Digital Elevation Model Working Group

WG participants list

Neigh, Christopher (Chris) -- NASA GSFC (Chair)

Carroll, Mark -- NASA GSFC / SSAI

Goetz, Scott -- Northern Arizona University

Goulden, Tristan -- NEON

Griffith, Peter -- NASA GSFC / SSAI

Hoy, Elizabeth (Liz) -- NASA GSFC / Global Science and Technology, Inc.

Kumar, Jitendra (Jitu) -- Oak Ridge National Laboratory

Macander, Matthew -- Alaska Biological Research, Inc.--Environmental Research & Services

McLennan, Donald -- Polar Knowledge Canada

Miller, Charles (Chip) -- NASA JPL

Montesano, Paul -- NASA/SSAI

Morin, Paul -- University of Minnesota - Polar Geospatial Center

Whitley, Matthew -- University of Alaska Fairbanks

7/15/2016 Kotuy River Expedition, Krasnoyarsk Russia
2:30 AM 67.83N 99.06W Photo by: Chris Neigh

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Institutional Collaborations

- Federal or state Management agencies
- Alaskan Native groups
- Other stakeholder organizations
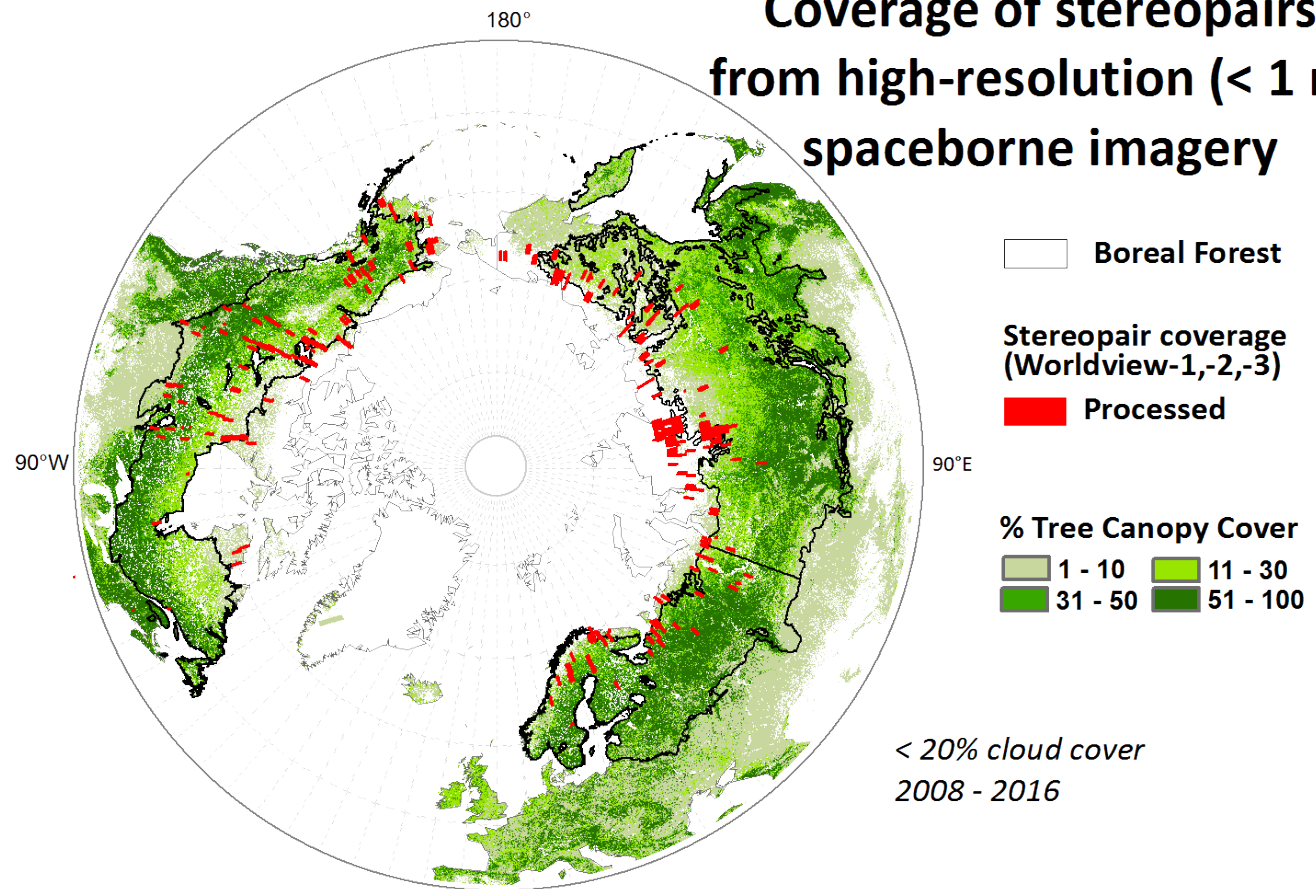
N/A

