

[illegible]

Polar Geospatial Center
University of Minnesota



Scott!



Palmer Station

Amundsen - Scott
South Pole Station

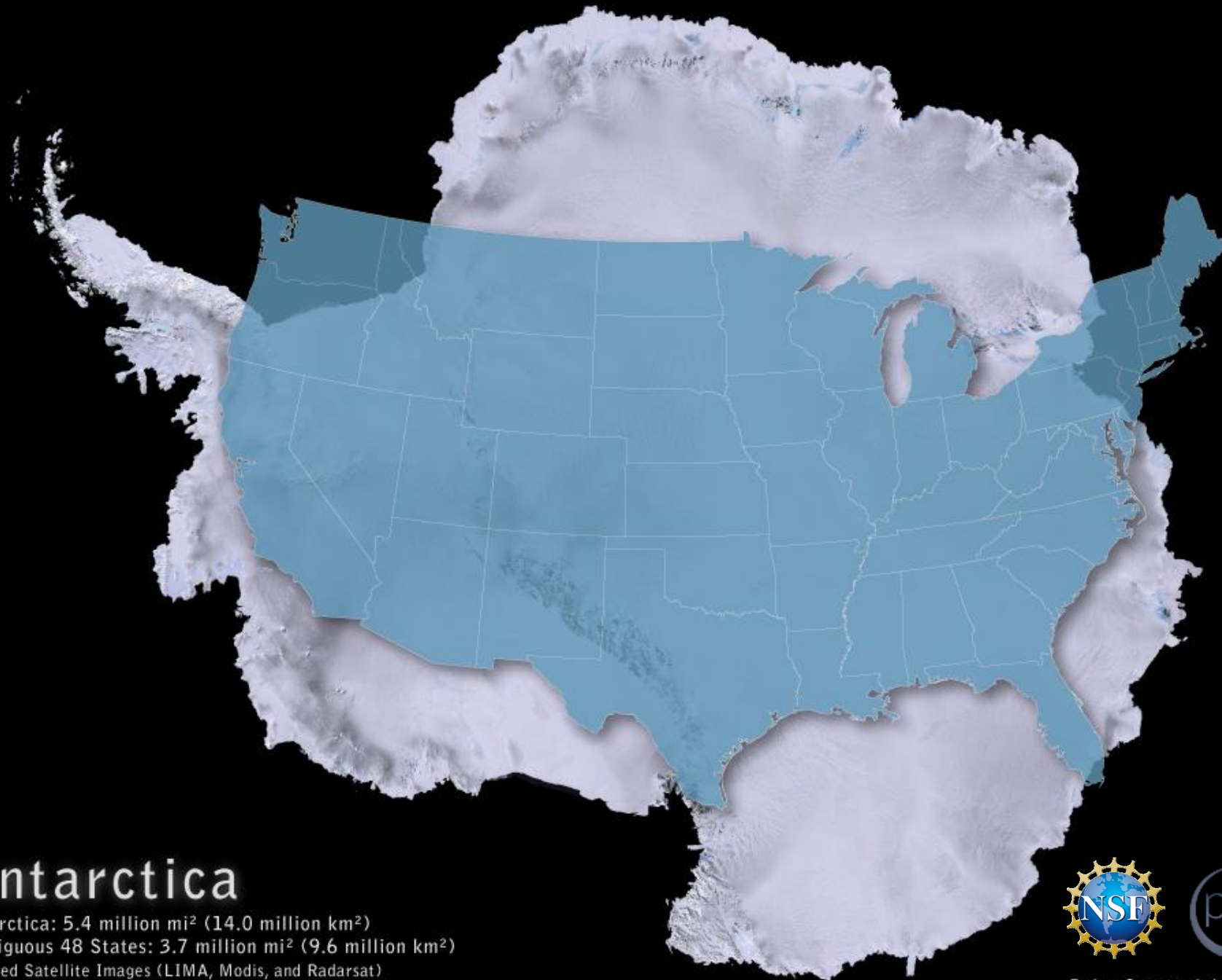
McMurdo Station

500 Miles

Antarctica
Permanent US Stations



Polar Geospatial Center



Antarctica

Antarctica: 5.4 million mi² (14.0 million km²)
Contiguous 48 States: 3.7 million mi² (9.6 million km²)
Blended Satellite Images (LIMA, Modis, and Radarsat)



Polar Geospatial Center





PGC HELPS YOU SEE THE GROUND

SUMMIT CAMP, GREENLAND



source: Polar Geospatial Center, imagery © 2018 DigitalGlobe, Inc.

BLOOD FALLS, TAYLOR VALLEY, ANTARCTICA



source: Polar Geospatial Center, imagery © 2018 DigitalGlobe, Inc.

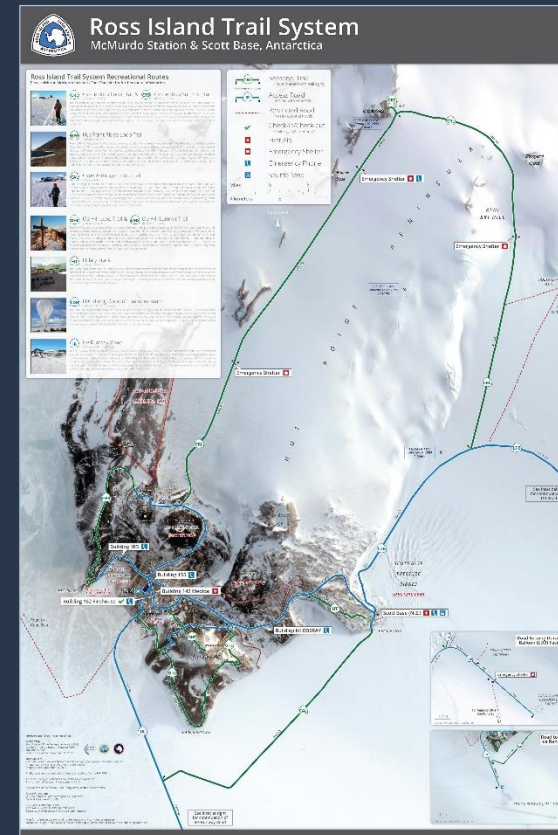
PGC MAKES MAPS

LOCKHEED-MARTIN / PGC COLLABORATION – ANTARCTICA



source: Polar Geospatial Center

MCMURDO STATION, ANTARCTICA

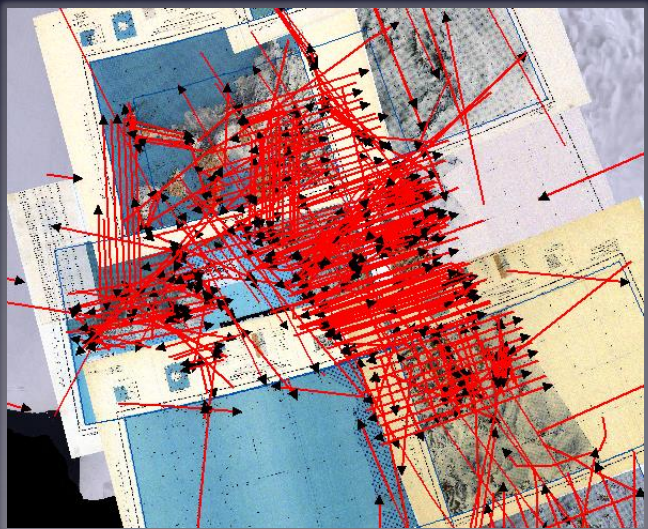
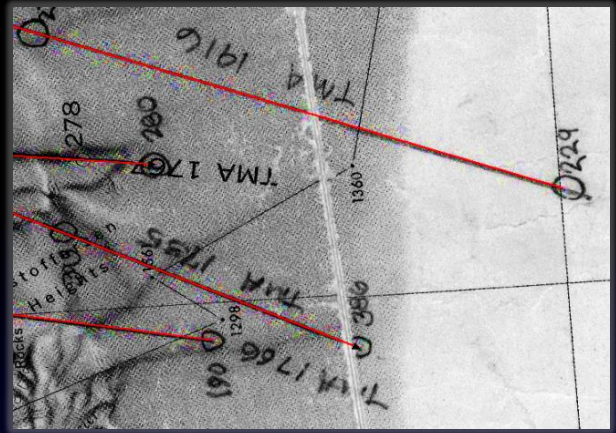
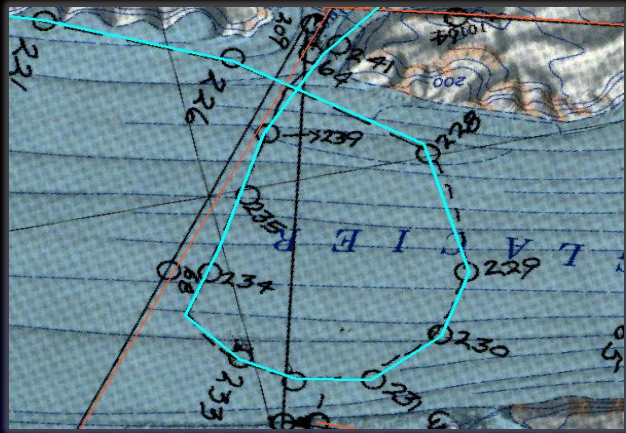
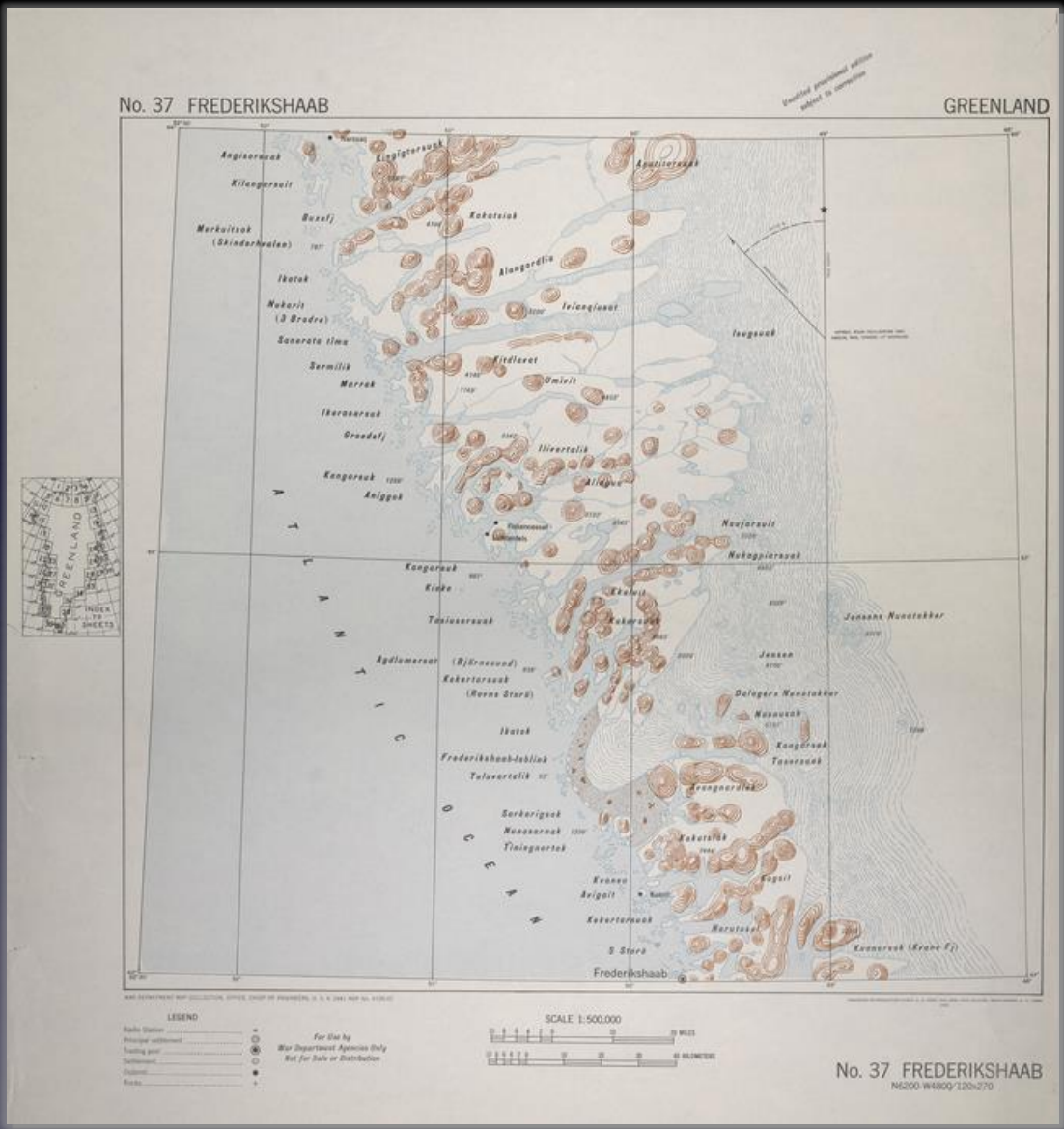


source: Polar Geospatial Center, imagery © 2018 DigitalGlobe, Inc.

THWAITES GLACIER, ANTARCTICA

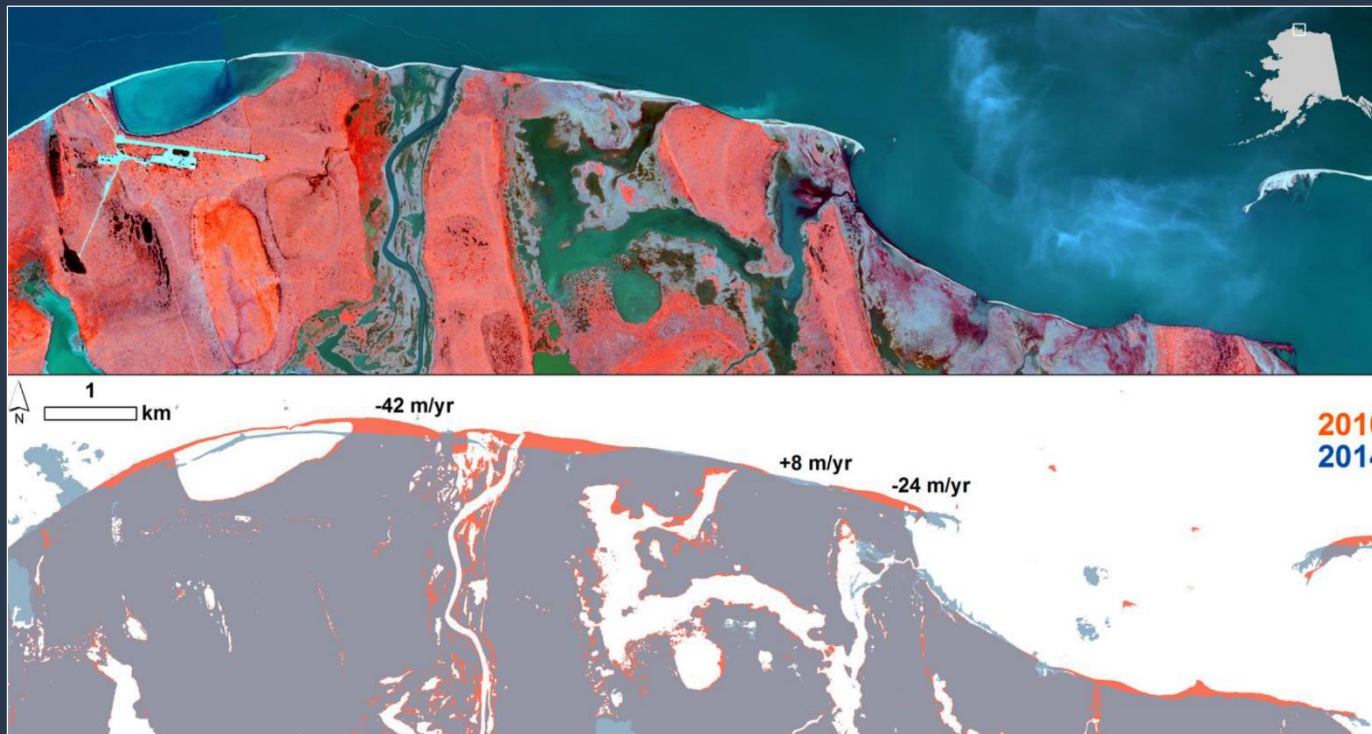


source: Polar Geospatial Center

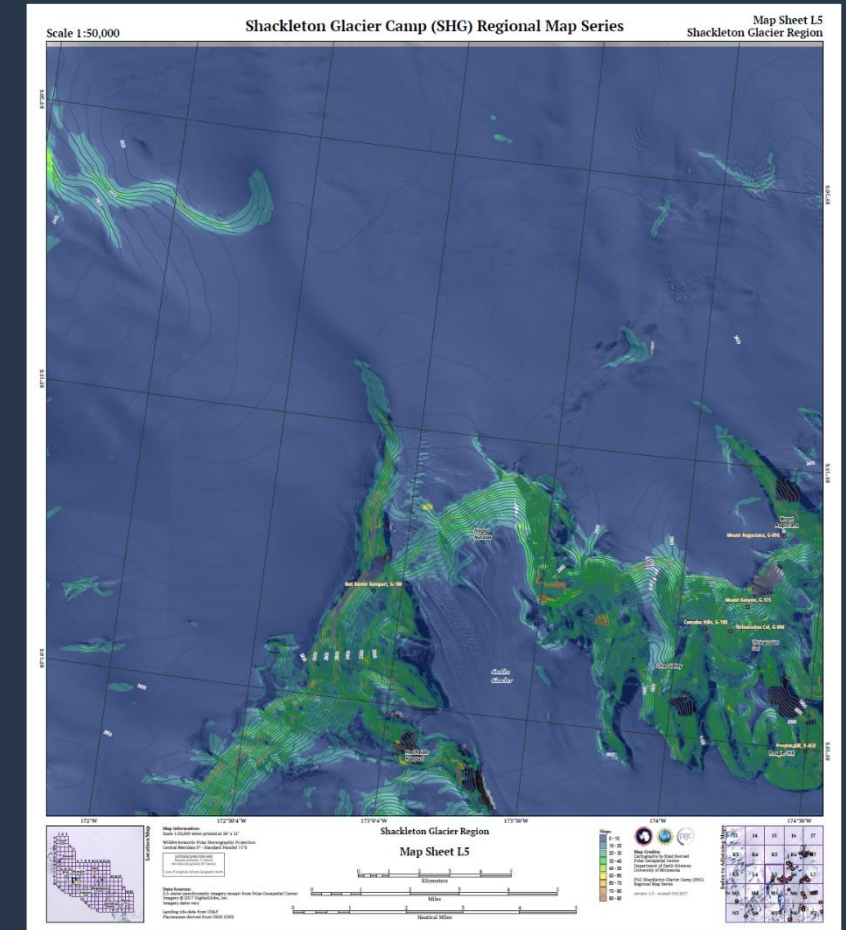


PGC PROVIDES ANALYSIS

COASTAL INUNDATION – ARCTIC OCEAN, ALASKA

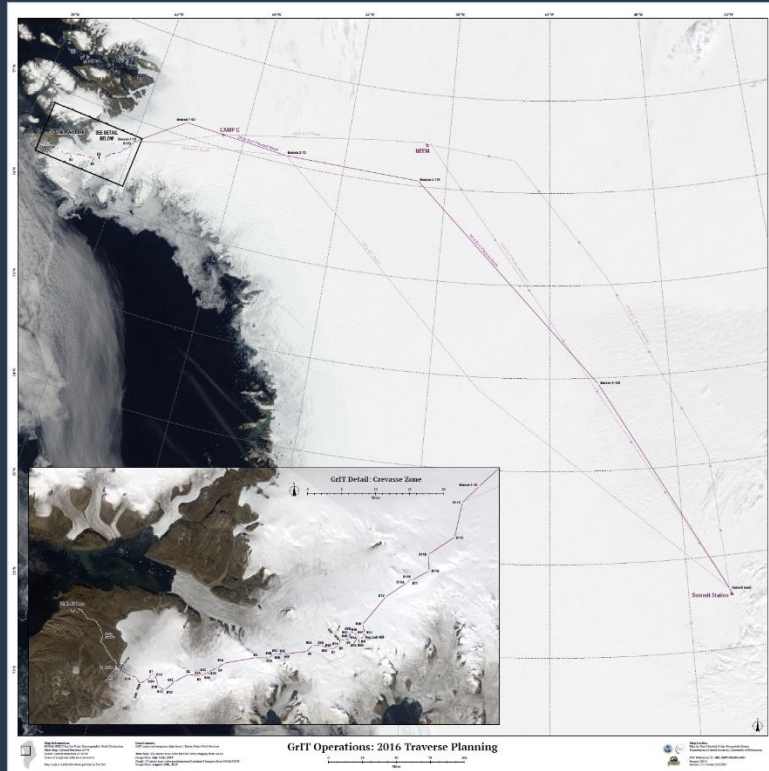


SLOPE ANALYSIS – TRANSANTARCTIC MOUNTAINS



PGC SUPPORTS POLAR LOGISTICS

GrIT TRAVERSE PLANNING 2016



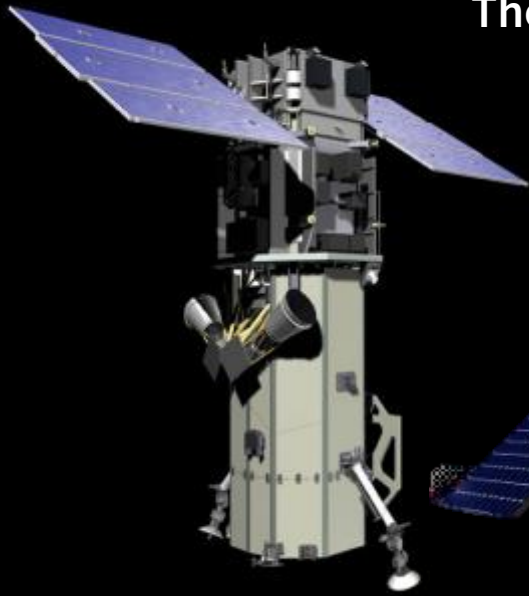
source: Polar Geospatial Center, imagery © 2018 DigitalGlobe, Inc. and from NASA MODIS

