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ARCTIC BOREAL VULNERABILITY EXPERIMENT



# NASA Arctic Field Campaign to Examine Ecosystem Impacts of Changing Climate



The ABoVE campaign will combine field work, airborne surveys, satellite data and computer modeling to study the effects of climate change on Arctic and boreal ecosystems, such as this region at the base of the Alaska Range south of Fairbanks.

**Credits: NASA/Ross Nelson**

**31 Aug 2015**

## Development of ABoVE (the short version)

- Scoping proposal (Oct 2008) selected (Jan 2009)
- Workshop in Fairbanks with ~90 participants (Aug 2009)
- Scoping study submitted to NASA (Oct 2010)
- Science community feedback solicited (May-Aug 2011)
- NASA external expert committee review (Sept 2011)
- 2<sup>nd</sup> workshop in Boulder ~100 participants (June 2012)
- Report of Boulder workshop released (Fall 2012)
- Science Definition Team formed – held 4 workshops (thru 2013)
- Concise Experiment Plan completed (Spring 2014)
- First call for core team proposals (Dec 2014)
- Selection of 21 proposals / teams (Aug 2015)
- 1<sup>st</sup> Science Team meeting (late Sept – early Oct 2015)

# ABOVE Science Objectives

## (from Concise Experiment Plan)

### *Tier 2 Science Objectives: Ecosystem Dynamics*

1. Determine how interactions among vegetation, soil characteristics, hydrology, and disturbances influence surface energy exchange and <b>mediate permafrost vulnerability and resilience</b> to climate change.	2. Determine how and where interactions among <b>microbes, plants, and animals</b> exert control over ecosystem responses to climate change and disturbances.	3. Understand how <b>vegetation</b> attributes and <b>hydrologic</b> conditions interact, and respond and <b>feedback to disturbance</b> .	4. Quantify how changes in the spatial and temporal <b>distribution of snow impacts</b> ecosystem structure and function.
5. Determine the causes of <b>greening and browning trends</b> and their <b>impacts</b> on ecosystem form and function.	6. Elucidate how climate change and disturbances interact with above- and belowground communities and processes to alter <b>carbon biogeochemistry</b> , including release to surface waters and the atmosphere.	7. Determine how the spatial and temporal dynamics in both faunal abundance and characteristics of <b>fish and wildlife habitat</b> co-vary across gradients of <b>climate and disturbance</b> .	

### *Tier 2 Science Objectives: Ecosystem Services*

1. Assess how future climate warming is likely to affect <b>infrastructure and transportation</b> networks.	2. Determine how changes to disturbance regimes, flora and fauna, permafrost conditions, and/or hydrology influence <b>human health outcomes</b> in the ABR.	3. Evaluate how changes to ecosystems will influence <b>subsistence</b> opportunities.	4. Analyze how changes to natural and cultural resources will impact local communities as well as influence <b>land management</b> policies and practices.	5. Determine the sources of variations in climate feedbacks from Arctic and boreal ecosystems and assess the potential for future changes to <b>climate regulating</b> services at regional to global scales.	6. Determine the degree to which changing environment and altered human activities result in synergistic or antagonistic <b>changes in ecosystem services</b> .
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## Current Science Team Project Summary

