

Panel Recommendations

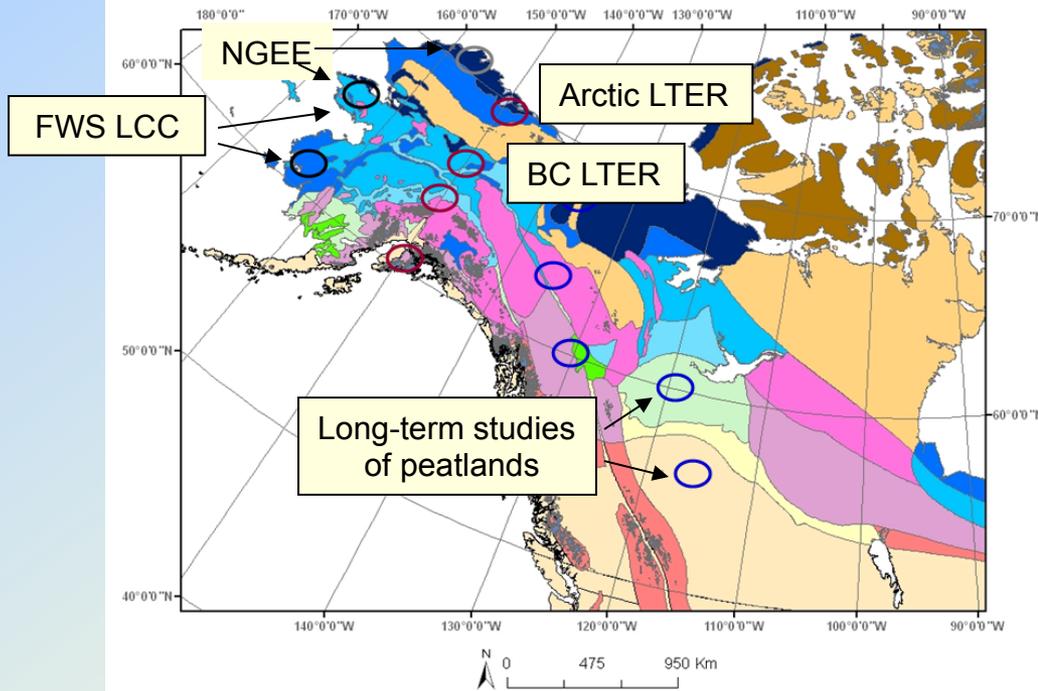
Proceed with ABoVE but suggest revisions to:

- Refine the overarching science question(s) to be more specific to key knowledge gaps and address societal relevance
- Refine discussion of the importance of NASA in addressing the major research questions
- Consider expanding the scope to include ocean-ice-land-atmosphere interactions.
 - *“the potential for major scientific advances and societal payoffs seems much greater if the study addresses the entire system.”*

Post-review Activities

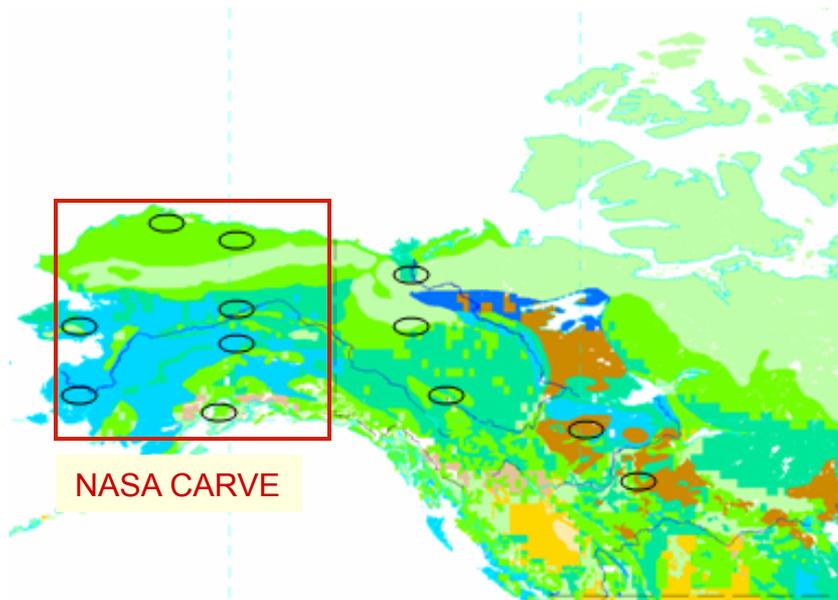
- Community discussion at CC&E mtg (Oct 2011)
- Presentations to NACP-SSG and CC-SSG
- Discussions with CC-IWG members wrt multi-agency support for expanded scope - *ongoing*
- Discussions with international participants / collaborators (e.g. CARBO-NA) - *ongoing*
- Discussion within NASA (e.g. this workshop)
- Executive Summary revised to incorporate panel suggestions
- Planning next workshop to revisit overarching science questions, consider expanded scope, discuss societal impacts/responses, address interactions and linkages among disciplines, etc.

