

# Mark Chopping



## Changes in Shrub Abundance in Arctic Tundra and Impacts on Albedo

Project code: Chopping-03

Collaborators: Zhuosen Wang, Ken Tape,  
Crystal Schaaf, Rocio Duchesne



[above.nasa.gov](http://above.nasa.gov) @NASA\_ABoVE



# Institutional Collaborations

- Montclair State University (Chopping)
- NASA Goddard Space Flight Center (Wang)
- University of Alaska-Fairbanks (Tape)
- University of Massachusetts-Boston (Schaaf)
- University of Wisconsin-Whitewater (Duchesne)
- NASA NCCS, PGC, ASC





# And... but... therefore

Climate change in the Arctic is unfolding rapidly  
AND in tundra this is driving changes in shrub  
cover and biomass and thus in albedo...

BUT we need to assess the rates and directions of  
change and magnitudes of the impacts on  
summer albedo...

THEREFORE we will provide 10- to 15-year  
assessments for ~200 sites in Alaskan & Canadian  
Arctic tundra, using high resolution imagery and  
the moderate resolution albedo record.



# Science Questions & Objectives

- Tier 2 Science Questions:
  - How are flora and fauna responding to changes in biotic and abiotic conditions, and what are the impacts on ecosystem structure and function?
  - How are the magnitudes, fates, and land/atmosphere exchanges of carbon pools responding to environmental change, and what are the biogeochemical mechanisms driving these changes?

