



The Use of GeoSAR in Alaska SDMI Elevation Mapping

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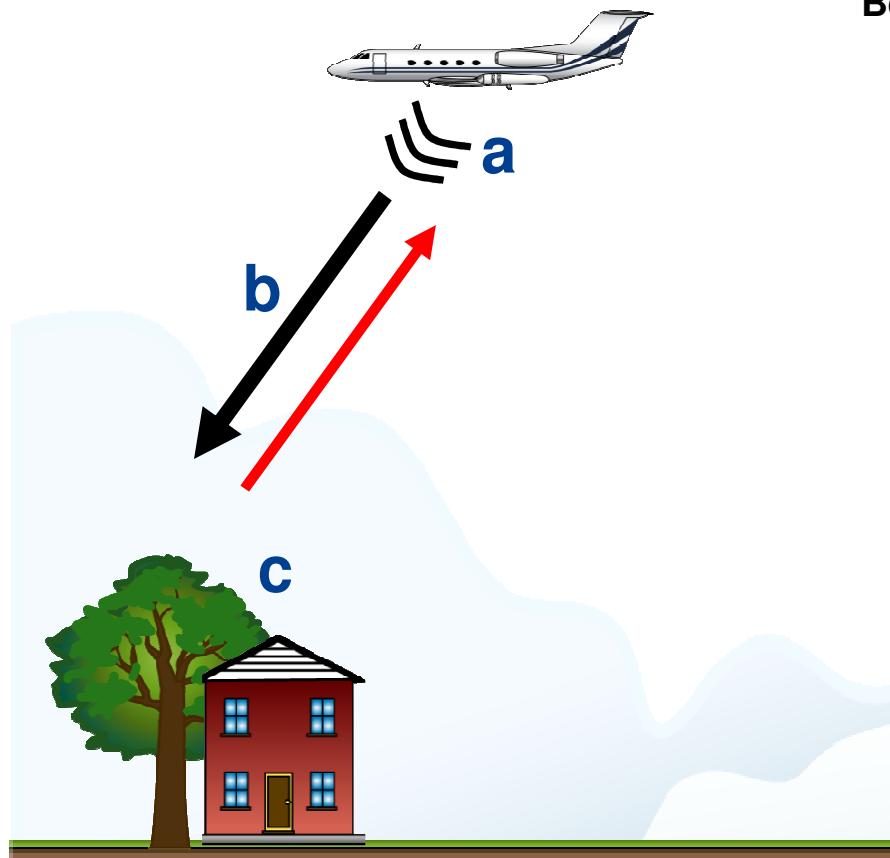


GeoSAR in Fairbanks, AK



RADAR Transmits and Receives Microwaves

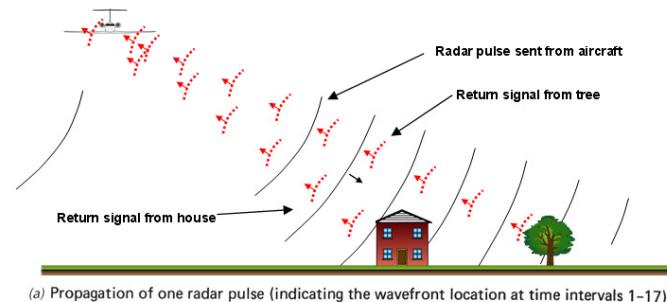
RADAR (RAdio Detecting And Ranging) is an active sensor that **transmits** a microwave signal (**a**) in a focused beam (**b**) towards targets and **detects** the backscattered portion of the signal (**c**).



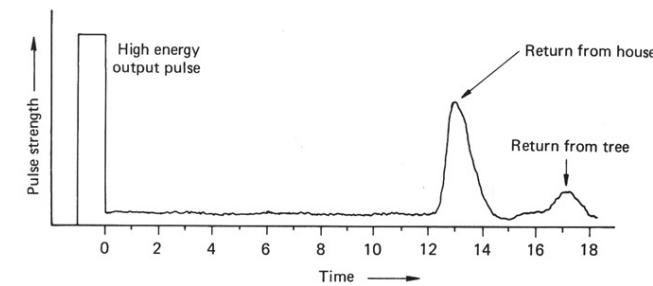
The **strength** of the backscattered signal is measured to discriminate between different targets. The **time delay** between the transmitted and reflected signals determines the distance (or range) to the target.

Benefits:

- Day/night, most weather
- Foliage penetration (P-band)



(a) Propagation of one radar pulse (indicating the wavefront location at time intervals 1-17)

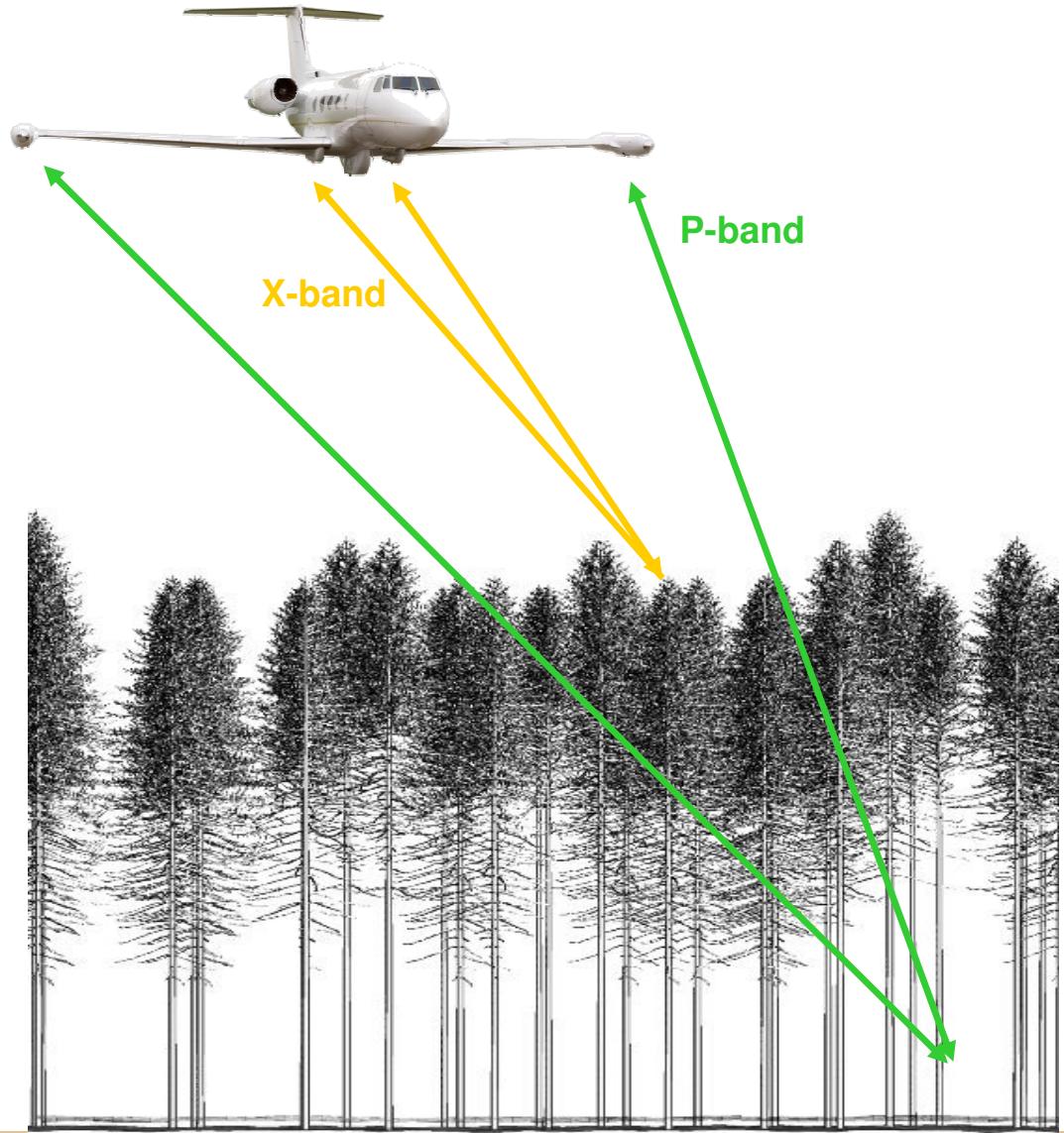


(b) Resulting antenna return

X-band vs P-band

- X-band (yellow) reflects off of the first surface
 - Produces DSM and magnitude image of surface features (vegetation, houses, roadways)

- P-band (green) penetrates vegetation, ice, dry soil, to collect terrain features
 - Basis for DTM and magnitude image of underlying features (paths, cultural features, fences, geologic features, most metallic features, wetlands)



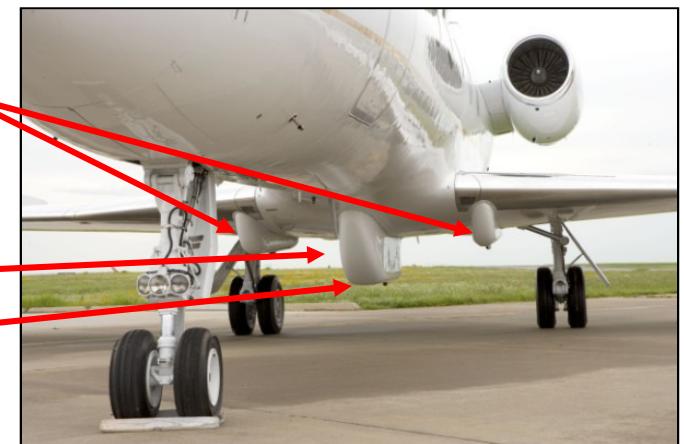
GeoSAR System



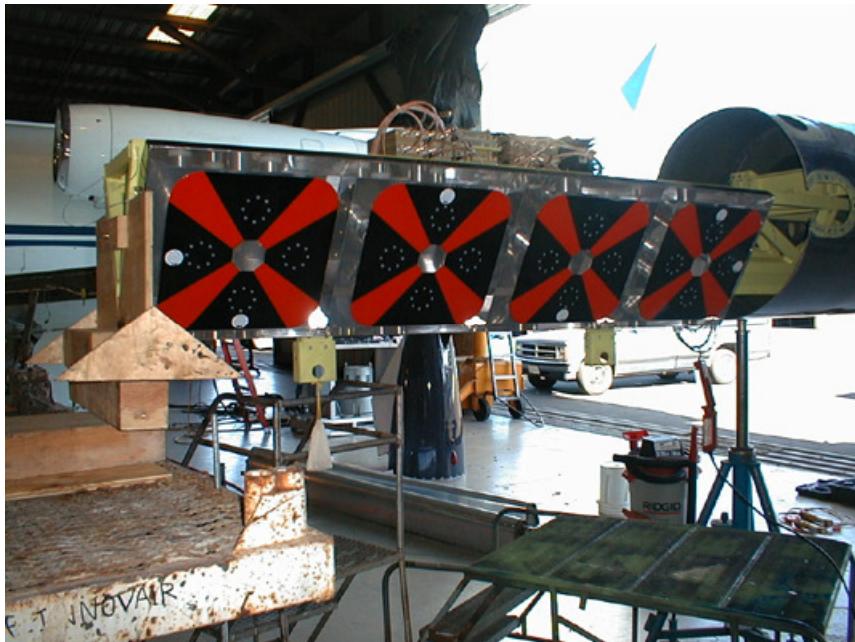
- Two **P-band** Antennas per Pod (22 m baseline)



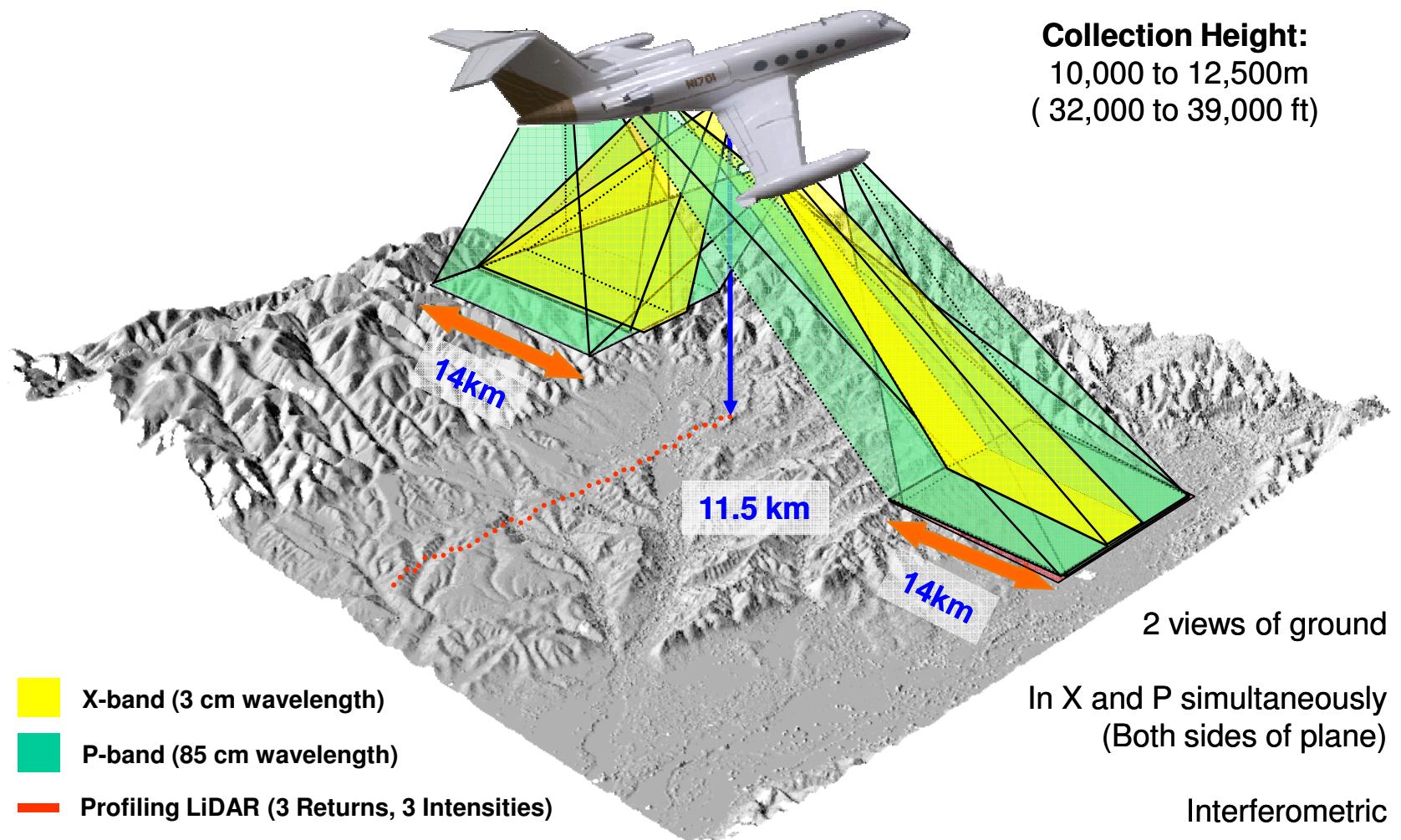
- Two **X-band** Antennas per Pod (2.6 m baseline)
- Antenna Positioning Measurement Unit (APMU)
- LiDAR Profiler



