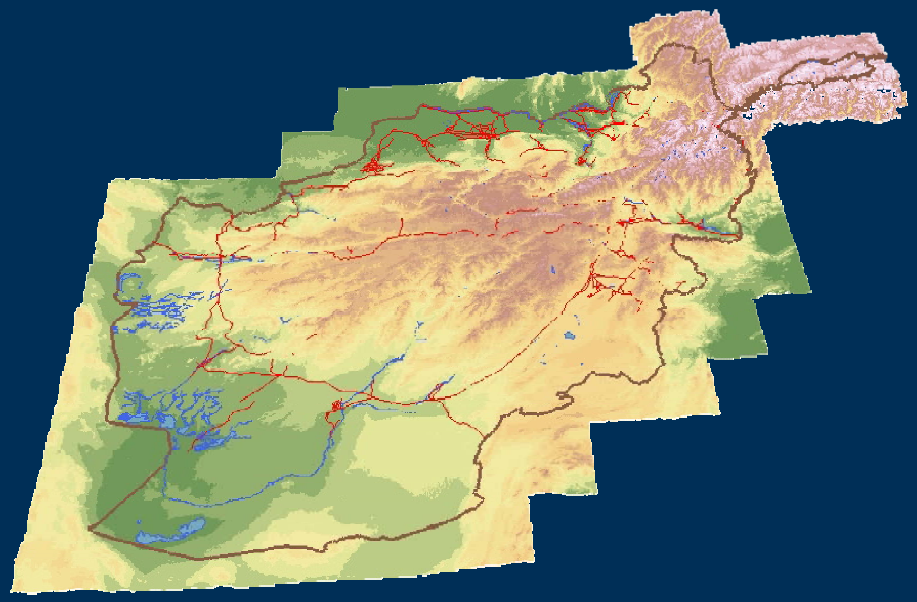
ASTER DEM Development in Mountainous Terrain for Natural Resource Assessments in Afghanistan



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U.S. Department of the Interior
U.S. Geological Survey

Introduction: Geography of Afghanistan

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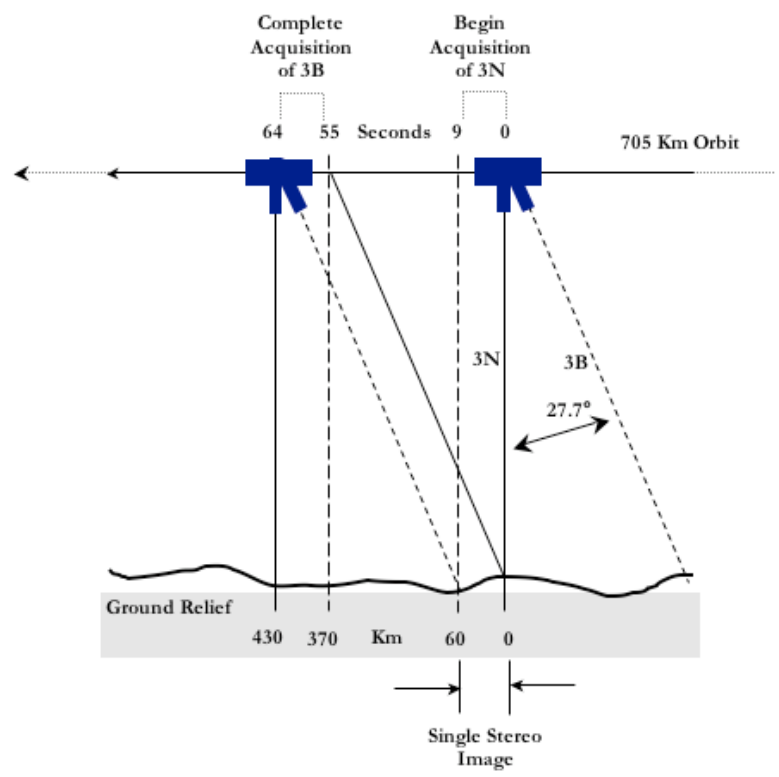
Introduction: The Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER)

- Launched December 19th, 1999
- Primary objective is to obtain high spatial resolution global, regional, and local images of the earth in 14 colors (spectral bands).
- Consists of three subsystems:
  - VNIR - 15 m resolution
  - SWIR - 30 m resolution
  - TIR - 90 m resolution
- VNIR subsystem generates along-track stereo images



Along-Track Imaging Geometry of the ASTER VNIR Nadir and Backward-Viewing Sensors

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Objectives

- The objectives of this project are to:
  - Create 30m resolution digital elevation models for natural resource assessments
  - Develop a methodology that uses publicly available datasets to create the DEMs
  - Test the ability to derive regional-scale DEMs developed from ASTER
  - Investigate DEMs created from scenes with high, off-nadir pointing angles