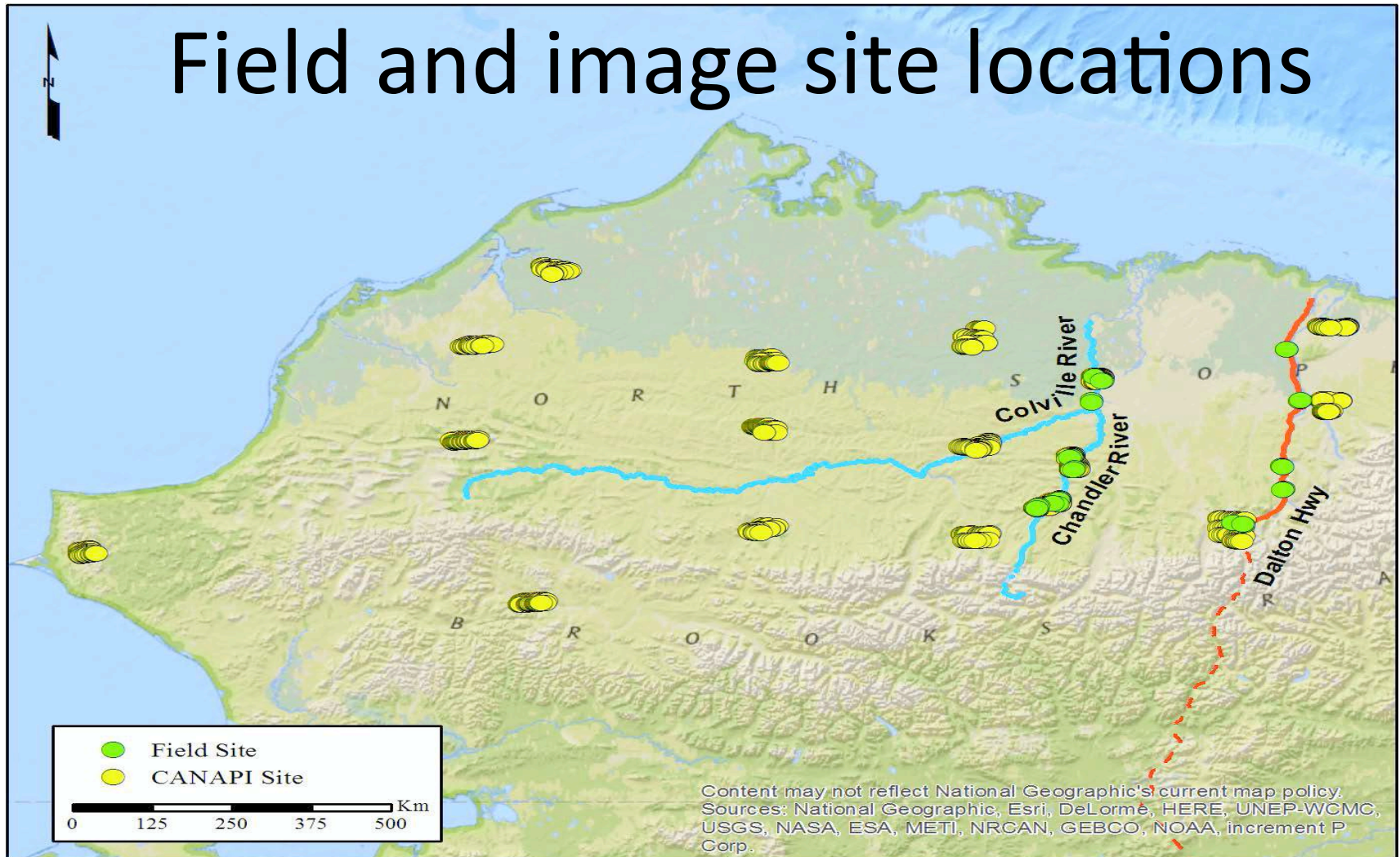
# Science Questions & Objectives

Tier 2 Science Objectives:

Flora/Fauna & Ecosystem Dynamics: we will use high resolution mapping over 10- to 15-year periods to quantify the response of vegetation – and tall shrubs in particular – to the changing Arctic tundra environment, for a variety sites in N. Alaska and N. Canada within the ABoVE Study Domain, with a focus on the impact on tundra albedo in the summer (when albedo matters).



# Field and image site locations



Field surveys were completed in 2010/2011.  
CANAPI/high resolution imagery: 1,039 sites.



# Field Studies

- Extensive field surveys were effected in 2010/2011
- Data: shrub location, type, size, height.
- We will leverage the NACP Woody Vegetation Characteristics database (1,039 sites) as reference; these CANAPI-based estimates were calibrated against field inventory data.
- No additional ground measurements will be acquired by this project BUT
- Potential for synergistic collaborations



[About Us](#)[Products](#)[Data](#)[Tools](#)[Help](#)[Complete Data Set List](#)[Search for Data](#)[Field Campaigns](#)[Validation](#)[Regional/Global](#)[Model Archive](#)[Home](#) [Sign in](#)

Data ▾

[DAAC Home](#) > [Data](#) > [Field Campaigns](#) > [NACP \(North America\)](#) > [Data Files](#)

# NACP Woody Vegetation Characteristics of 1,039 Sites across the North Slope, Alaska

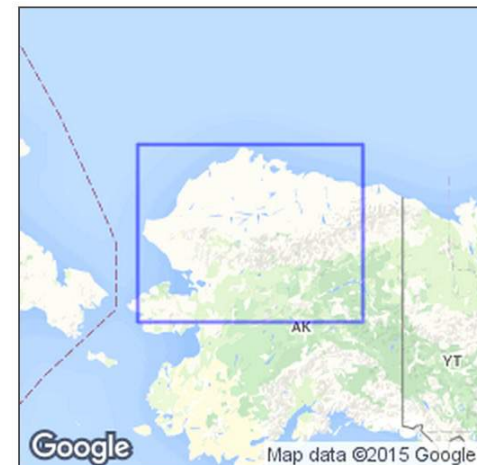
## Download Data

## Data Set Overview

Data set	NACP Woody Vegetation Characteristics of 1,039 Sites across the North Slope, Alaska
DOI	10.3334/ORNLDAAC/1270
Release date	2015-02-10
Project	<a href="#">North American Carbon Program (NACP)</a>

## Description

This data set provides the results of (1) field measurements of woody vegetation (shrubs) at 26 diverse sites across the North Slope of Alaska during 2010 and 2011, (2) field-based statistical estimates of site shrub structural characteristics, (3) high-resolution panchromatic satellite imagery-based estimates of the field site shrub characteristics using the Canopy Analysis with Panchromatic Imagery (CANAPI) model, and (4) adjusted CANAPI estimates of shrub characteristics at 1,013 selected sites widely distributed across the North Slope. A site characterization file is included with the assigned "Physiognomic vegetation class", which was one of the criteria for the selection of the 1013 CANAPI sites, and with the sources of the high resolution imagery used to obtain CANAPI estimates. The CANAPI crown detection algorithm (Chopping, 2011) is also provided as a companion file. As part of a NASA-funded research project to map changes in tall shrub (taller than 0.5 m) abundance in Arctic tundra, a 3-week field campaign was carried out in 2010