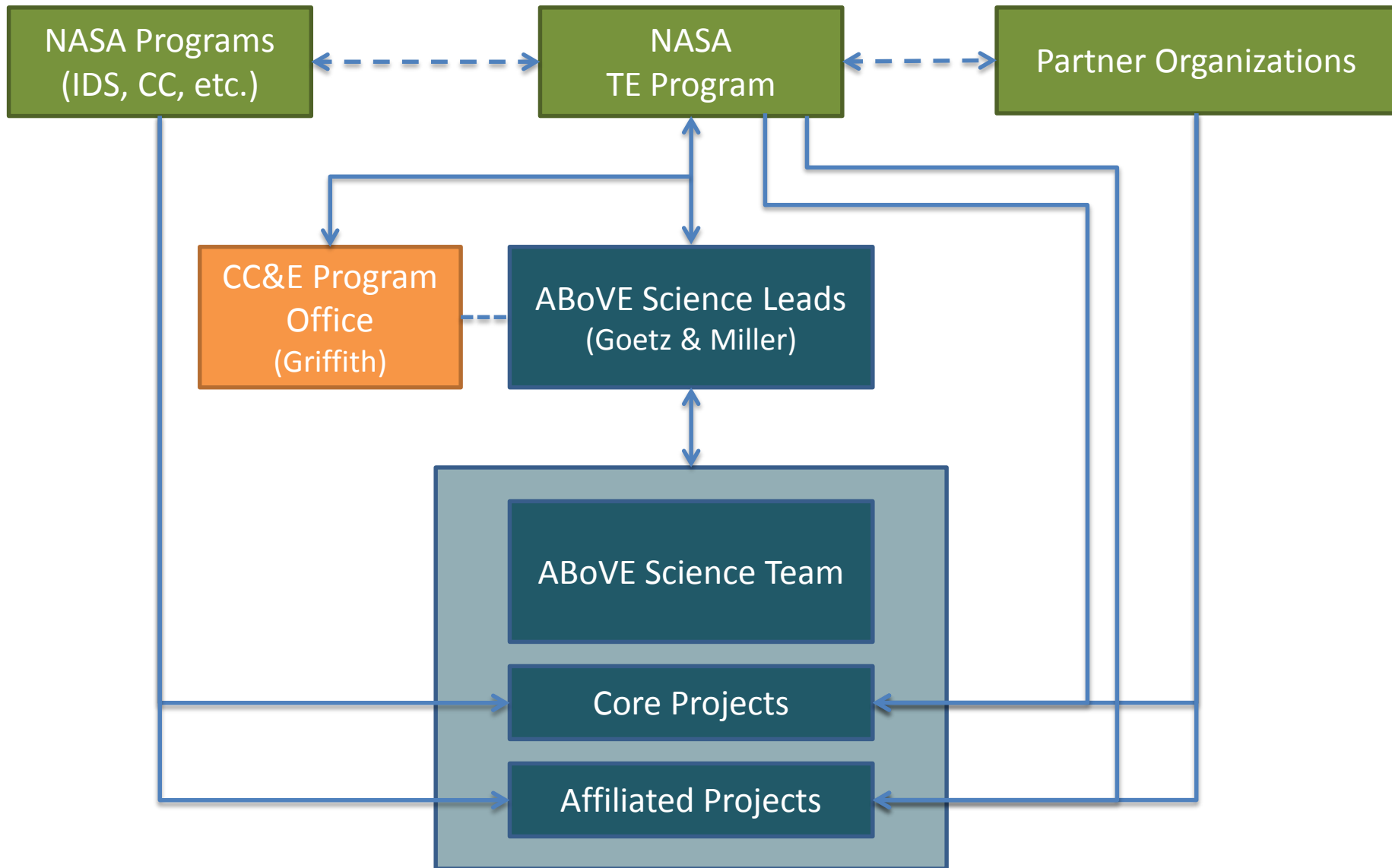
- 21 Projects from 2014 competition
  - 7 Pre-ABOVE, NASA-funded Projects (data products)
  - 7 related NASA-funded Projects from Study Domain
  - 2 NASA Earth System Science Fellowships
  - 1 CHARS-funded Project
- = 38 Total (as of Oct 2015)

## Current Science Team Membership

	Investigators	Organizations
Principal Investigators	34	21
Funded Investigators	100	58
Collaborators	131	55
Total	231	103

## Organizations Currently Represented on the Science Team

	U.S.	Canada	Europe	Japan	Total
University	43	10	3		56
National Agencies/Labs	17	6	4	1	27
State/Provincial/Territorial	2	8			10
Private	4	2			7
Native/Aboriginal Organizations	2	1			3
Total	68	27	7	1	103