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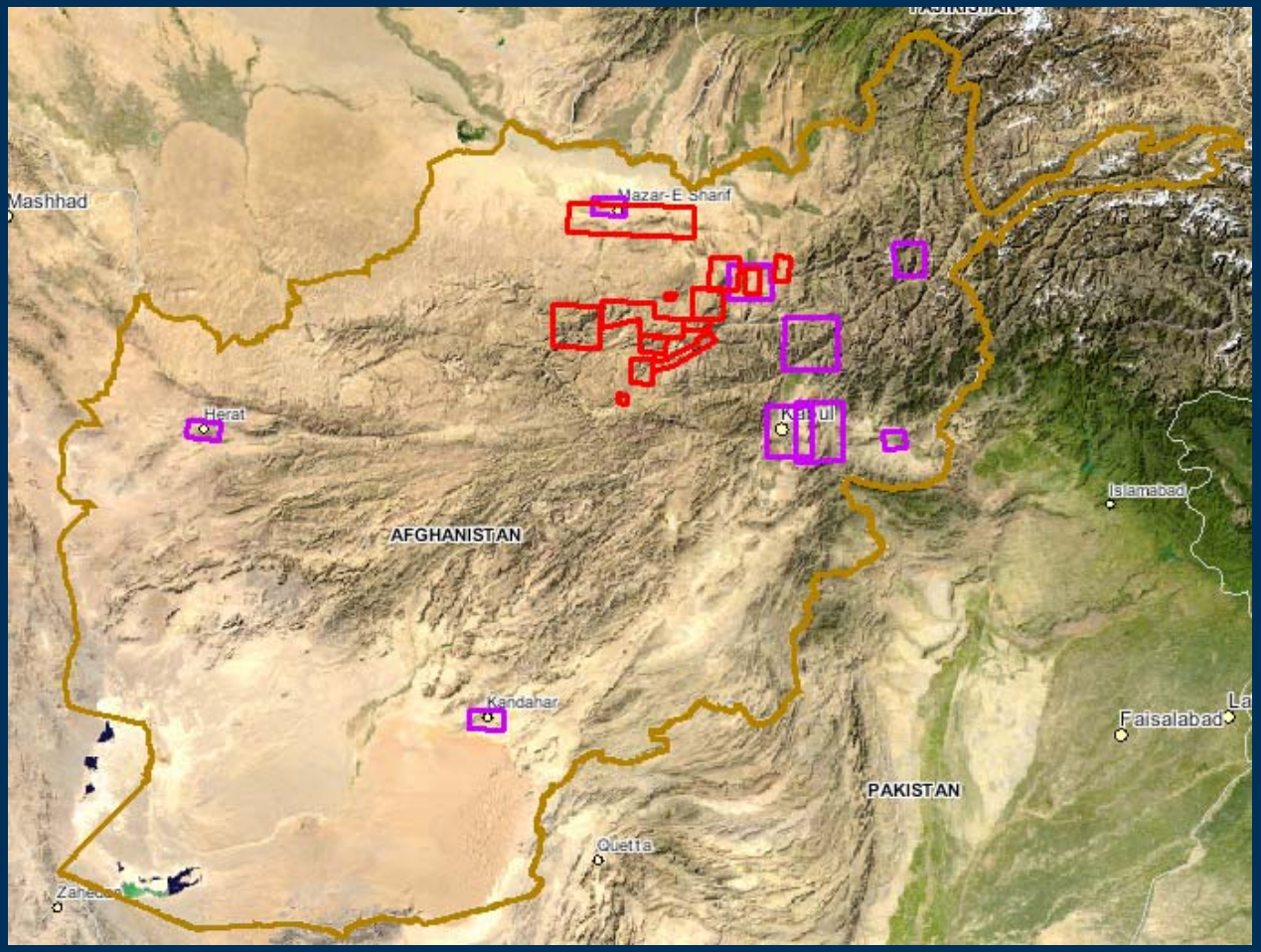
Study Areas:

The study areas for this project include the cities of Kabul, Kandahar, Herat, Pul-E-Kuhmri, Mazar-E-Sharif, and Jalalabad, as well as other mineral rich locations



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Process: DEM Production

- Use PCI Geomatica's Orthoengine software to:
  - Collect ground control points to create **absolute** DEMs
    - Ortho-rectified Landsat data
    - Collect at least 15 ground control points per image and keep RMS <1.0
  - Collect elevation for each GCP by extracting it from the publicly available 90m SRTM data
  - Extract DEM and review for errors
- Created 86 DEMs throughout the country
- Mosaiced and edge matched individual DEMs to produce regional scale models