MODIS IMAGERY ANIMATION – NARES STRAIT

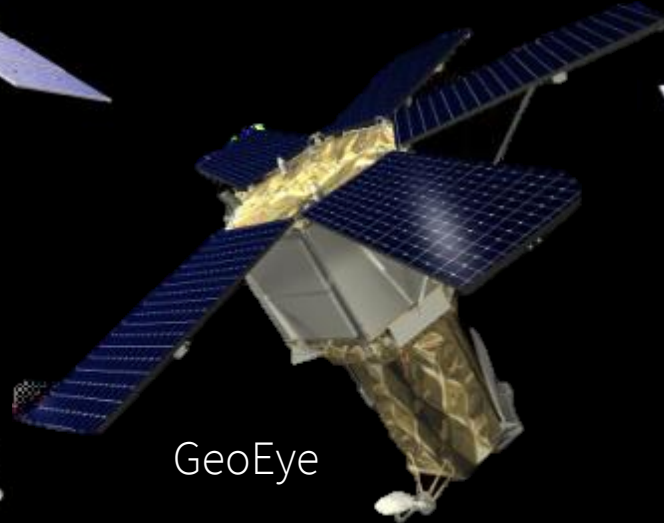


source: Polar Geospatial Center, imagery from NASA MODIS

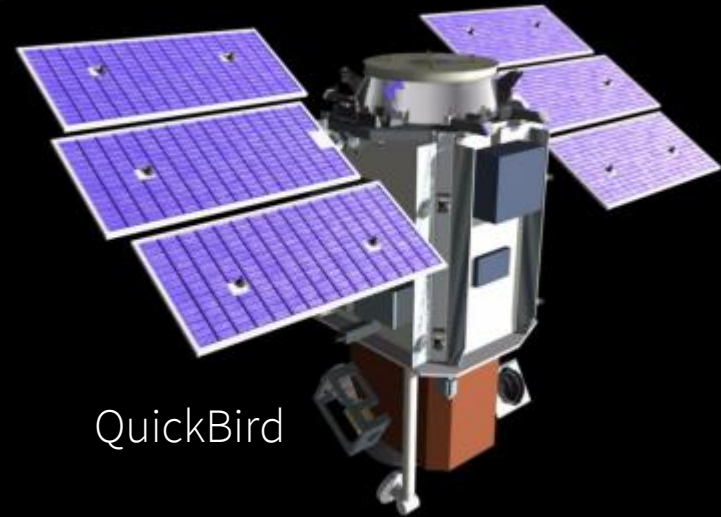
The DigitalGlobe Satellite Constellation



WorldView-2



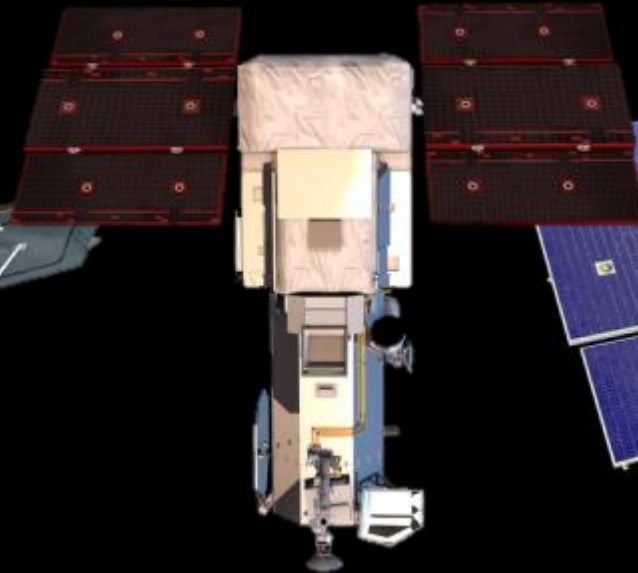
GeoEye



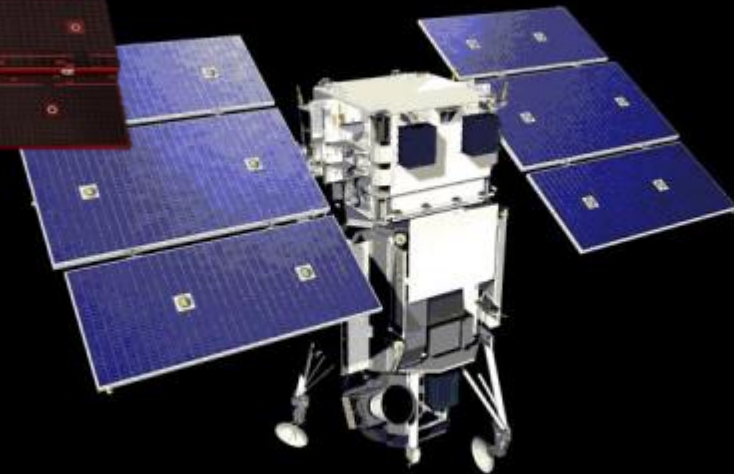
QuickBird



IKONOS

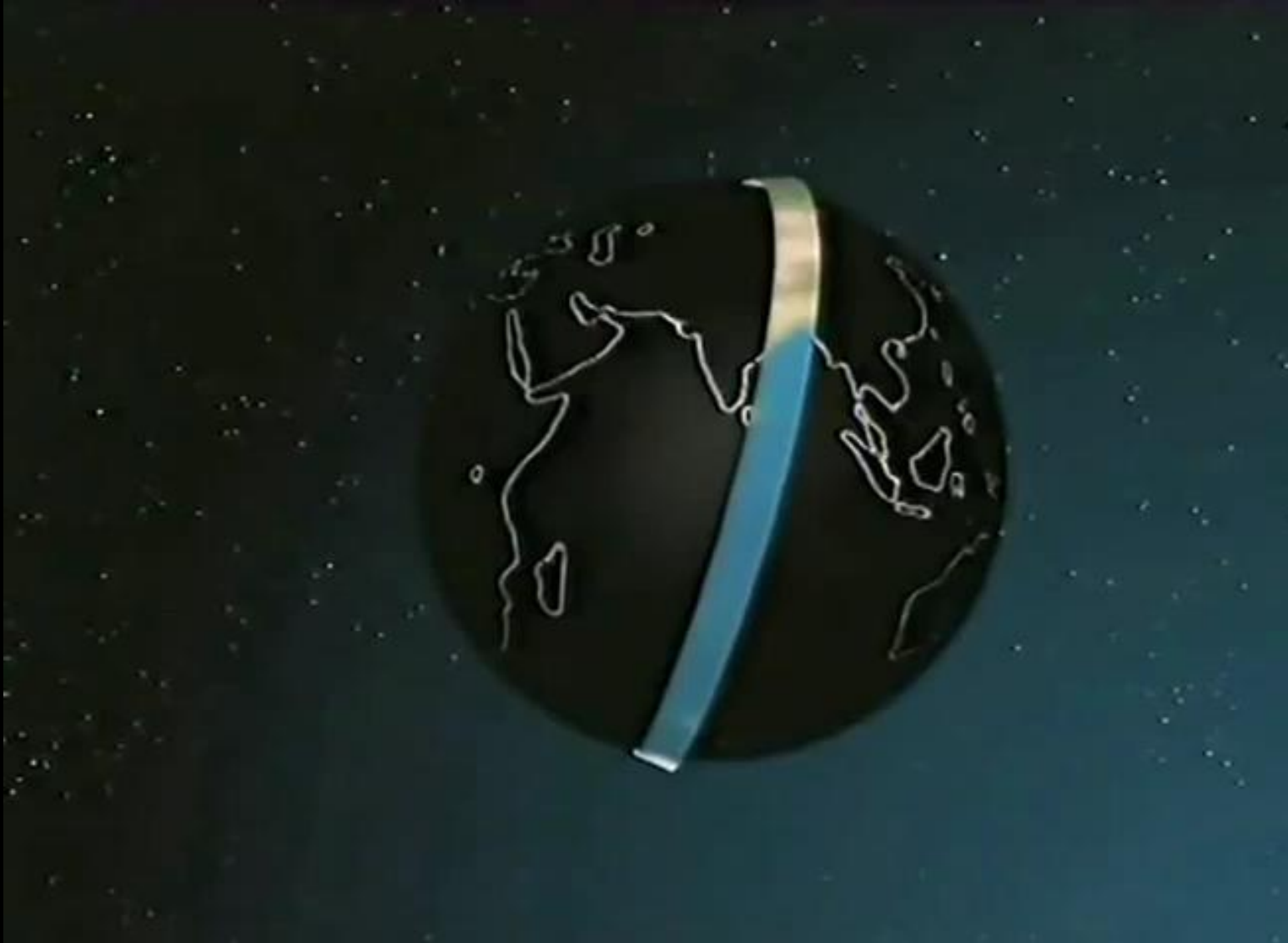


WorldView-3



WorldView-1

How does this work?

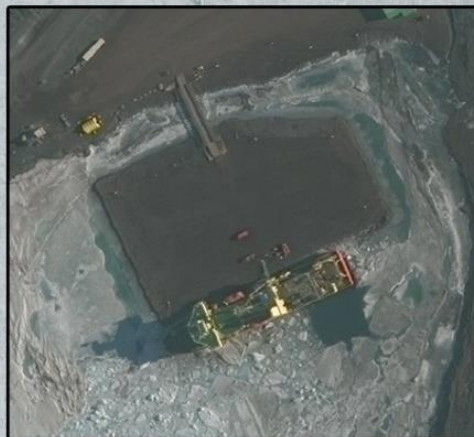








Shipping
Channel



R/V Nathaniel B. Palmer (research vessel)

McMurdo Station

Turning
Basin

U.S. Coast Guard Cutter Polar Star (icebreaker)



Vessel Activity McMurdo Station

0.4m pansharpened true-color WorldView-3
Image date January 22, 2015
Imagery © 2015 DigitalGlobe, Inc.
Compilation by Polar Geospatial Center



Imagery © 2015 DigitalGlobe, Inc.

Emperor Penguins

Circumpolar distribution

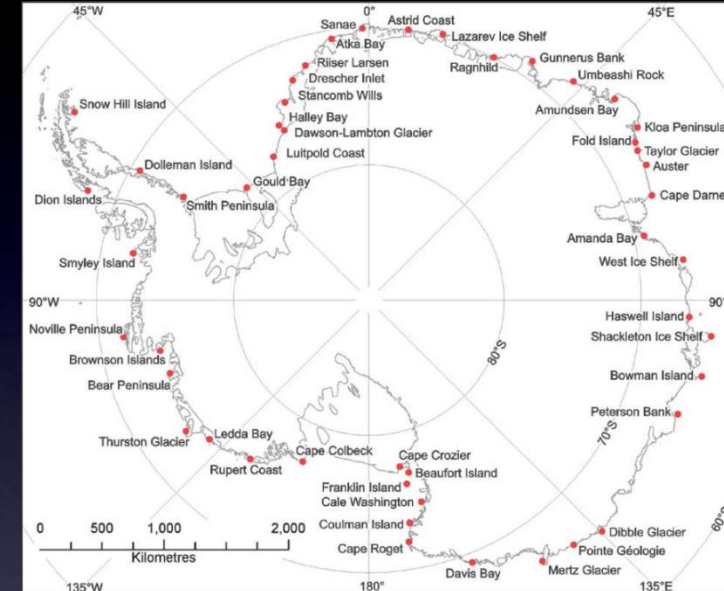
Only sea-ice obligate penguin species

Less sea ice, fewer emperor penguins

46 Colonies

10 found 2 years ago using LANDSAT

6 found using commercial imagery



An aerial photograph of a vast, snow-covered mountain range. The terrain is rugged with numerous ridges and valleys. In the lower-left foreground, there is a dark, dense forest of evergreen trees. The rest of the image is dominated by white snow and light-colored rock faces. The lighting creates soft shadows, emphasizing the topography.

**Atca Bay Emperor Colony near
Newmeyer Station
September 2, 2012**

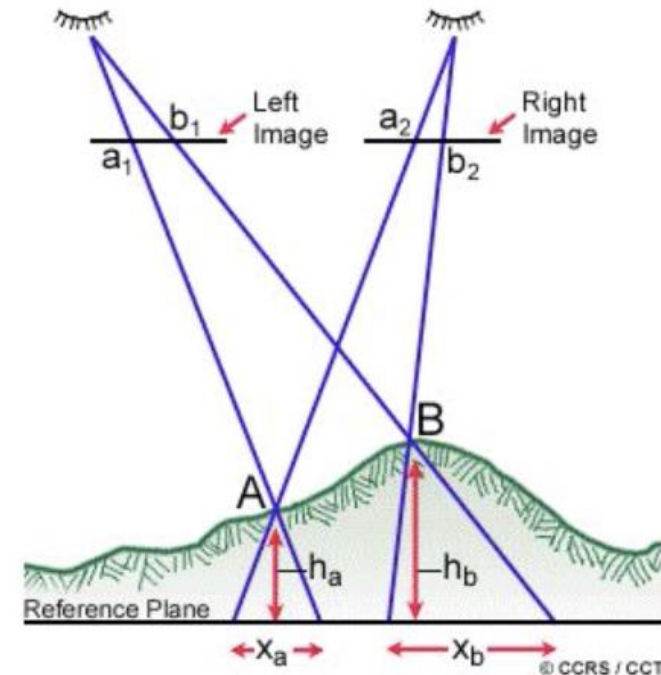
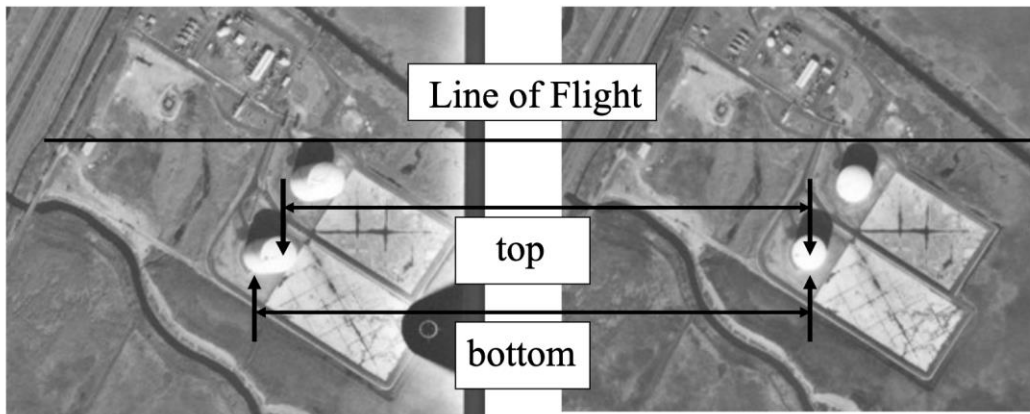
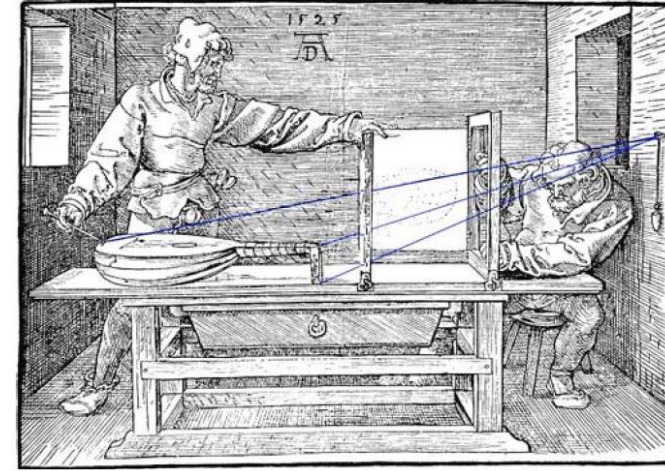
Terrain from Space

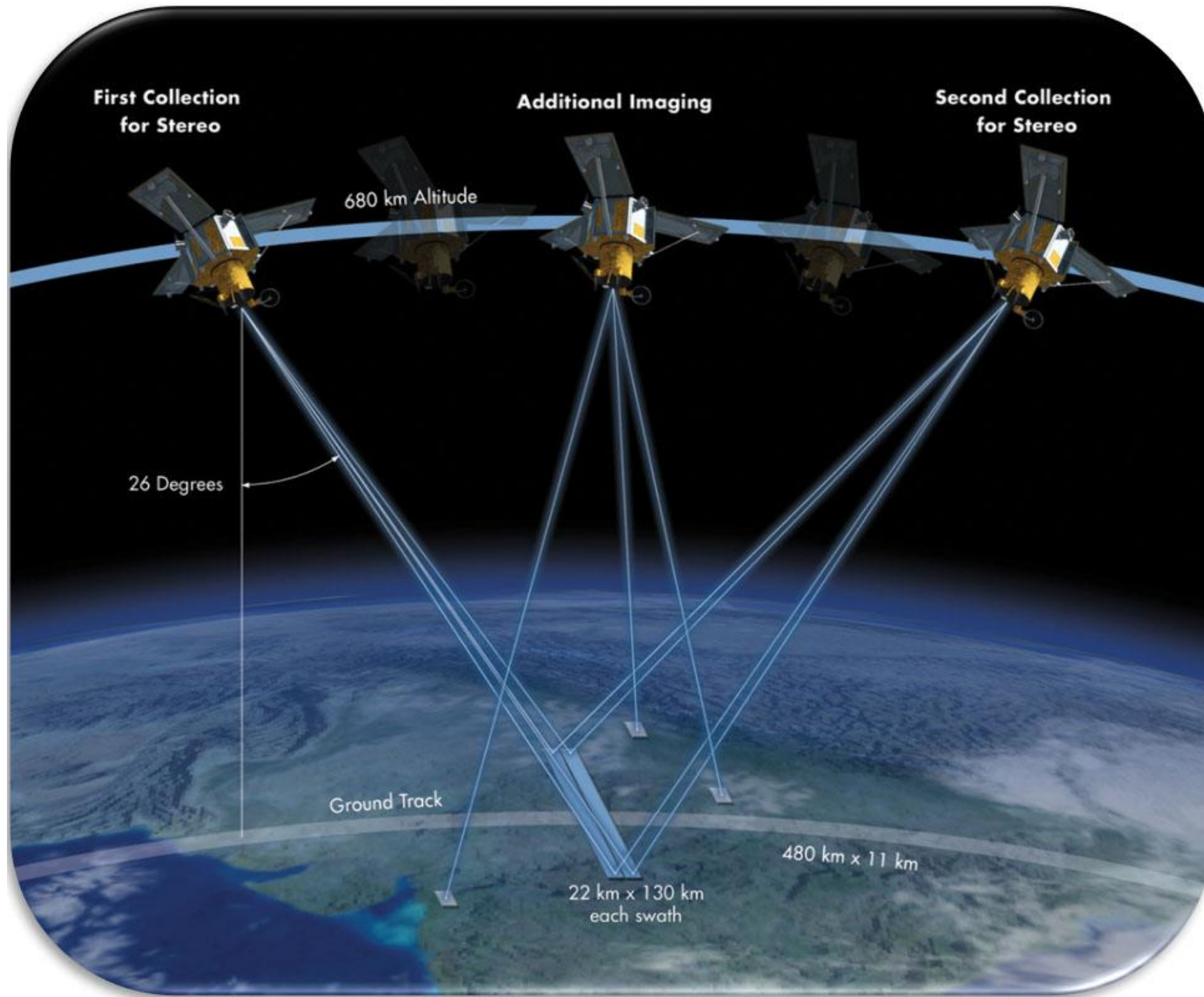
Measurement from images: Photogrammetry

"Perspective is nothing else than the seeing of an object behind a sheet of glass,... the surface of which all the things may be marked that are behind this glass."

All things transmit their images to the eye by pyramidal lines, and these pyramids are cut by the said glass. The nearer to the eye these are intersected, the smaller the image of their cause will appear."