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Science Objectives

- ABoVE Science Objectives addressed
  - Vegetation, hydrology, disturbance interactions
    - 2 - 8 m posting DTM for hydrology modeling
    - Forest structure information
  - Snow impacts
    - Multi-temporal DSM changes to estimate snow depth
  - Veg Greening and Browning
    - Forest structure within these locations

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~~Field Studies~~ Processed DEMs

Coverage of stereopairs from high-resolution (< 1 m) spaceborne imagery

□ **Boreal Forest**

Stereopair coverage (Worldview-1,-2,-3)
■ **Processed**

% Tree Canopy Cover
1 - 10	11 - 30
31 - 50	51 - 100

< 20% cloud cover 2008 - 2016

- Ames Stereo Pipeline, ecotone study
- (Liz) SETSM to complement Arctic DEM

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ArcticDEM for ABoVE

- Processing ABoVE areas south of 60N using the Arctic DEM protocol.

- Saskatchewan in progress.
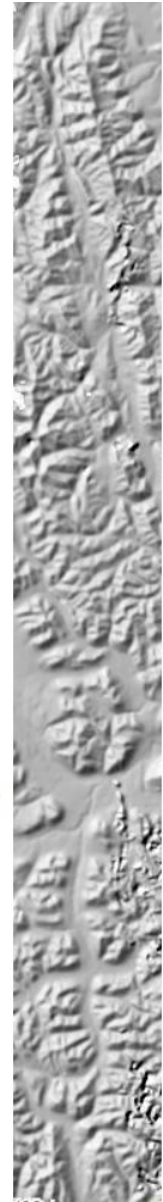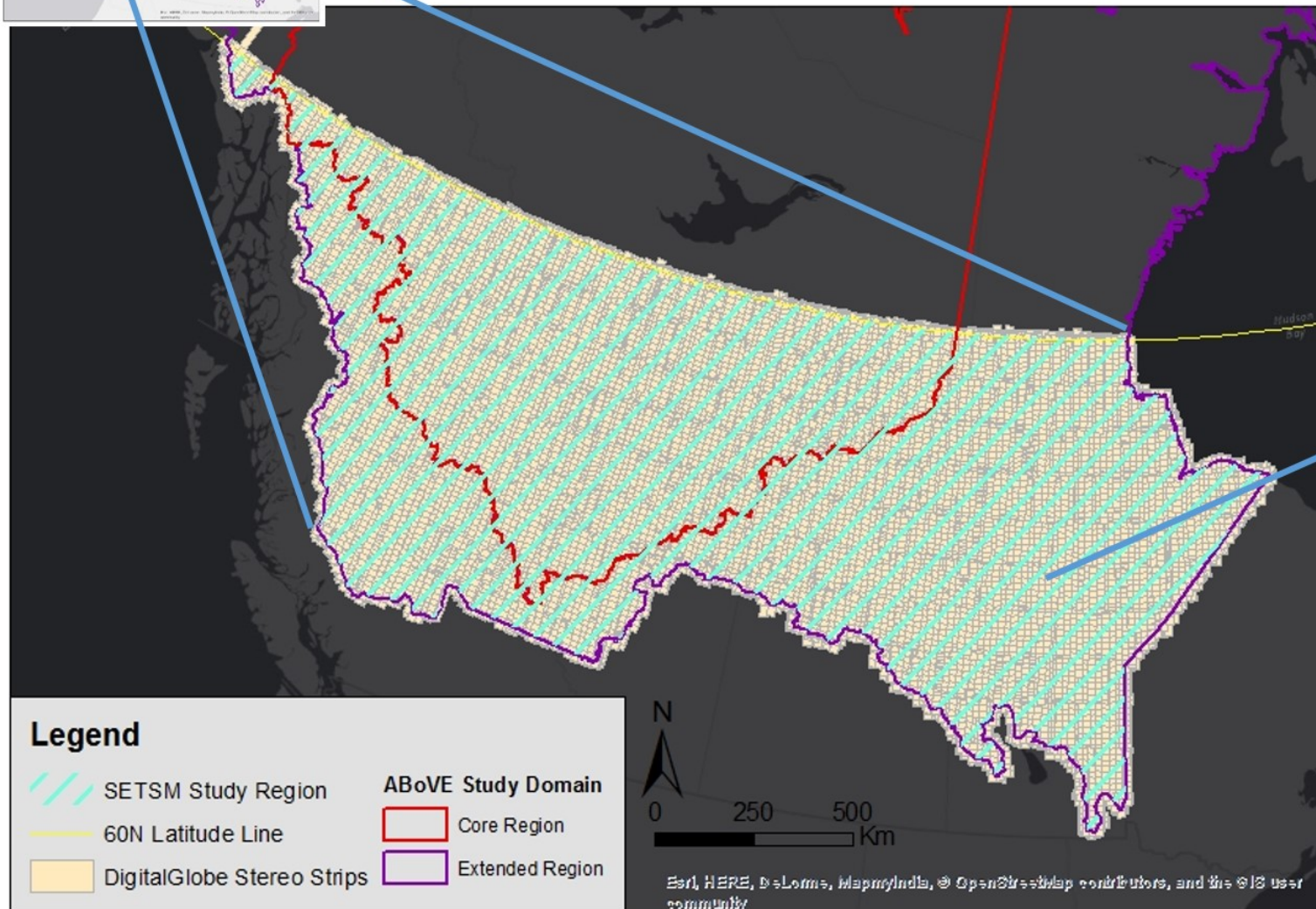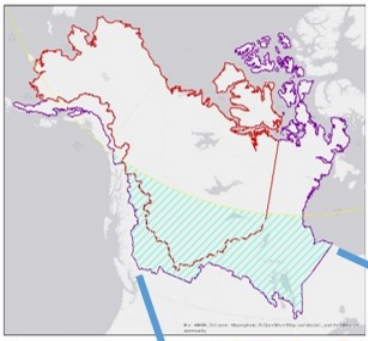
Example DEM Strip
(~17 km X 110 km)

Legend

- SETSM Study Region
- 60N Latitude Line
- DigitalGlobe Stereo Strips

ABoVE Study Domain
- Core Region
- Extended Region

0   250   500
Km

Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

~~Field Studies~~ slide(s)

- Any specifics of site measurements you'd like to highlight
  - This might be an (updated) table from your implementation plan input

N/A

- What you learned during the 2016 field season
  - Transition from ADAPT to Discover to improve bulk processing of DEMs

- How might this inform / change plans for the 2017 field season
  - Intend to process ~10,000 stereo strip pairs on a sampled basis.

- Identified synergies with other WG projects
  - Multi-DEM products to produce Canopy Height Models in sparse forest canopies.