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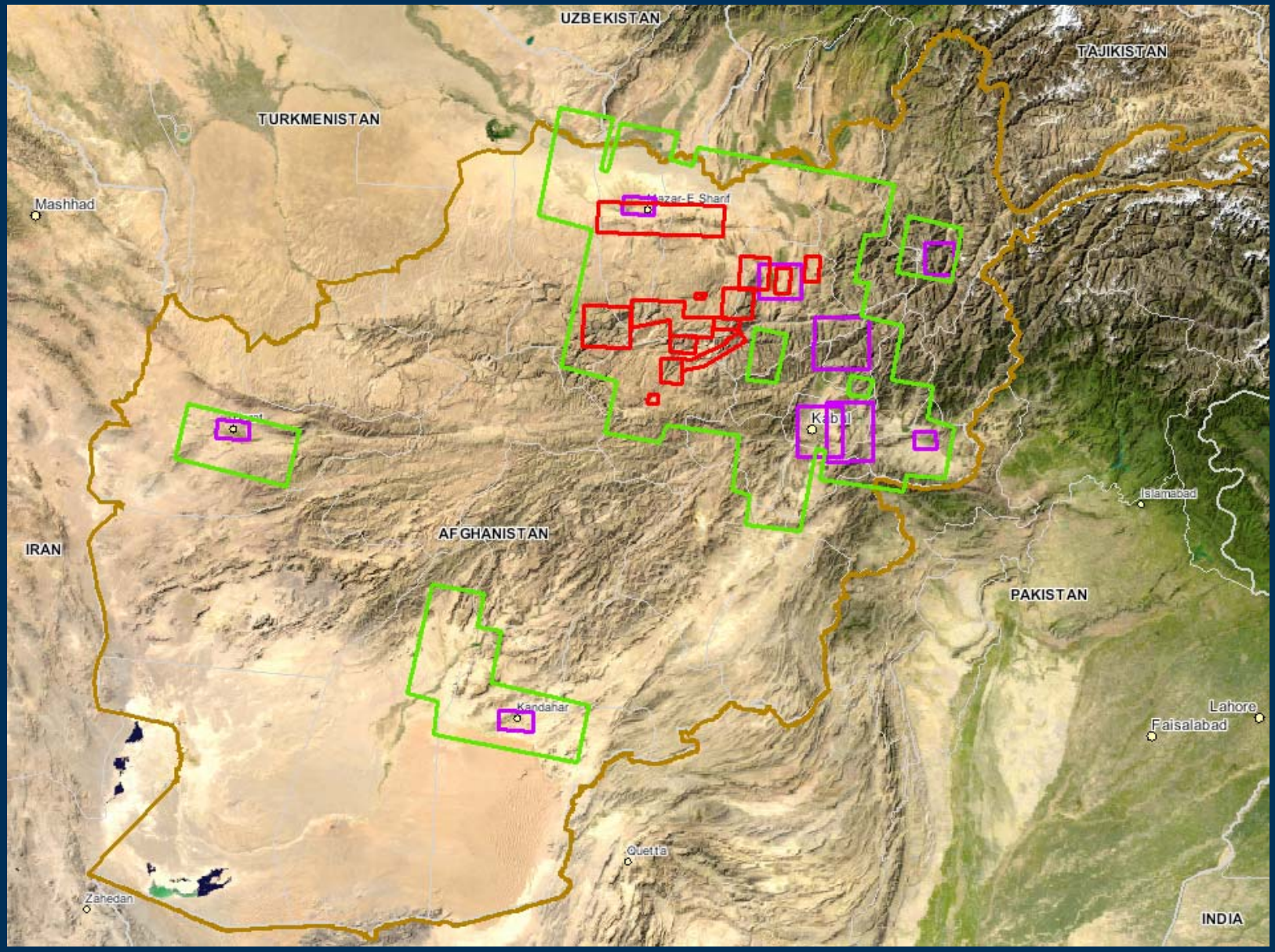
UZBEKISTAN
TAJIKISTAN
TURKMENISTAN
Mashhad
Mazar-E Sharif
Kabul
Herat
Islamabad
AFGHANISTAN
IRAN
PAKISTAN
Kandahar
Lahore
Faisalabad
Quetta
Zahedan
INDIA

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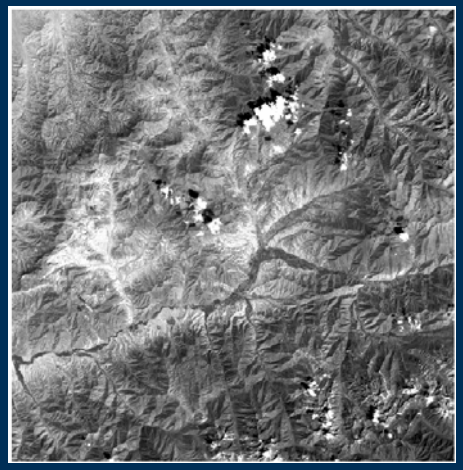
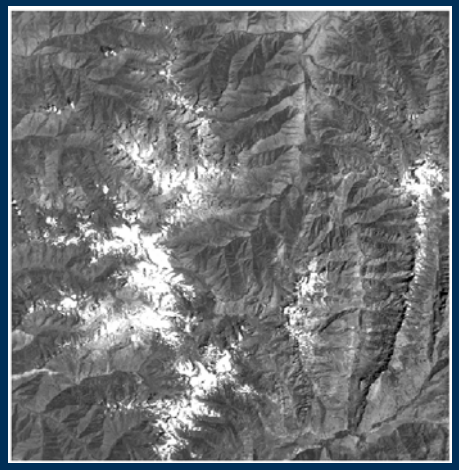
Challenges Associated with Regional Scale DEM Production

- Areas with a high albedo: i.e. cloudy and snow covered areas
- Bodies of water
- Areas with steep and southeastern facing slopes
- Filling void areas
- Acquiring scenes with low pointing angles
- Remove seams that were introduced during the mosaicing process
- Removing erroneous values, “pits and spikes” from each DEM