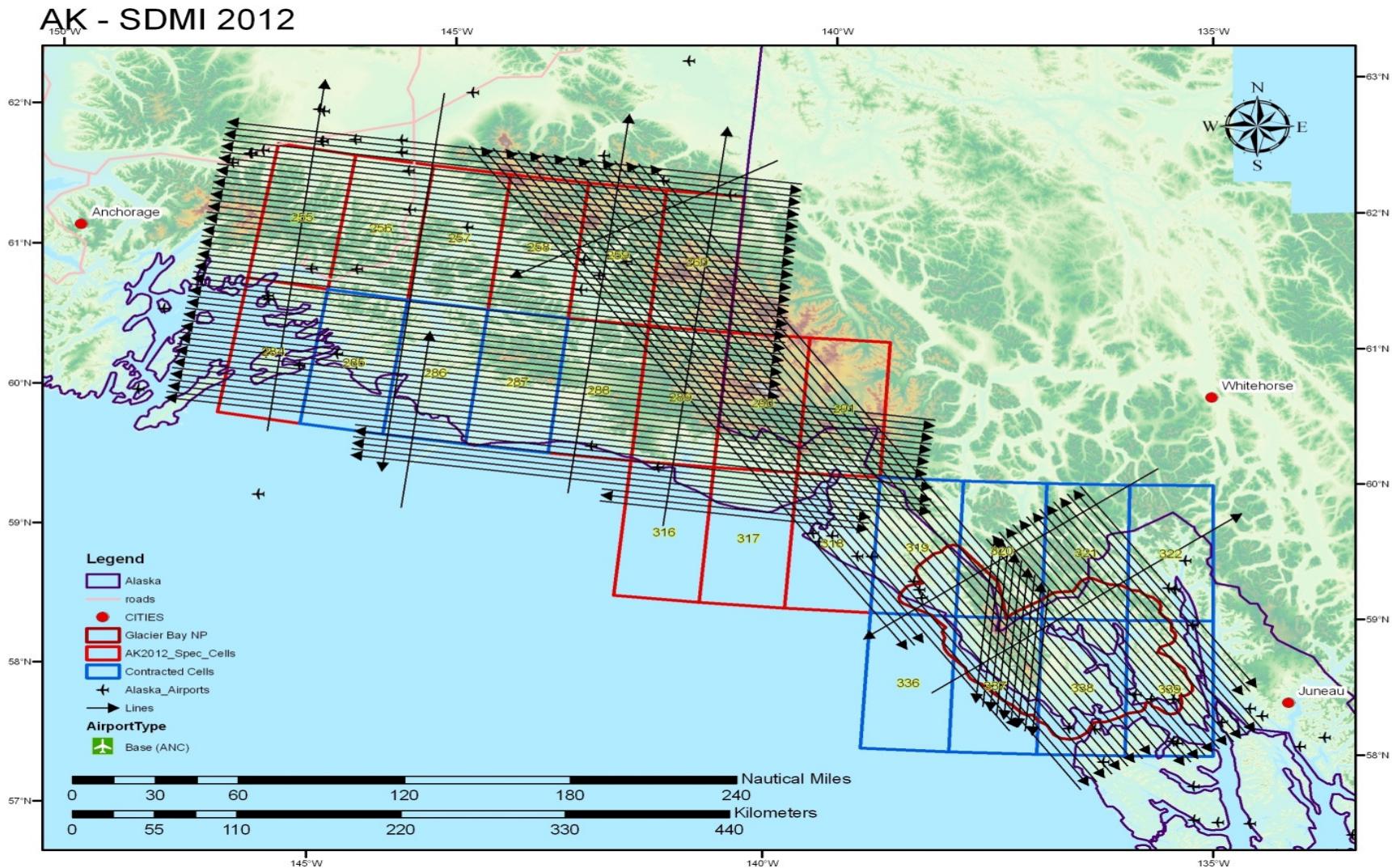
P-band Antennas



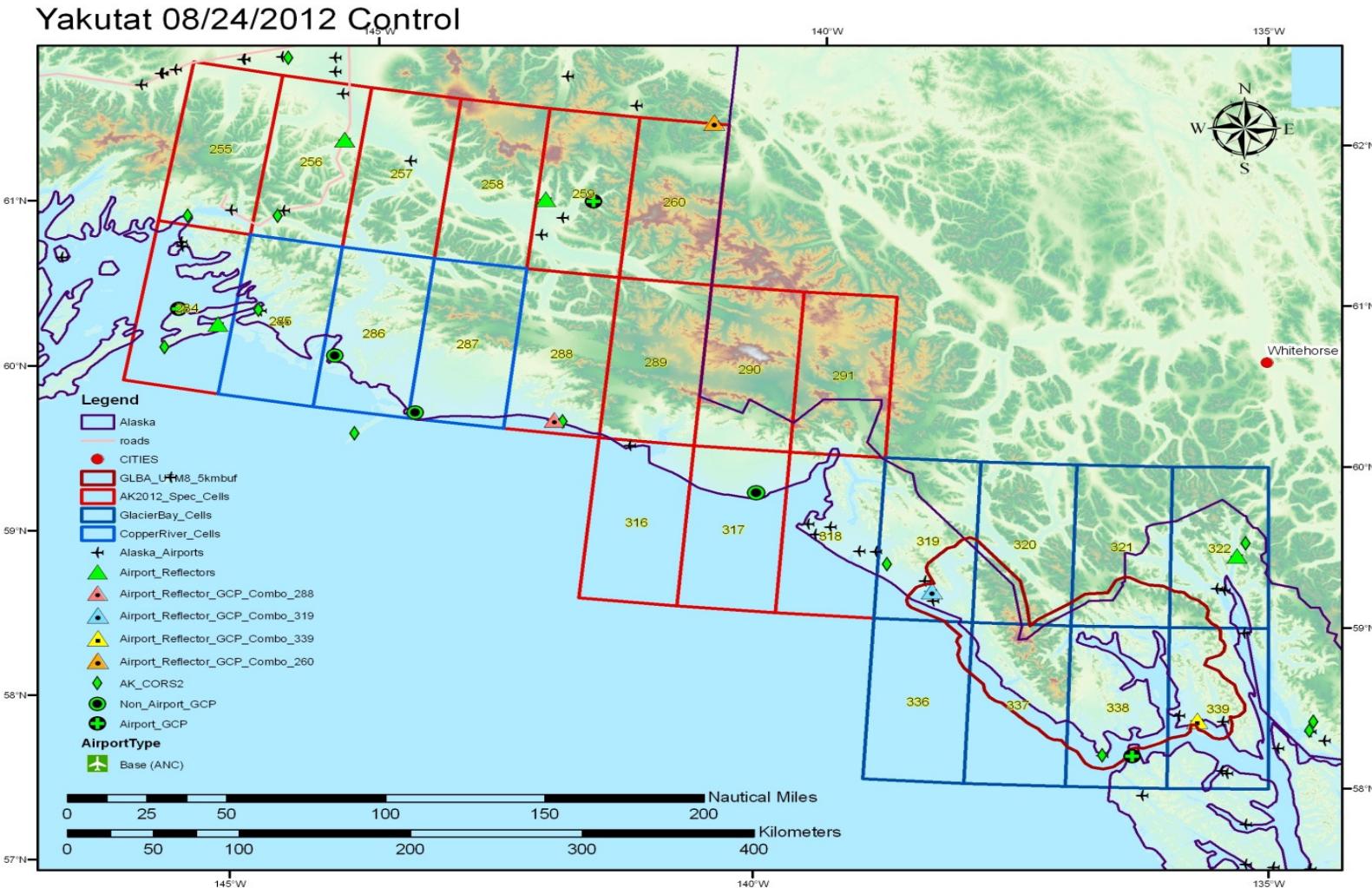
Data Collection



Alaska SDMI – 2012 Acquisition



Alaska SDMI – 2012 Ground Control Plan

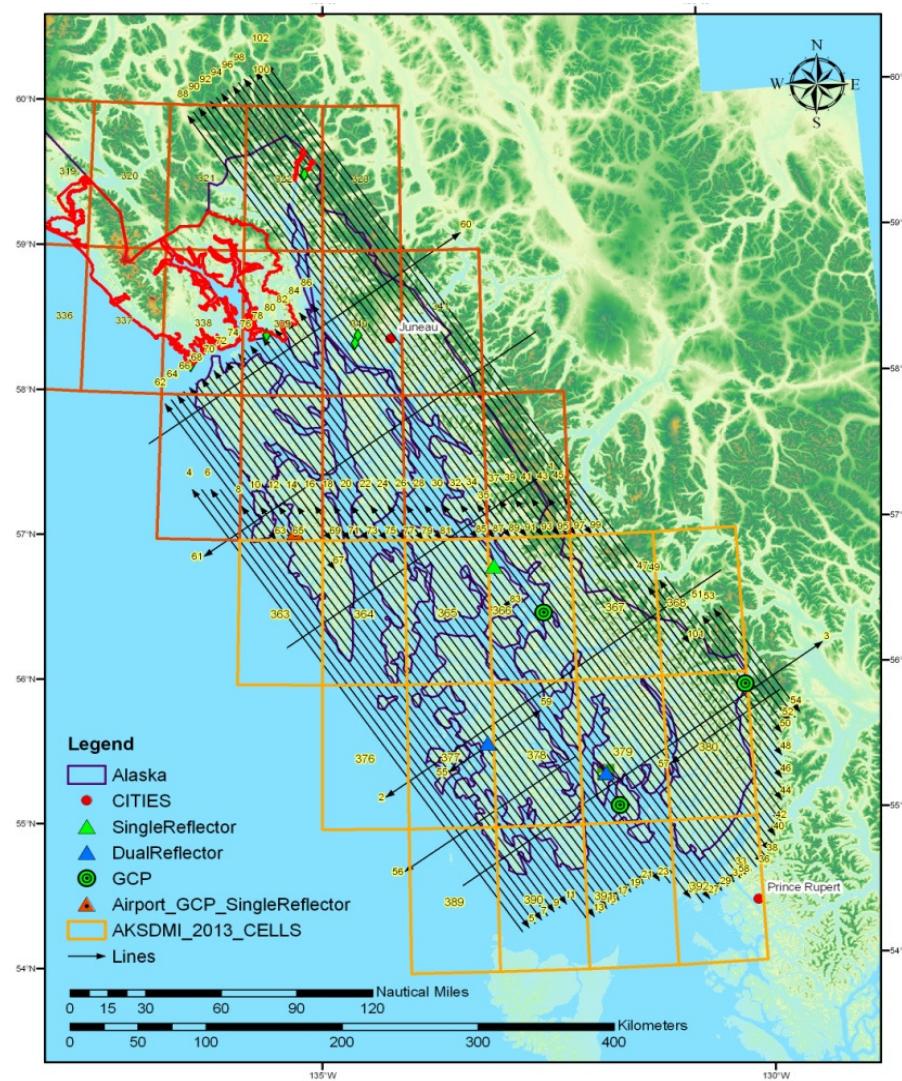




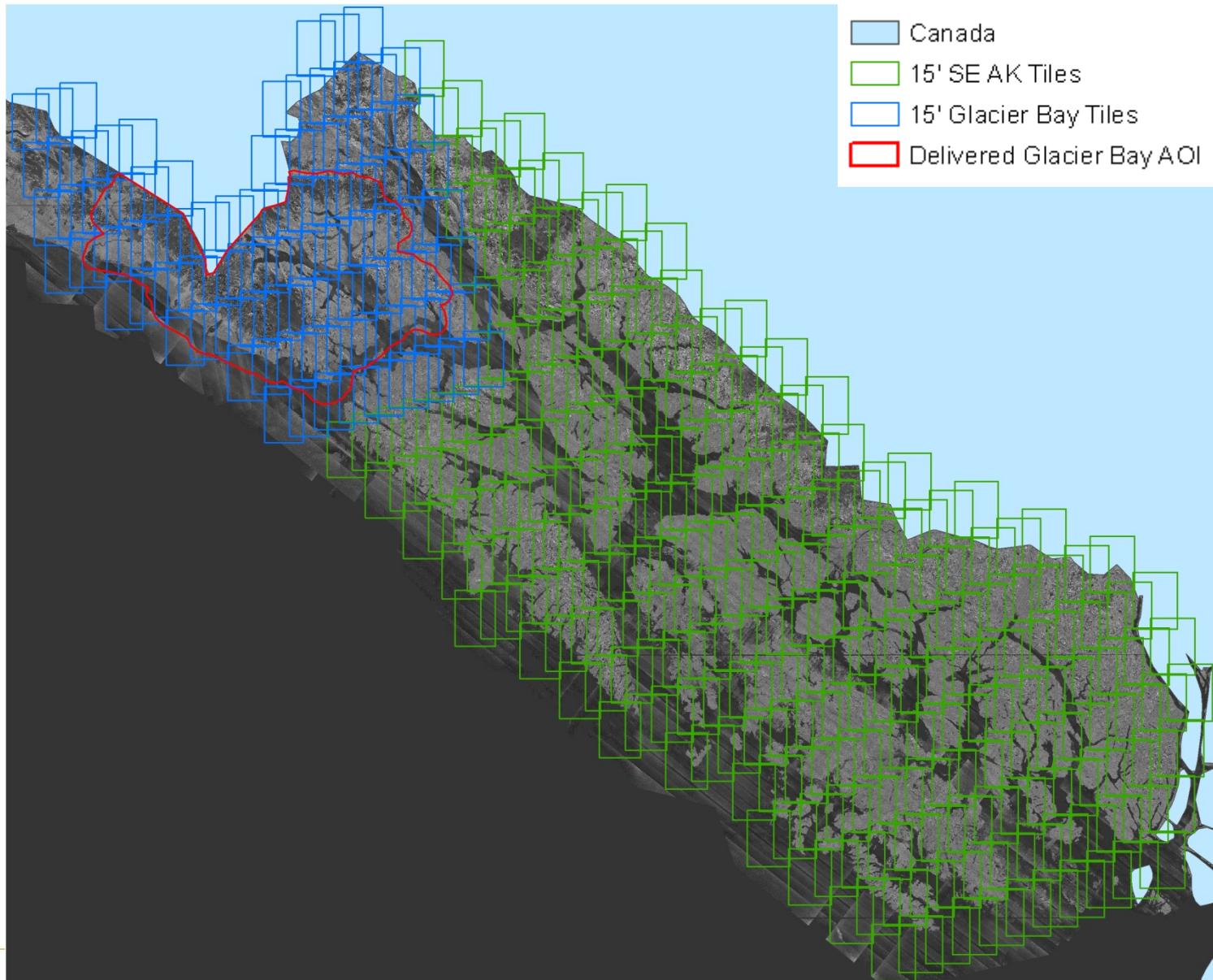
Alaska SDMI – SEAK 2013 Status

- Mission planning started – July 2013
- Mobilization to Ketchikan, Alaska – 2 August
- Acquisition begins – 15 August
- Acquisition complete – 2 September
- Processing to take place in 2 blocks
- All data collected without contract – spec collect
- All data processed in the United States of America