- Key identified data gaps / needs

N/A

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Progress toward high-res DSM generation for ABoVE

C.S.R. Neigh, K.J. Ranson, P. Montesano SSAI, E. Hoy GST Biospheric Sciences, NASA GSFC Code 618
J. Sexton, S. Channan, M. Feng, J. Townshend UMD, D. Shean U. of Washington and P. Morin U. of Minnesota

Sub-meter stereo data with supercomputing provide earth surface information at unprecedented scales to cal/val NASA EOS products.

Fig. 1 Maps of (A) Landsat 30 m Vegetation Continuous Fields (VCF) - Tree Canopy Cover (TCC) have been calibrated and validated with transects of airborne LiDAR in North America and will soon be calibrated with circumpolar DigitalGlobe (DG) digital surface models (DSMs) providing a baseline estimate of the northern limit of forests; (B) Distribution of TCC height calibration/validation data and (C) Landsat TCC model estimated root mean square error. Note the largest boreal TCC uncertainty is at the ecotone (Montesano et al. 2016).
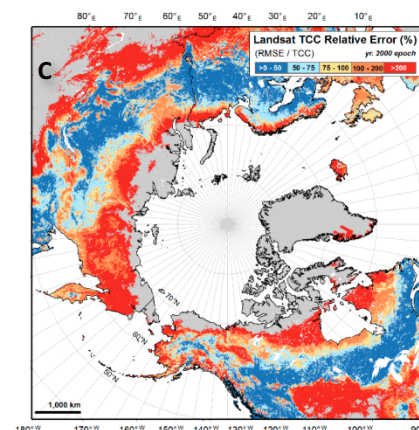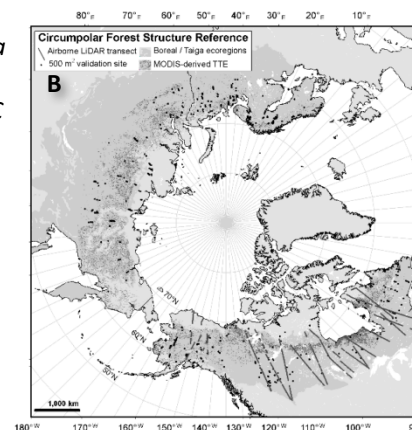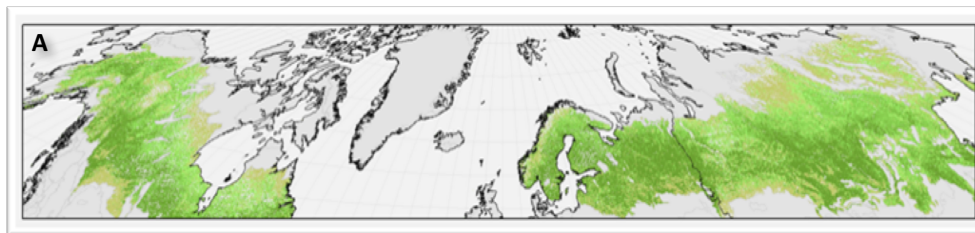