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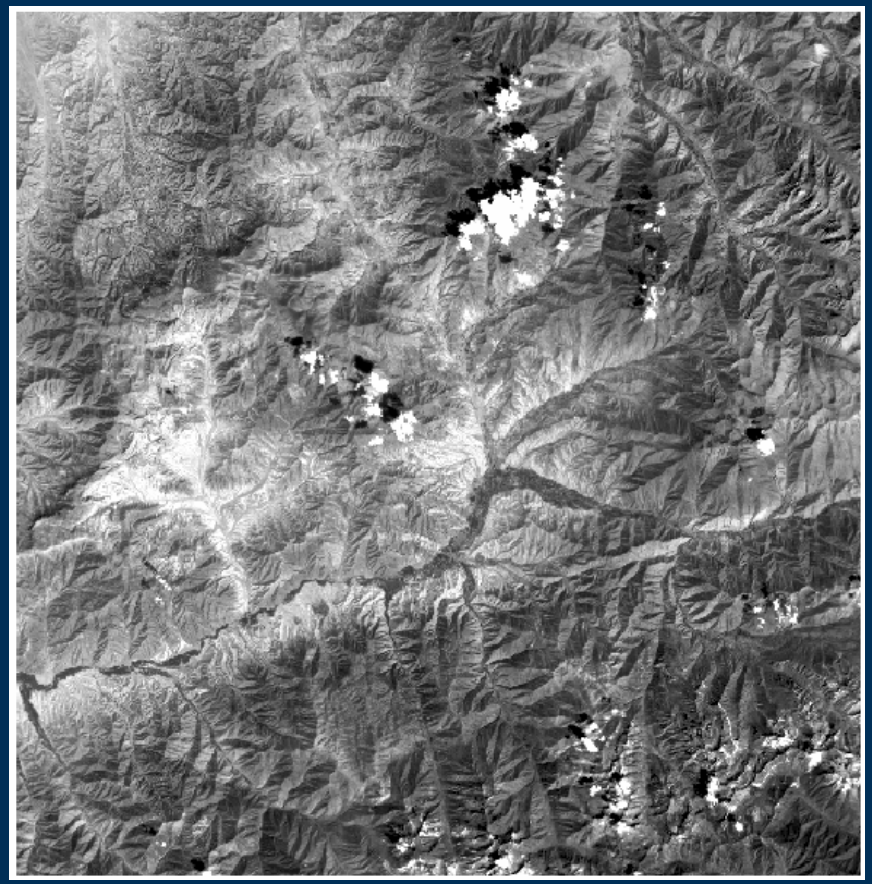
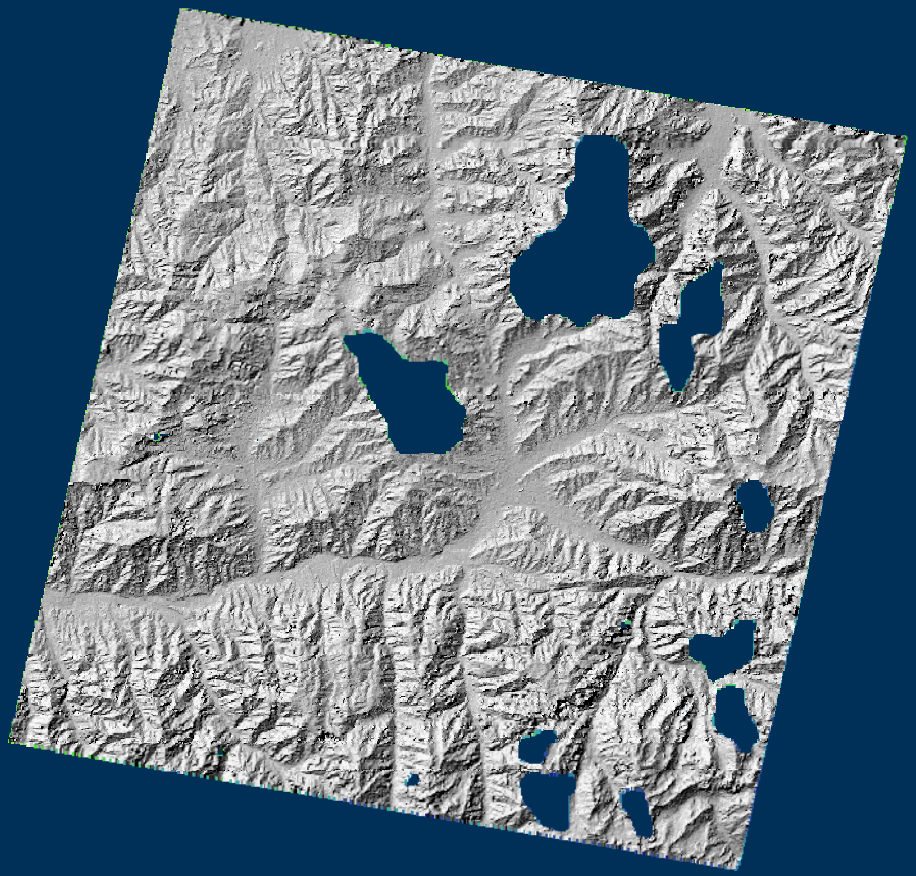
DEM Products: Results of Cloud Cover





