ARCTIC SDI
Arctic Spatial Data Infrastructure

Pan-Arctic Digital Elevation Map

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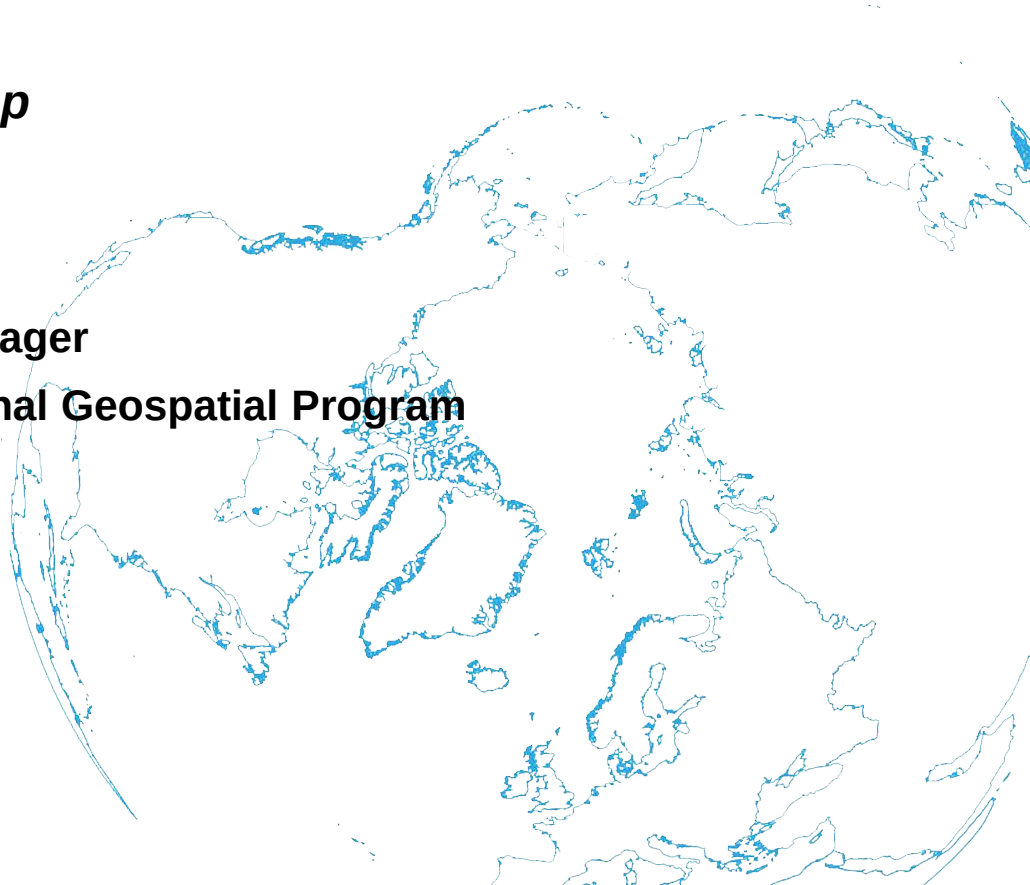
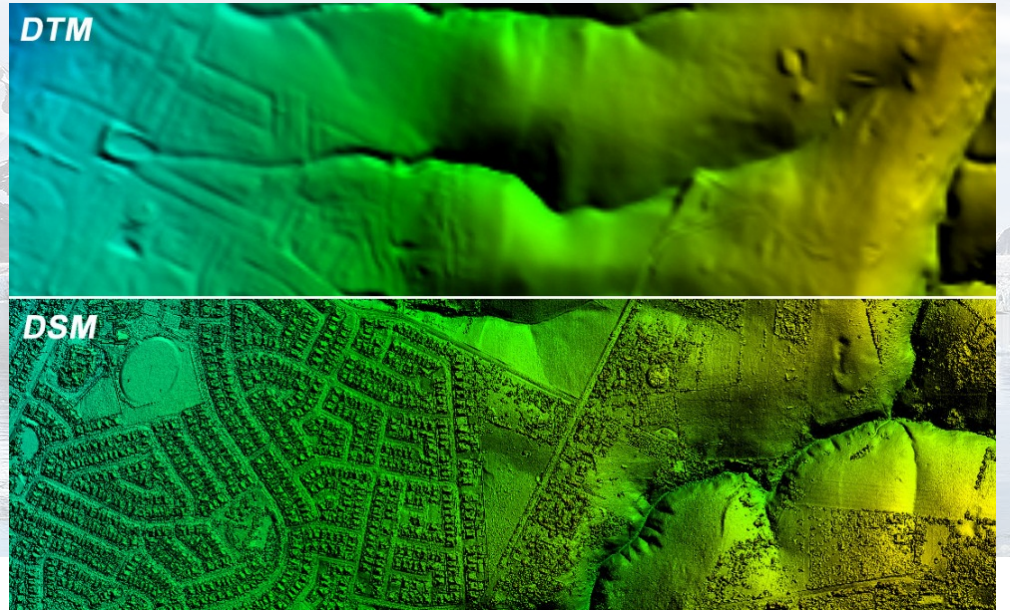
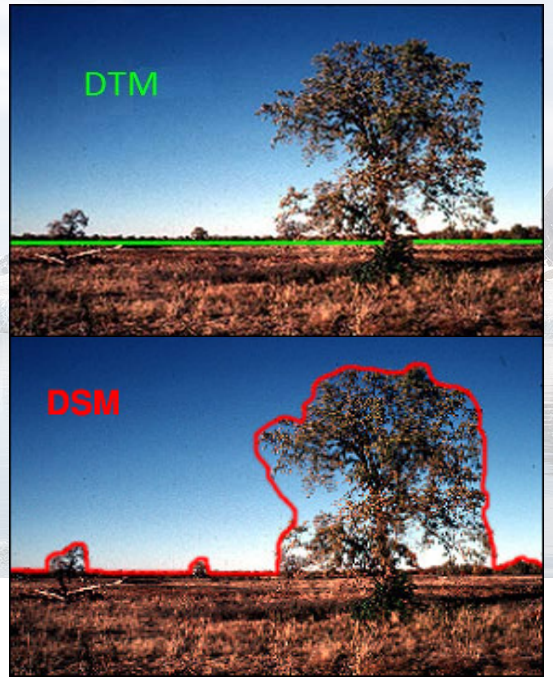