Alaska SDMI – 2013 Spec Acquisition



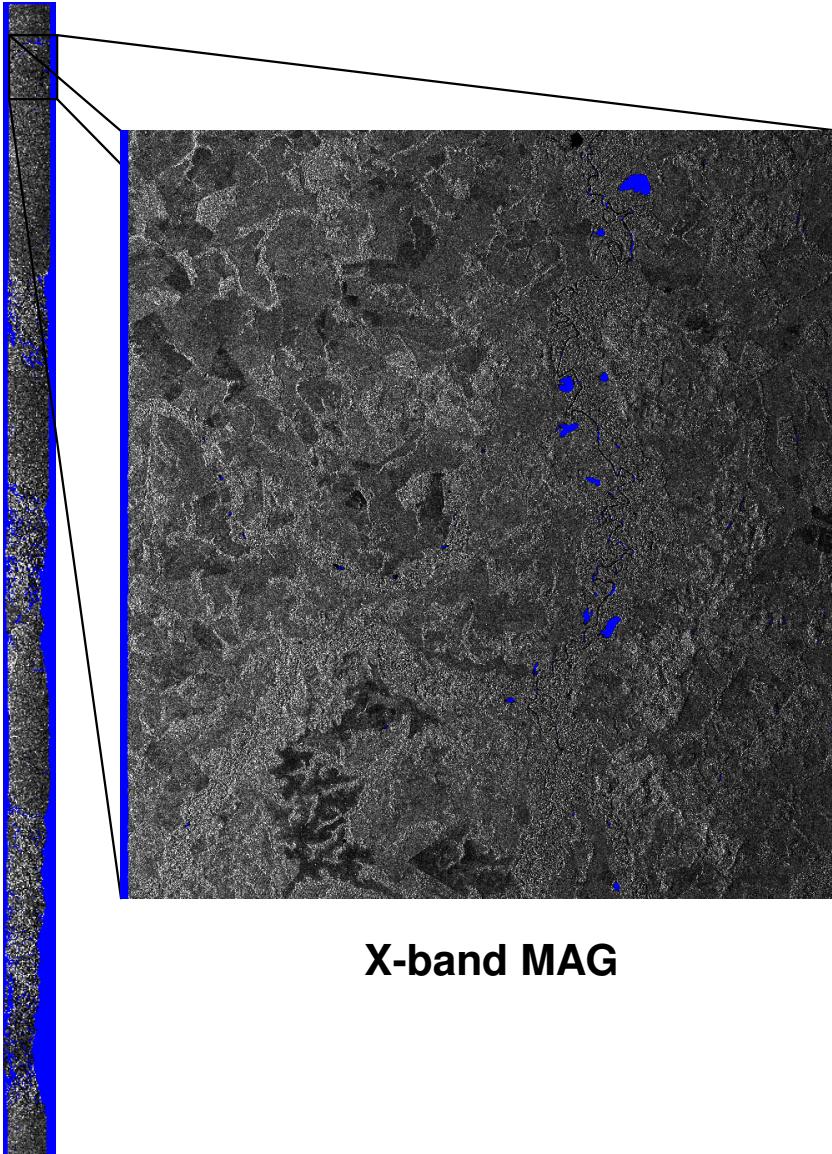
SEAK Collected Areas 2013



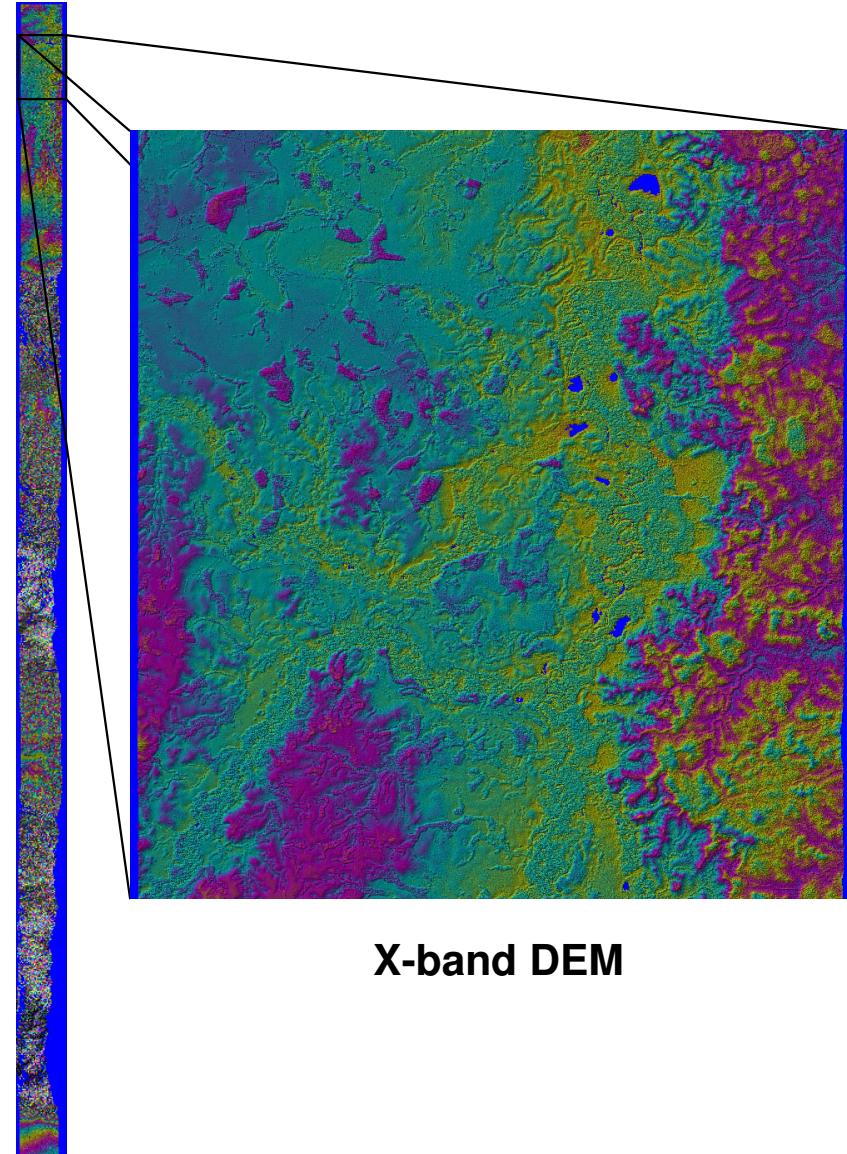


PROCESSING AK SDMI DATA

Production - Signal Conversion - MAG and DEM

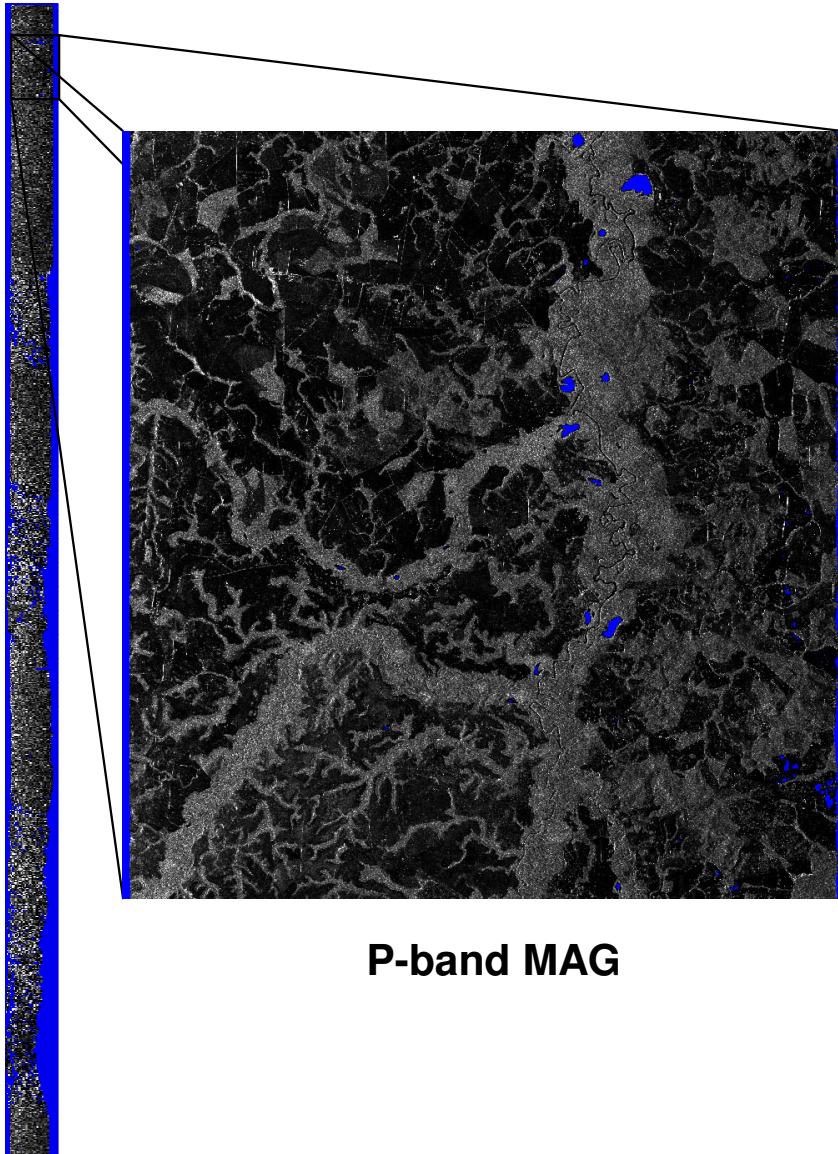


X-band MAG

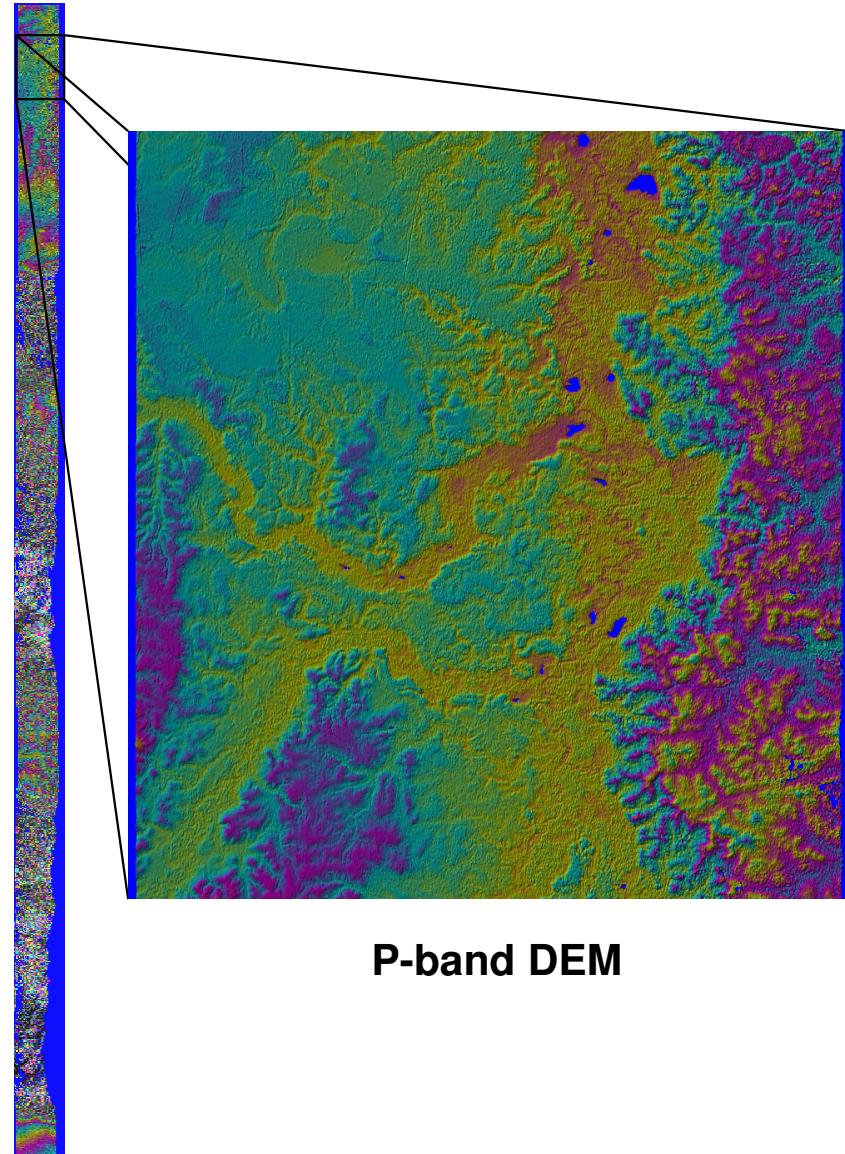


X-band DEM

Production - Signal Conversion - MAG and DEM

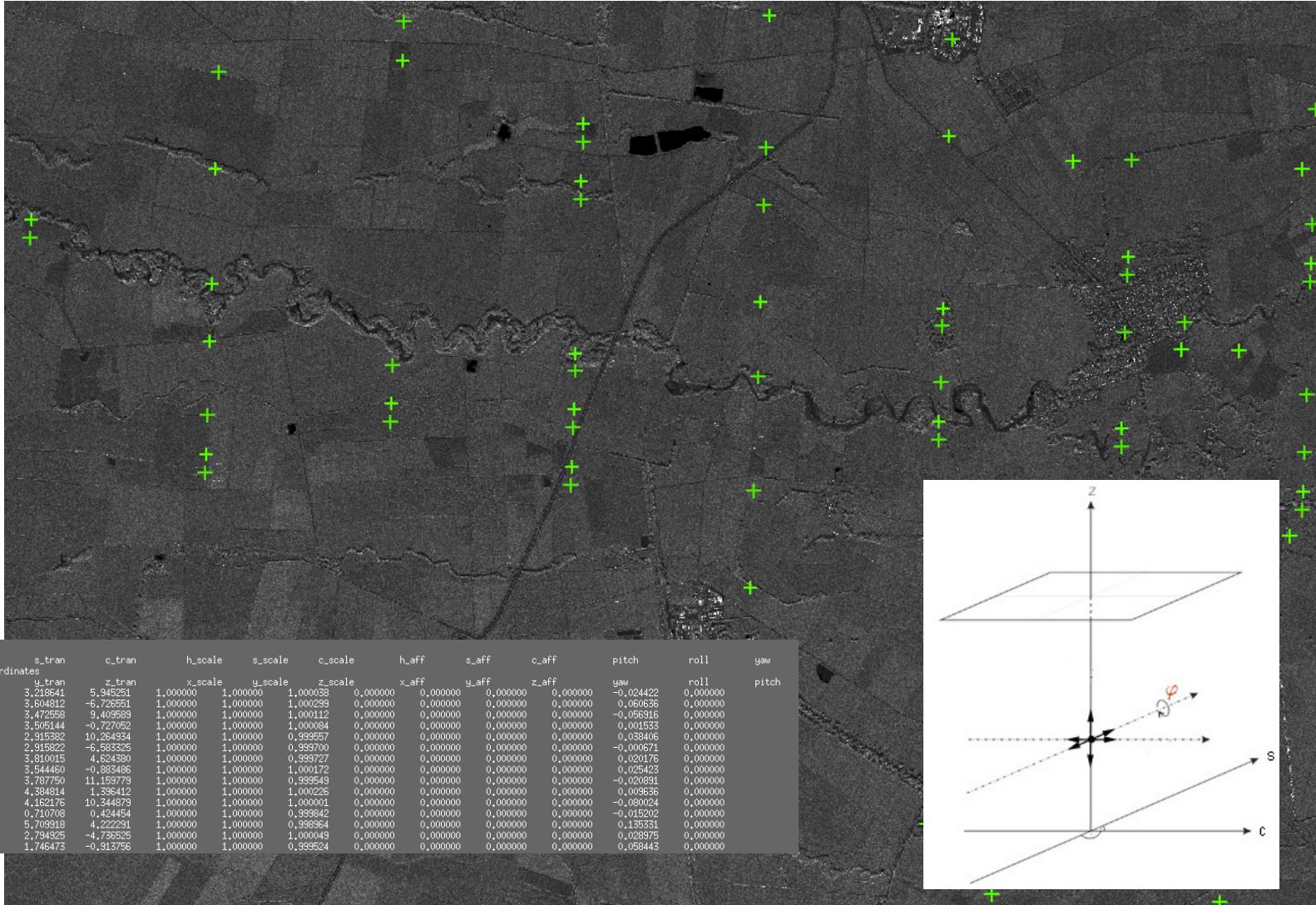


P-band MAG

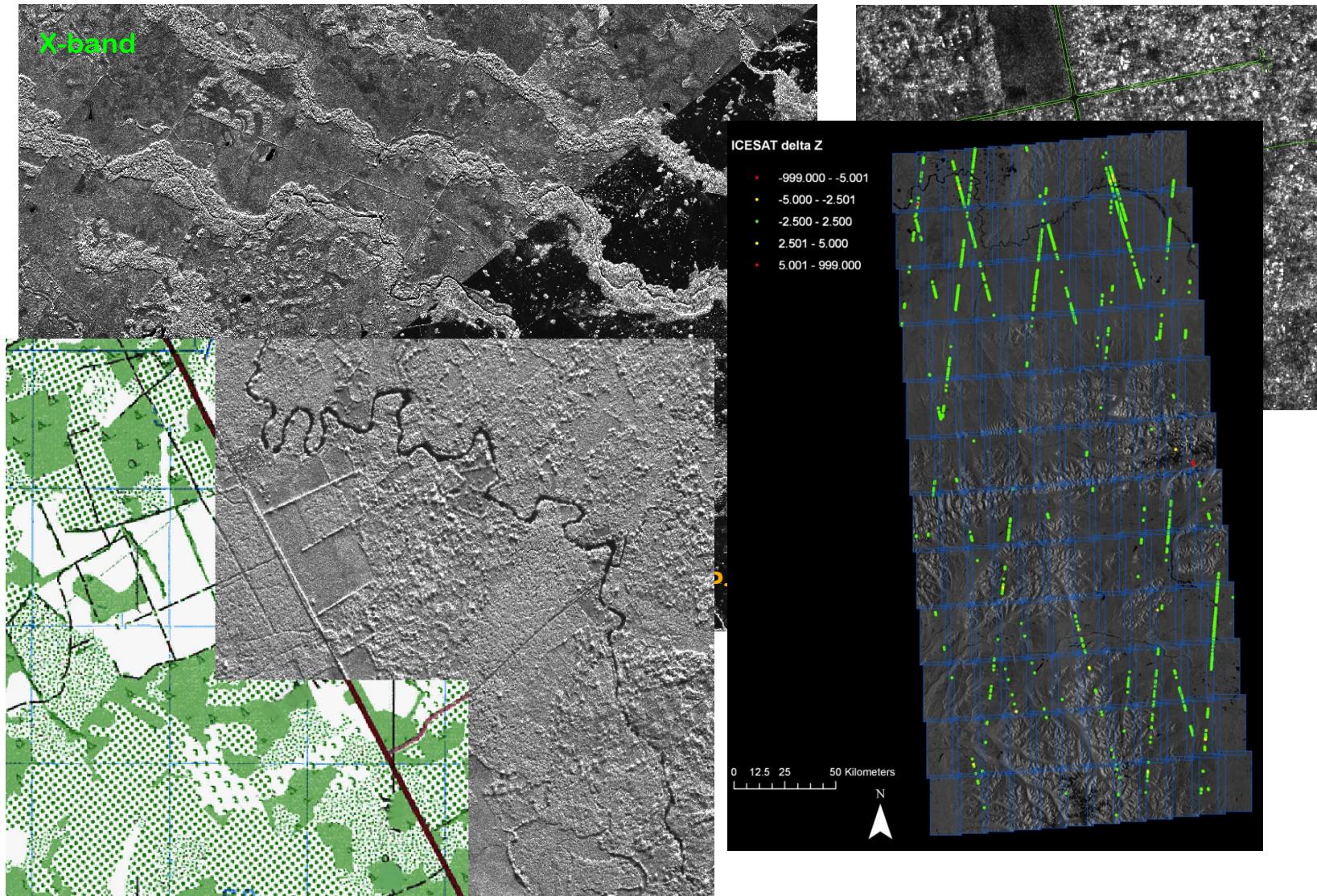


P-band DEM

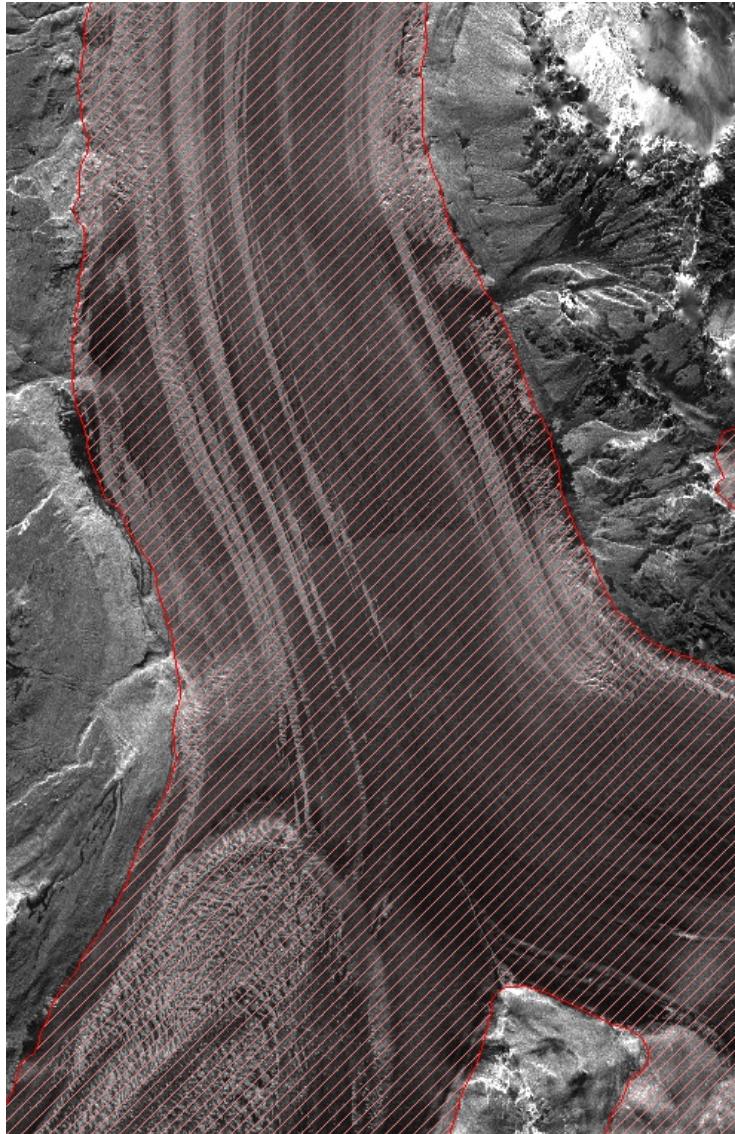
Mosaic / Swath Matching



Production - Quality Control Checks



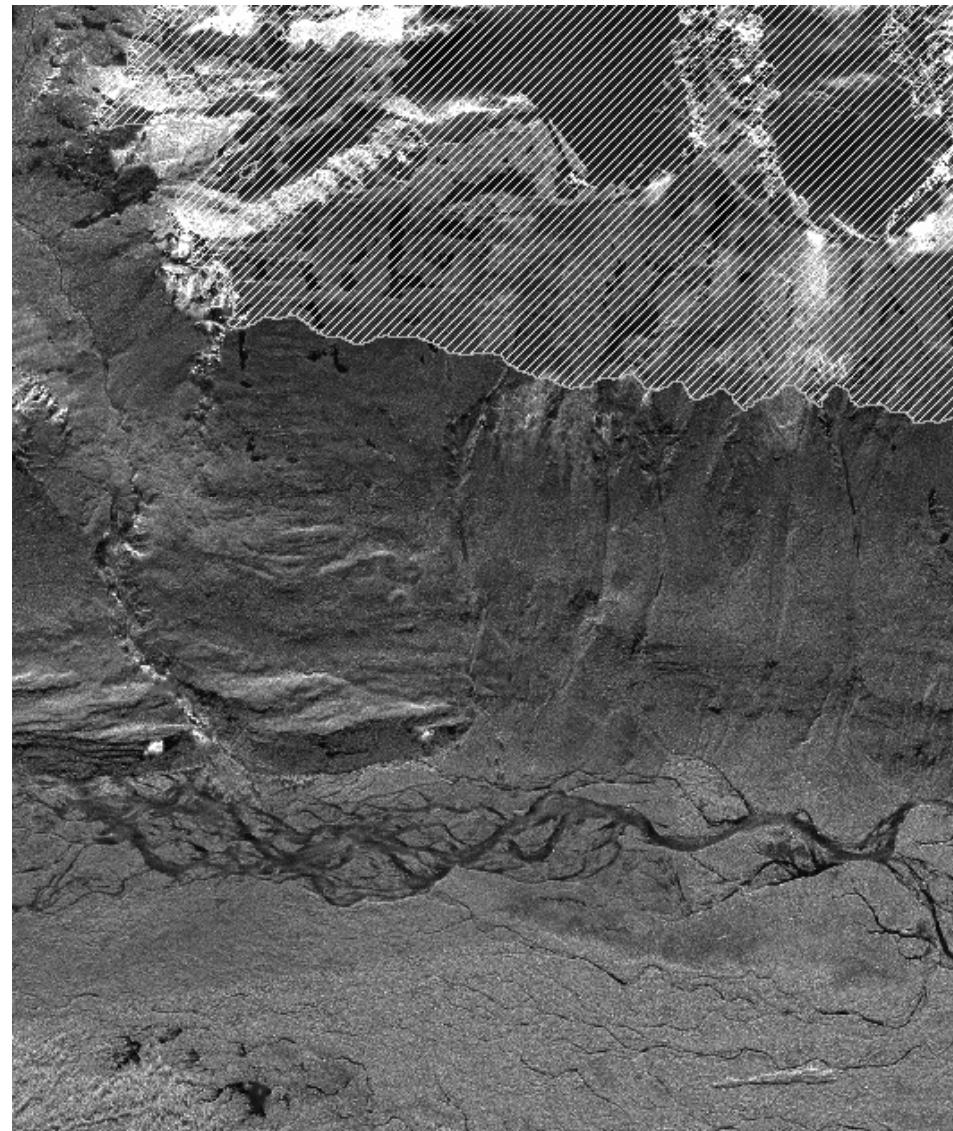
DTM Development – Ice Mask



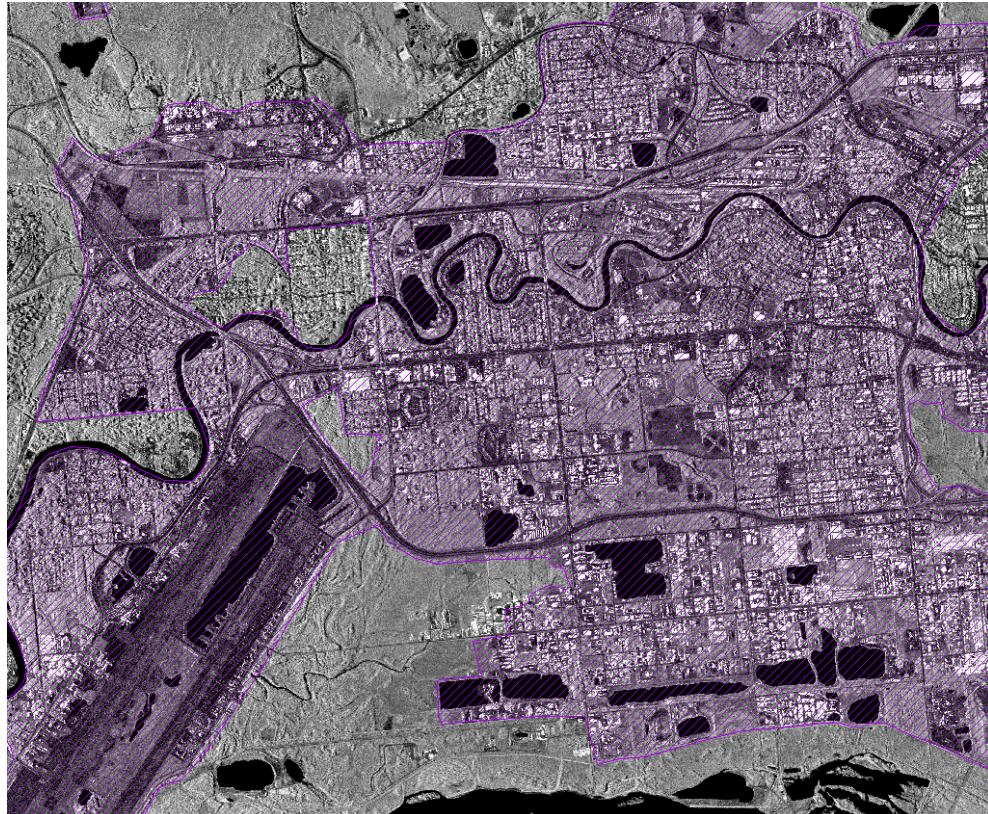
- Areas of ice and snow cover are masked using an initial glacier mask provided by University of Alaska, Fairbanks.
- This mask is expanded upon by a heads up digitizing and comparing X and P surfaces for P-band ice penetration.