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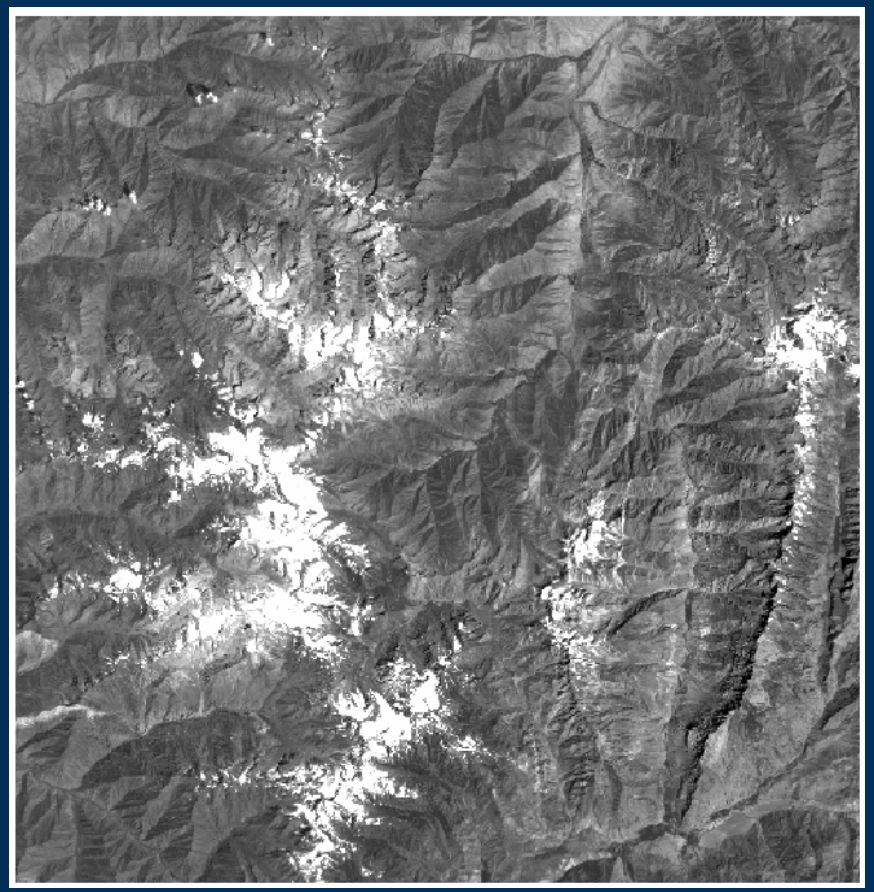
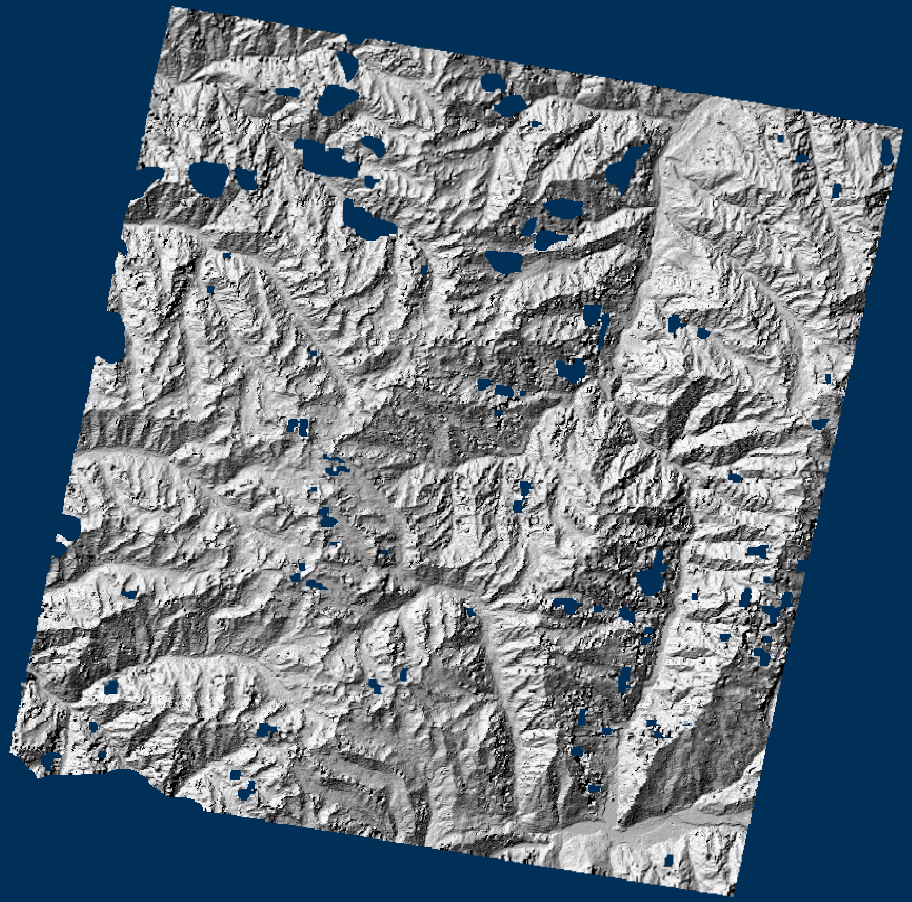
DEM Products: Results of Snow Cover