Digital Elevation Model Primer

Digital Surface Model (DSM) and Digital Terrain Model (DTM)

- DSM shows ‘tops of trees and structures’, DTM removes cover to show ‘bare earth’
- Both are important for modeling and mapping applications





Digital Elevation Model Primer

- **Elevation Uses**
  - **Primary layer for many Arctic applications**
  - **Examples: Wildfire modeling, biomass calculation, storm surge and tsunami risk, coastal change monitoring, climate modeling, general map generation**



U.S. Arctic Council Chairmanship Program 2015-2017

Addressing the Impacts of Climate Change

Improving Arctic Climate Science: Arctic Digital Elevation Map

Original Proposal

- Improve access to high resolution Arctic elevation data
- Public available data
- Single point of access
- Arctic Nations, through Arctic SDI, harmonize existing Arctic data into a Pan-Arctic DEM
- Series of workshops and intermediary steps would:
    - research appropriate technical specs, including geographic coverage and resolution
    - plan for implementation
    - harmonize data
    - assess quality
    - coordinate data delivery

Announcements and Activities Since Proposal Acceptance

- Arctic SDI Board approves Arctic nations' mapping representatives to
  - support initial requirements gathering and data inventory efforts
  - support initial workshop scheduled in conjunction with the Second Polar Data Forum (PDF II) scheduled October 26-29, 2015 in Waterloo, Canada
- U.S. President announces the Polar Geospatial Center's Pan-Arctic DEM collaboration project
  - funded by the U.S. National Science Foundation
  - backed by satellite imagery licensed by the U.S. National Geospatial Intelligence Agency (NGA)
  - Imagery licensed, but derivative DSM is Public Doman
- NASA preparing to release a world-wide DSM generated from ASTER satellite imagery
  - October 2015 release
  - 20m resolution (coarser than the proposed 2m-8m resolution PGC data)