- The resulting mask encompasses areas of major ice and snow where P-band may penetrate and should not be used in the DTM layer.

DTM Development – Elevation Mask

- Utilizing published tree line information and DSM derived aspect layers, an elevation mask is produced, covering areas within the project that are above the tree line.

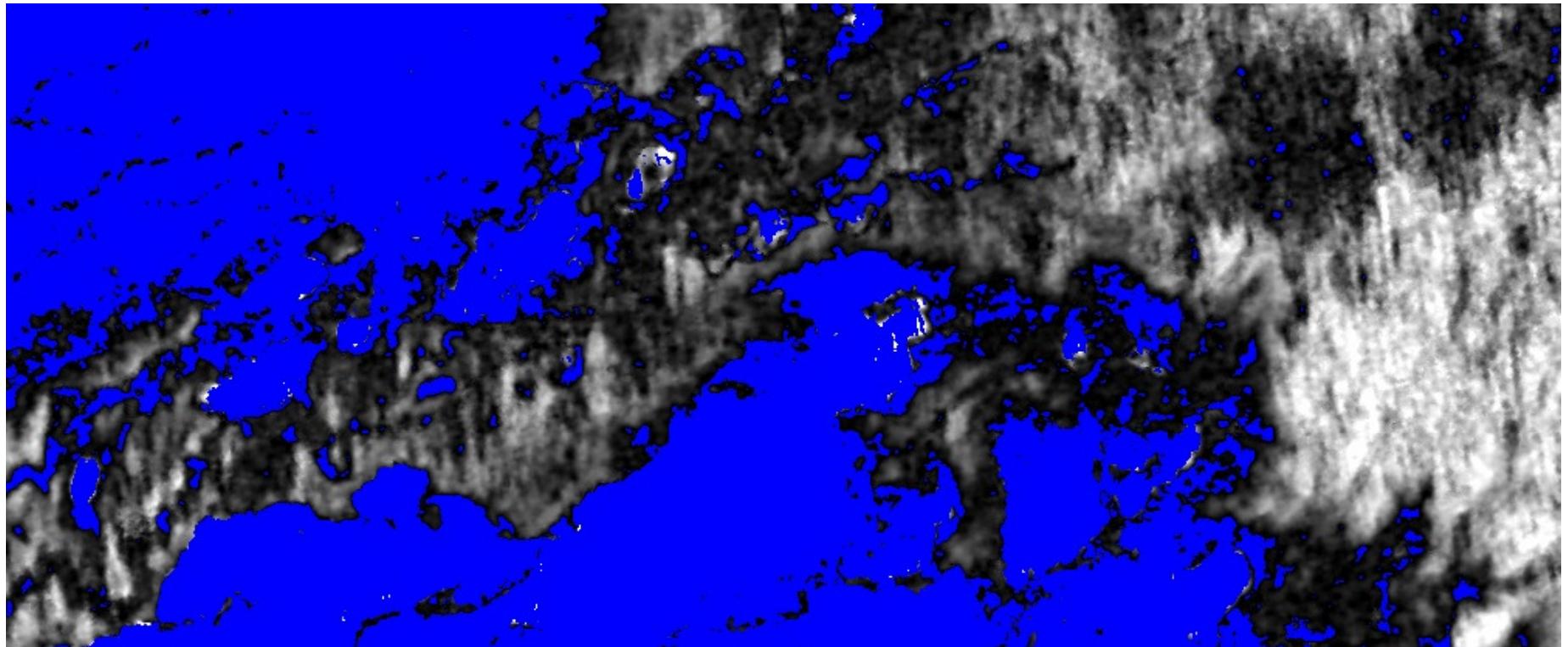


DTM Development – Cultural Features



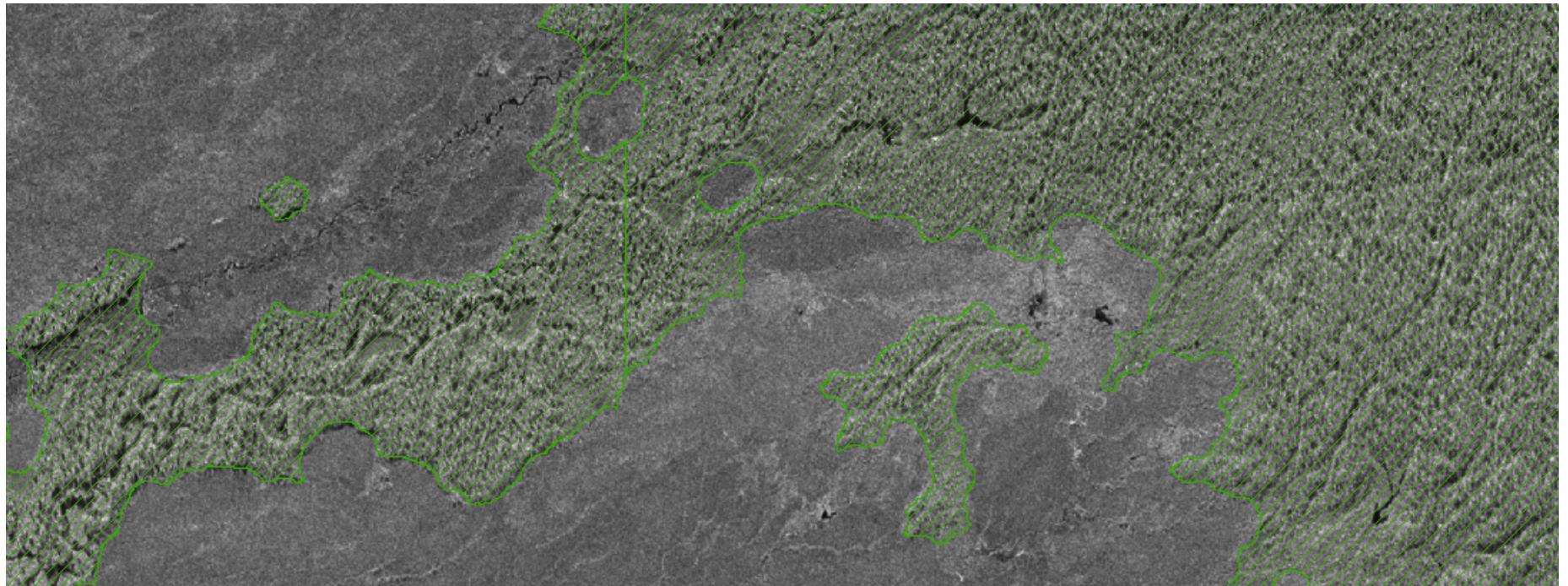
- Areas with cultural features or structures are identified from the radar image and ancillary remote sensing data if available.
- These areas are digitized to create a mask. Buildings and structures are removed from the DTM in these areas through manual and automated editing methods.
- Several surface macros from LiDAR processing have been adapted for GeoSAR DTM development.