Leonardo da Vinci, 1480





Blue Waters Computing System



Aggregate Memory – 1.5 PB

*Scuba Subsystem -
Storage Configuration
for User Best Access*

120+ Gb/sec



100-300 Gbps WAN

**10/40/100 Gb
Ethernet Switch**

100 GB/sec



Spectra Logic: 300 usable PB

External Servers

IB Switch

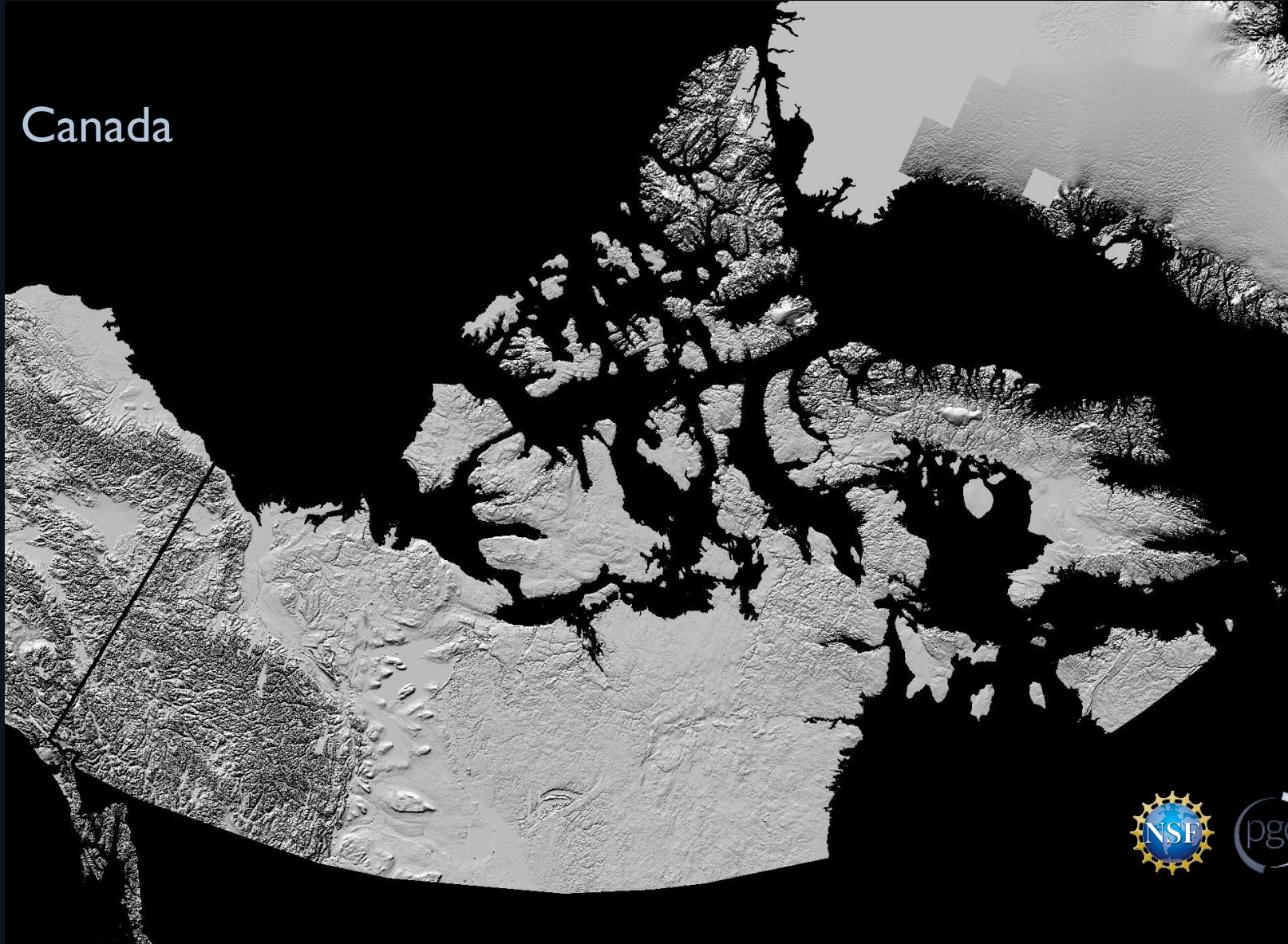
>1 TB/sec



Sonexion: 26 usable PB

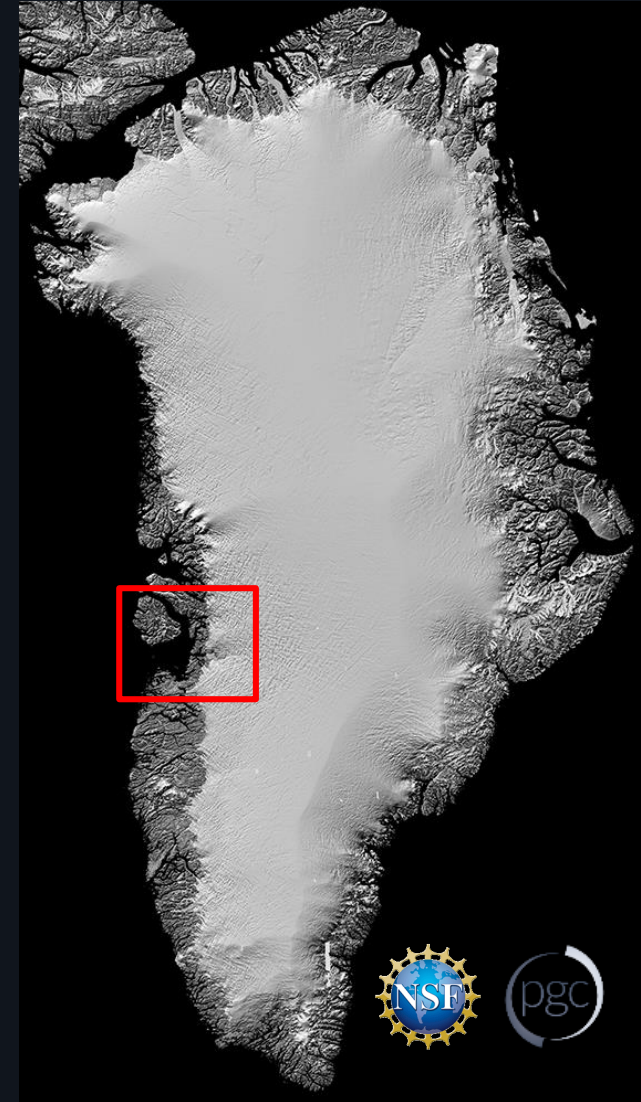
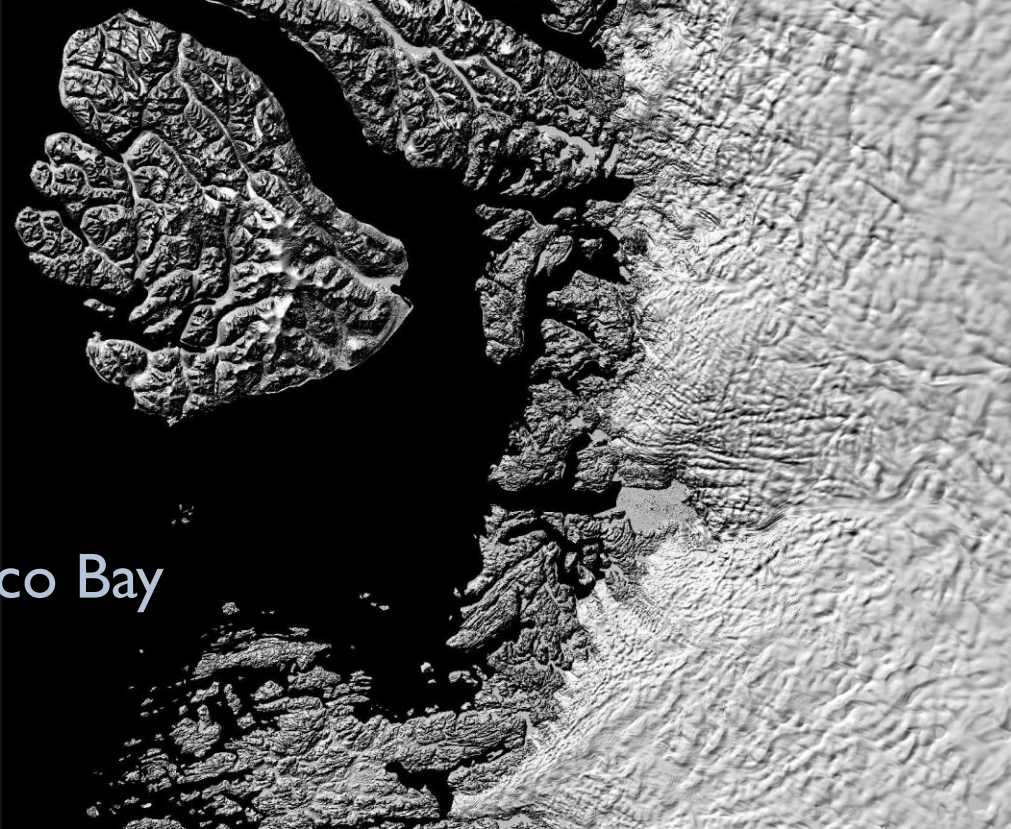


Canada

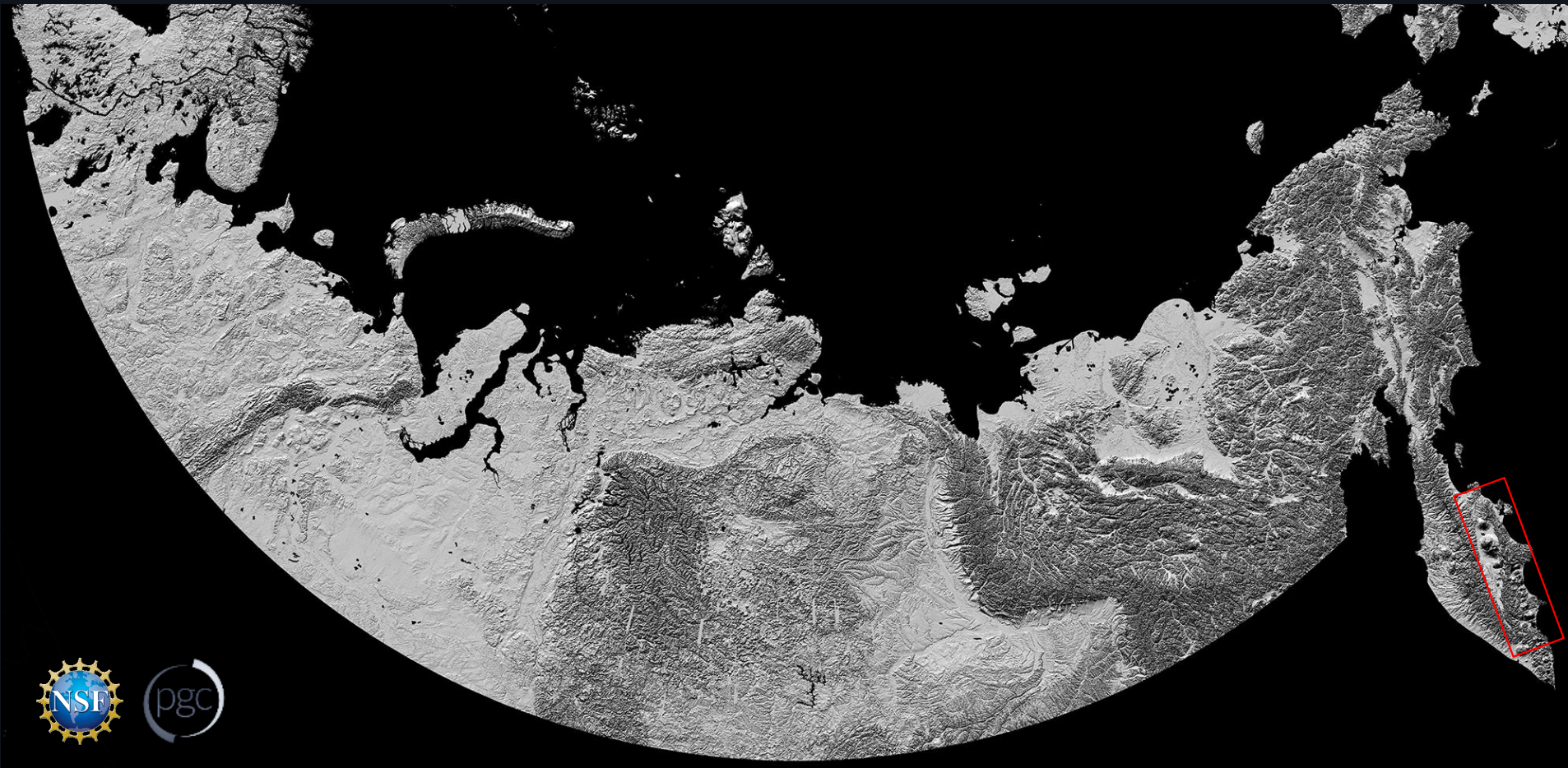


Greenland

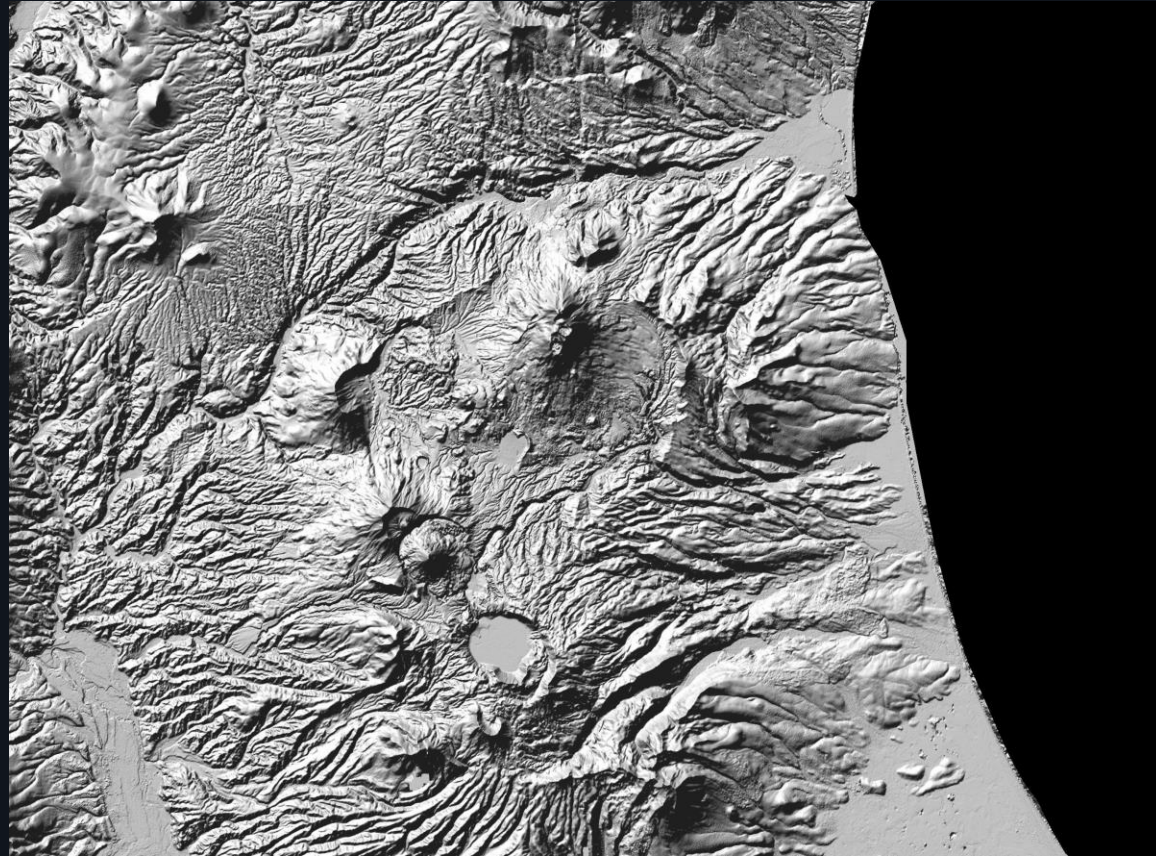
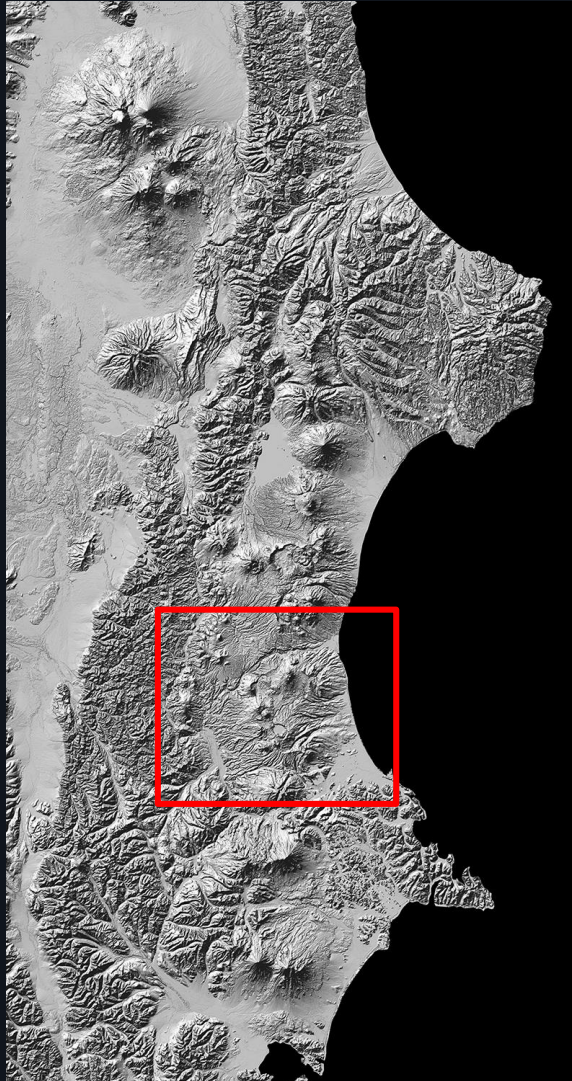
Disco Bay