Results from Information Gathering Efforts

Data Inventory

- Gathering detailed information on Arctic Nation existing elevation data
- Many (but not all) nations have public domain DTM and DSM data nationwide
- Varying resolutions from 5m to 90m
- Some countries working to complete new acquisitions

Requirements Gathering

- Current Pan-Arctic dataset generally in use is 1km resolution
- Wide range of resolutions requested – 10m, 100m, 200m, 500m
- Requests for Pan-Arctic DEM solution to be well thought out, in consultation with the science community

Polar Geospatial Center Arctic DEM Project Highlights

PGC DEM Basic Characteristics

- 2m-8m point DSM (resolution depends on funding for supercomputer cycles)
- Some ‘artifacts’ with fully automated process - can be visually distractive to professional cartographers – correctable with new imagery and editing

Polar Geospatial Center Arctic DEM Project Highlights

Fully Automated System

- No human intervention by PGC to cartographically enhance the data (seeking assistance)
- Unprecedented capacity for REPEAT coverage – image request/image delivery/DEM processing all automated, satellite overflight every 2 days (although competition for imagery and clouds can reduce acquisition opportunities)

Cost: Estimated $3M-$5M U.S., full funding anticipated by U.S. NSF

Timeline

- Working Greenland and Iceland now; Alaska by spring 2016; full Pan-Arctic by spring 2017

Data Delivery Options

- U.S. NGA, ESRI, Inc., Google, and Open Geospatial Consortium are in talks, and some representatives from these organizations plan on attending upcoming Waterloo workshop

Arctic Nation, Permanent Participation and Observer Collaboration Opportunities

- Review satellite image stereo pair browse images to find improved imagery scenes
- Provide high resolution coastline data to improve masking of coastal imagery
- Provide Ground Control Points and lidar where available to PGC to improve the process
- Provide data assessment and editing capability

Workshops Critical to Review Options and Plan Implementation

1st Workshop October 26-27 in Waterloo Canada; 2nd Workshop proposed spring 2016 (at PGC?)

Requirements Analysis

- Review initial requirements feedback; finalize questions for upcoming international survey
- Great opportunity to network with and gather requirements from PDF II participants

Data Inventory

- Review and finalize inventory of existing Arctic DEM data
- Consider viability and specifications for a near-term data harmonization project

In-depth Review of Polar Geospatial Center Project Methodology and Deliverable

- PGC will prepare samples of data over Arctic nations' suggested AOIs
- Participants will review samples, consider collaboration opportunities with PGC

Data Delivery

- Review options for serving data (internet download, web coverage service)

Pan-Arctic DEM Hackathon

- Participating technical practitioners will test data harmonization and delivery options

2 Possible Scenarios to Consider for Pan-Arctic DEM

Support very near term development of a harmonized Pan-Arctic dataset

- Harmonize existing best-available Arctic nation data
- Support resolution(s) (100m, 500m) required by global climate science modeling community
- Arctic SDI consider appropriate delivery mechanism
- Replace current 1-km data used by many modelers with improved resolution and data vintage
- Cost quote to standardize to single resolution product is $90,000 U.S. (or in-kind labor)

Support 18-month PGC effort to generate 2m-8m Pan-Arctic DEM coverage

- Consider opportunities to support PGC: assess imagery to fill gaps, assess delivered data, provide improved coastline data
- U.S. Alaska example: U.S. NGA to perform hands-on cartographic enhancements to directly improve the data