Fig. 2 An example of the hi-res stereo processing workflow with maps of (A) pixel count, (B) median elevation, and (C) standard deviation for a stack of co-registered DG DSMs for Tracy Glacier, Greenland. (D) This example was developed for the NASA AMES Pleiades supercomputer to process thousands of ~17 x 112 km image strips for Greenland and Antarctica (Shean et al. 2016). A similar approach is underway on NASA GSFCs Discover supercomputer for ABoVE.
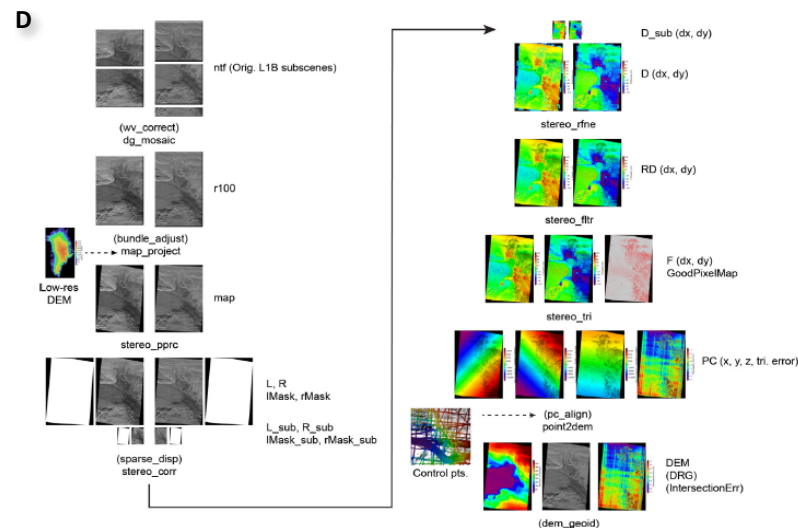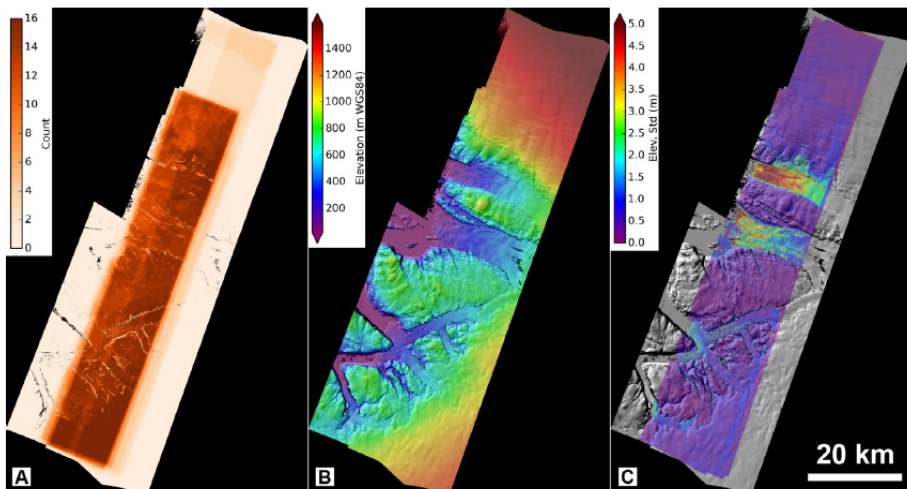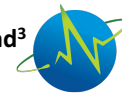
Reduced uncertainty of 30m North American Boreal Forest Cover

Christopher S.R. Neigh[1], Paul M. Montesano[1,2], K. Jon Ranson[1], Joe Sexton[3], Saurabh Channan[3], Min Feng[3] and John Townshend[3]
[1]Biospheric Sciences Lab., NASA GSFC , [2]Science Systems Applications Inc., [3]University of Maryland College Park, Geog.

Science Question: How will climate change impact northern forest productivity and carbon storage?

Findings: Satellite derived data overestimated tree canopy cover by up to15%. Landsat-derived estimates were corrected and validated by long latitudinal transects of portable airborne laser scanner data.

2010 calibrated and validated Landsat 30 m % tree canopy cover (%TCC) for trees taller than 2 m in height.

Impact: The calibrated and validated estimate of tree cover will provide a baseline estimate to inform analyses of forest cover change and vulnerability in response to climate change.

Why It Matters: Climate change is expected to alter the distribution of northern forests and a validated high resolution baseline is required to monitor change. Northern forests are currently experiencing the greatest amount of warming, responding to climate change, natural disturbances from drought, fire, pests and pathogens etc., and human induced disturbances primarily from fire and harvest.

Montesano, P.M.; Neigh, C.S.R.; Sexton, J.; Feng, M.; Channan, S.; Ranson, K.J. & Townshend, J.R. 2016. Calibration and Validation of Landsat Tree Cover in the Taiga–Tundra Ecotone. Remote Sensing, 8, 551.