DTM Development – Initial Tree Mask



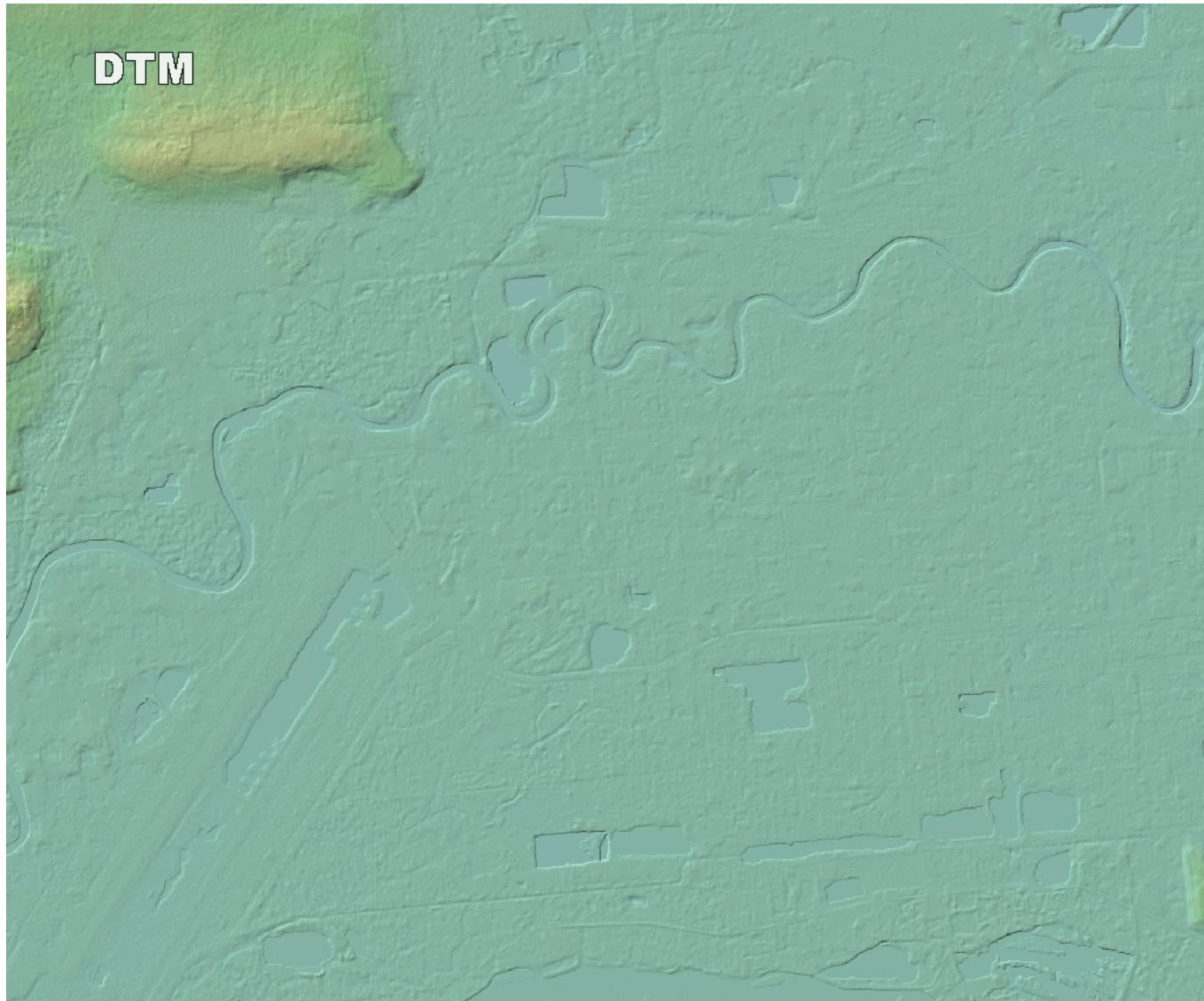
- The tree mask starts with an X-band / P-band elevation subtraction. Using this layer, areas where P is under X are identified. This serves as the basis for the tree mask. Areas in black and white show where X-band elevation is significantly above P-band elevation.

DTM Development – Final Tree Mask

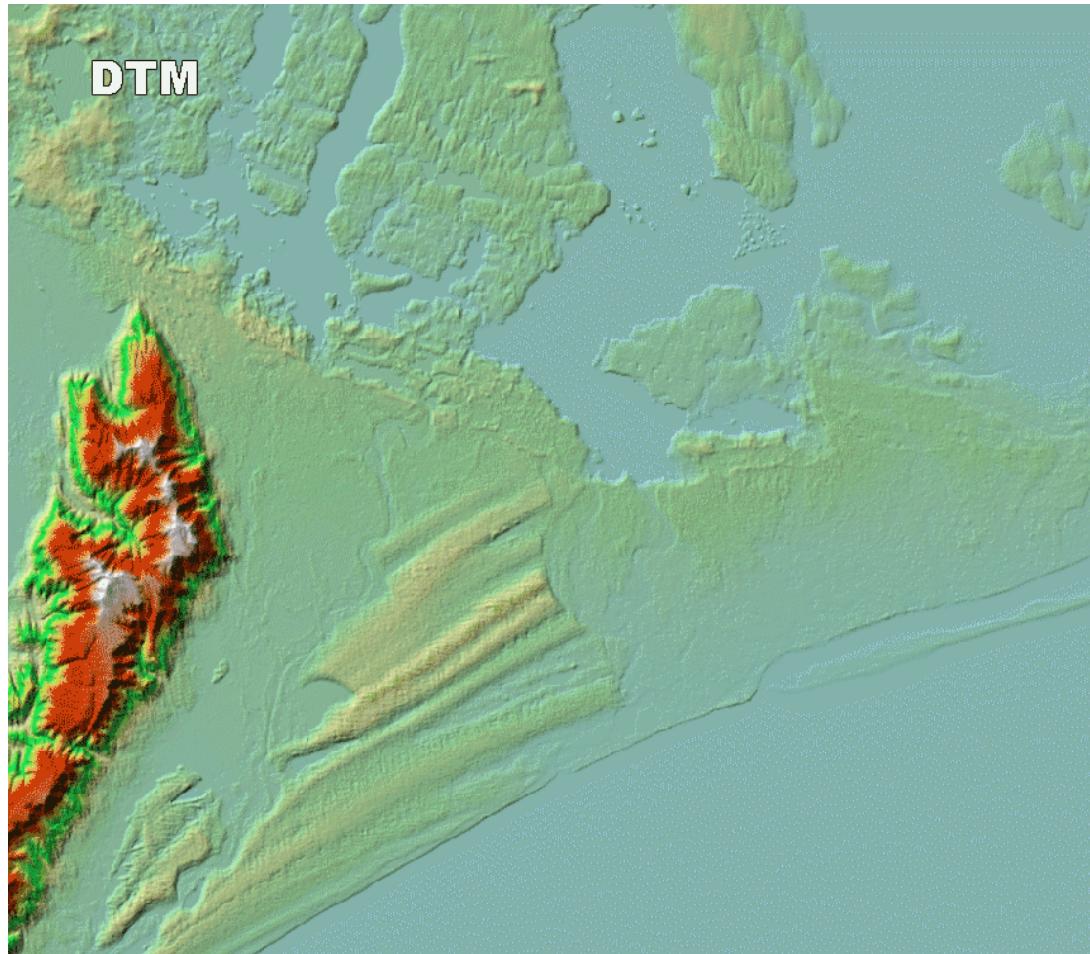


- A combination of texture analysis, classification, and heads up digitizing are utilized to transform the initial X/P difference into a final mask of all vegetated areas. These are the main areas in which P-band will be present in the final DTM.