Russian Federation



Volcanoes in Kamchatka





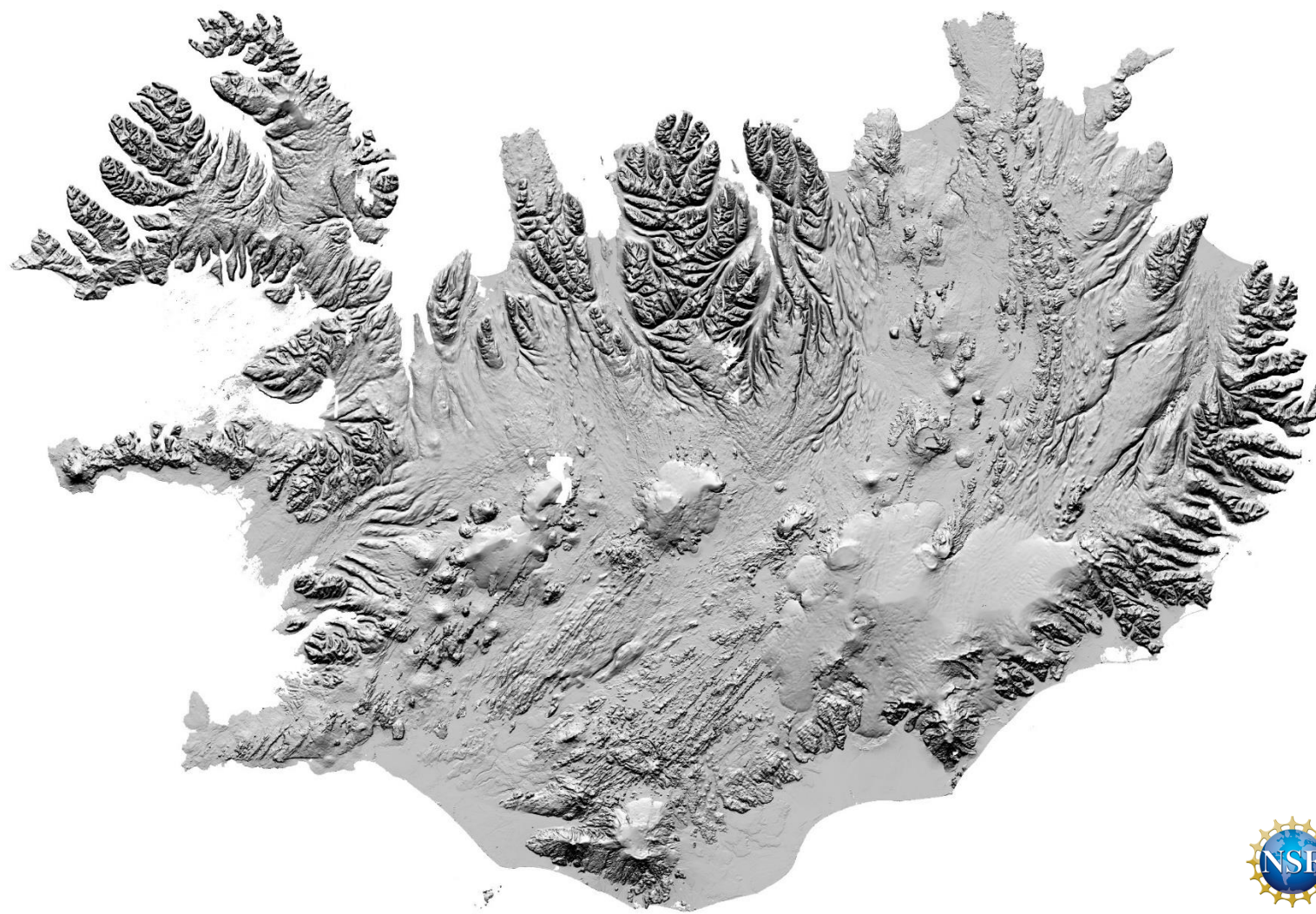
Testing of the Arctic DEM in Iceland

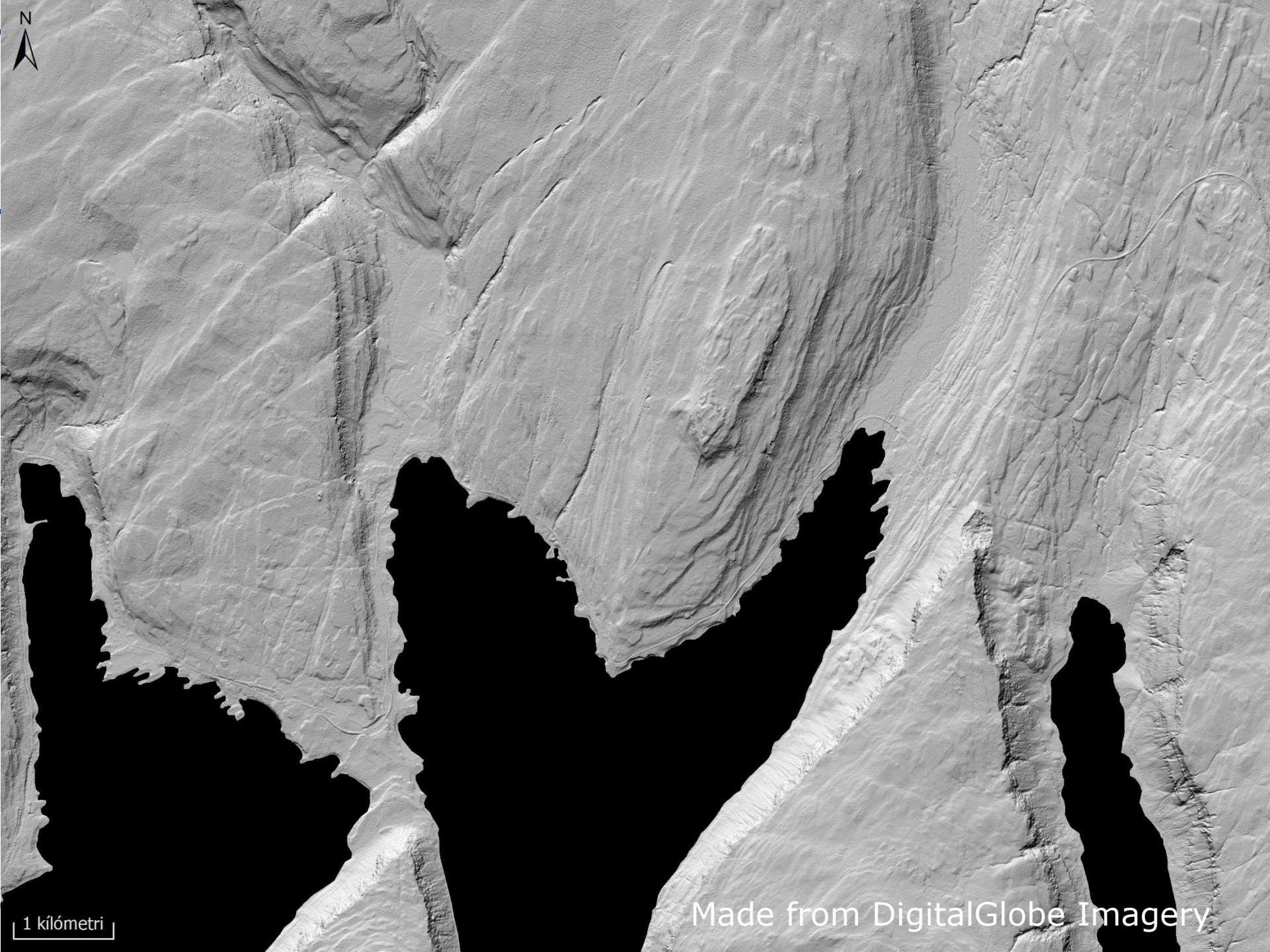
Guðmundur Valsson

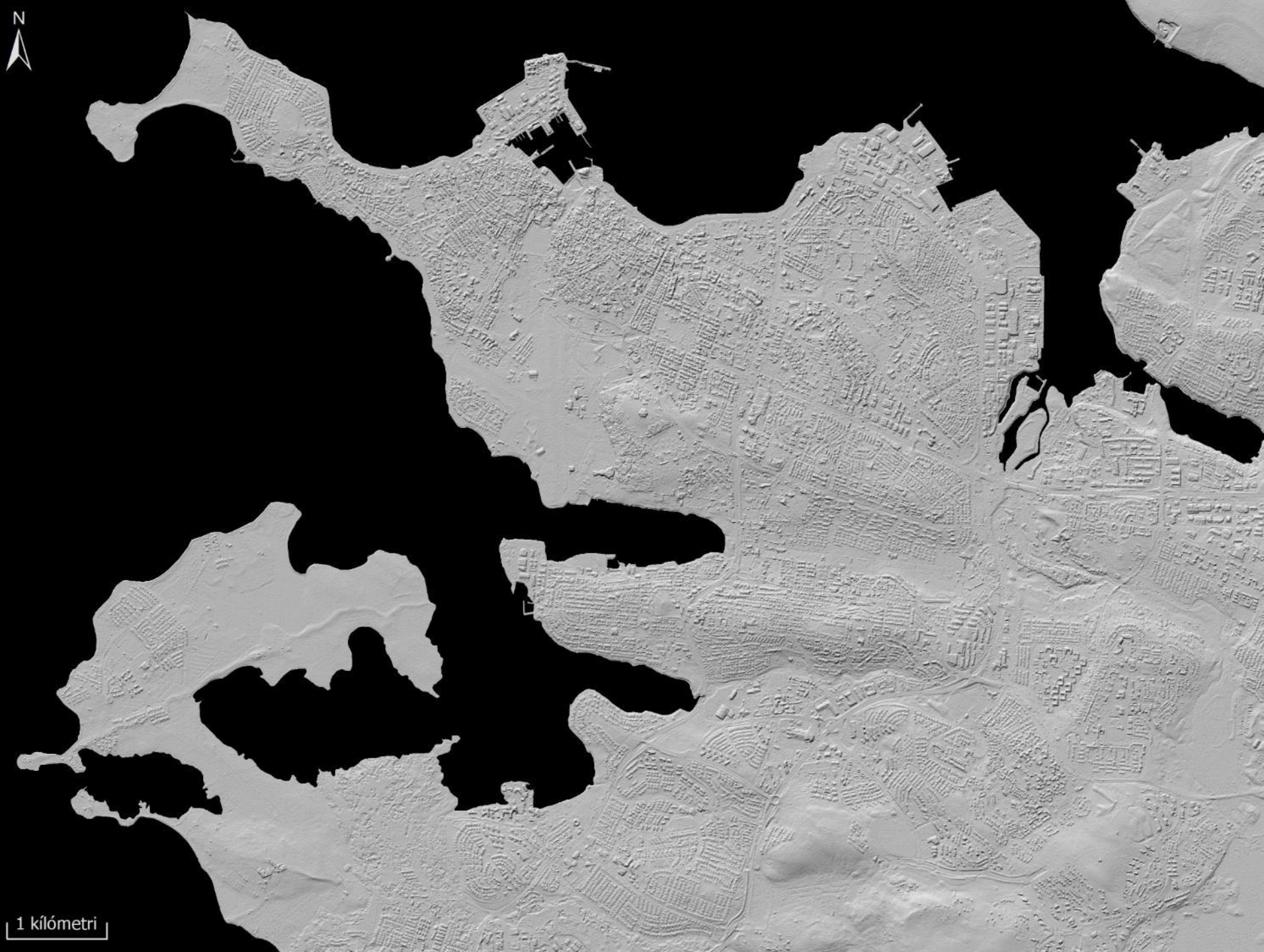
National Land Survey of Iceland

Tómas Jóhannesson and Ragnar Heiðar Þrastarson

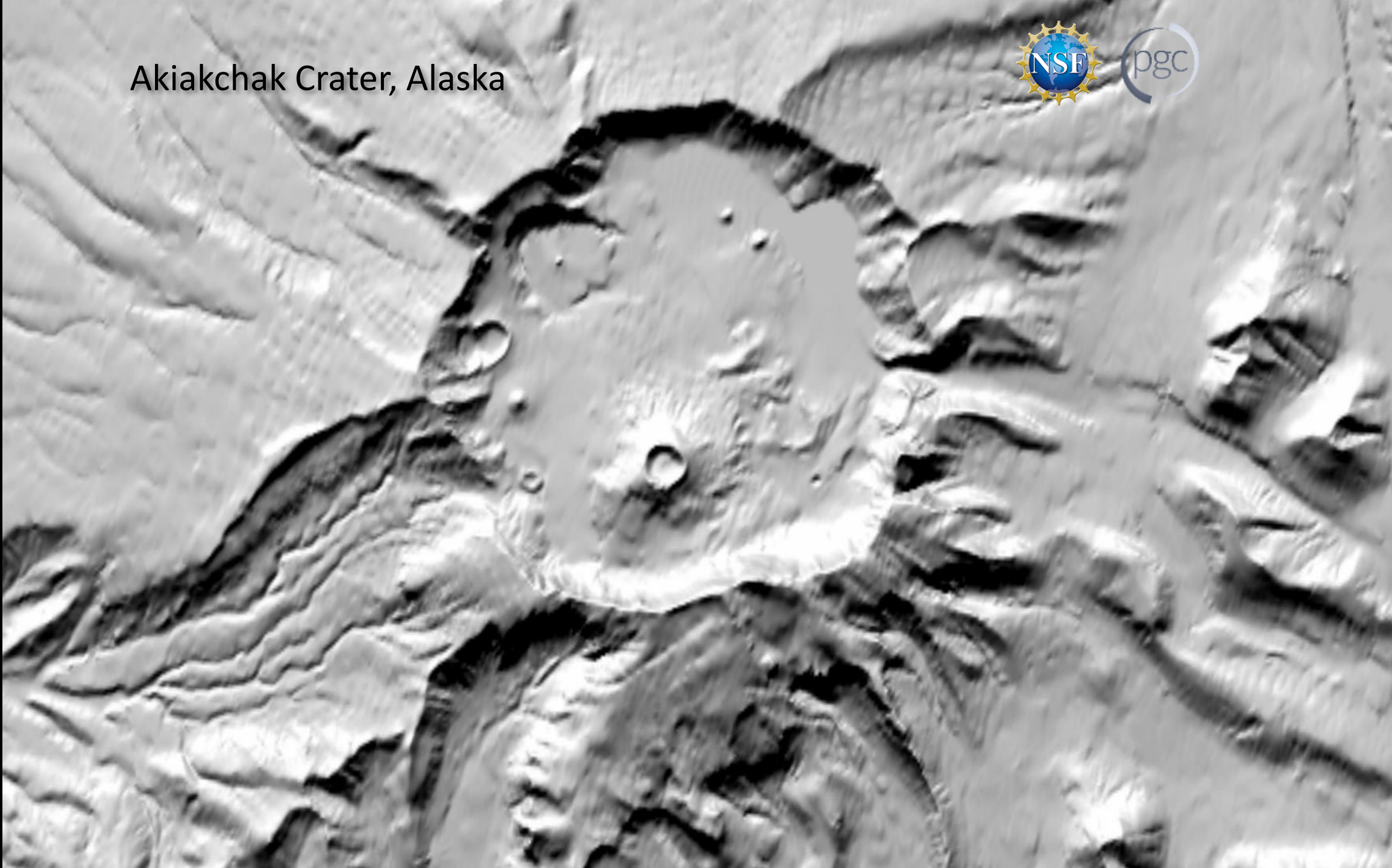
Icelandic Met Office



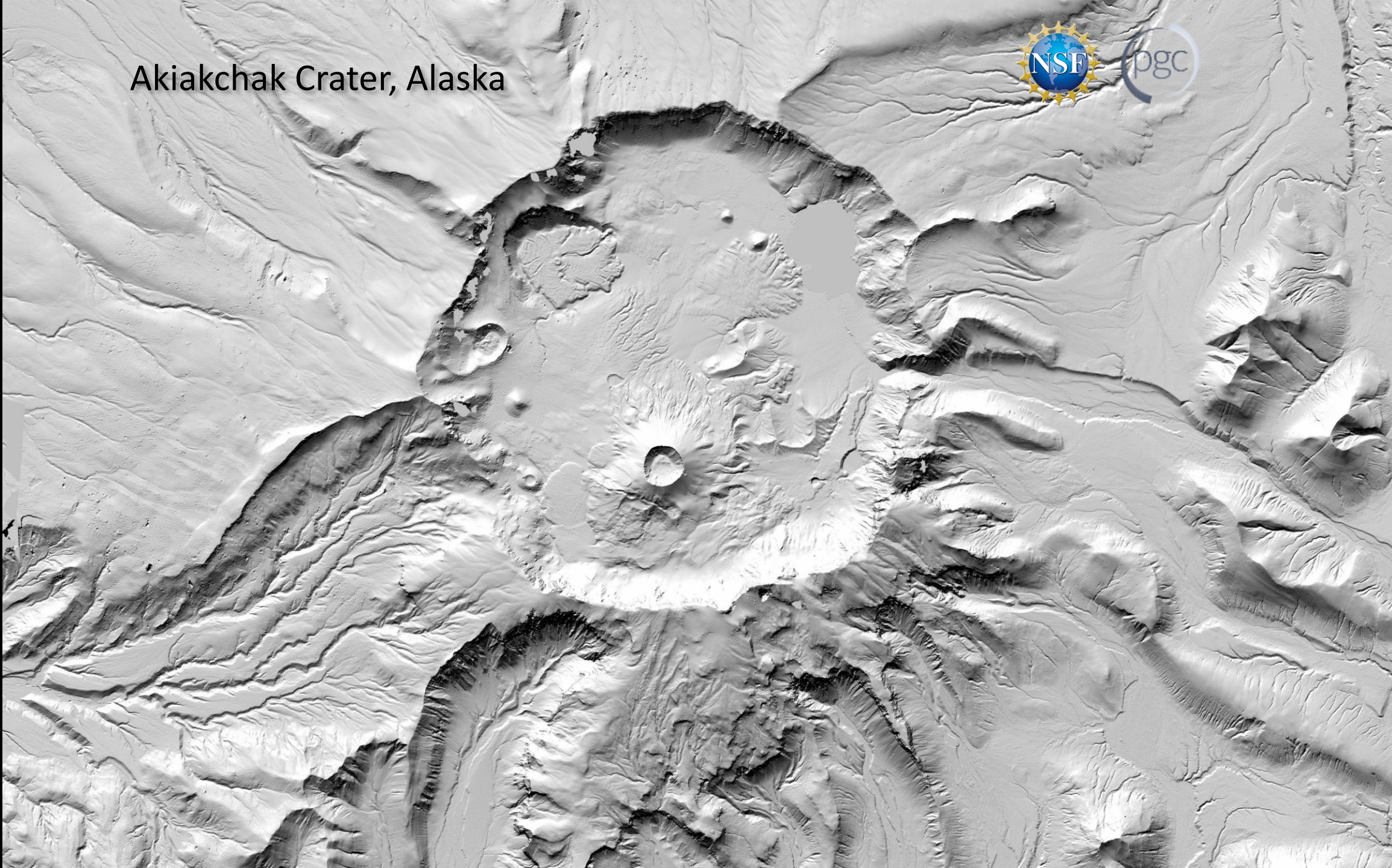




Akiakchak Crater, Alaska



Akiakchak Crater, Alaska





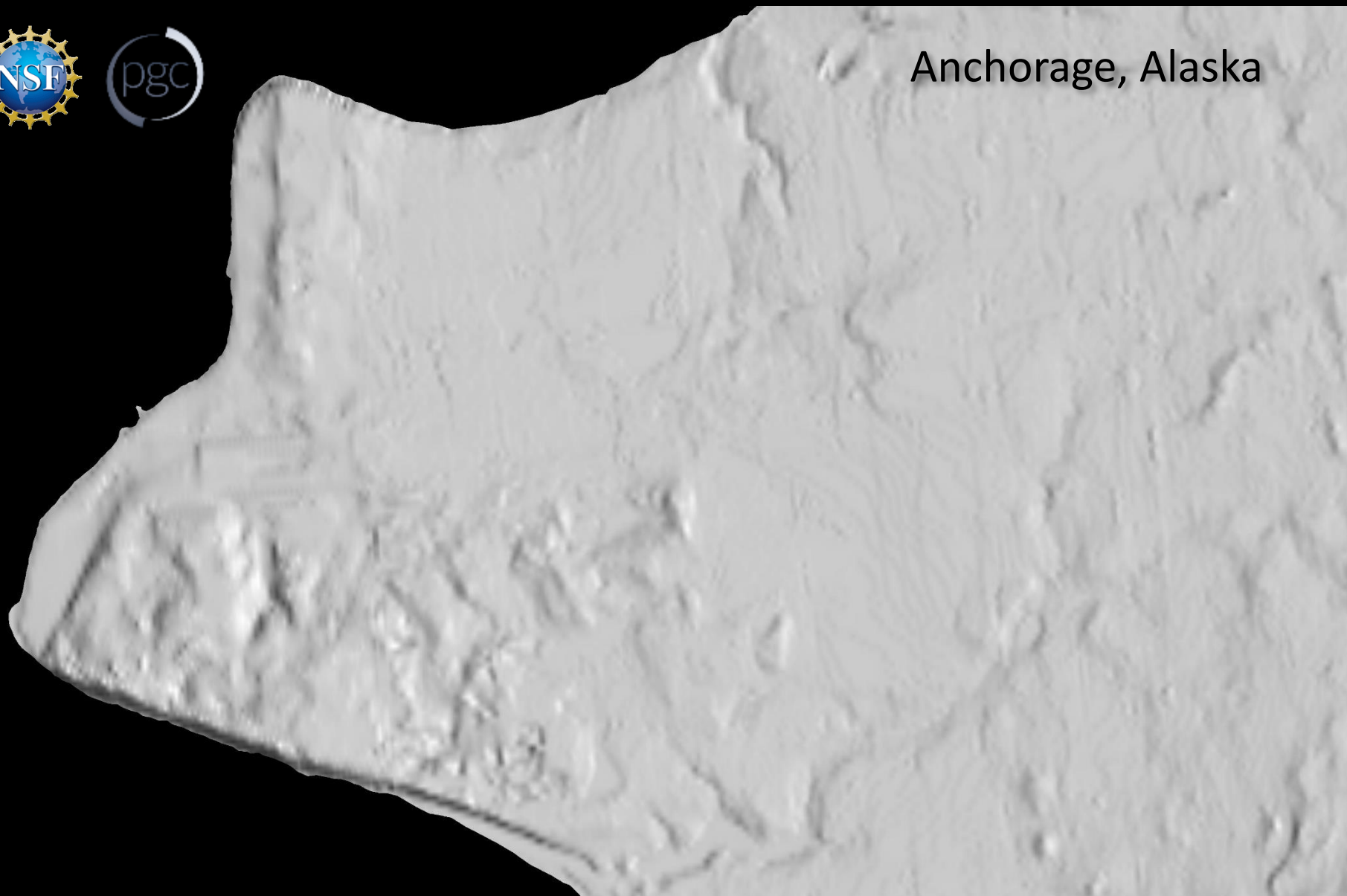
Kotzebue, Alaska



Kotzebue, Alaska

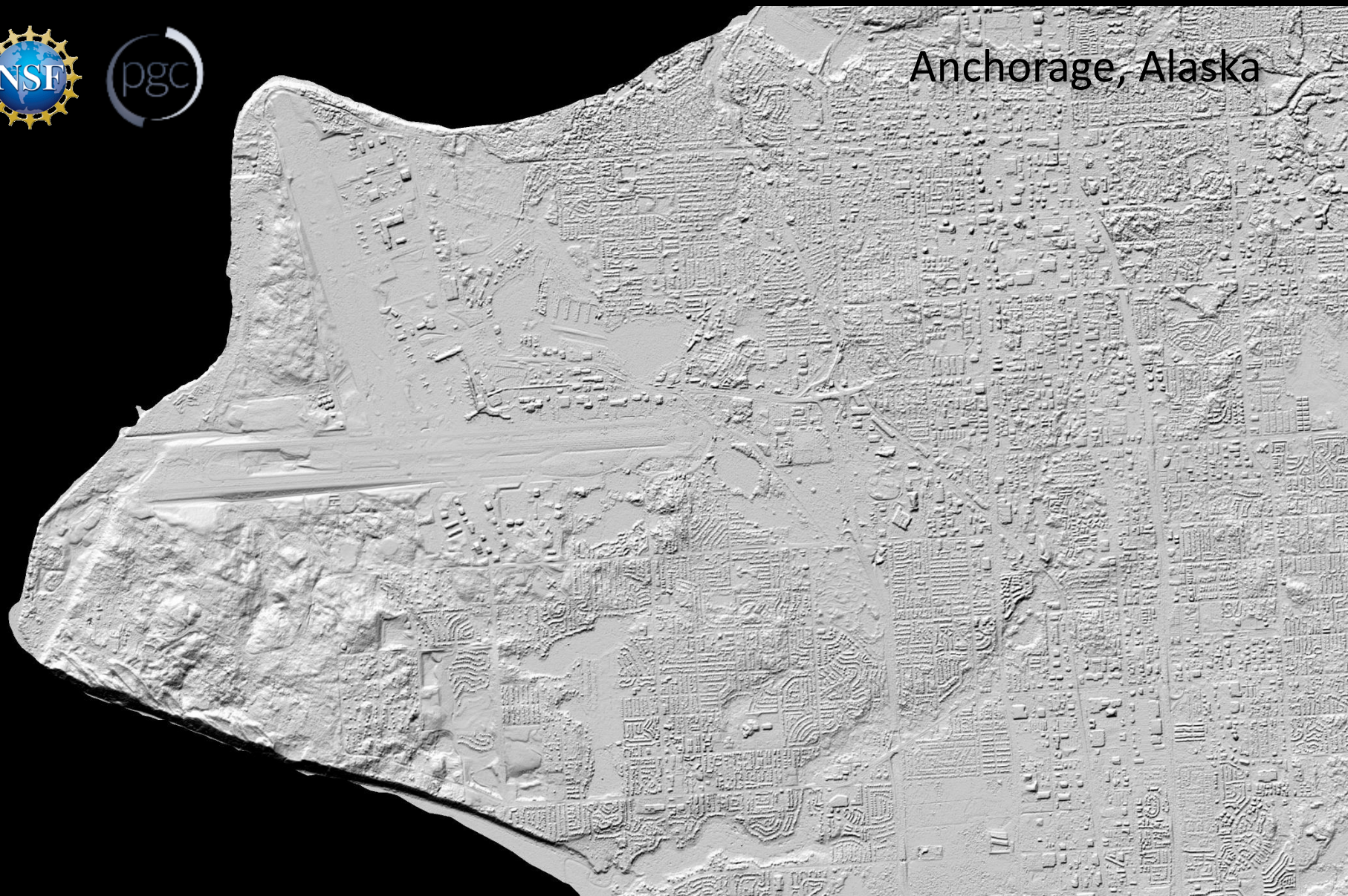


Anchorage, Alaska





Anchorage, Alaska



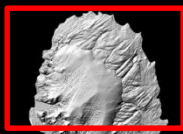


Ted Stephens Airport

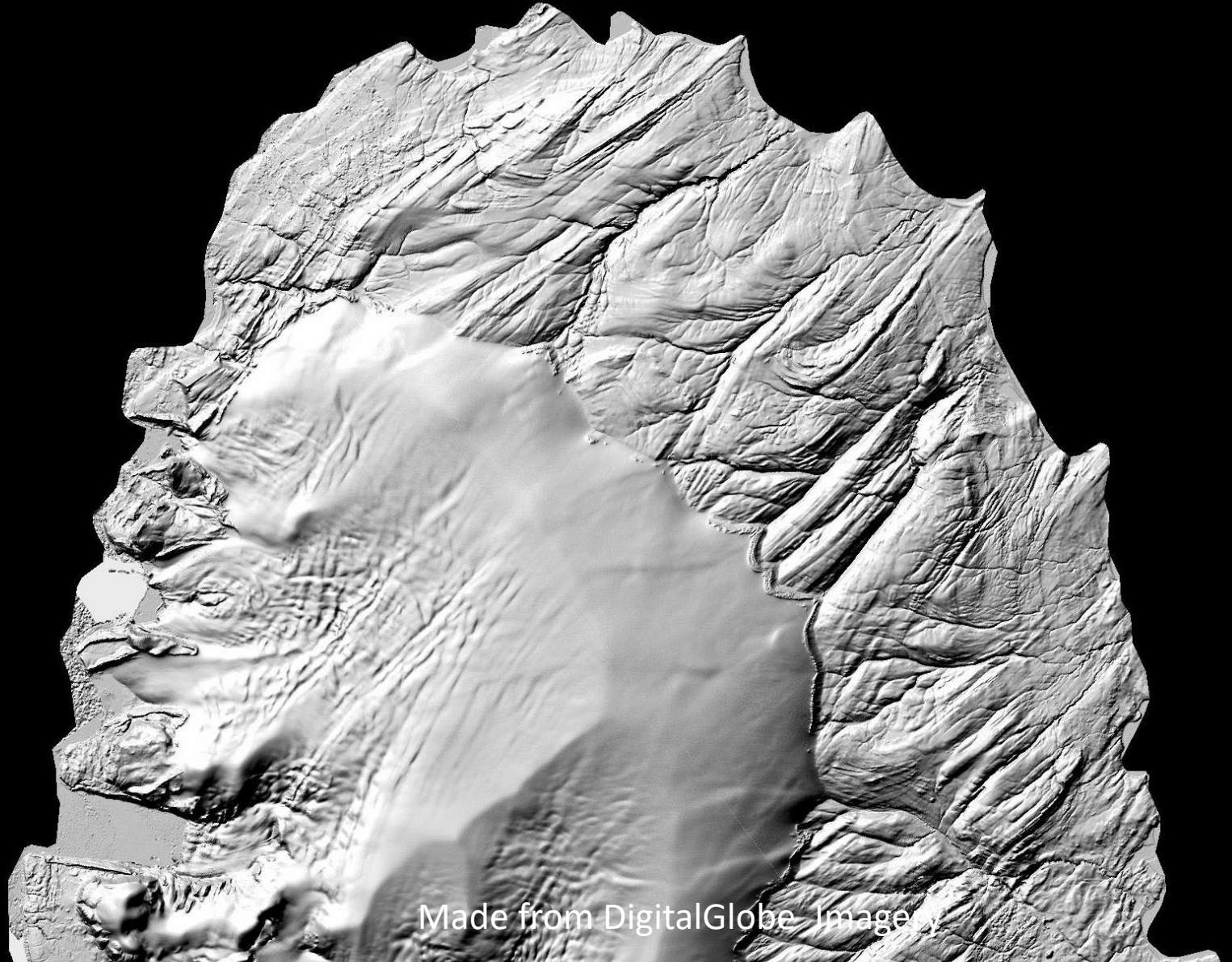
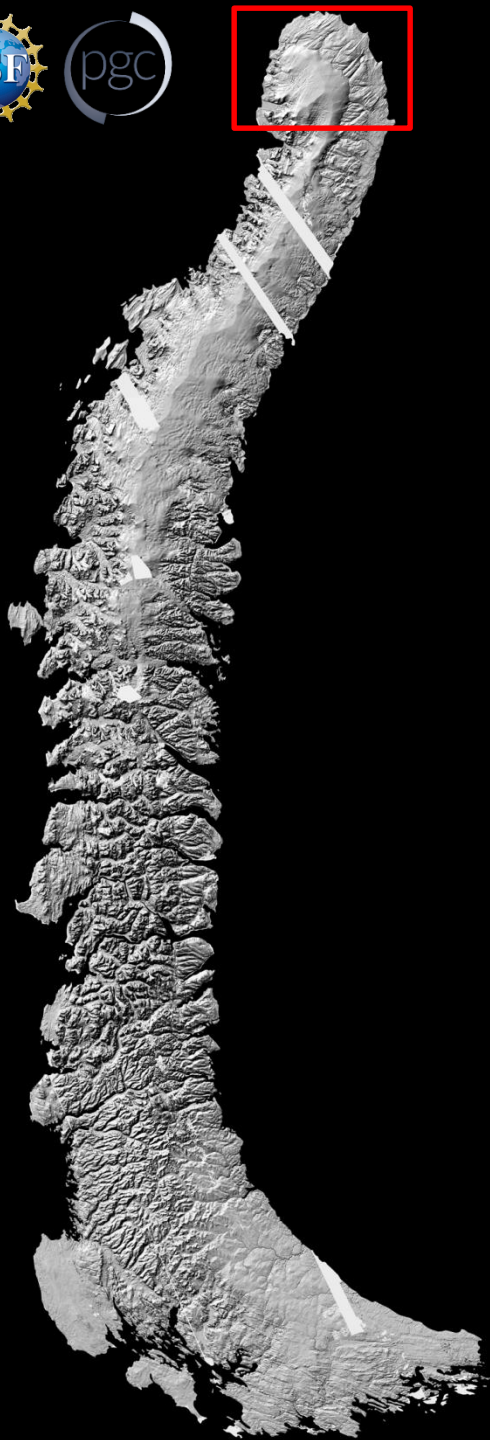
Stefansson Island, Nunavut



Made from DigitalGlobe Imagery

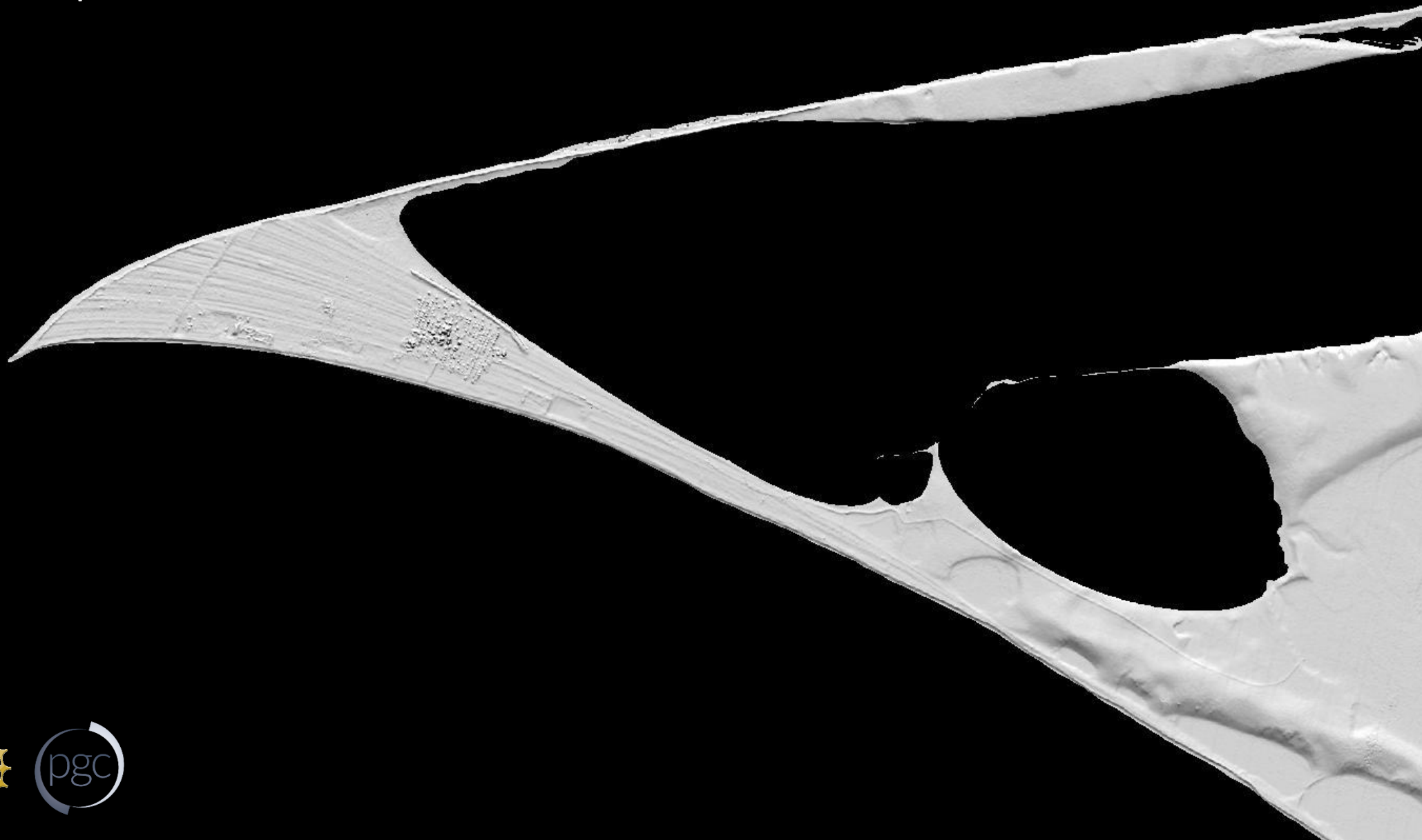


Novaya Zemlya, Russia



Made from DigitalGlobe Imagery

Point Hope, Alaska



The Reference Elevation Model of Antarctica (REMA)



The Reference Elevation Model of Antarctica (REMA)

A High-Resolution, True-Shaped Digital Elevation Model for the Antarctic Ice Sheet

Background
The Reference Elevation Model of Antarctica (REMA) provides the first high-resolution, true-shape digital elevation model of the entire continent. REMA is a comprehensive, high-resolution, true-shape digital elevation model of the entire continent. It is derived from a combination of satellite altimetry, ice thickness measurements, and ground-based elevation data. The model is based on a 1 km resolution grid and covers the entire continent, including the ice shelves and ice streams. The model is available in a variety of formats, including a 1 km resolution grid, a 1 km resolution grid with 100 m resolution, and a 1 km resolution grid with 100 m resolution and 100 m resolution. The model is available in a variety of formats, including a 1 km resolution grid, a 1 km resolution grid with 100 m resolution, and a 1 km resolution grid with 100 m resolution and 100 m resolution.