Earth Sciences Division – Hydrosphere, Biosphere, and Geophysics

GLCF is mapping tree and surface-water cover, as well as forest change, across the ABoVE domain in 2000, 2005, and annually from 2010 to 2015.

Data are available for visualization via terraPulse (http://52.54.49.254:8080/terraView.html)

Download from GLCF (www.landcover.org).
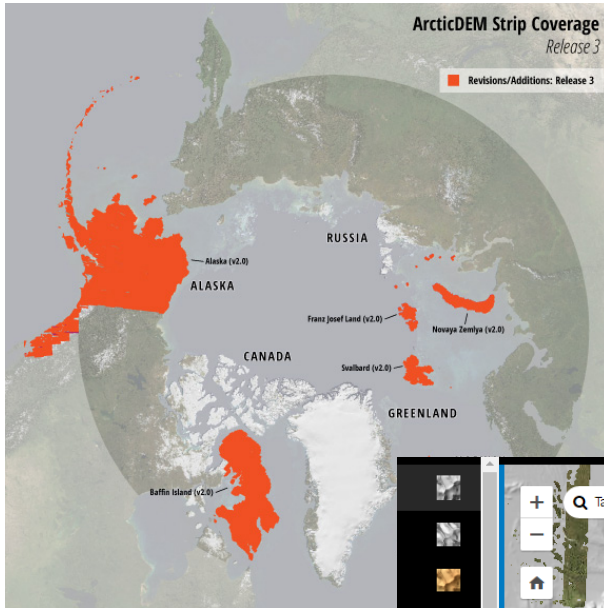
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Airborne Remote Sensing

- Existing or planned airborne remote sensing work you are / will be conducting as part of WG projects
  - What measurements are needed from the 2017 Airborne campaign?
    - A distributed sample of high resolution DEMs from LiDAR for hi-res stereo cal/val
  - What key ground cal/val measurements might be made by ~~your~~ WG field teams to support the airborne data acquistions?
    - Photo identifiable Ground Control Points (GCPs) with differentially corrected GPS in x,y,z domain with sub-meter error.

Spaceborne Remote Sensing

- Summary of remote sensing activities being conducted as part of the WG
  - (Output Data)
    - WorldView 0.5, 2 & 8 m posting, 110 x 17 km
      - DEMs, CHMs, point clouds, Biomass Maps, resampled ortho'ed imagery
    - Landsat
      - Tree Canopy Cover > 2m & 5 m in height
      - Ecotone map < 30% canopy cover for trees > 2m height
      - FCC Forest Age Map (time since disturbance 1972+)
    - Site Index (New CCS Project)
  - (Software) ASP, SETSM, Ecog, ArcGIS, QGIS