Interactions with ongoing/planned programs

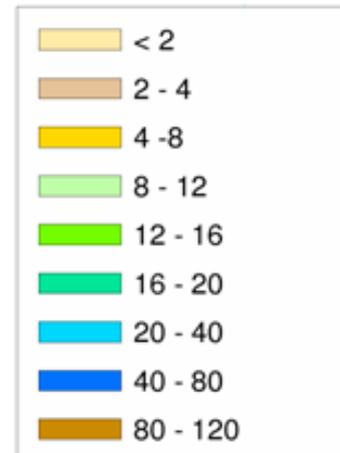


Permafrost Extent (percent of area)	Ground Ice Content (visible ice in the upper 10-20 m of the ground; percent by volume)				
	Lowlands, highlands, and intra- and intermontane depressions characterized by thick overburden cover (>5-10m)			Mountains, highlands, ridges, and plateaus characterized by thin overburden cover (<5-10m) and exposed bedrock	
	High (>20%)	Medium (10-20%)	Low (0-10%)	High to medium (>10%)	Low (0-10%)
Continuous (90-100%)	Dark Blue	Light Blue	Lightest Blue	Dark Purple	Light Purple
Discontinuous (50-90%)	Medium Blue	Light Blue	Lightest Blue	Dark Purple	Light Purple
Sporadic (10-50%)	Dark Green	Light Green	Lightest Green	Dark Purple	Light Purple
Isolated Patches (0-10%)	Dark Green	Light Green	Lightest Green	Dark Purple	Light Purple

Legend: Ice caps and glaciers (Blue), Land (Orange)



Soil Organic Carbon (kg m⁻²)



ABoVE Next Steps

Near to mid-term..

- workshop in Boulder next month (13-15 June 2012)
- post-workshop formation of a science advisory group
- development of a concise Experiment Plan
- survey of data sets, research activities, programs within the study domain
- continue inter-agency discussions & coordination
- develop international collaboration
- initiate solicitations to support effort (e.g. 2012 TE call)
 - *Preparatory modeling and data compilation and analysis studies in support of a future arctic-boreal vulnerability field campaign in western North America to focus on carbon, ecosystems, and biogeochemical cycling, with emphasis on interactions with the hydrosphere, atmosphere, coastal oceans, and human activities.*



Overarching science questions in Scoping Study

What patterns of changes in ecosystem dynamics and land surface characteristics have occurred over the past 25-50 years and are likely to occur in the near future (5 to 25 years) and over the longer term (25 to > 100 years)?

What processes, interactions, and feedbacks control the vulnerability of Arctic and Boreal ecosystems and landscapes to structural and functional change in a changing climate?

How will potential future changes to the land surface in Arctic and Boreal regions contribute to positive and negative feedbacks to local, regional and global climates?

Stated Objectives in Scoping Study

Quantify and model (i) the processes and interactions controlling natural disturbances, permafrost, and surface hydrology and (ii) the responses of ecosystems, changes in carbon stocks, and feedbacks between the land surface and the atmosphere that influence global climate.

Identify and quantify the critical tipping points where changes in state occur, and the processes underlying these state changes.

Understand how potential future changes to Arctic and Boreal ecosystems and landscapes will impact ecosystems services, resource exploitation, and land management activities.