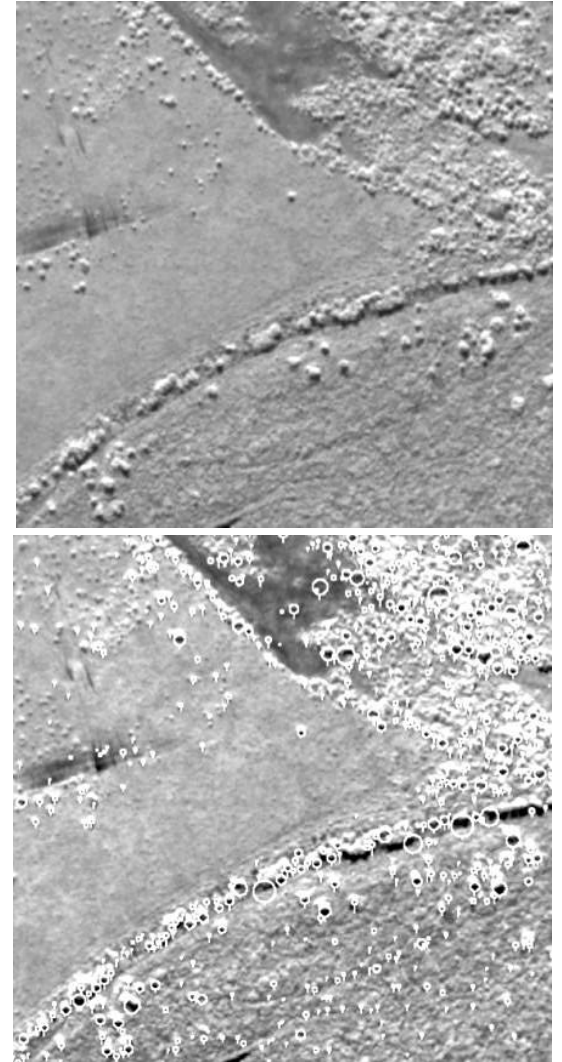
**Data set bounding box.**

Lat: 71.40N to 65.00N, Long: 167.00W to 145.00W



# Spaceborne Remote Sensing

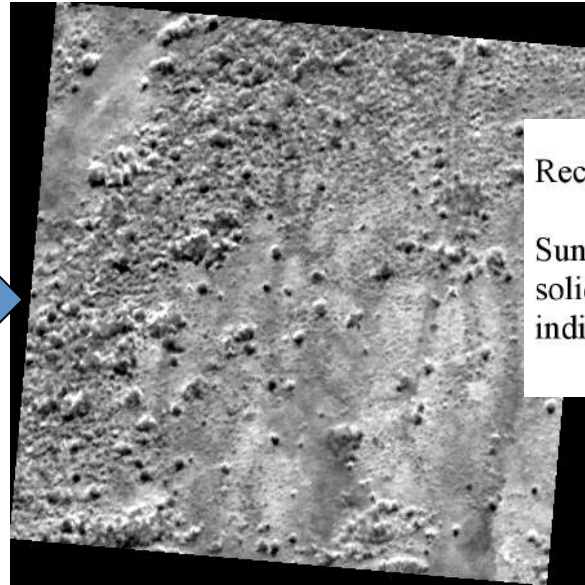
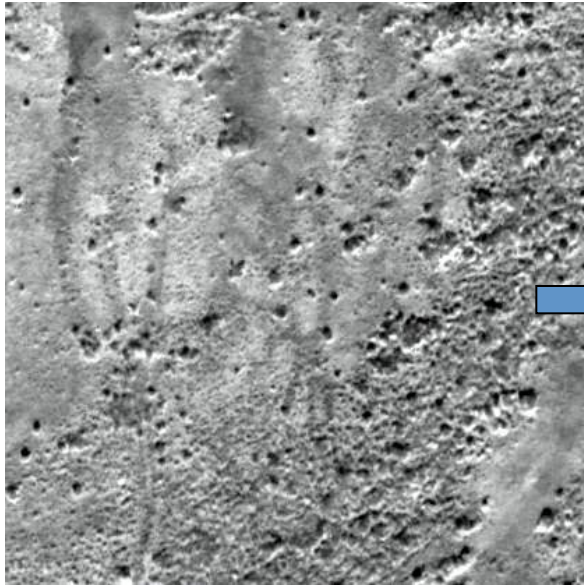
- NGA imagery: QuickBird, GeoEye, and WorldView are core data, starting with available QuickBird imagery for the 2002-2003 through 2013-2017. The imagery will be interpreted using an updated version of the CANAPI algorithm.
- Surface albedo estimates will be obtained from the MODIS, MISR & VIIRS records using the MODIS BRDF/Albedo Product MCD43 method. Screening will also use the MODIS NDVI/Fire products.