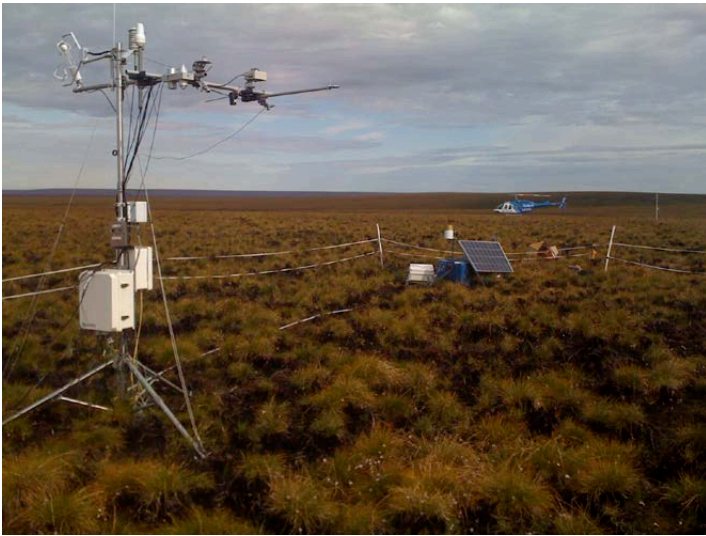
## Science themes / Disciplinary Working Groups (WGs)

- Fauna
- Flora
  - veg dynamics & distribution
  - Veg structure & function
- Disturbance
  - Fire & insects
- Carbon dynamics / BGC
- Hydrology
- Permafrost
- Modeling framework
- Ecosystem Services
- Data
- Other *ad hoc* WGs will form as needed

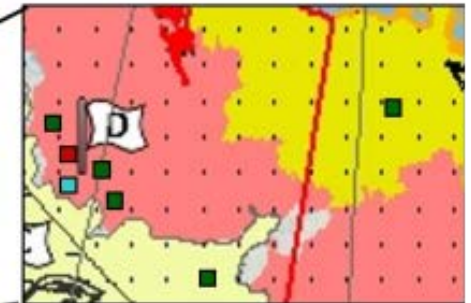
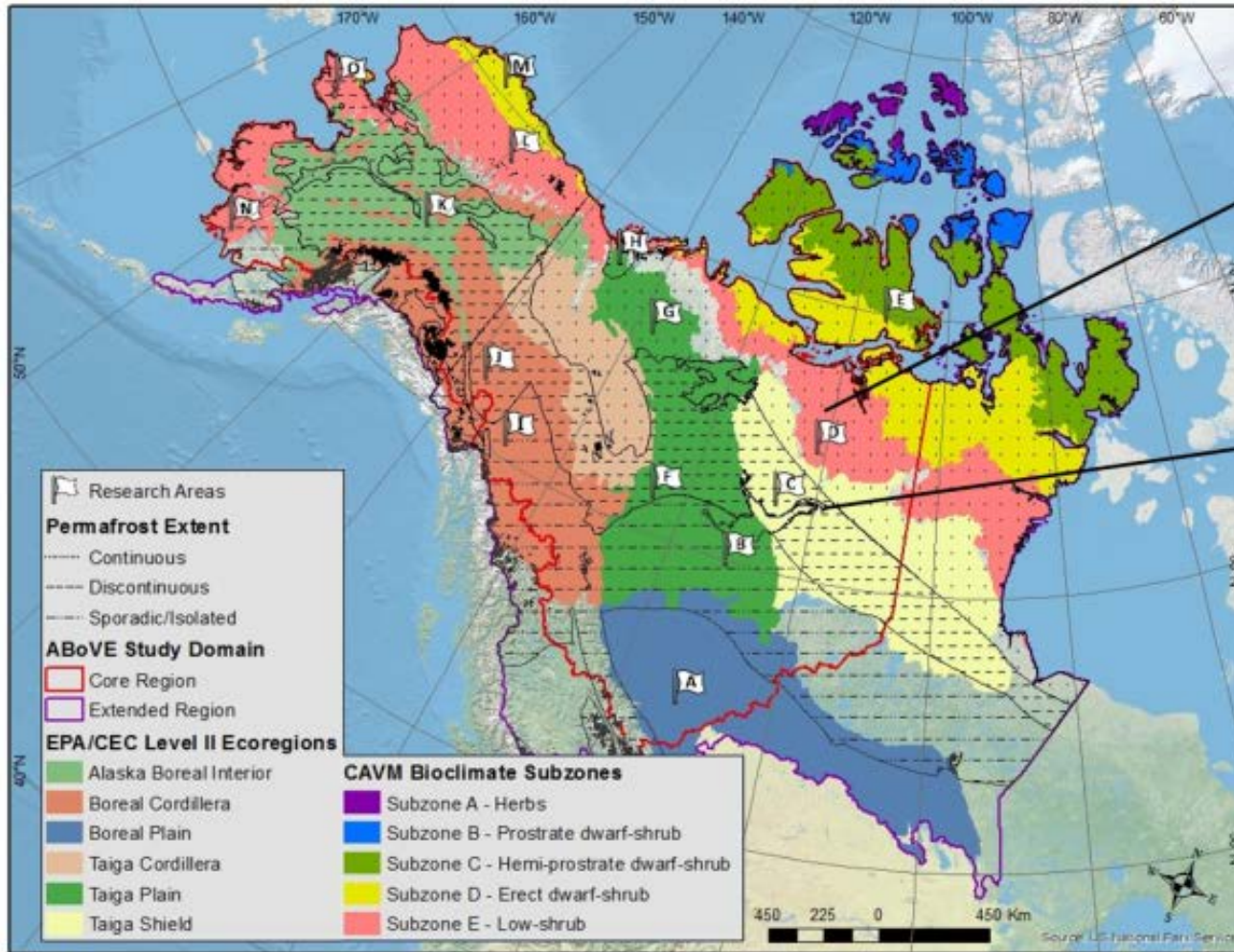