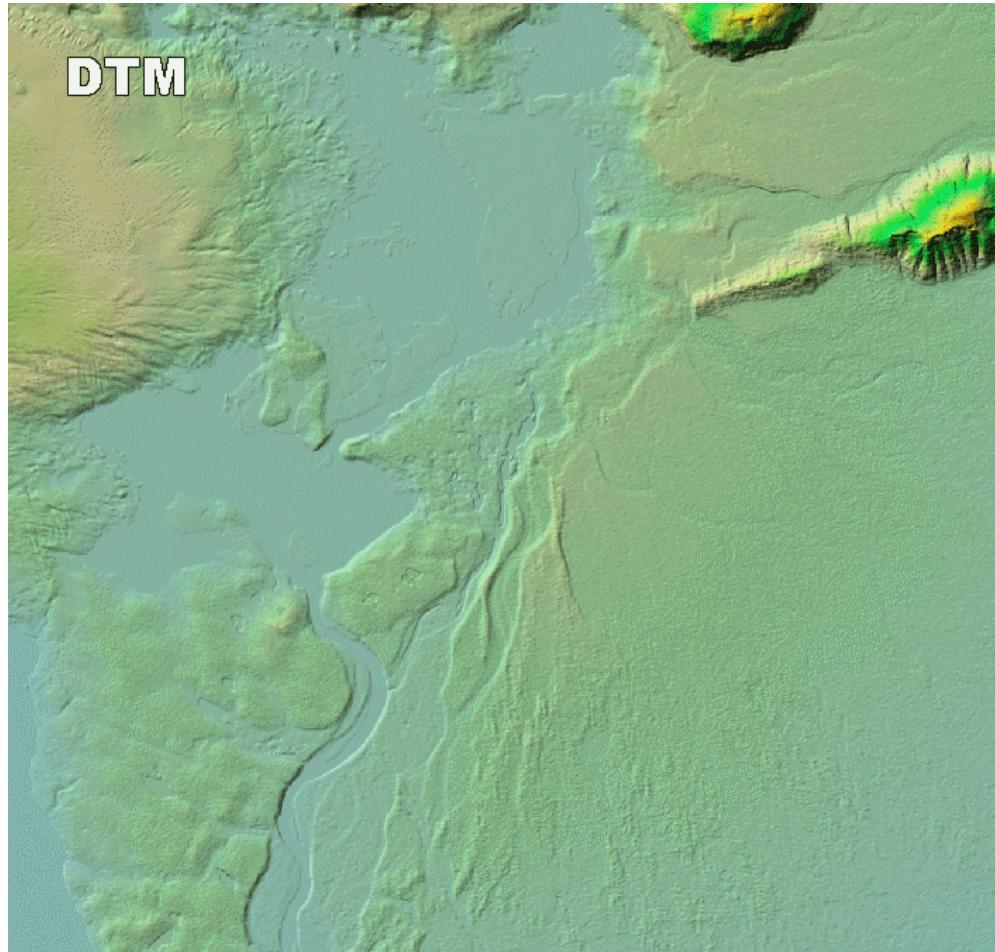
DSM / Hybrid DTM Comparison



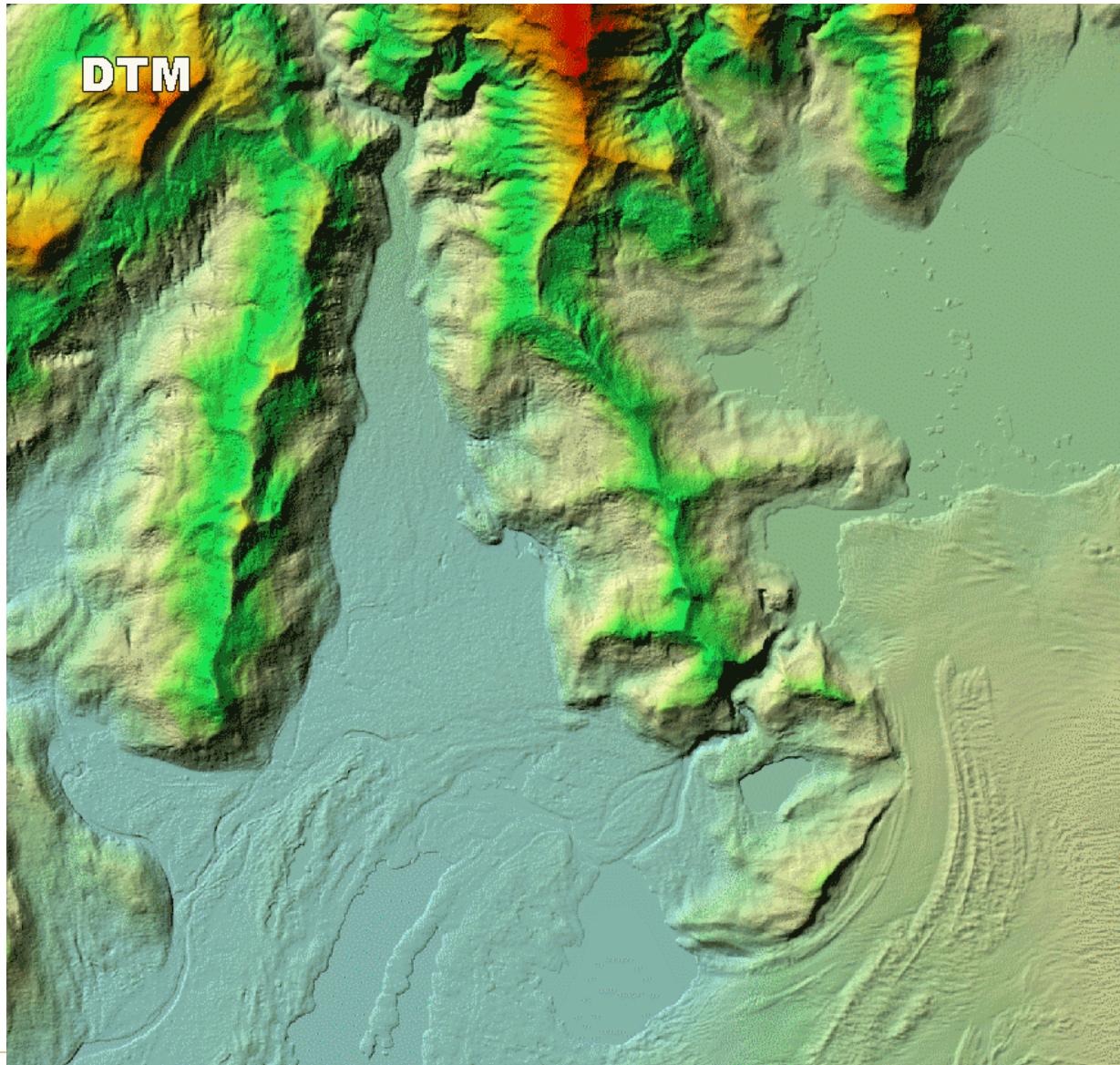
DSM / Hybrid DTM Comparison



DSM / Hybrid DTM Comparison

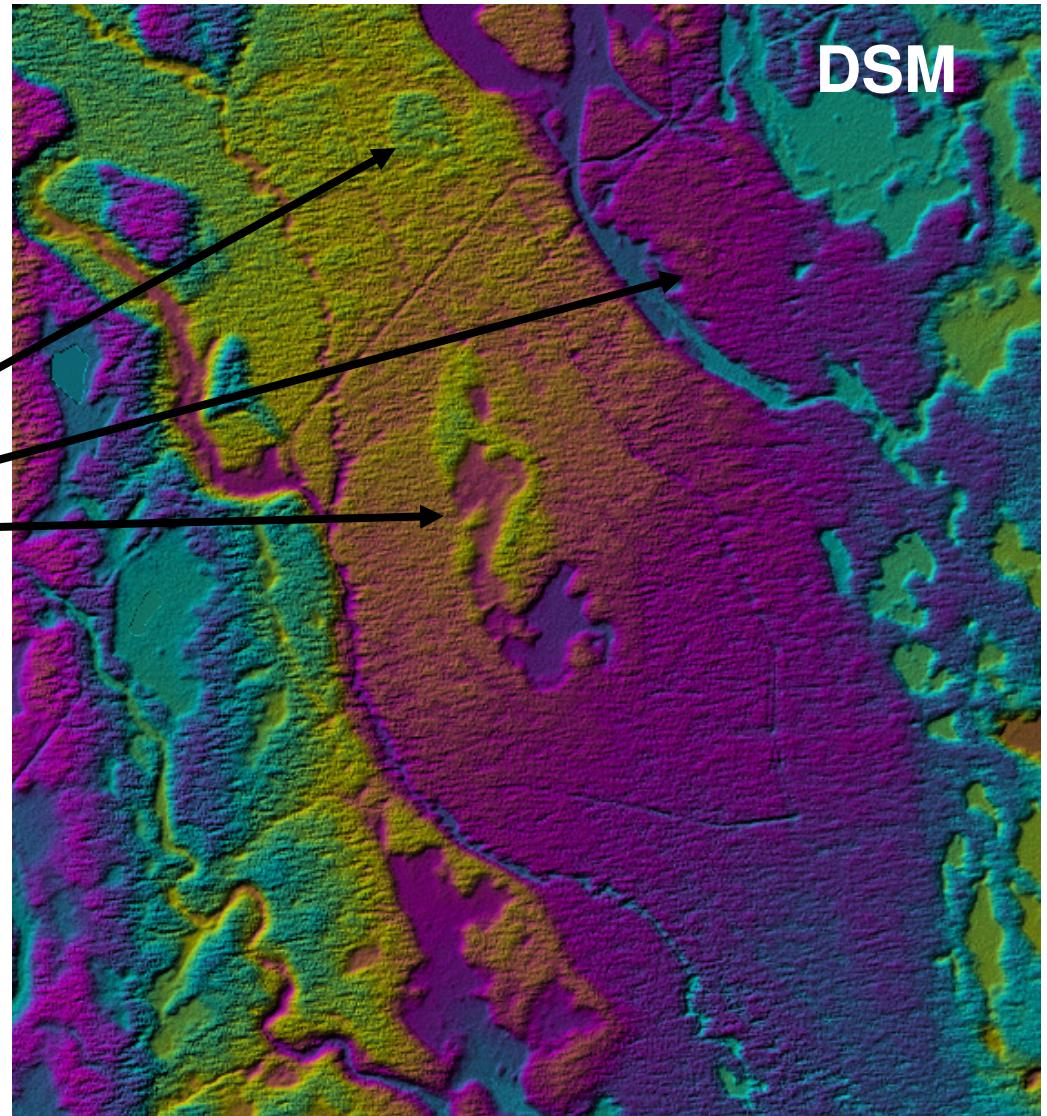


DSM / Hybrid DTM Comparison



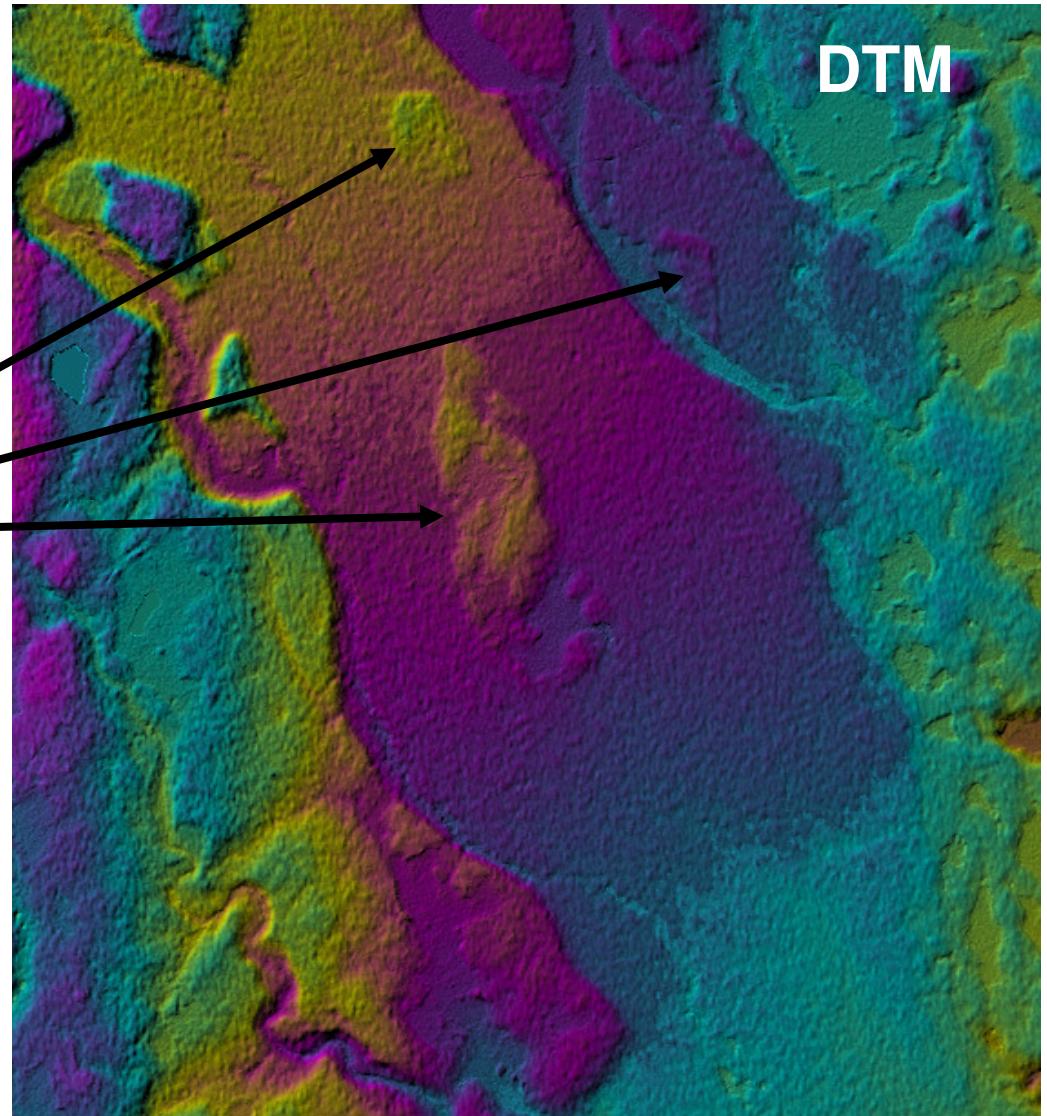
Power of P-band - Ability to See Underlying Terrain