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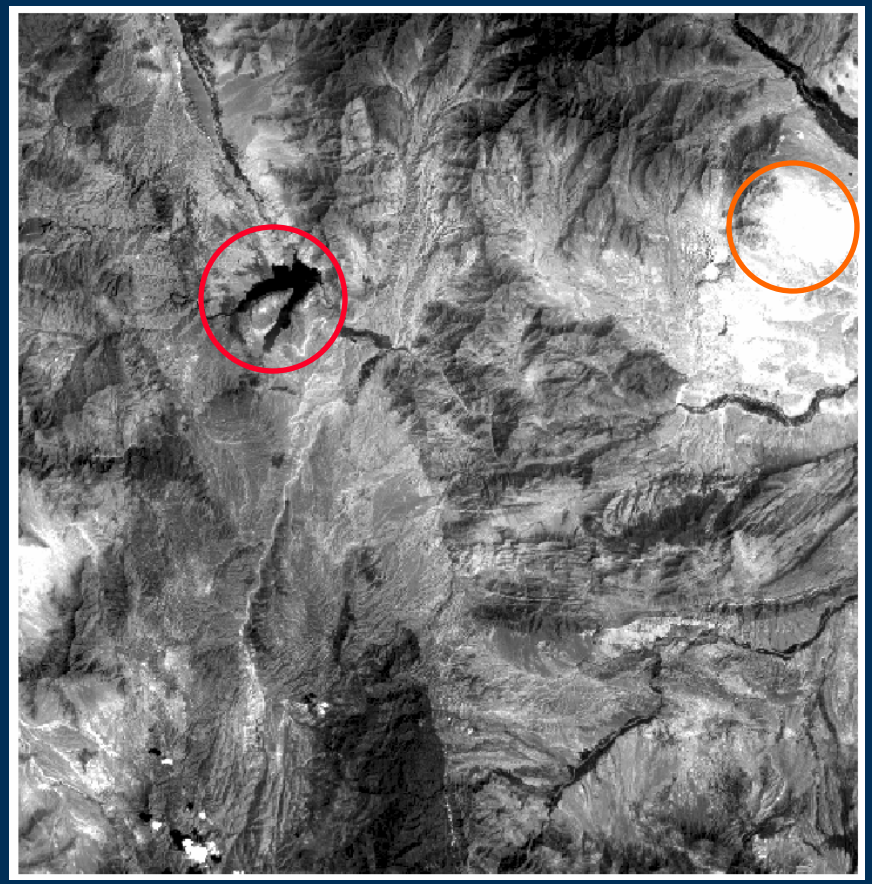
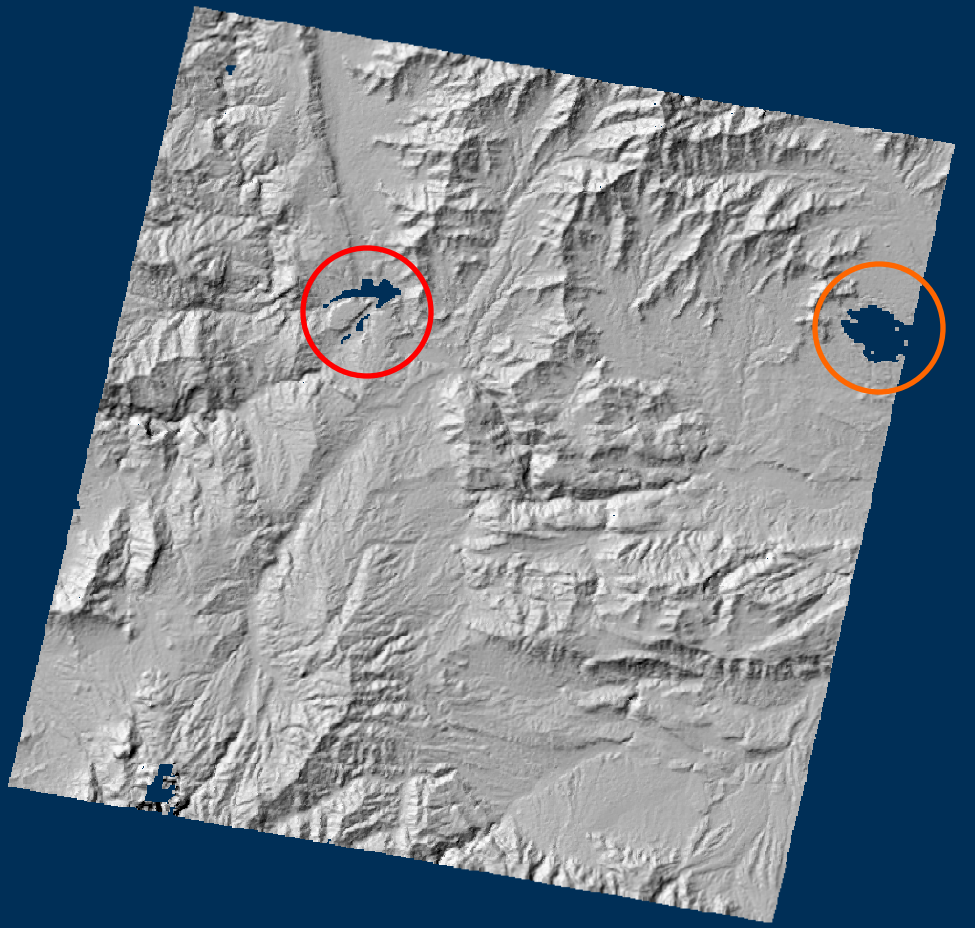
DEM Products: Results of Areas with High Albedo and Bodies of Water