U.S. Alaska Example of 2-Path DEM Approach

U.S. 5m radar DEM project for Alaska

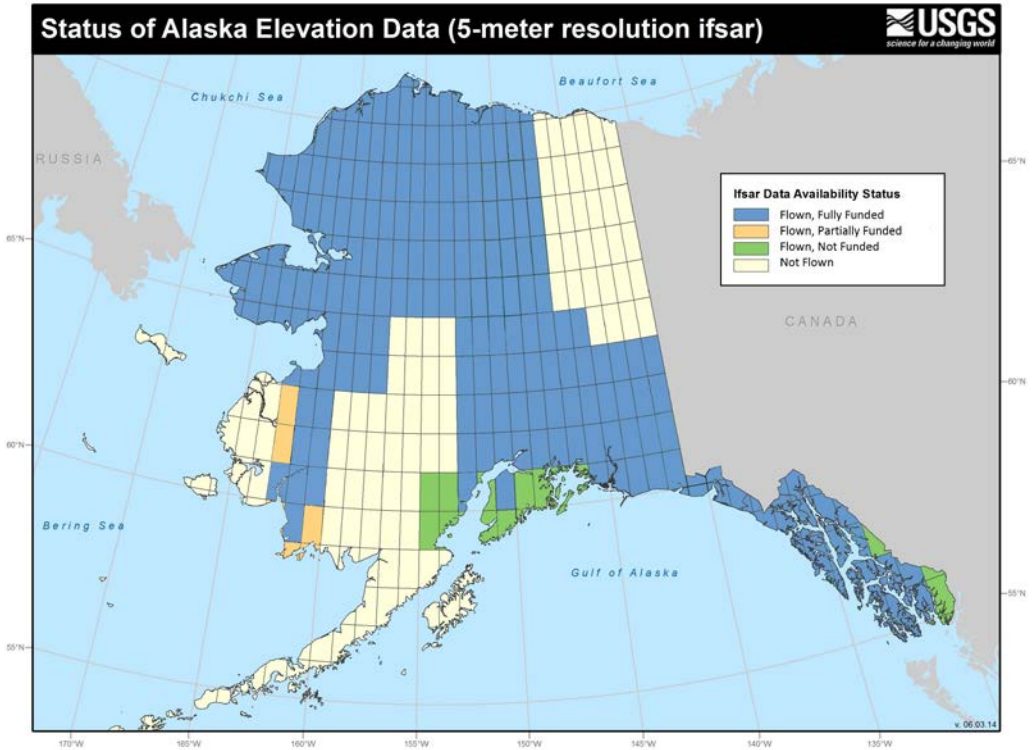
- U.S. Geological Survey, State of Alaska, and other federal agencies funding
- Anticipate 3-4 years to complete radar collection of both DSM and DTM 5m elevation products for all of Alaska except for the Aleutians
- Total project cost of $60M US, with $23M remaining, $7.5M avg. annual
- Critical for accurate ‘bare-earth’ topographic and cartographic applications – Baseline DEM

U.S. NGA to support PGC effort by improving auto-generated data

- PGC data fills gaps until radar data collection is complete over main body of Alaska
- PGC DEMs provide strong option for areas that are difficult to access, i.e. Aleutians
- PGC provides rapid and costly repeat coverage where needed
- NGA to filter data, find an fill gaps, flatten water, hydro-enforce with breaklines, and where available use additional ground control points and lidar data to improve accuracy

U.S. Alaska Example of 2-Path DEM Approach

- **60% airborne radar elevation acquisition complete**
- **Use PGC data for Aleutians**
- **USGS will assess PGC data over Alaska when delivered**
- **Plan to complete remaining mainland Alaska with 5m ifsar data**



Potential Roles for CAFF and Arctic SDI to Consider

CAFF

- Provide contacts to improve requirements gathering effort
- Consider sponsoring workshops
- Consider providing CAFF server space for data storage, depending on Arctic SDI suggestions and outcomes from the Waterloo workshop

Arctic SDI

- Sponsor workshops and provide science contacts
- Support completion of requirements gathering and data inventory efforts
- Attend workshops and providing data and technical expertise
- Provide storage and data delivery for a potential near-term harmonized data product
- Support PGC effort so final product in 18 months is improved beyond the fully automated version