Terrain underneath the canopy

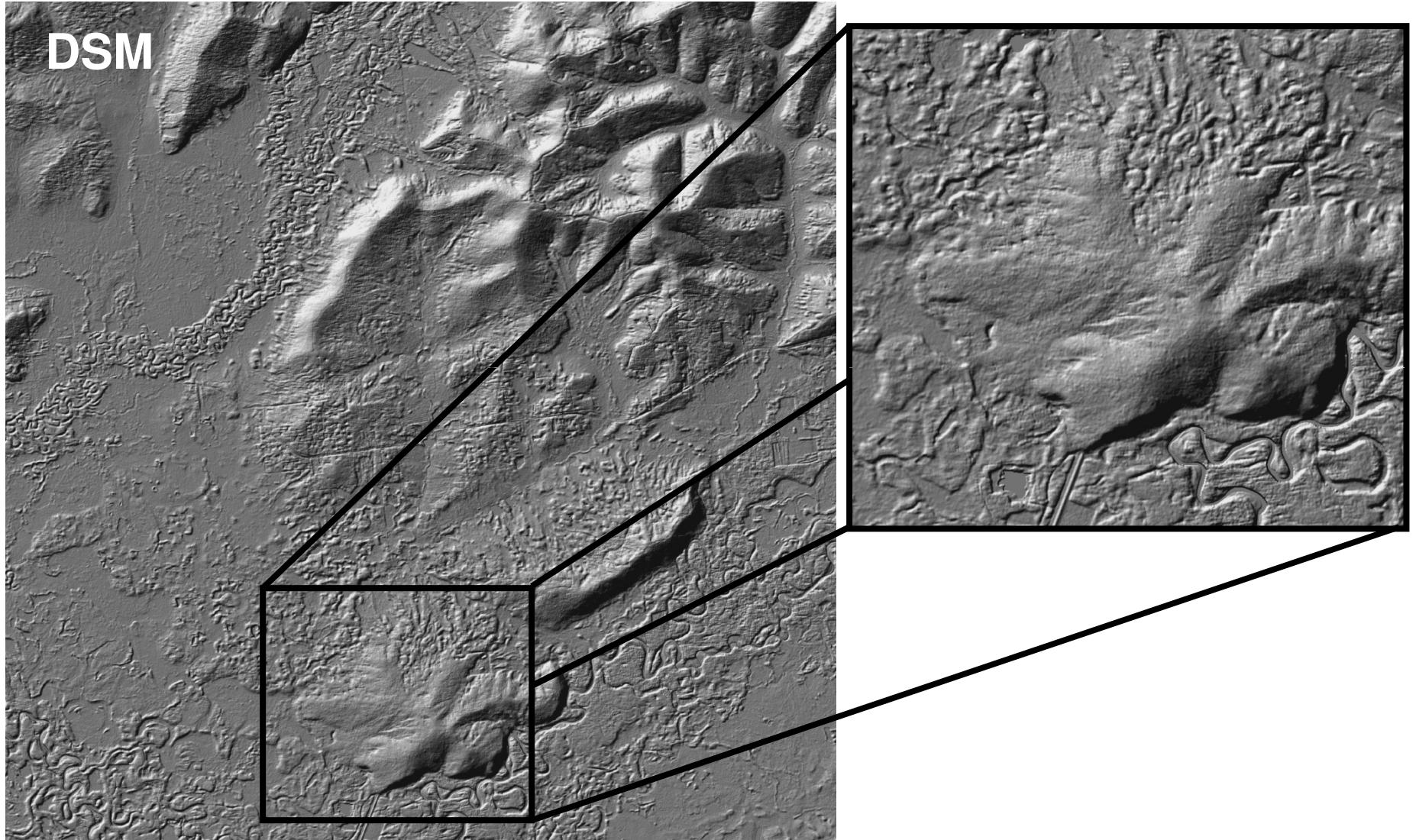


Power of P-band - Ability to See Underlying Terrain

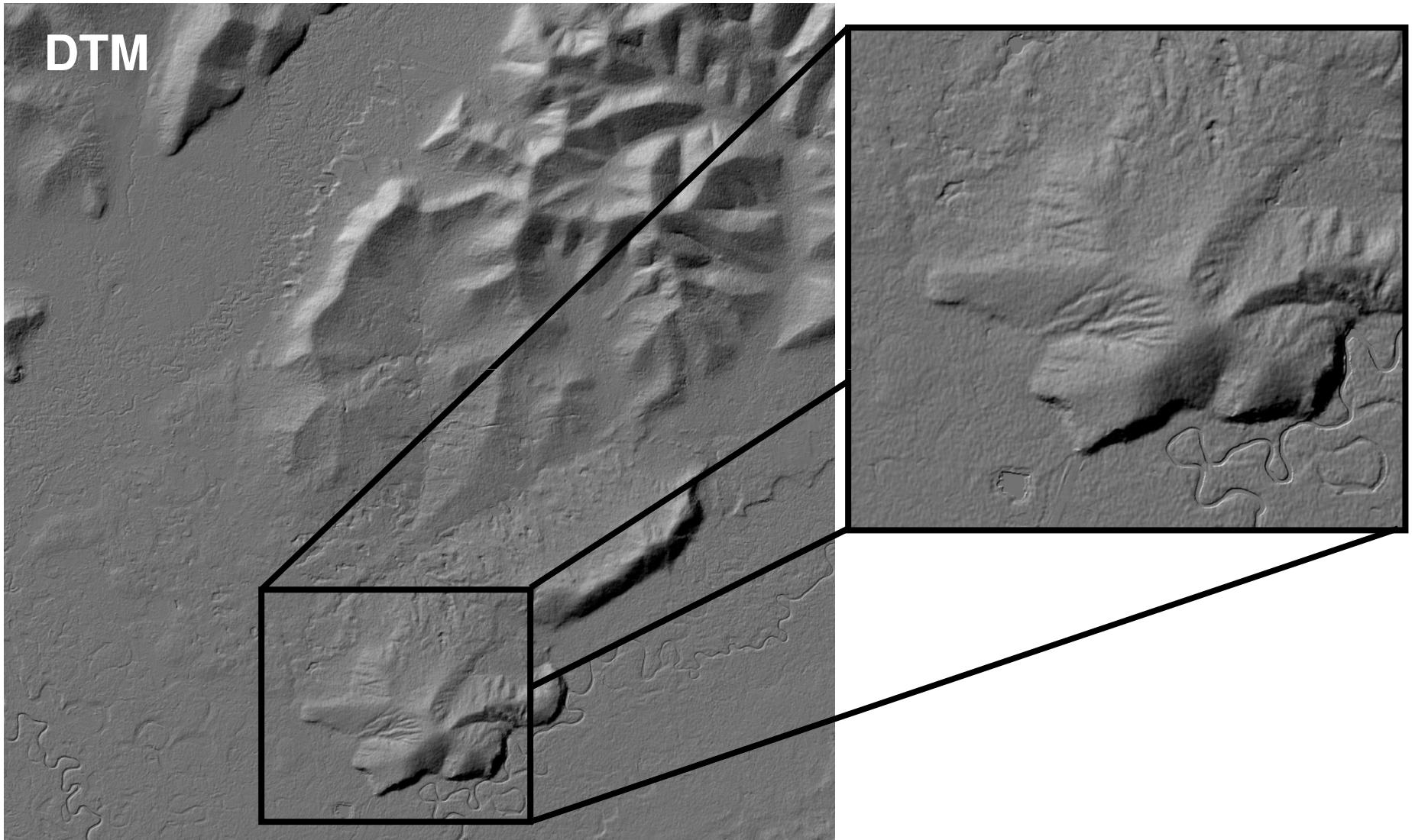
Terrain underneath the canopy



Power of P-band - Drainage Networks Covered By Canopy

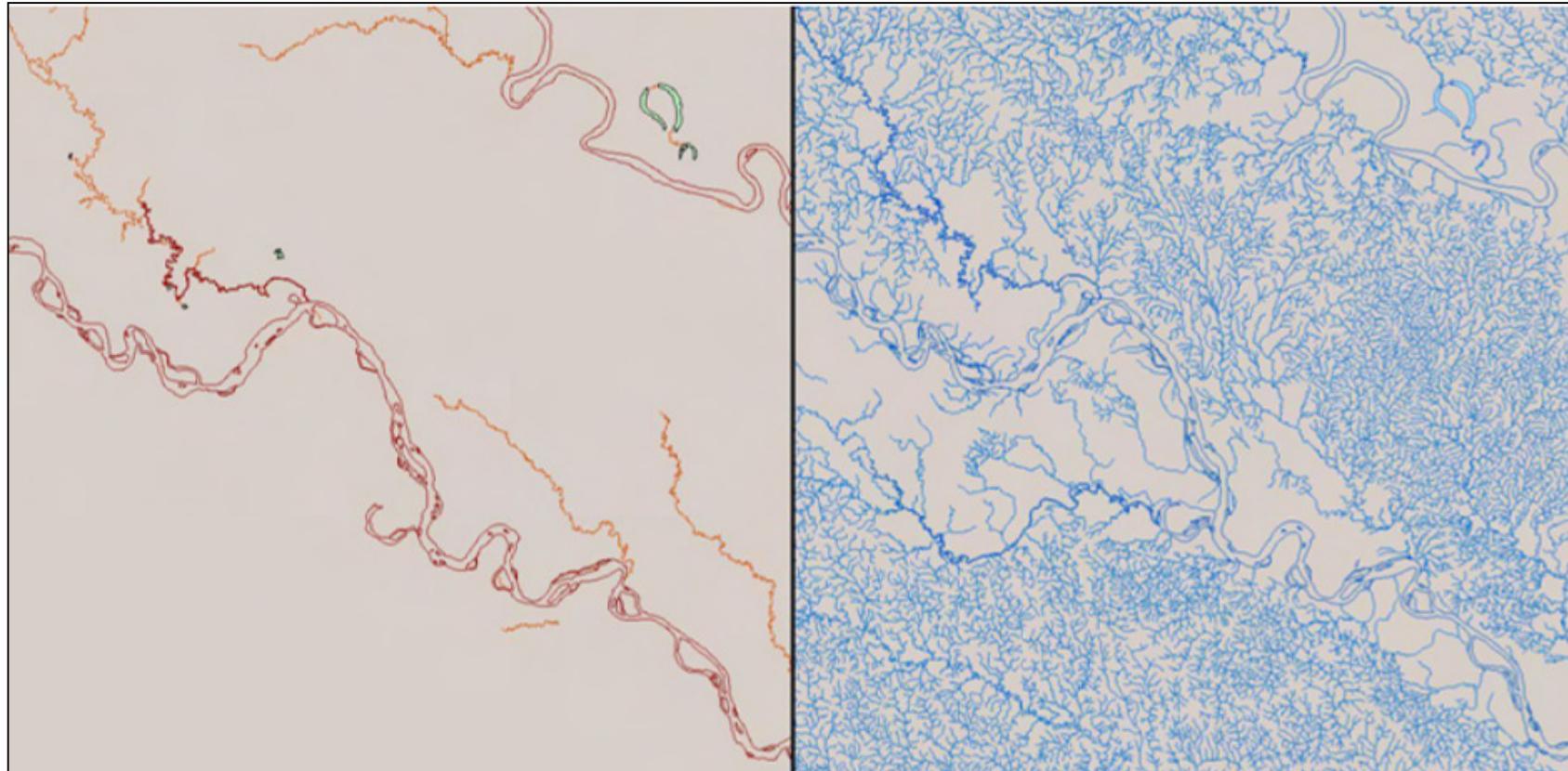


Power of P-band - Drainage Networks Covered By Canopy



GeoSAR Thematic Information

Extraction of Hydrographic Network

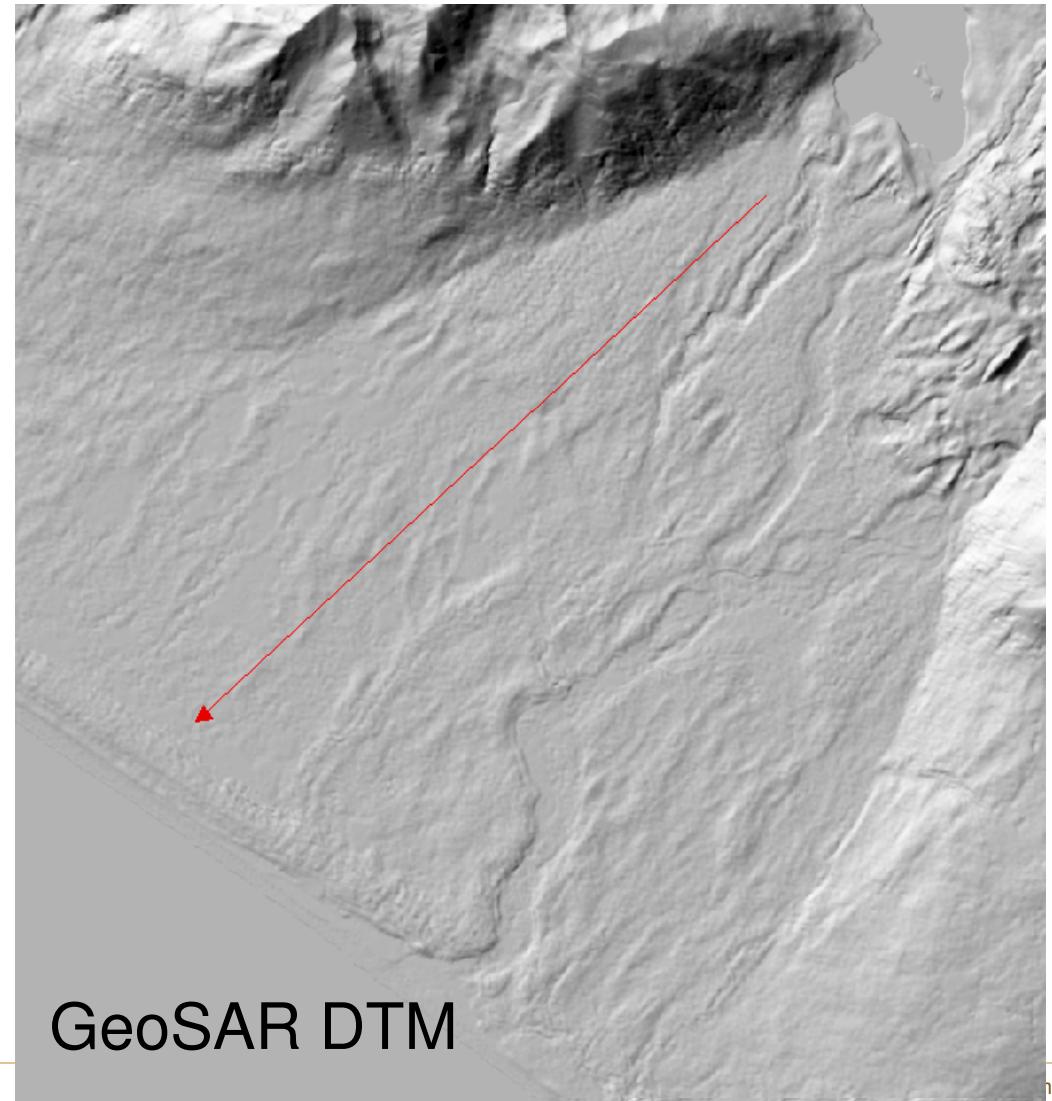
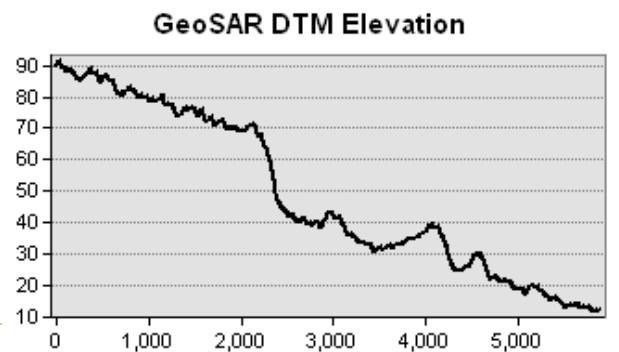
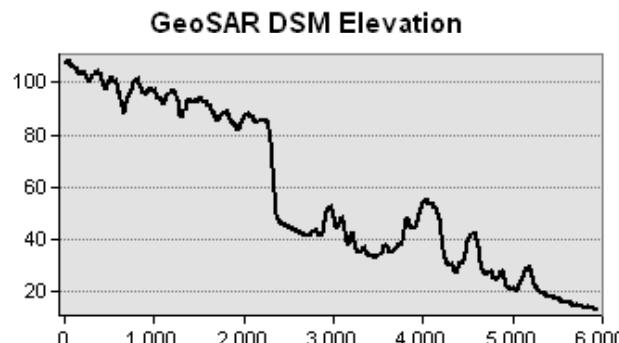
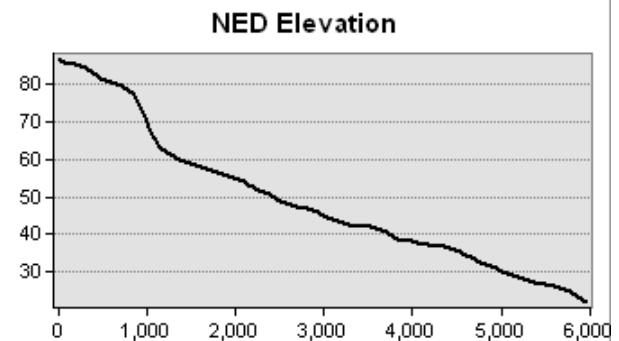


Existing hydrographic network
(from 1982)

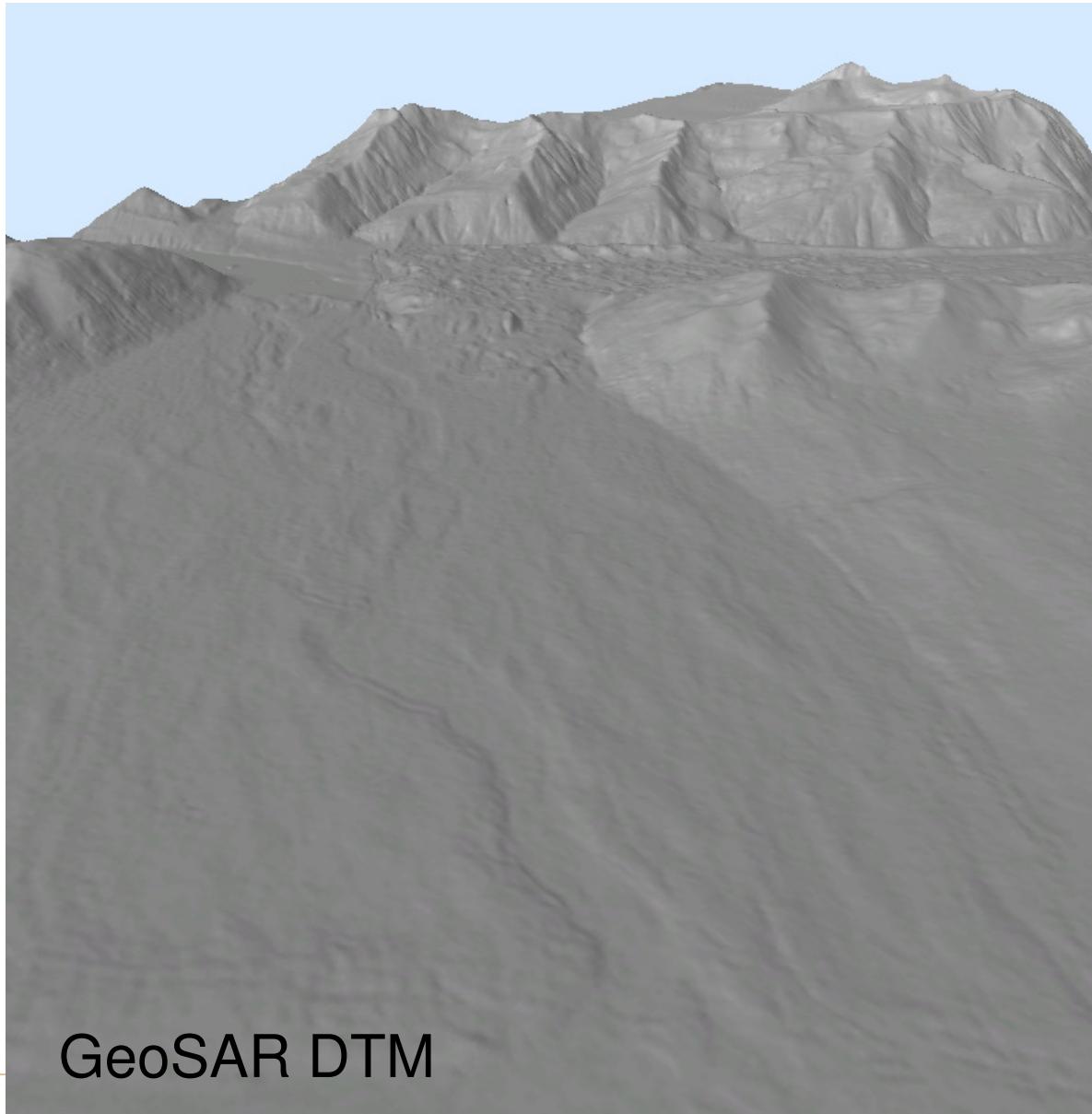
New hydrographic network
(from GeoSAR data, 2006)