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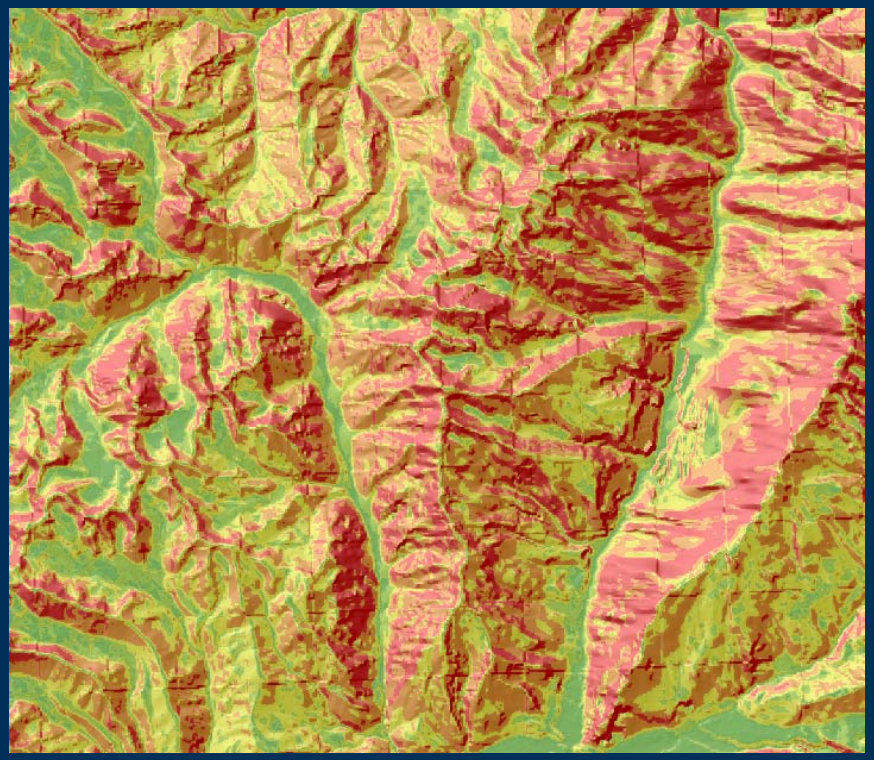
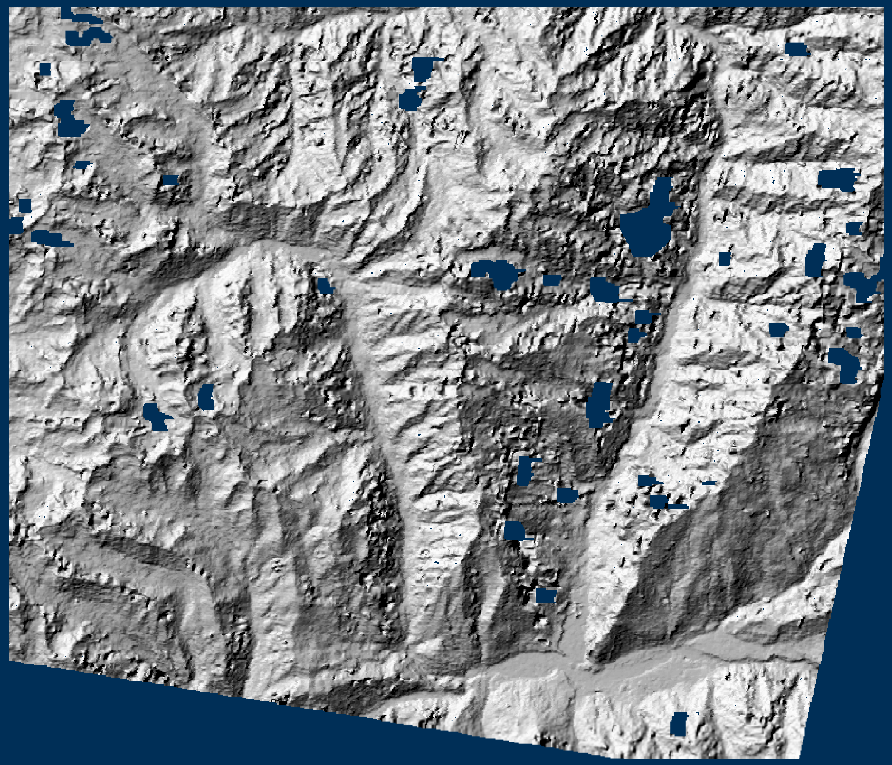
DEM Products: Areas with Steep and Southeastern Facing Slopes





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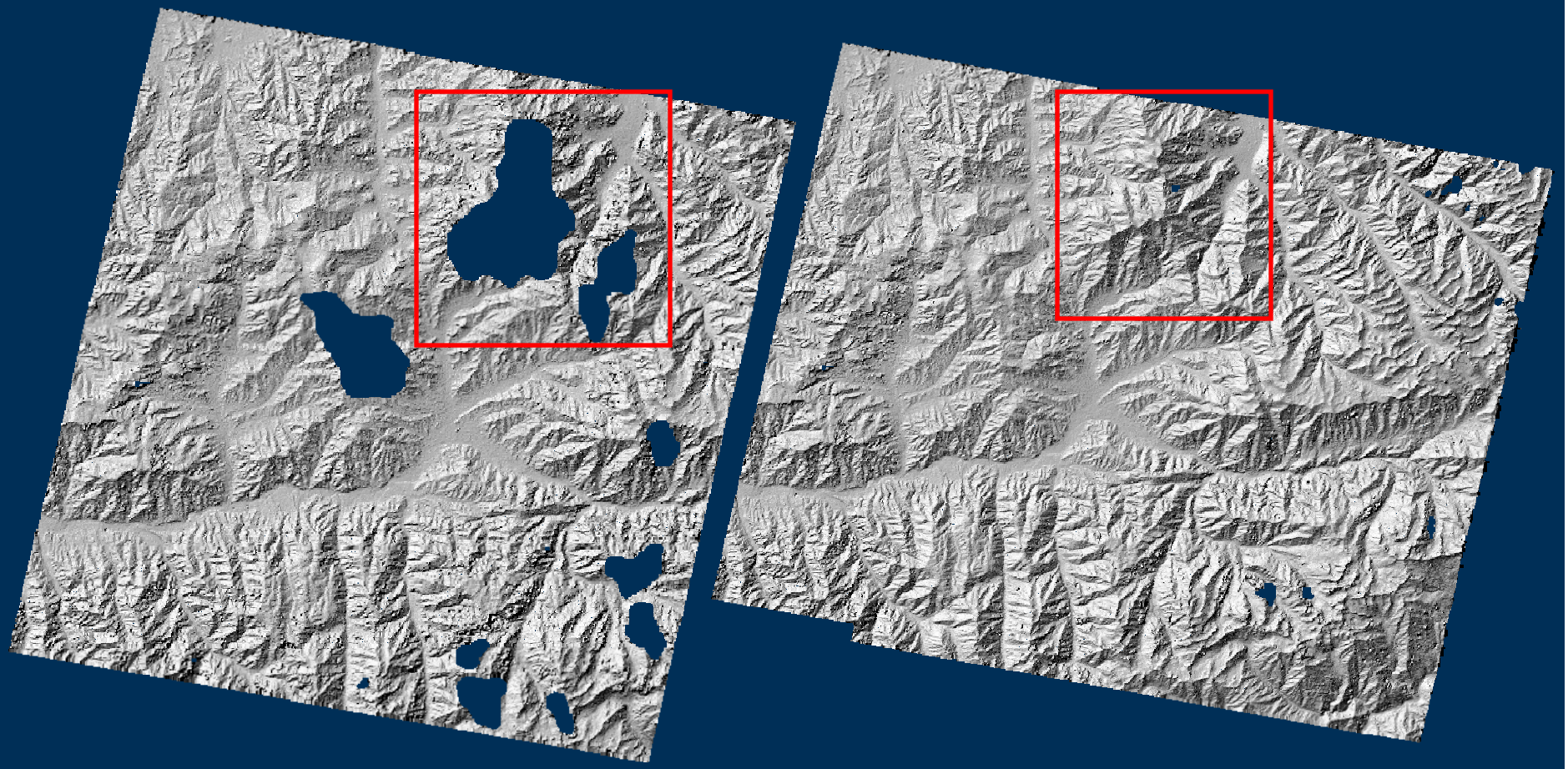
Solutions: Filling Void Areas