http://pgc.umn.edu/arcticdem

ArcticDEM Strip Coverage
Release 3

Revisions/Additions: Release 3

Current Release
The current ArcticDEM release (Release 3) contains version 2.0 of Alaska (United States), Novaya Zemlya (Russia), Franz Josef Land (Russia), Baffin Island (Canada), Svalbard (Norway), and Iceland. Release 3 has added or updated 4,977 strip DEM components at 2 meter resolution to the ArcticDEM inventory and includes 1,442 mosaic tiles at 8 meter resolution.
Release History
Release 1: v1.0: Alaska
Release 2: v1.0: Novaya Zemlya (Russia) and Franz Josef Land (Russia)
Release 3 (current): v2.0: Alaska, Novaya Zemlya (Russia), Franz Josef Land (Russia), Baffin Island (Canada), Svalbard, (Norway), and Iceland
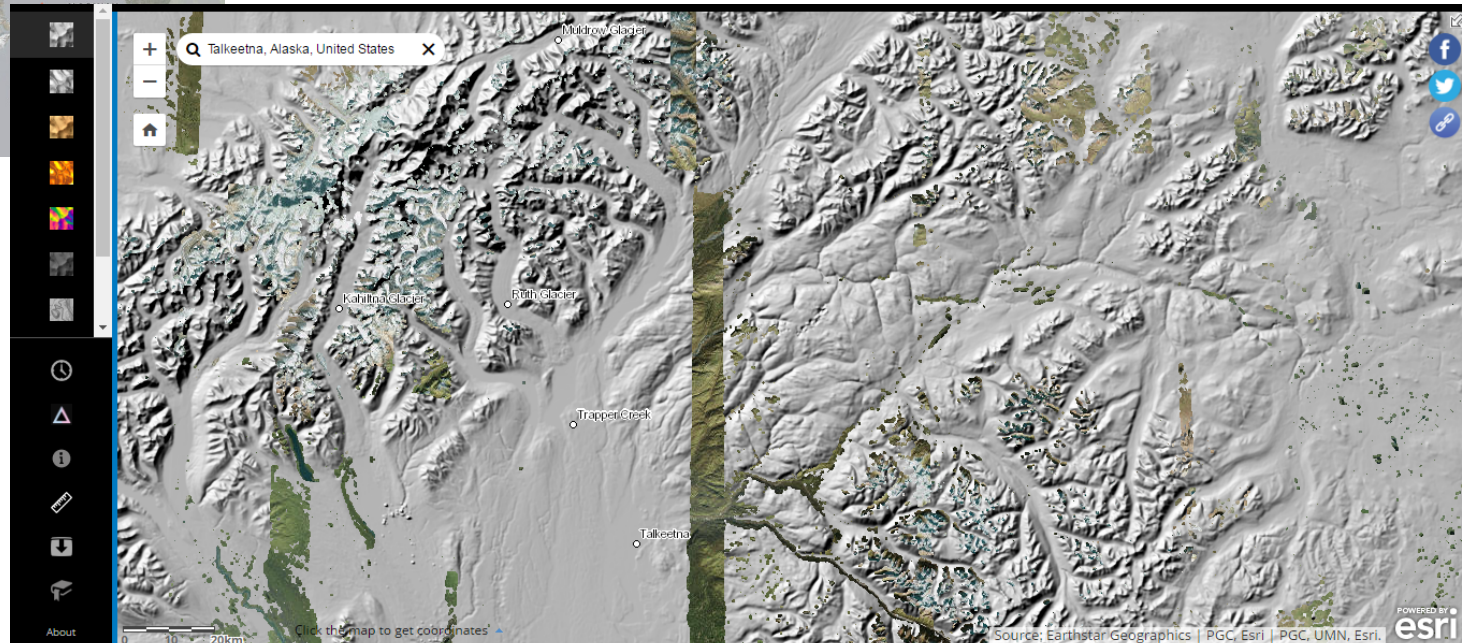
Modeling

- Summary of modeling activities being conducted as part of the WG
  - Types of models & modeling approaches
    - Point to DEM (point cloud to raster)
    - Cubist
    - LPJ DGVM
  - Input / driver data sets
    - WorldView, Landsat, ASTER, SRTM, GLAS, MODIS
  - Expected output data sets / predictions
    - Remote sensing derived benchmarks for LPJ for forest age, growth rates, carbon storage & flux (new project)
  - Any key identified data gaps / needs
    - Small footprint LiDAR for DEM validation

Summary

- Field measurement efforts & expected datasets
- Remote sensing efforts & expected products
  - 2 & 8 m posting DEMs for the entire ABoVE Domain
  - Cal/Val'ed Landsat Tree Canopy Cover for epochs 2005, 2010 & 2015
- Modeling efforts & expected outputs
  - LPJ DGVM benchmarked forest growth, age, & flux (new project)
- Timing & coordination & synergies among WG projects and between WGs
  - Multi stack DEMs for CHMs, Snow depth, hydrology
- Identified data gaps / needs
  - Validation data = airborne small footprint LiDAR, in situ GCPs

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