But really it's about facilitating cross disciplinary efforts

- Fauna - vegetation interactions
- Fire - veg recovery / interactions
- Permafrost-fire-BGC interactions
- Hydrology-permafrost interactions



## Spatial domain & Core Site locations



- Investigator Site
- Core Variable Site
- Remote Sensing Site

## Expected phases & timing (2015-2025)

	Phase I			Phase II			Phase III		
	Focus on Ecosystem Dynamics Objectives			Focus on Ecosystem Services Objectives			Focus on Analysis and Synthesis		
	Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7	Yr8	Yr9
<b>Intensive Study Period</b>	■	■	■	■	■	■	■		
<b>Research Activity Focus (4.2)</b>									
<i>Field-based research (4.2.1)</i>									
Collection of field observations	■	■	■	■	■	■	■	■	■
Synthesis, integration and scaling of field-based research			■	■	■	■	■	■	■
<i>Societal Drivers, Consequences &amp; Responses Research (4.2.2)</i>									
Societal drivers, consequences and responses to change		■	■	■	■	■	■	■	■
Decision support information product development						■	■	■	■
<i>Remote Sensing Research (4.2.3)</i>									
Airborne data collection		■	■	■	■	■			
Data product development - Ecosystem Dynamics	■	■	■	■	■	■			
<b>Data product development - Ecosystem Services</b>			■	■	■	■	■	■	■
<i>Modeling Research (4.2.4)</i>									
Initial benchmarking with existing data	■	■	■						
Refinement & assessment with ABoVE data			■	■	■	■	■	■	■
Integrated modeling - diagnosis and prediction						■	■	■	■
<i>Integration &amp; Scaling Research (4.2.5)</i>									
Integration of existing data and identification of gaps	■	■	■	■					
Spatial-temporal integration across individual studies			■	■	■	■	■	■	■
Cross-activity, cross-disciplinary synthesis						■	■	■	■

# Key Partners: Canadian High Arctic Research Station (CHARS)



Inset box is CHARS Experimental and Reference Area



## Key Partners: Next-Generation Ecosystem Experiment (NGEE Arctic)

Oak Ridge National Laboratory  
Brookhaven National Laboratory  
Los Alamos National Laboratory  
Lawrence Berkeley National Laboratory  
University of Alaska Fairbanks

- Objective is better representation of permafrost in ESMs
- Field sites in Barrow AK & on the Seward Peninsula
- ABoVE will facilitate remote sensing, scaling & integration



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# Recent WHRC publications relevant to this group

Berner, L. T., Alexander, H. D., Loranty, M. M., Ganzlin, P., Mack, M. C., Davydov, S. P., & Goetz, S. J. (2015) *Biomass allometry for alder, dwarf birch, and willow in boreal forest and tundra ecosystems of far northeastern Siberia and north-central Alaska*. **Forest Ecology and Management**, 337, 110–118.

Guay, K. C., Beck, P. S. A., Berner, L. T., Goetz, S. J., Baccini, A., & Buermann, W. *Vegetation productivity patterns at high northern latitudes: a multi-sensor satellite data assessment*. **Global Change Biology**, 20(10): 3147-3158