*NGA Nextview 2010 @DigitalGlobe*

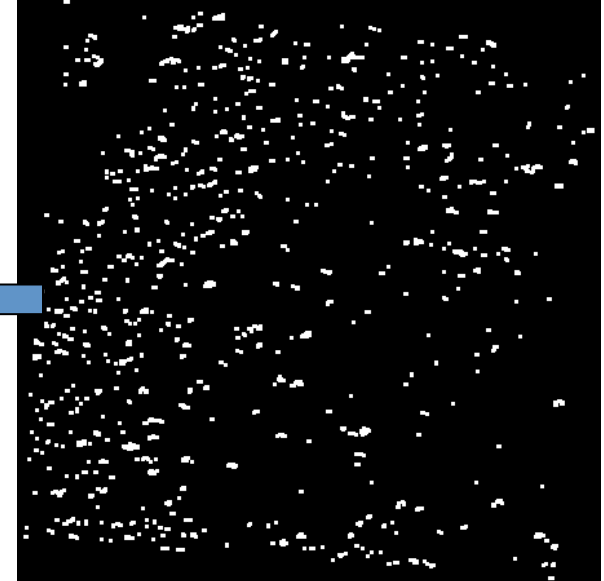
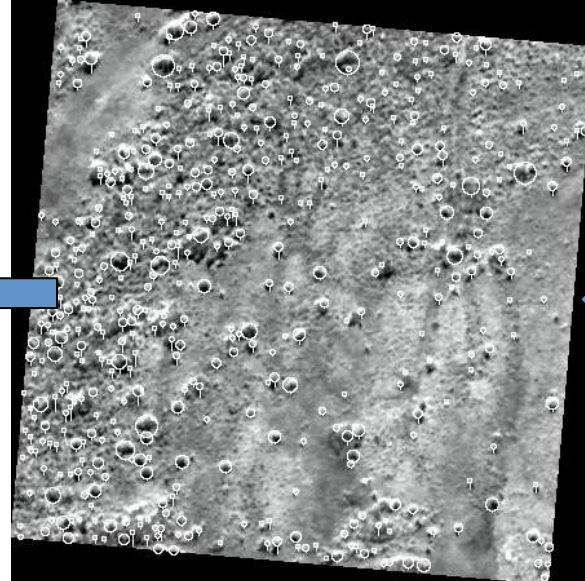
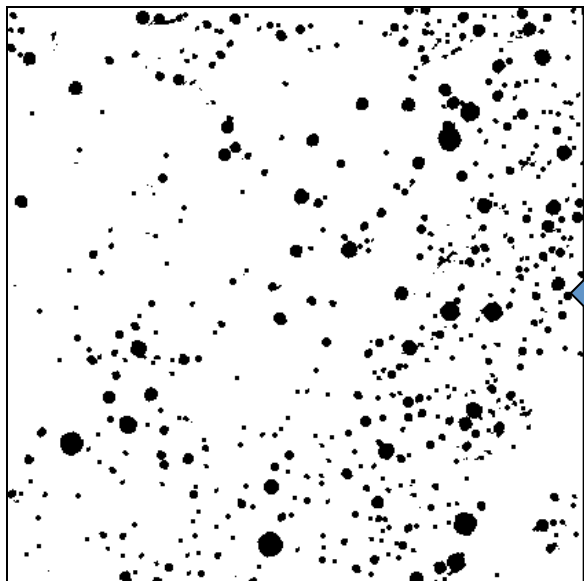
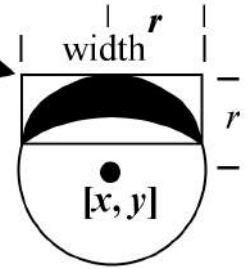