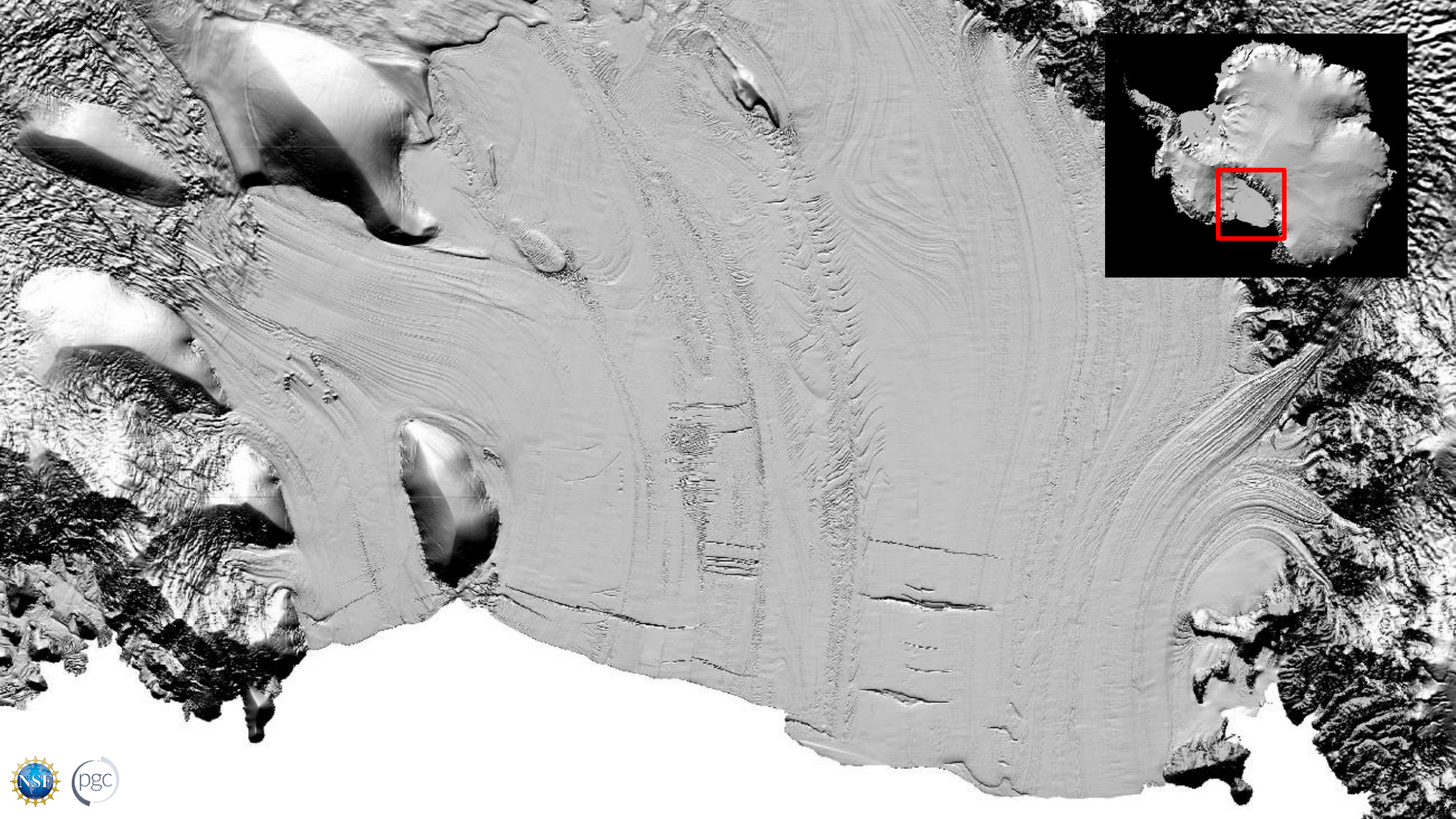
Data Description
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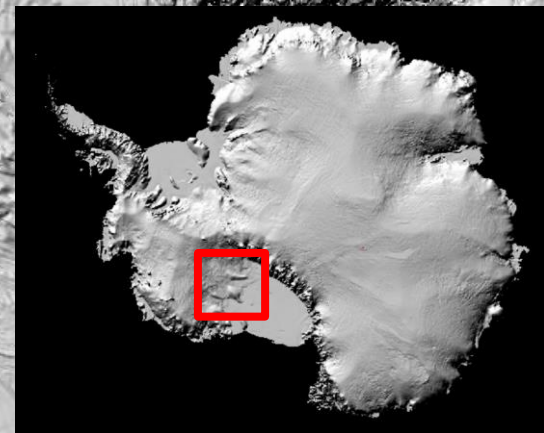
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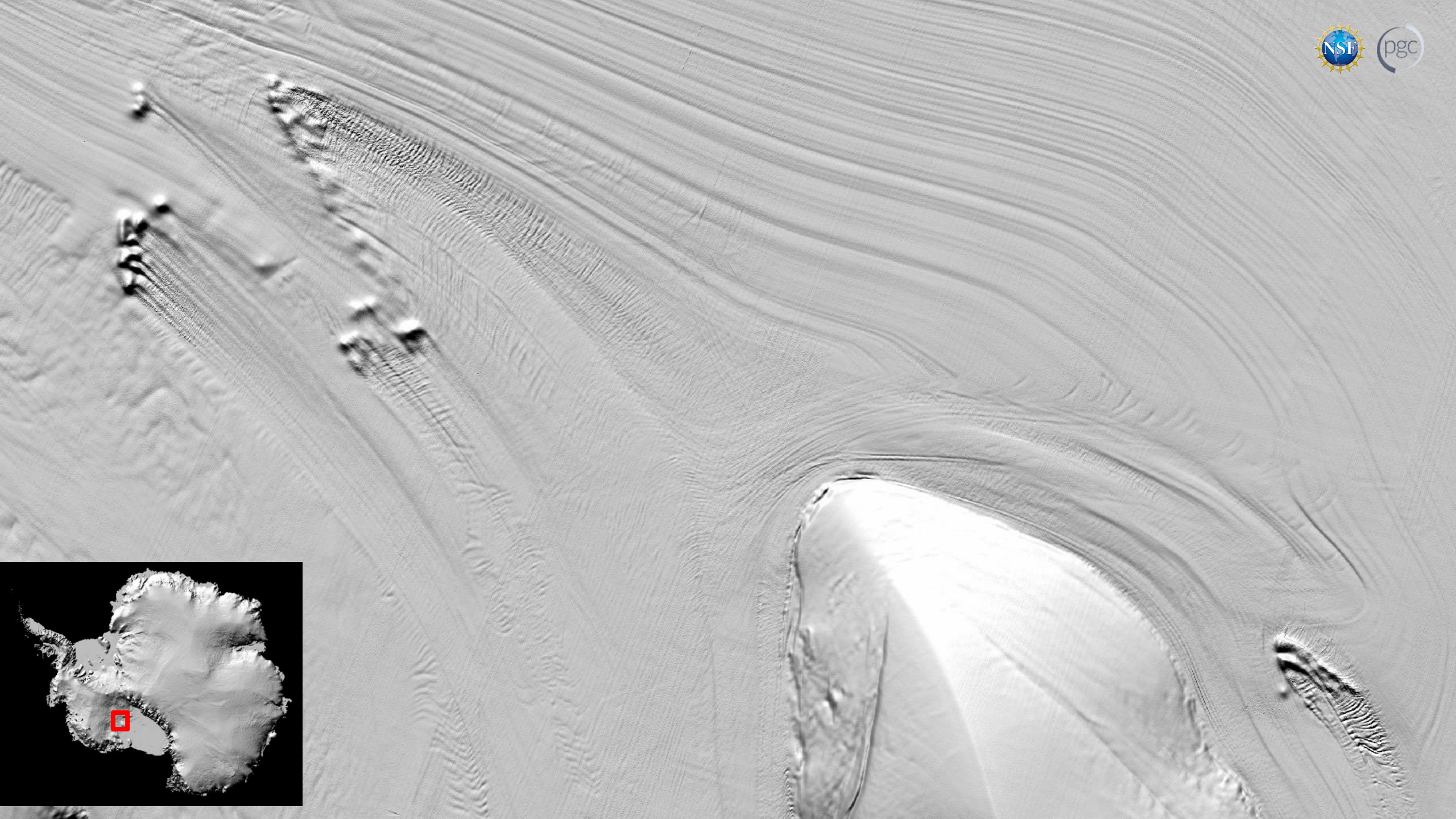
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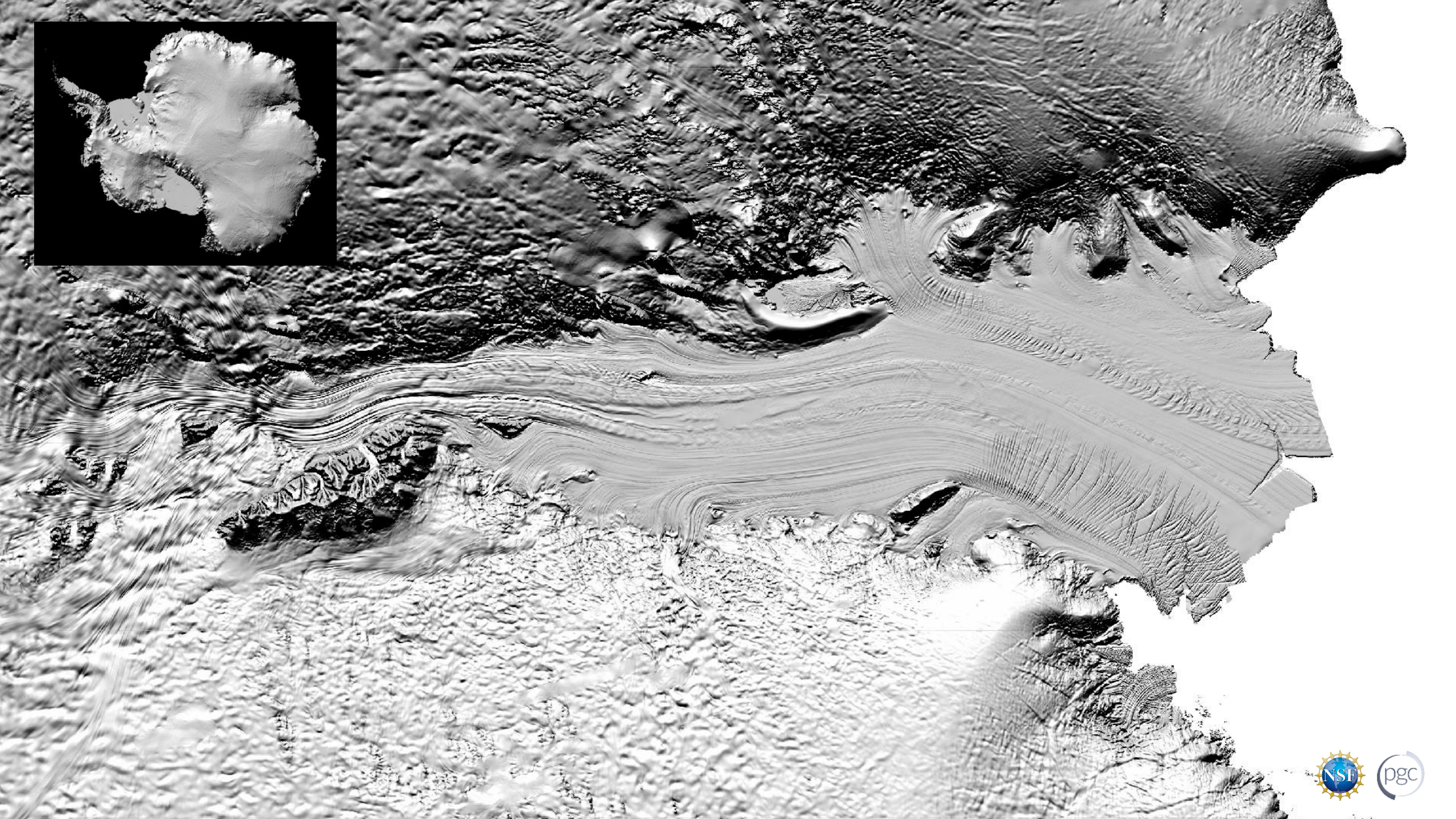
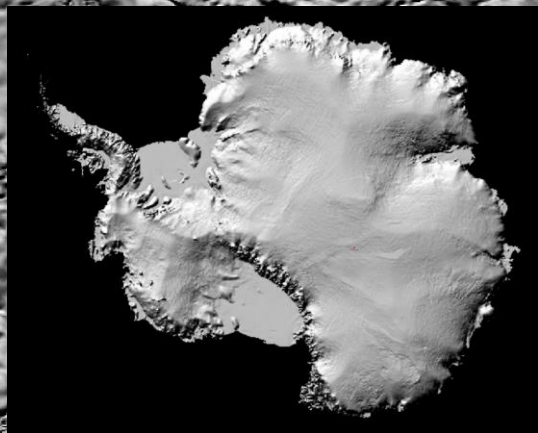
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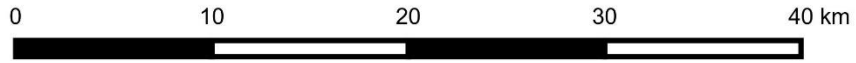
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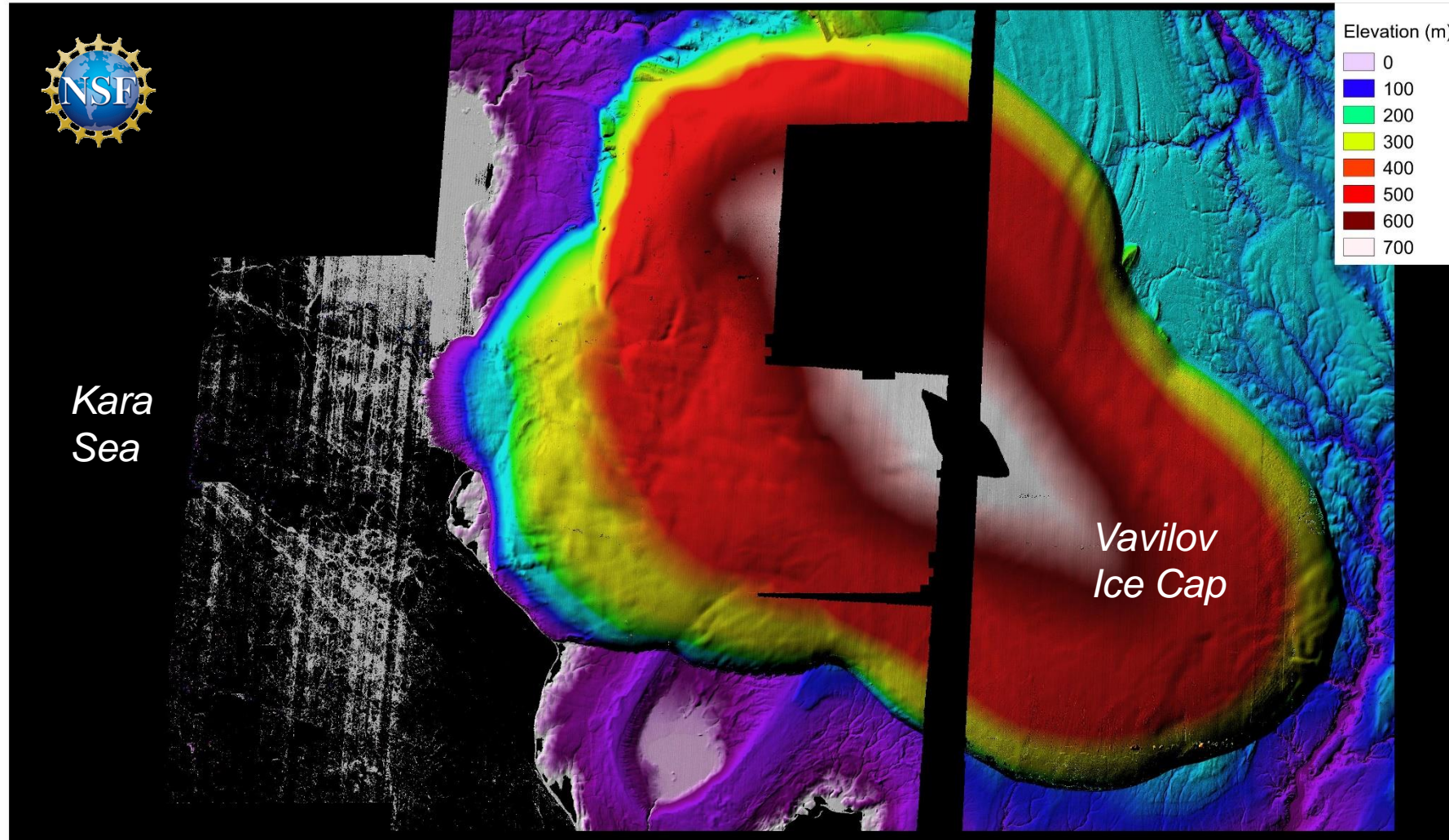