Hydrography and Forest Delineation

- Definition of drainages and forest areas

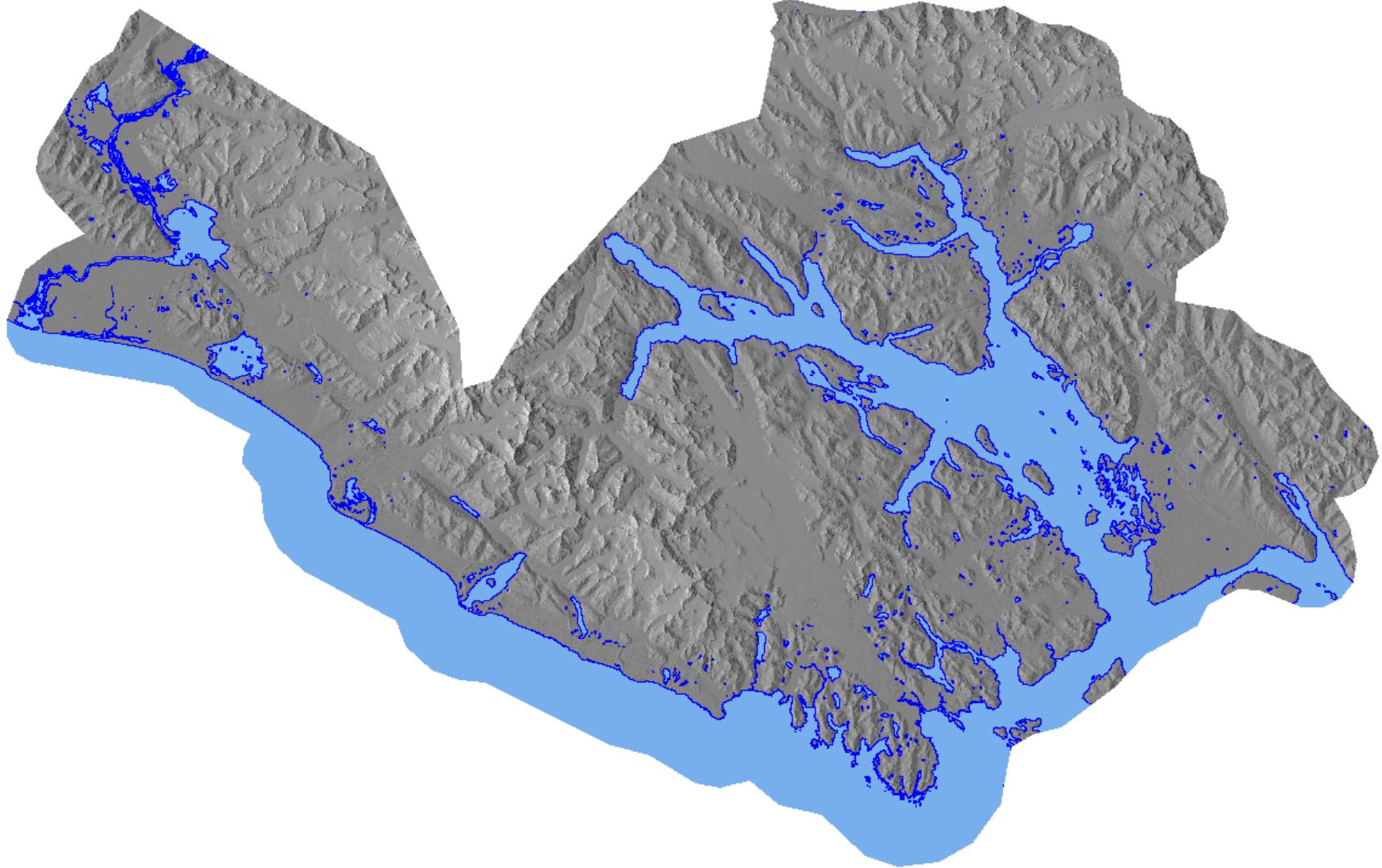


Hydrography and Forest Delineation

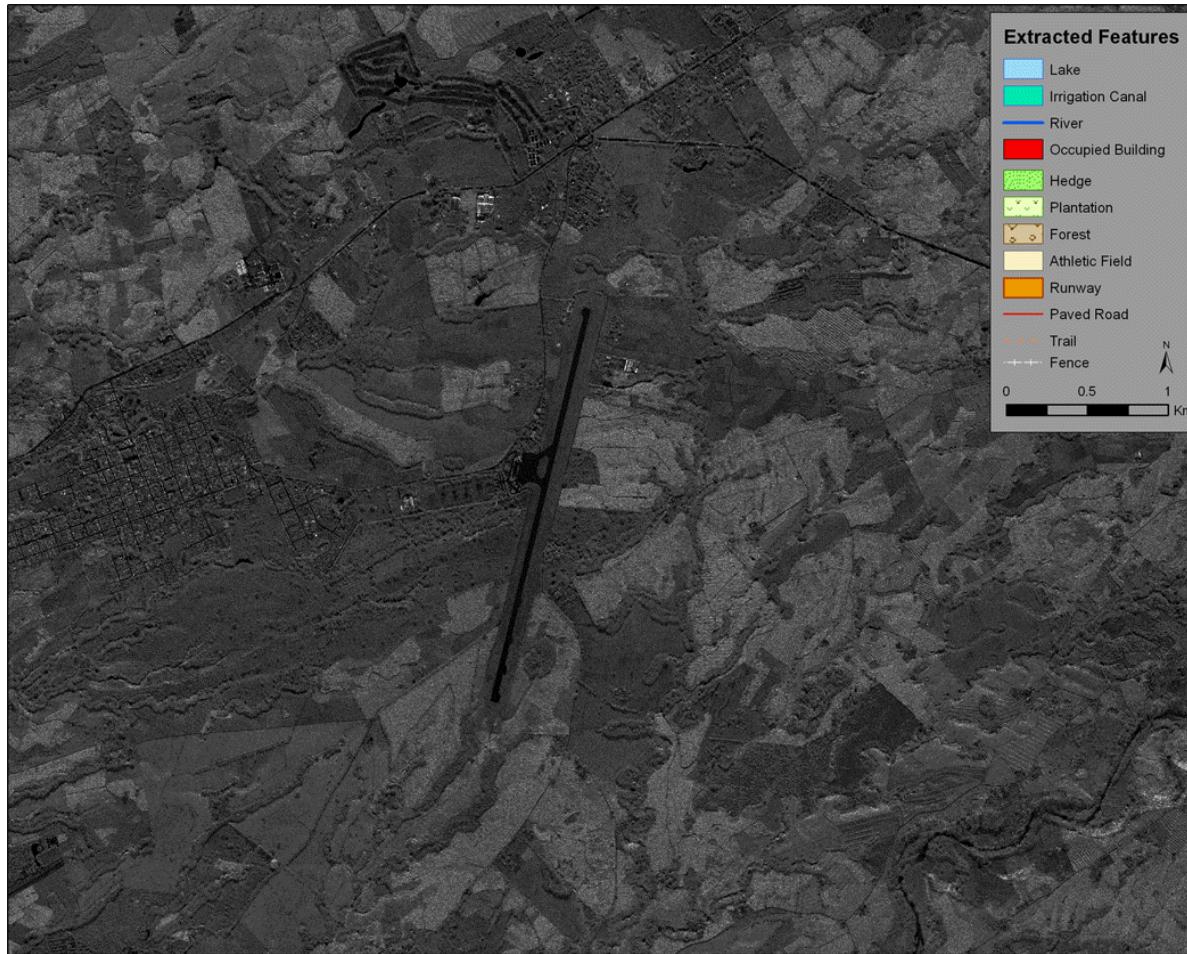




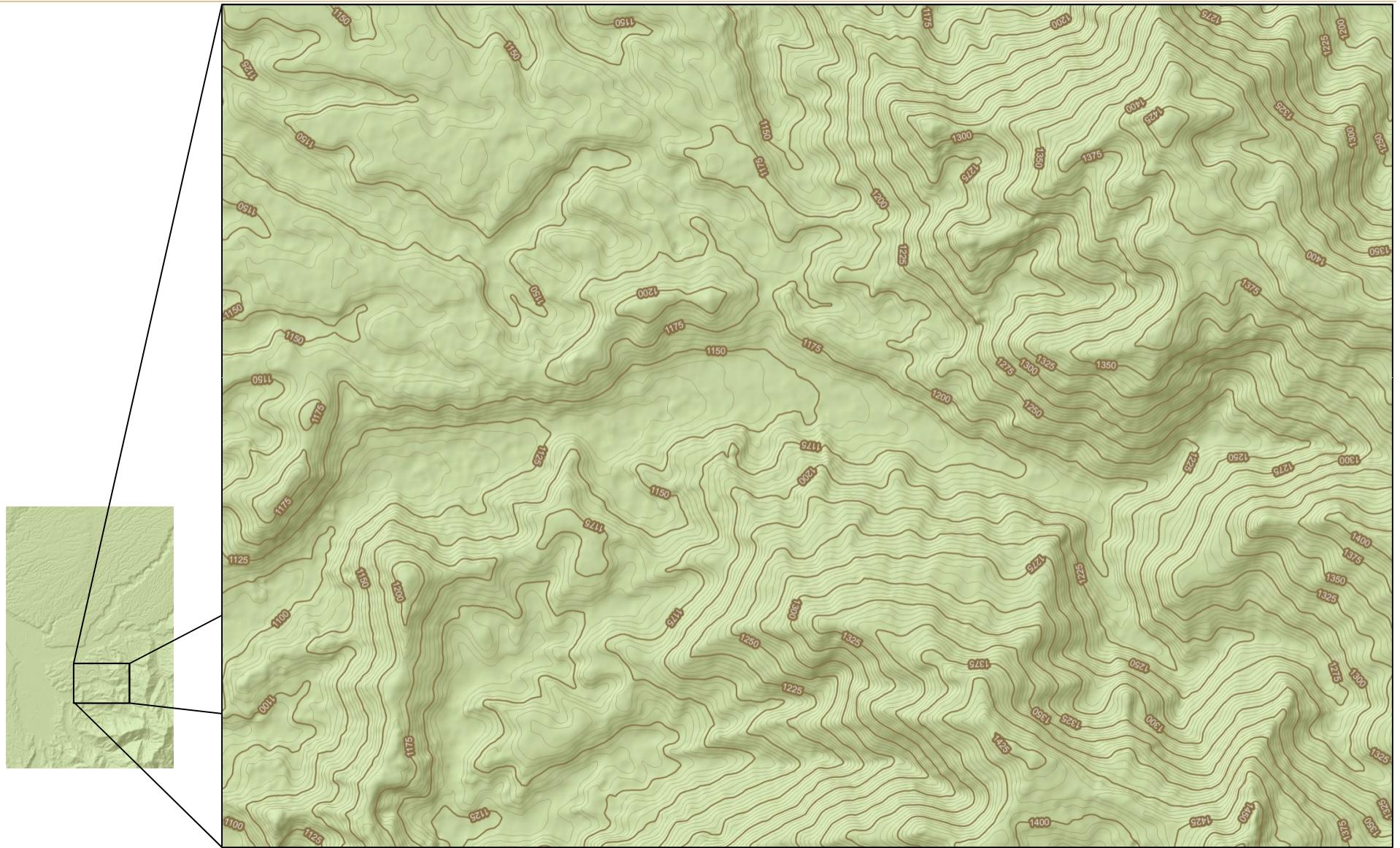
GeoSAR Glacier Bay Hydrography Network



GeoSAR 3D Feature Extraction

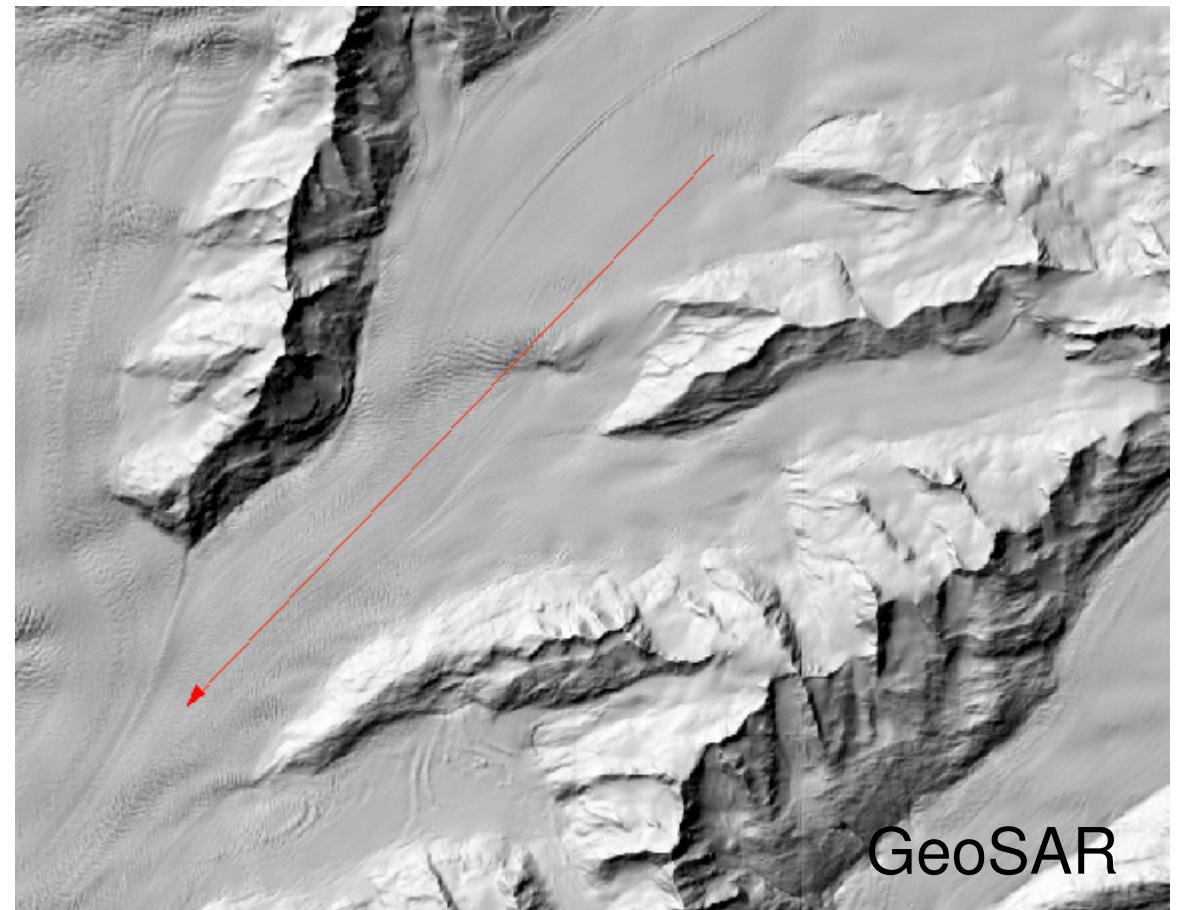
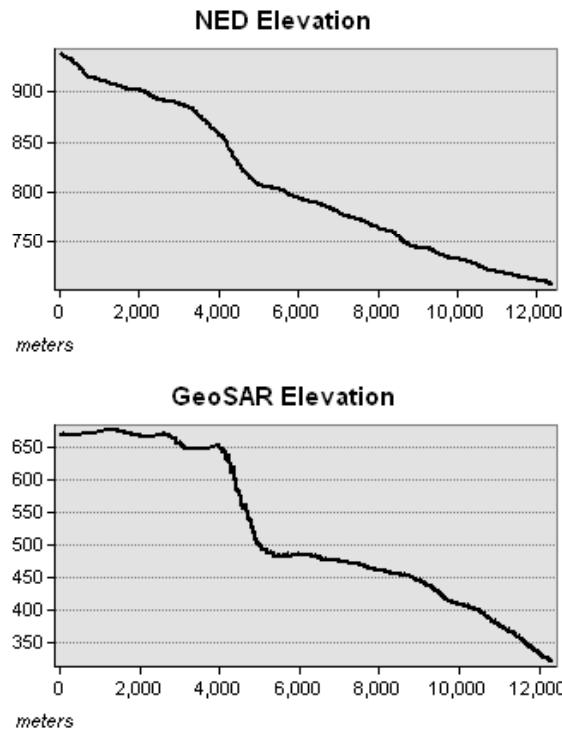


GeoSAR 5m Contours



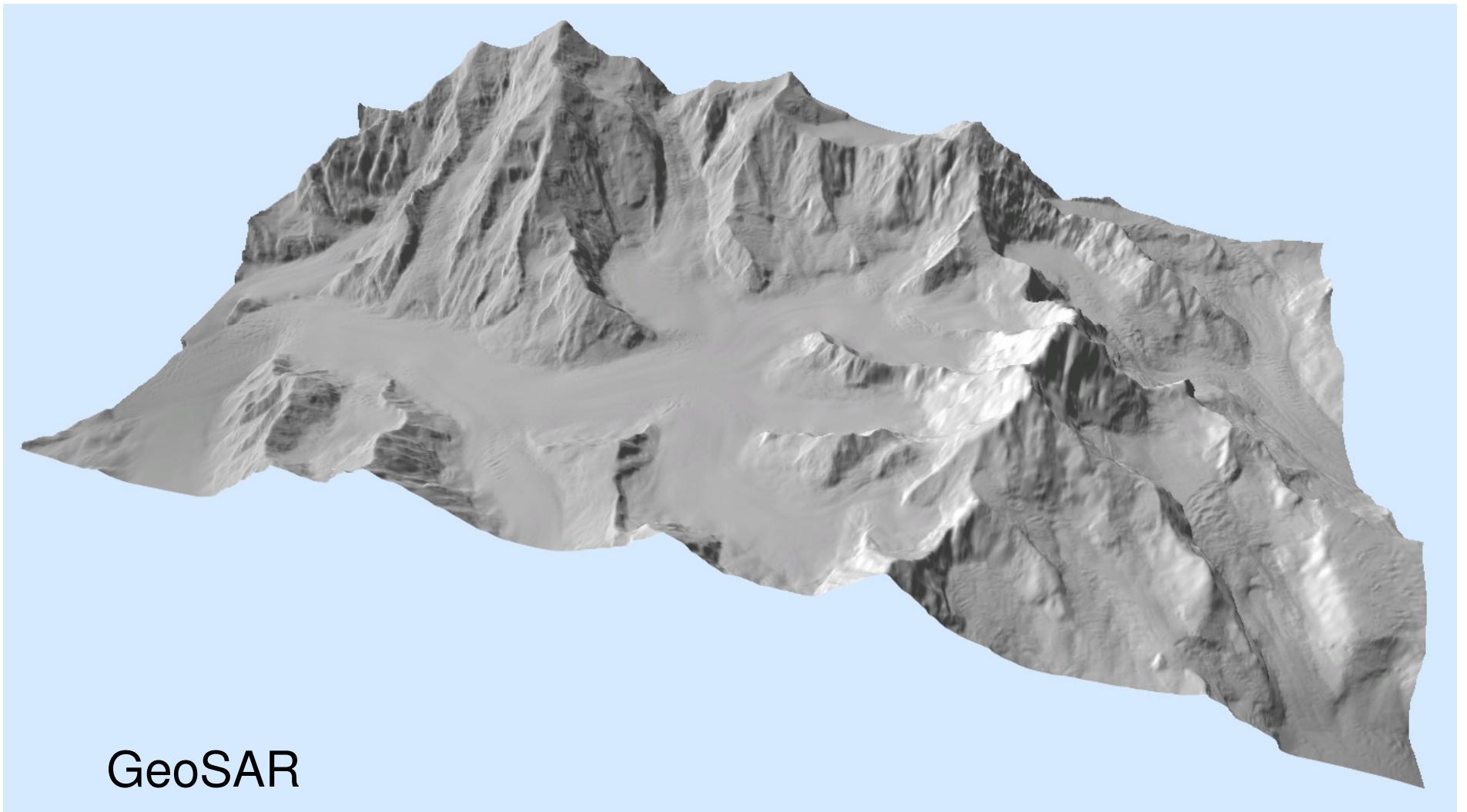
GeoSAR DTM vs. NED in Glaciers

- GeoSAR shows increased definition in glacier areas
- GeoSAR provides updated elevations of ice and snow
 - Profile drawn NE to SW, shows over 300m elevation difference



Improved Definition in Rugged Terrain

- Glacier Bay Alaska looking towards Canada border



GeoSAR



Fugro Investing in Alaska Mapping Initiatives

- Since 2010 Fugro has invested a total of \$3.5+ million in Alaska survey and mapping initiatives.
 - AK SDMI additional cell acquisitions
 - Sea ice monitoring program

- Fugro has invested a total of \$350k so we can process data in Alaska.
 - Support Sea Ice Monitoring
 - Support AK SDMI Elevation Mapping
 - Permanently established in Anchorage, AK



Thank You

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