# CANAPI method



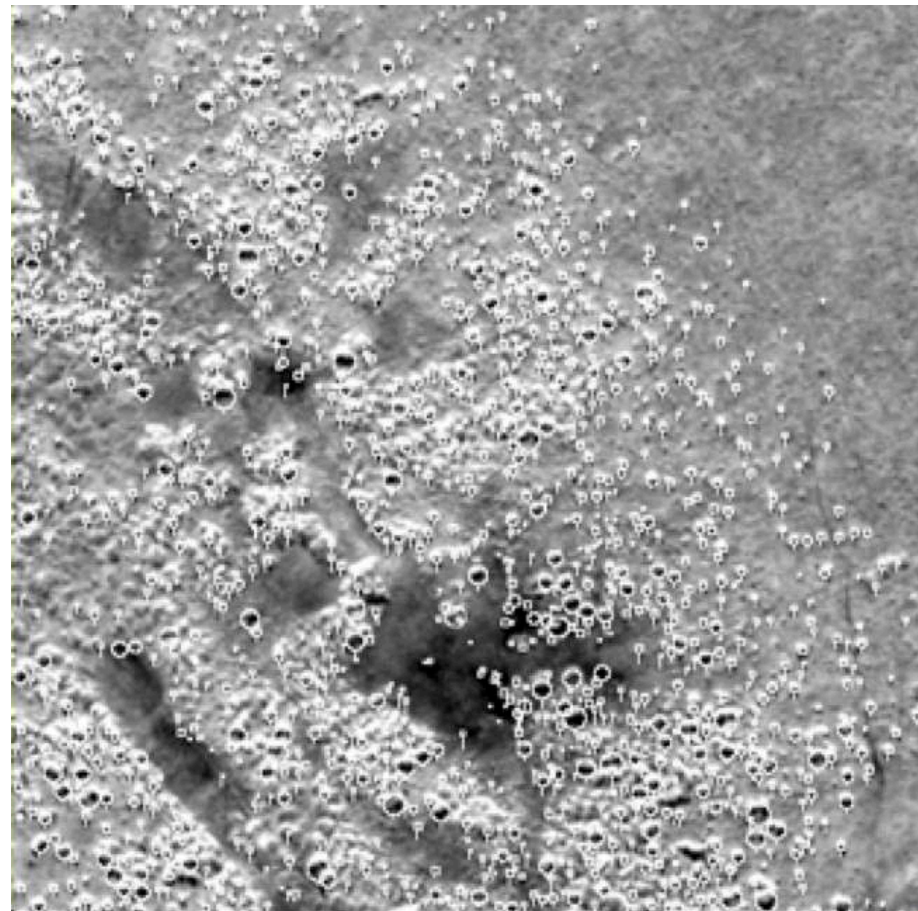
Rectangle upper-left  $x$  and  $y$

Sunlit crown is indicated in solid black; crown centre is indicated by the dot.





# Examples of mapping with Canopy Analysis with Panchromatic Imagery (CANAPI)



*NGA Nextview 2010 @DigitalGlobe*



# Airborne Remote Sensing

There are no plans to acquire new imagery from airborne platforms; a limited set of photographs were acquired in an earlier project.

# Geospatial Data Products

- Shrub cover and aboveground biomass estimates for ~200 sites of 1km x 1 km, with high resolution maps (vector/raster); per site albedo trajectories
- Geographic coverage: Alaskan & Canadian erect dwarf-shrub and low-shrub Arctic tundra zones.
- Data format and projection: GeoTIFF (Alaska Albers Conic projection/WGS84); tabular data.
- Temporal range: 2002 – 2017 (and later?)
- Users: All ABoVE researchers; medium/moderate remote sensing product validation needs; others?



# Other expected products / outcomes

- We hope to shed light on how changes in shrub abundance affect albedo in the summer time. Changes in summer albedo of Arctic tundra in the coming decades are potentially very important for boundary layer energy exchange and regional climate.
- Challenges:
  - No field data was acquired for Canadian sites
  - We do not yet know where our sites will be (cloud)
  - Coordination with other ABoVE projects

# Other expected products / outcomes

- The outputs from this research will also provide information that is relevant to other important aspects of Arctic tundra that are affected by changes in shrub abundance ,e.g., an increased probability of more extensive and severe wildfires, changes in hydrology, permafrost, and the snowpack; and changes to wildlife distributions.
- Synergies: airborne imaging; NISAR?



# Thank You!