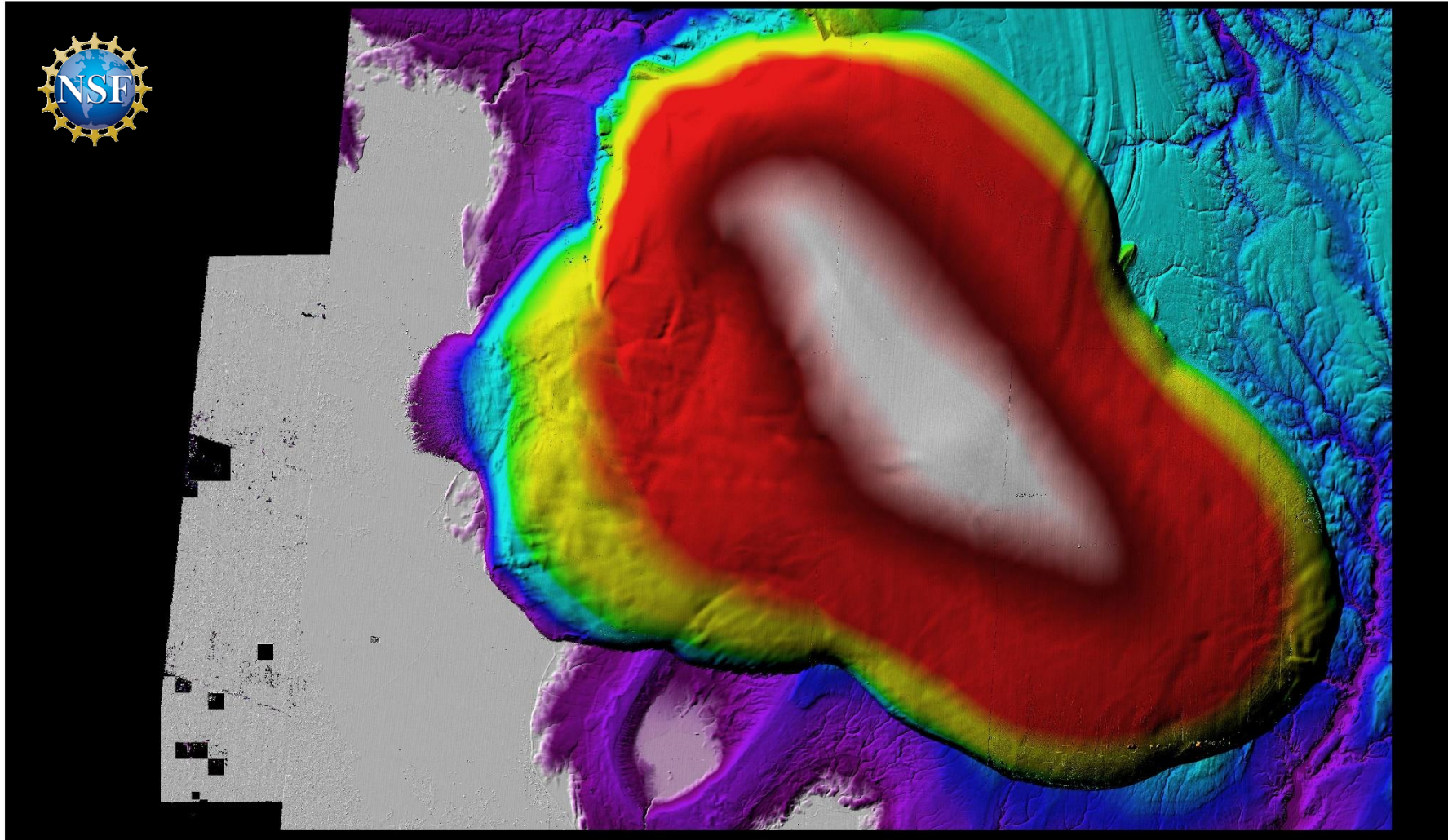


March 2013



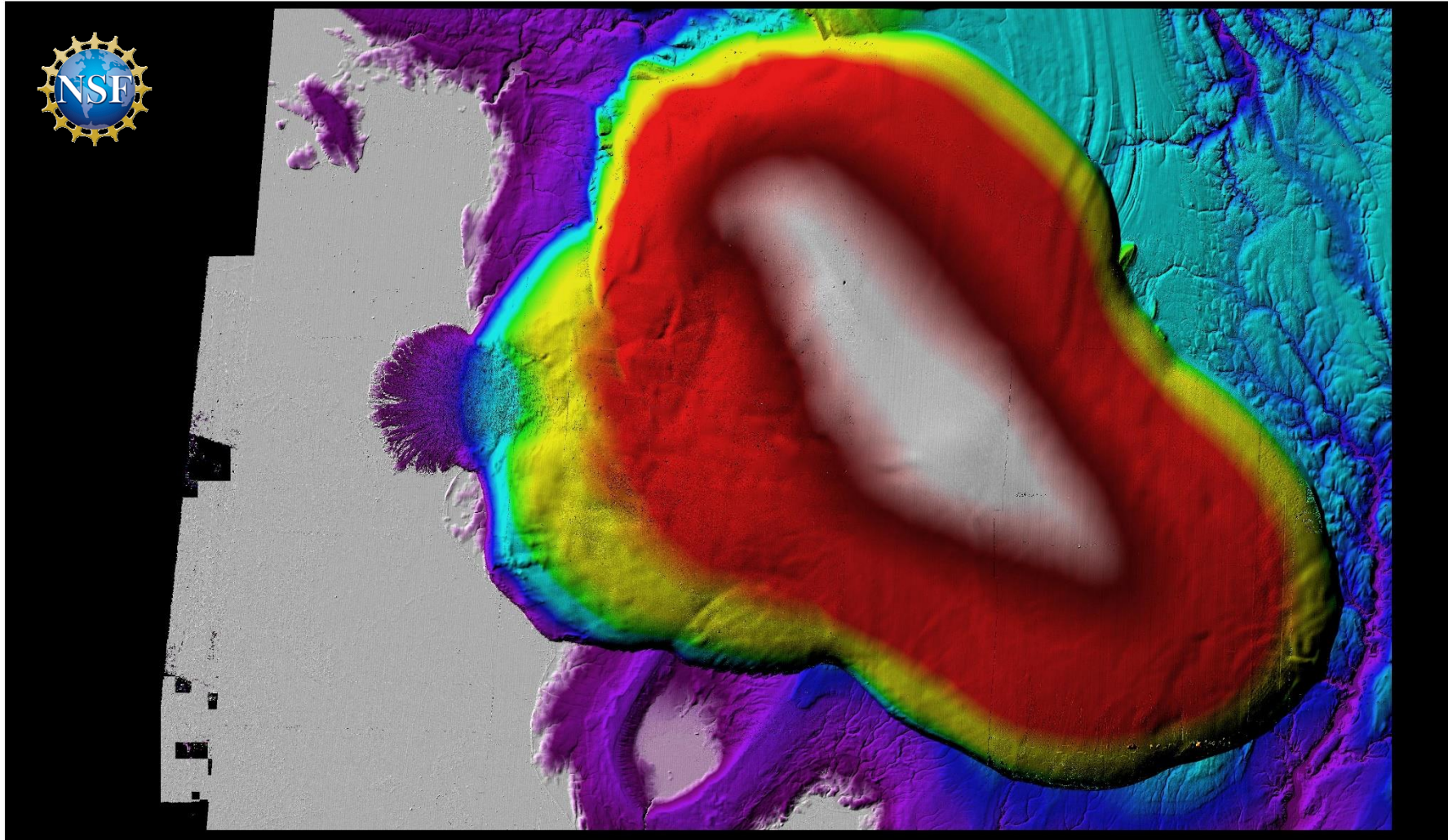
Cornell University

March 2014



Cornell University

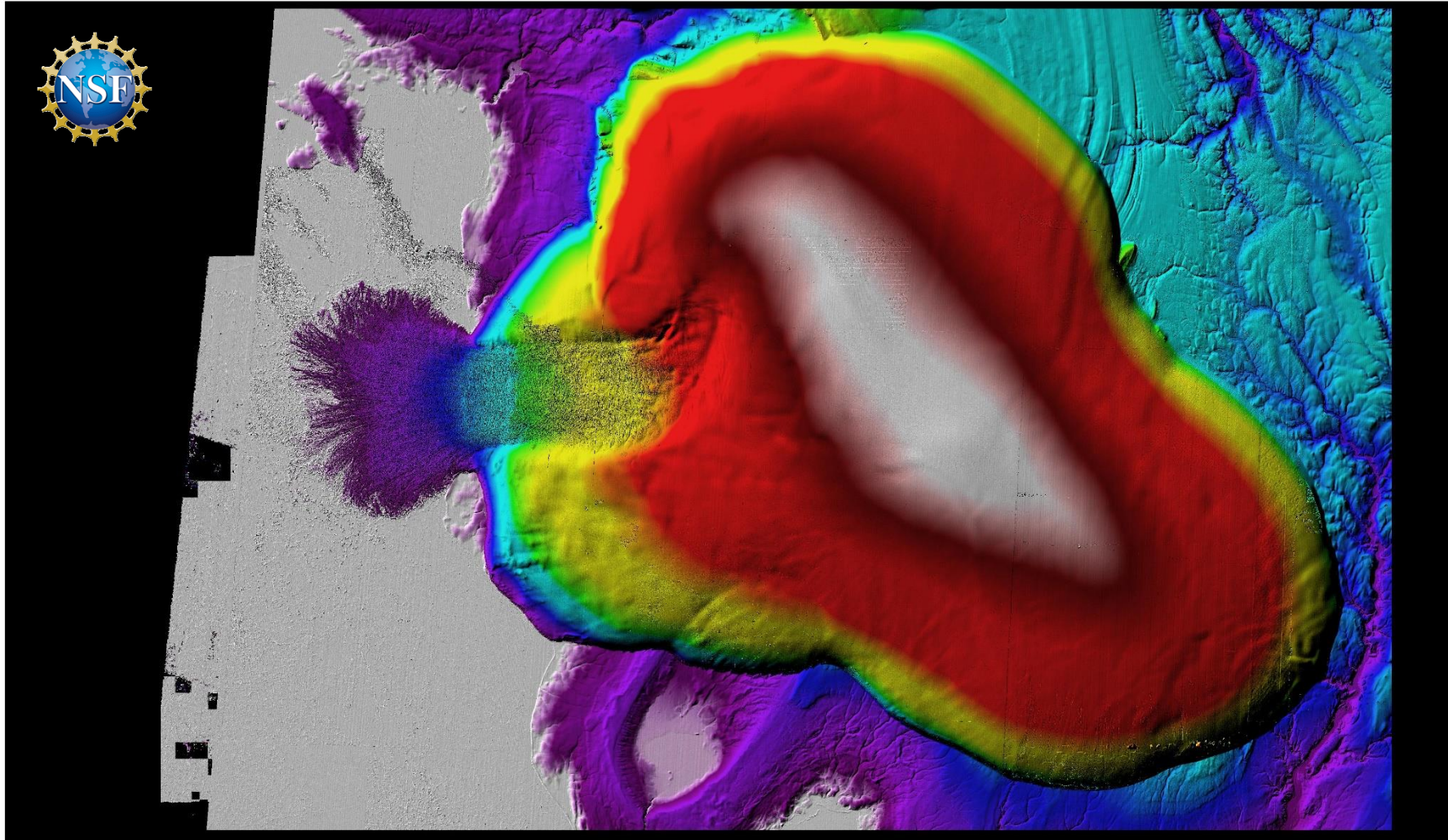
March 2015



Cornell University

DEMs from Saturday and Sunday

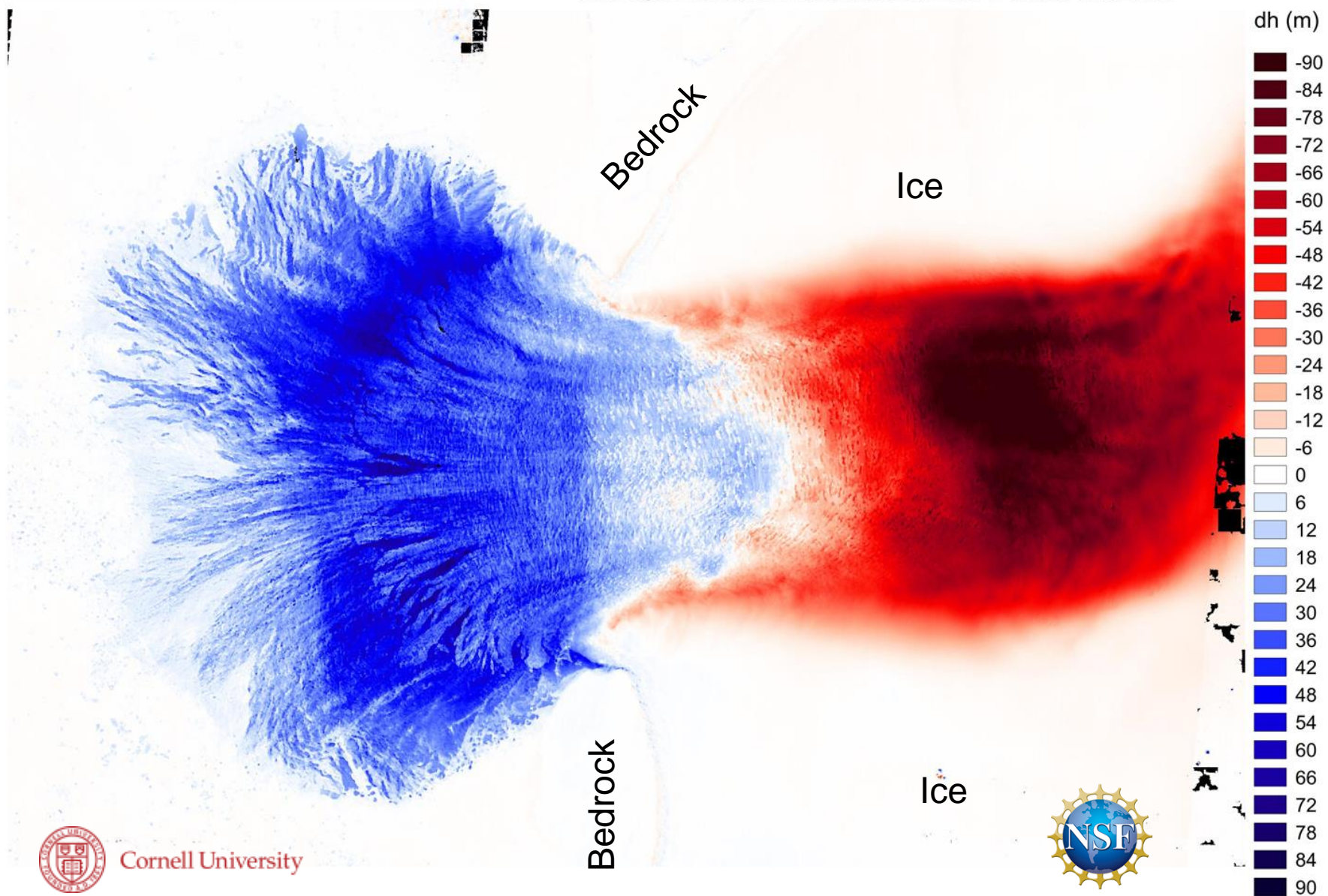
March 2016



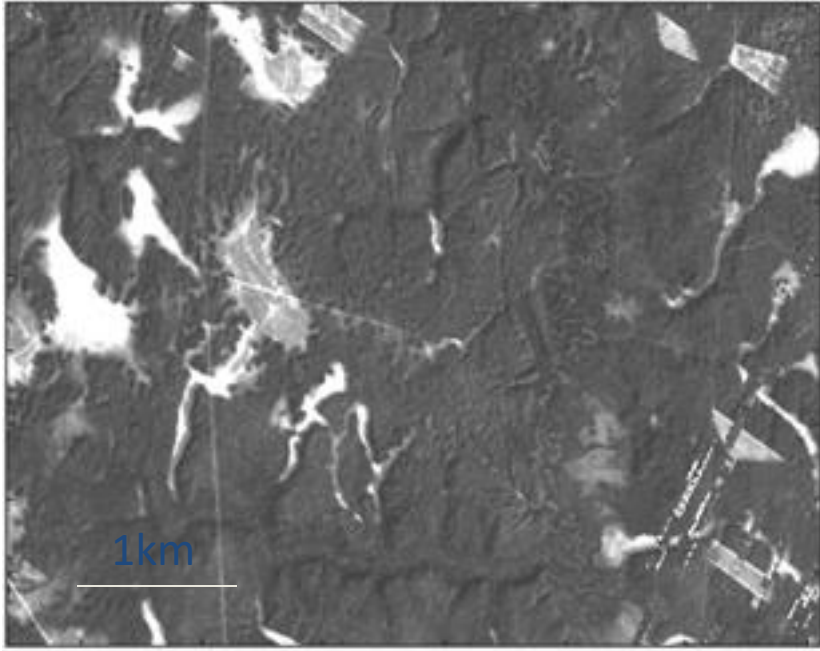
Cornell University

0 5 10 km

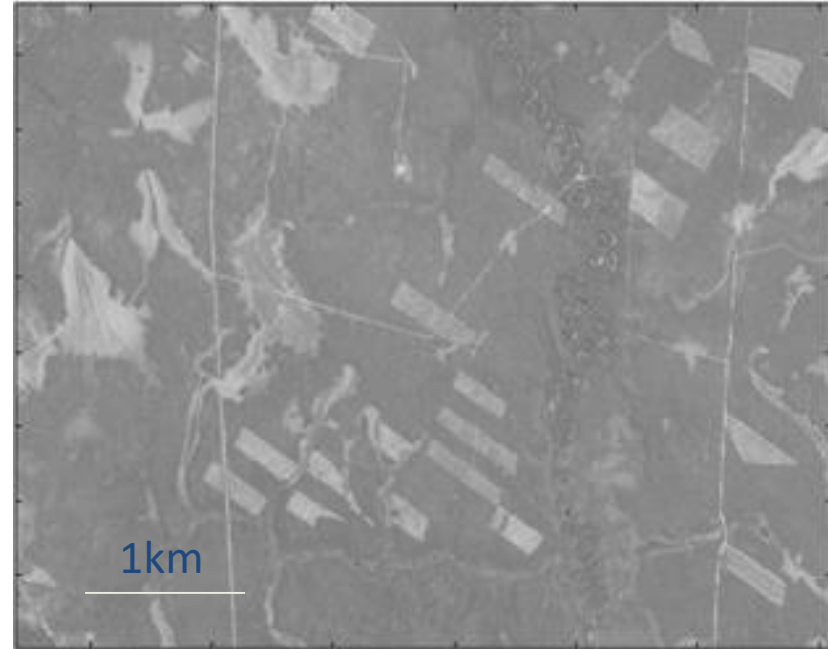
Ice Height Difference from March 20th 2015 to March 19th 2016.



Vegetation Change in Siberia

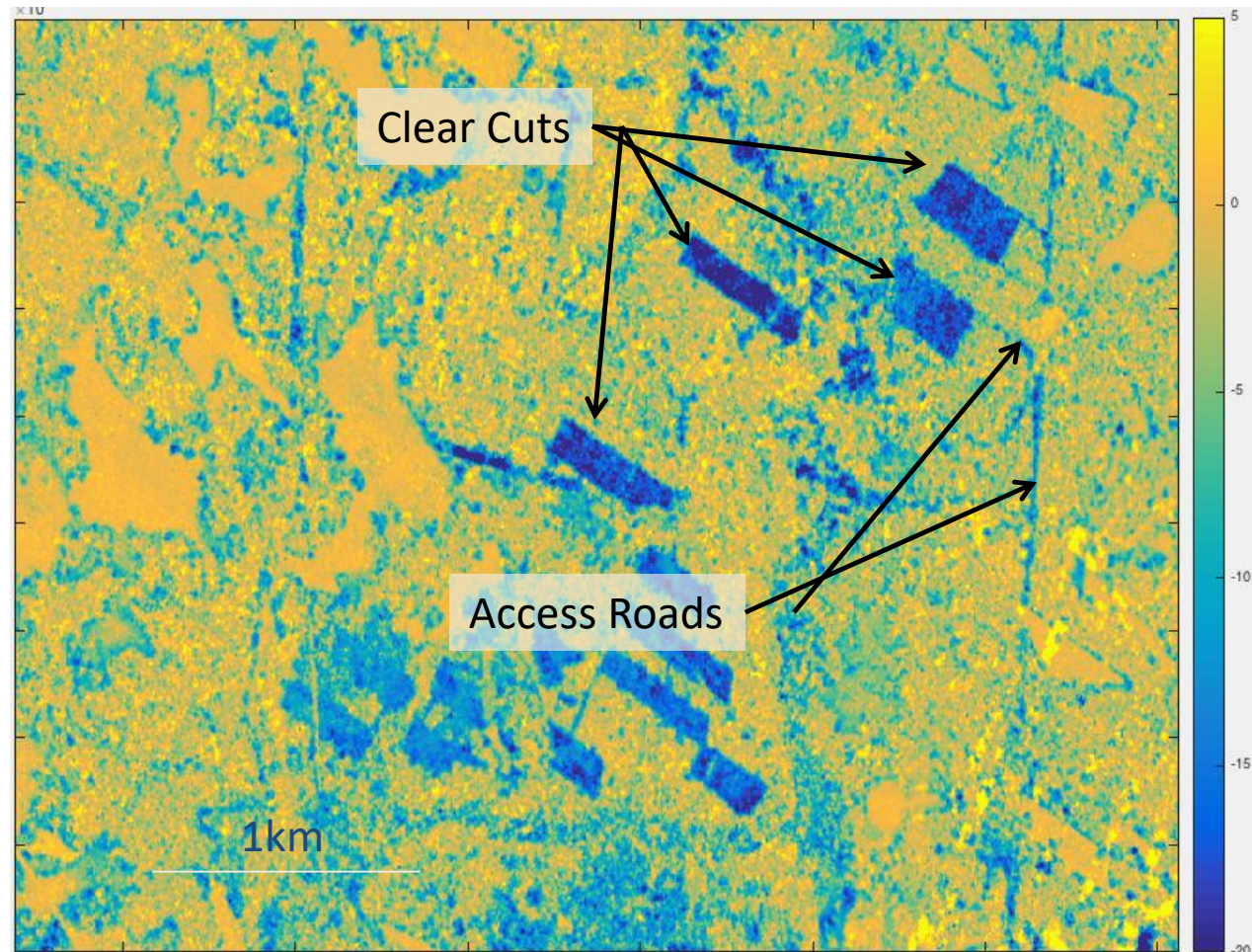


November 2012

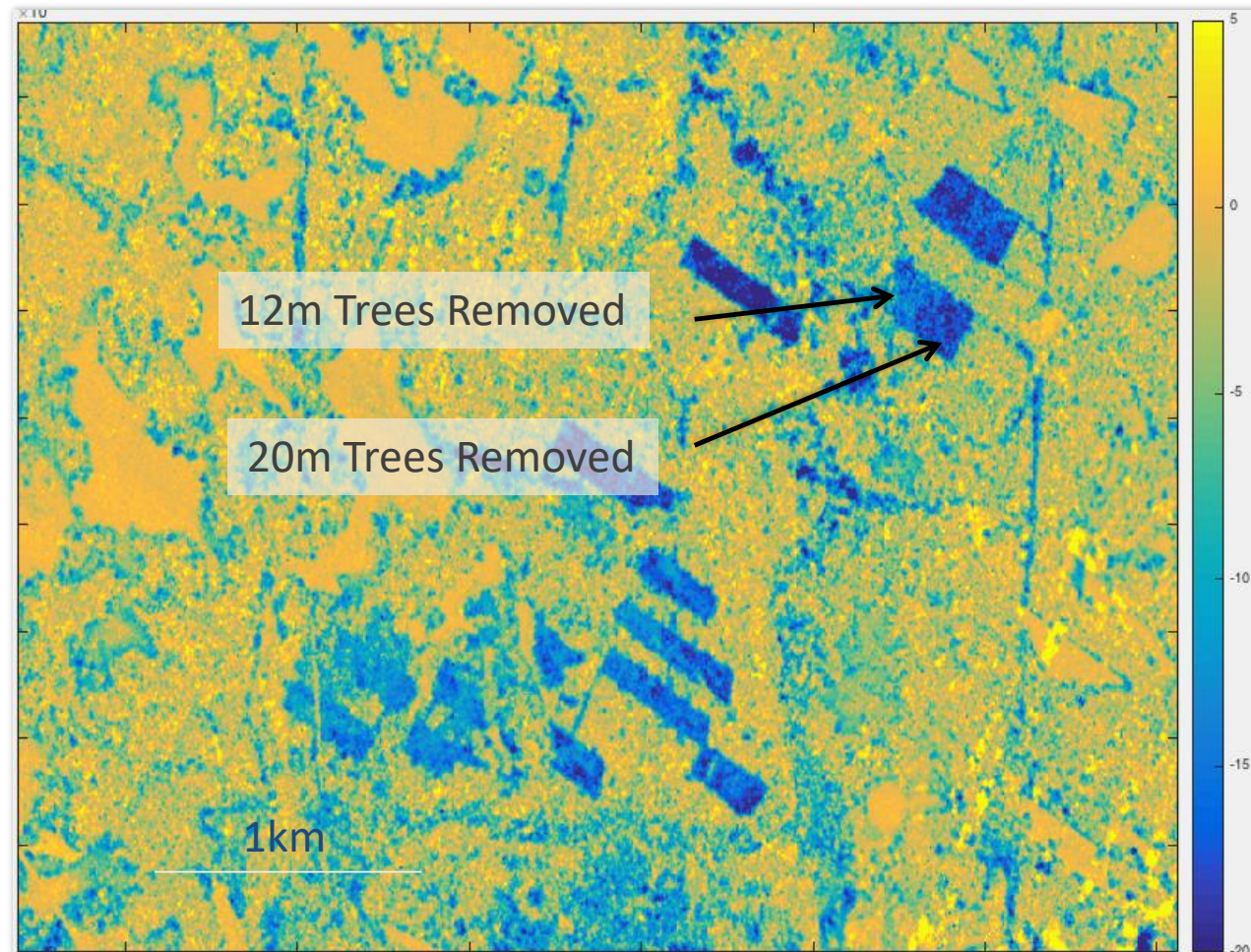


June 2015

2012 - 2015 Elevation Difference



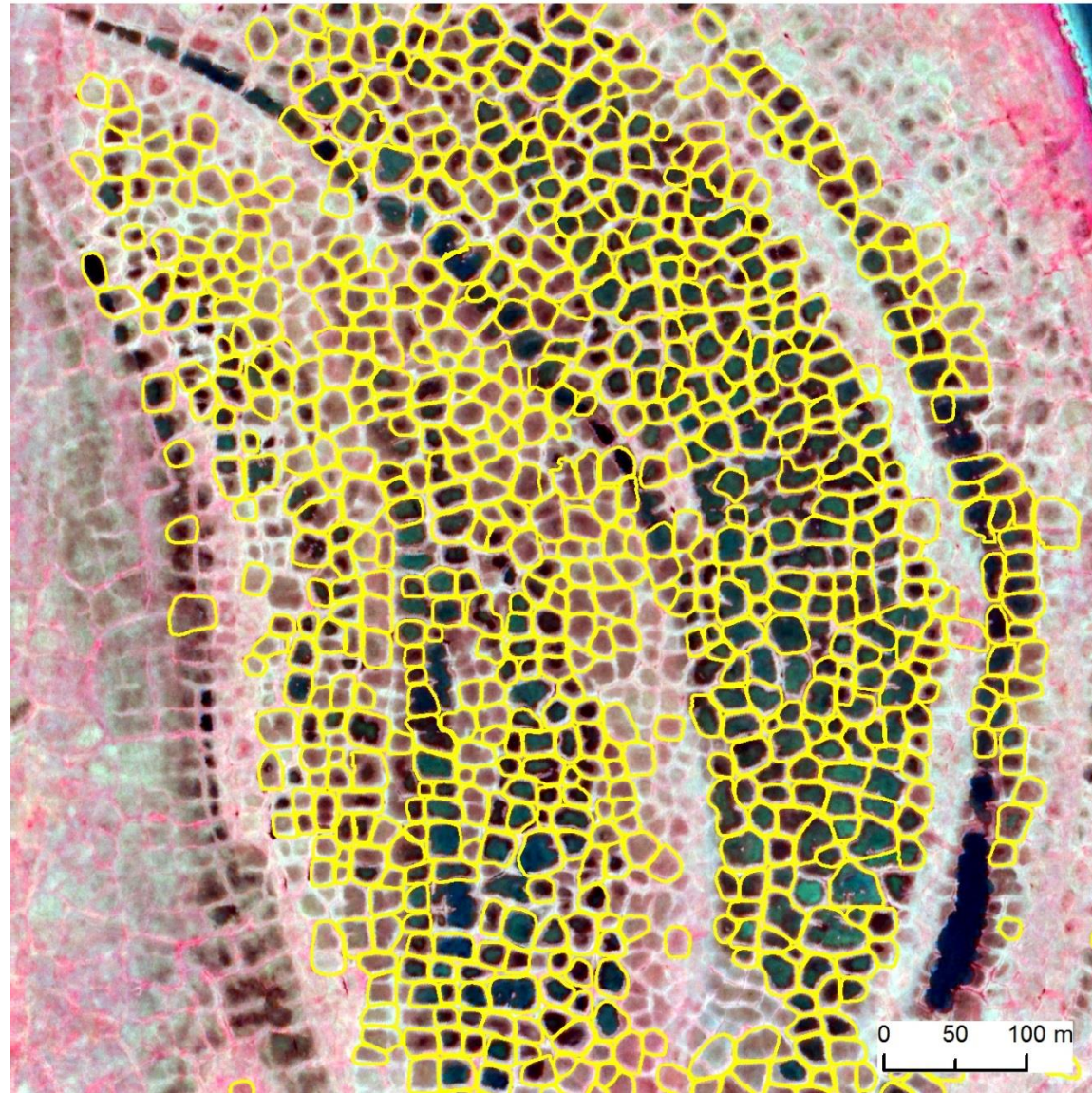
2012-2015 Difference





Worldview-2 image [0.5m, July, 2012]
[Imagery © 2018 DigitalGlobe, Inc.]





Automated detection of ice-wedge polygons

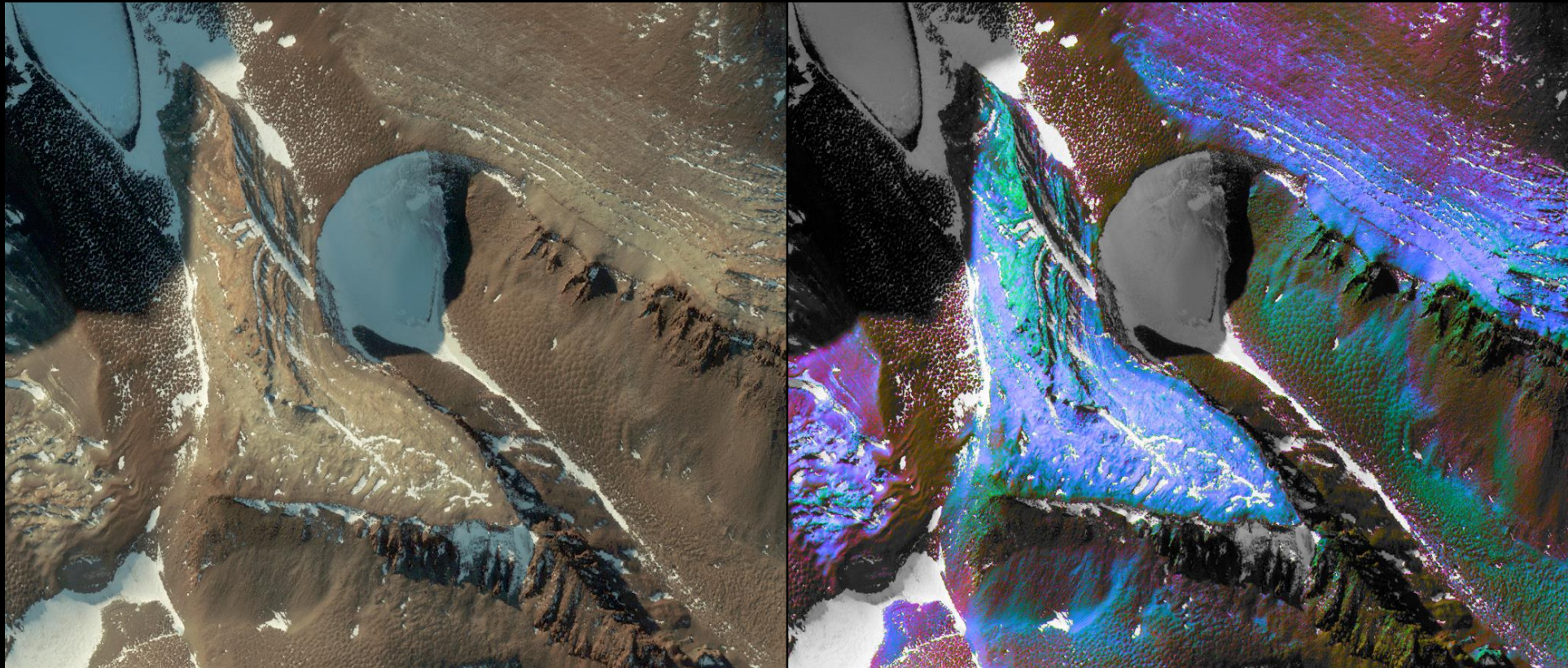
Bhuiyan and Witharana (unpublished)

Imagery © 2018 DigitalGlobe, Inc.

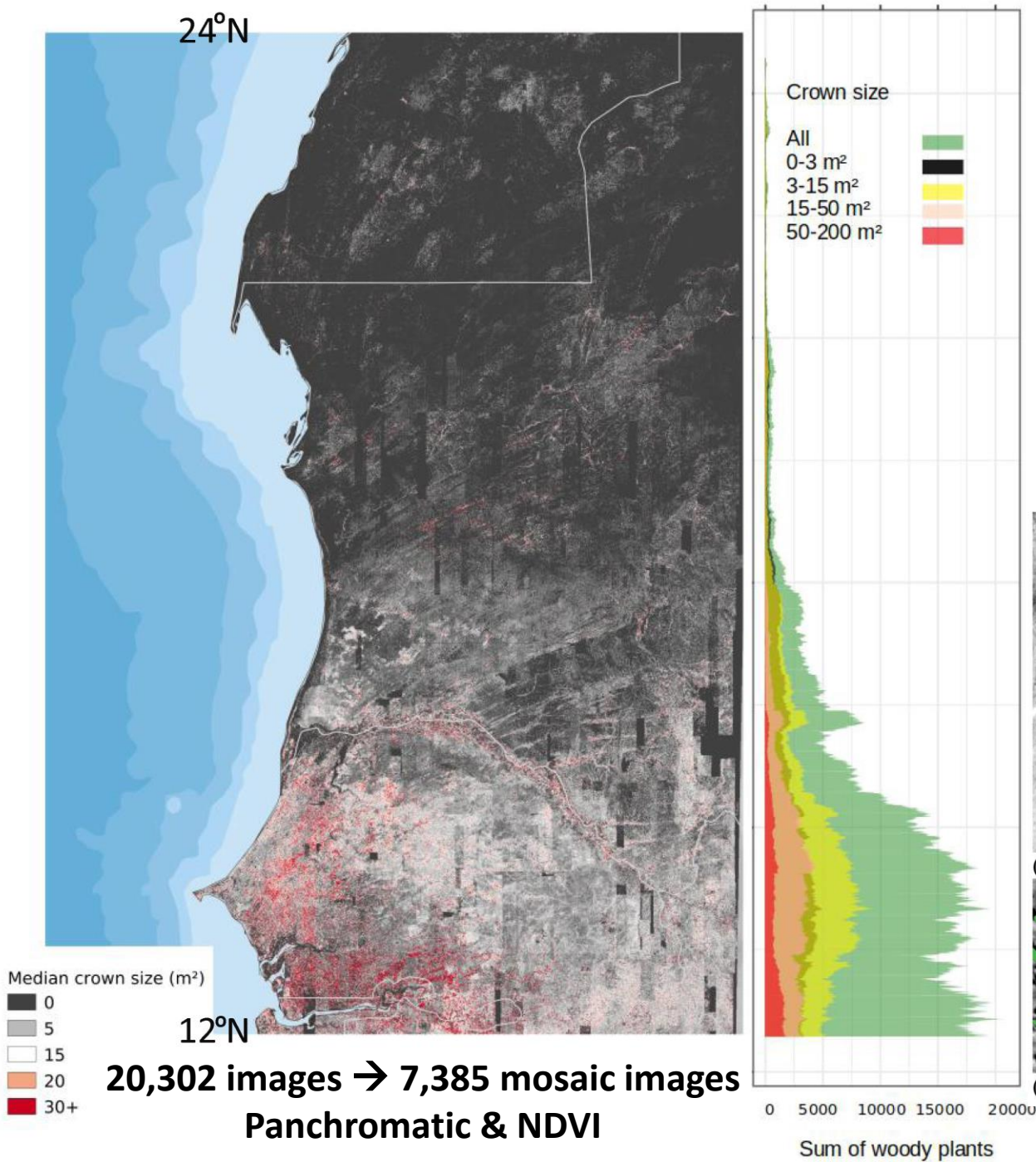


Mapping Surface Compositions from Orbit:

The Power of Multispectral Remote Sensing in Characterizing Planetary Surfaces



Mark Salvatore, Department of Physics & Astronomy, Northern Arizona University, mark.salvatore@nau.edu
Imagery © 2017 DigitalGlobe, Inc.

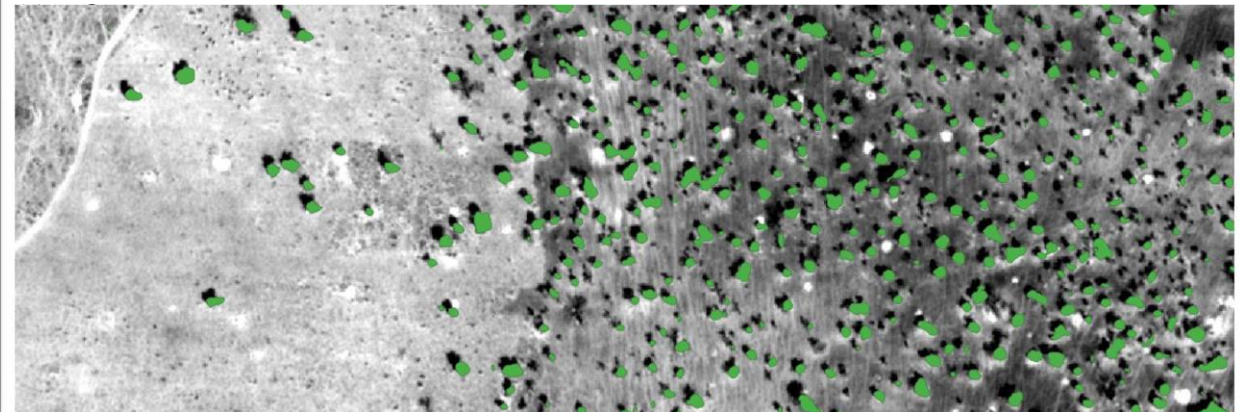


Semi-Arid Land Carbon Sink

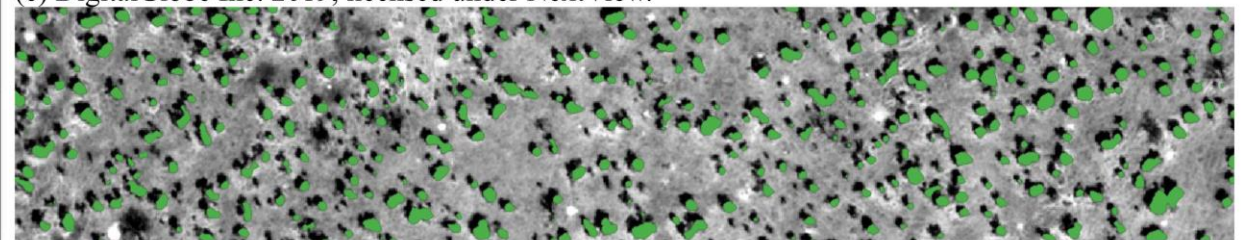
>690,000,000 trees identified with convoluted neural net processing from 12 N to 24 N latitude in UTM Zone 28

We have similar data from the Atlantic Ocean to the Red Sea, > 250,000 fifty cm images from 2006 – 2019

We are working on getting height → above ground biomass using shadows and using in-track stereo images at 50 cm

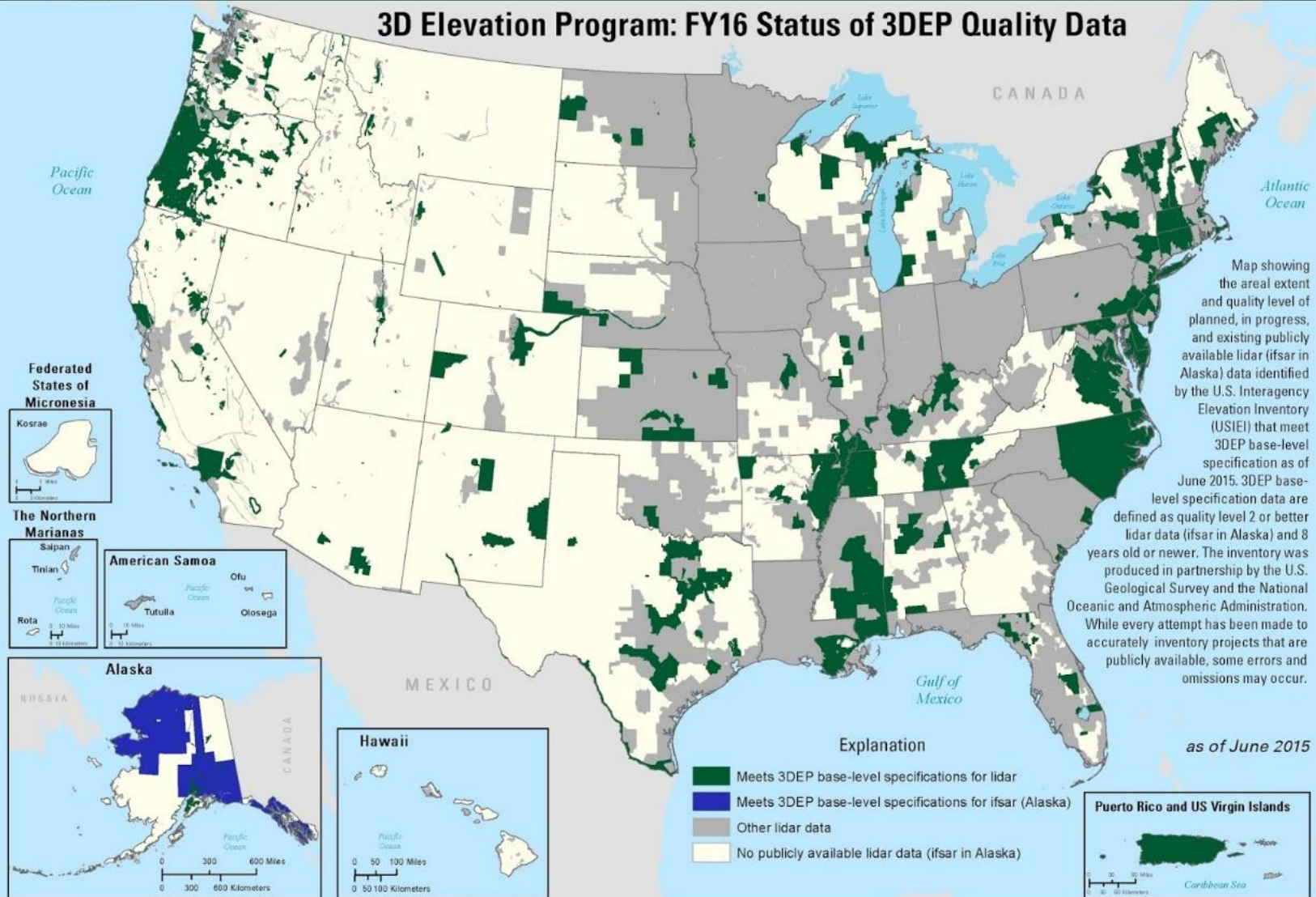


(c) DigitalGlobe Inc. 2019, licensed under NextView.



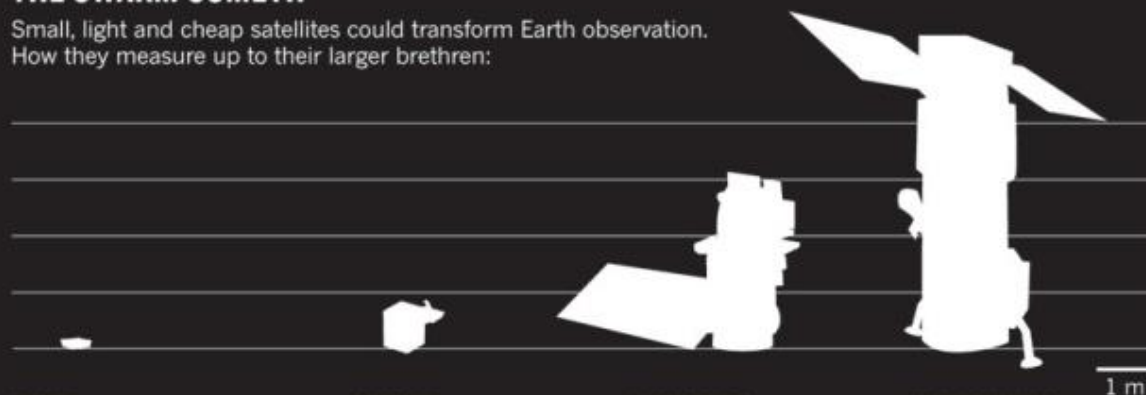
(c) DigitalGlobe Inc. 2019, licensed under NextView.

3D Elevation Program: FY16 Status of 3DEP Quality Data



THE SWARM COMETH

Small, light and cheap satellites could transform Earth observation. How they measure up to their larger brethren:



DOVE

Operator: Planet Labs
Number of satellites*: 32
Weight: ~5 kg
Instruments: Optical and near-infrared spectral bands
Spatial resolution: 3–5 m

SKYSAT

Operator: Skybox Imaging
Number of satellites*: 24
Weight: ~100 kg
Instruments: Optical and near-infrared spectral bands
Spatial resolution: ~1 m

LANDSAT 8

Operator: NASA
Number of satellites*: N/A
Weight: 2,071 kg[†]
Instruments: Multiple spectral bands
Spatial resolution: 15–100 m[‡]

WORLDVIEW-3

Operator: DigitalGlobe
Number of satellites*: N/A
Weight: 2,800 kg
Instruments: Multiple spectral bands
Spatial resolution: 0.3–30 m[‡]

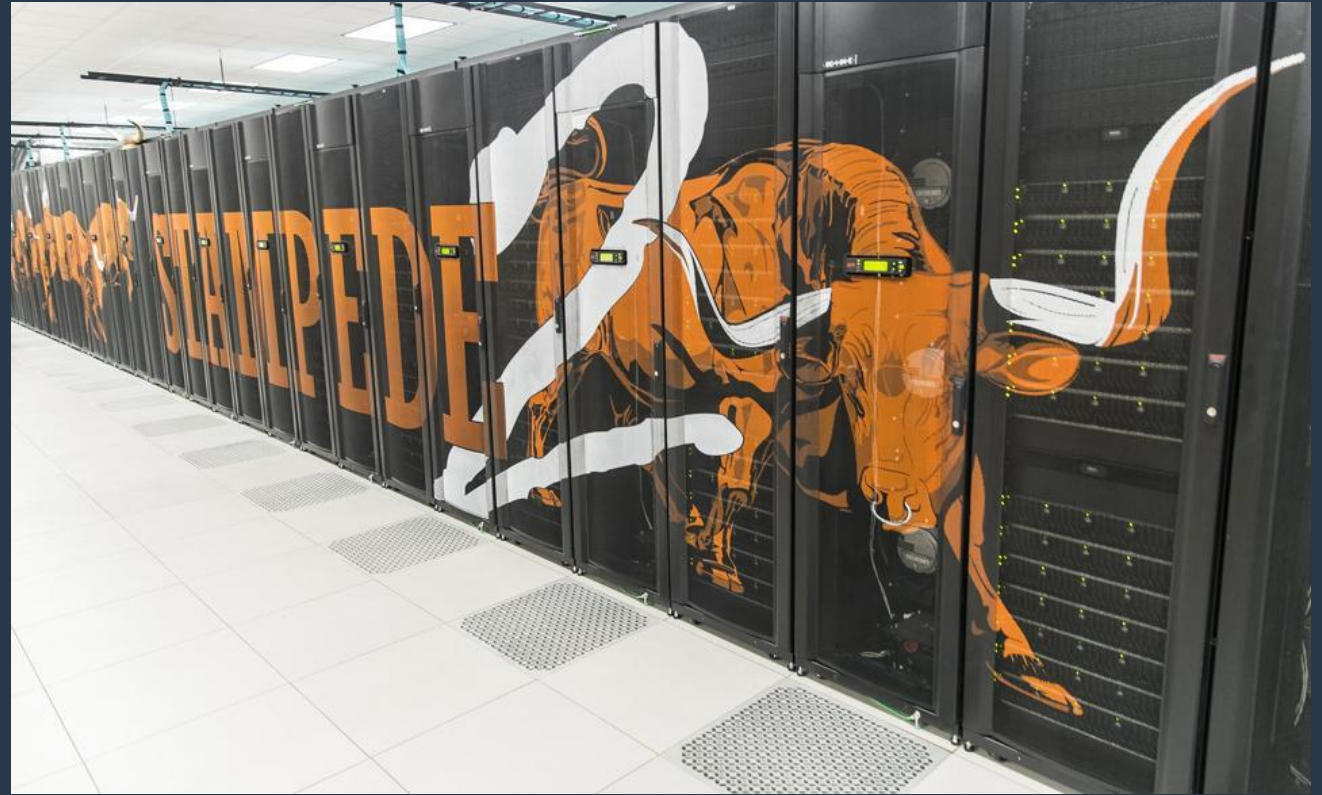
*When fully operational † Without instruments ‡ Depending on spectral frequency



Frontera



Stampede2



Blue Waters



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ArcticDEM map, produced on Blue Waters



REMA map, produced on Blue Waters

NCSA COLLABORATES WITH NGA TO CREATE THE WORLD'S MOST POWERFUL GEOSPATIAL SYSTEM

08.02.19 -  [Permalink](#)

The National Center for Supercomputing Applications (NCSA) at the [University of Illinois at Urbana-Champaign](#) has announced a new collaboration between the [Blue Waters Project](#), the [National Geospatial-Intelligence Agency](#) (NGA), the [University of Minnesota](#) and [The Ohio State University](#) to produce digital elevation models (DEM) of the entire Earth, among other geospatial research projects.

The collaboration, which is proceeding with an initial \$11.1 million in funding from the NGA through the [National Science Foundation](#) (NSF) for one year, will make Blue Waters the most powerful dedicated, non-classified geospatial system in the world, capable of bringing unprecedented speed and efficiency to global mapping, and fundamentally changing the way humans view the Earth. This collaboration will be a continuation of the existing Blue Waters machine and will leverage the Blue Waters Project's domain expertise in optimizing workflows, applications, and complex data analysis, The Ohio State University's programming domain expertise, and the University of Minnesota's data flow domain expertise.

"We're very excited to announce this relationship with NGA," said NCSA Director William "Bill" Gropp. "This is the beginning of building a long-term strategic relationship between NGA and the University of Illinois, centered on high-performance computing and data analysis. The Blue Waters collaboration is the first of what we anticipate will be many years of research collaborations between NGA and Illinois faculty as well as NCSA."

"The NGA is one of the primary organizations whose mission is to keep the United States secure and safe," said Bill Kramer, Blue Waters director at NCSA and research professor at Illinois's [Department of Computer Science](#). "They are pioneering new methods to understand the surface of our planet with advanced remote-sensing technology."

The first major project between the NGA and NCSA will be EarthDEM, a follow-up to the very successful [ArcticDEM project](#), which was conducted on Blue Waters by the [Polar Geospatial Center](#) at the University of Minnesota. Now, with the help of Blue Waters and the NGA, EarthDEM seeks to apply the same mapping and data processing techniques to the rest of the Earth, producing planet-wide DEM data sets. Once completed, these elevation models will be available to the public and have applications in areas that directly benefit society, from community planning to water resources, landslide, and seismic activity assessments.

Paris

Arch de Triomphe



Andes



Central Asia



St Louis



Ural Mountains



What we have learned...

Polar Cyberinfrastructure is about exploiting imagery.

Polar PIs are coming from *Field Based Science*.

A balance needs to be found between *Capacity/Capability* HPC as well as *Community/PI* projects within the HPC world.

We are limited by data, compute, and software/algorithms.

The community is being **crushed** by a wealth of data.

Large community projects span **multiple agencies**.

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IMAGERY COLLECTION