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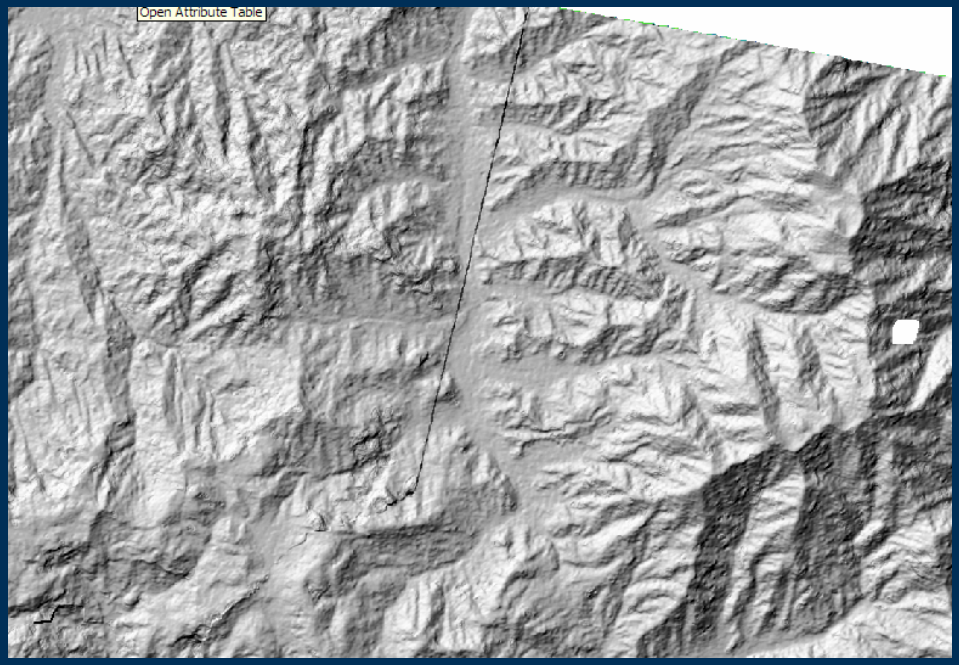
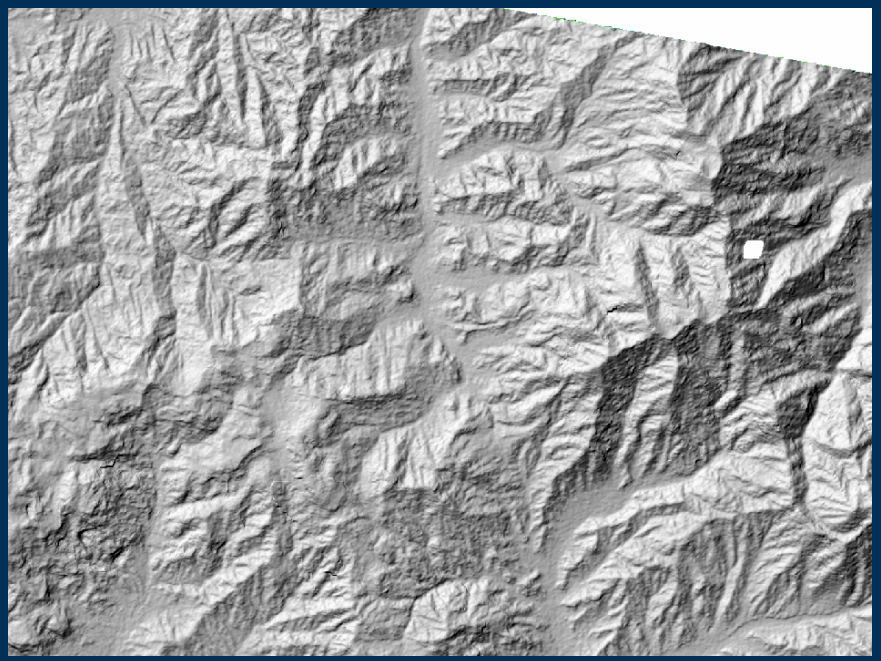
Solutions: Removing seams





Solutions: Pointing Angle

- Sensor has up to 8.55 degrees of pointing capabilities
- > pointing angle = more terrain displacement
- > pointing angle = higher RMS values when georeferencing

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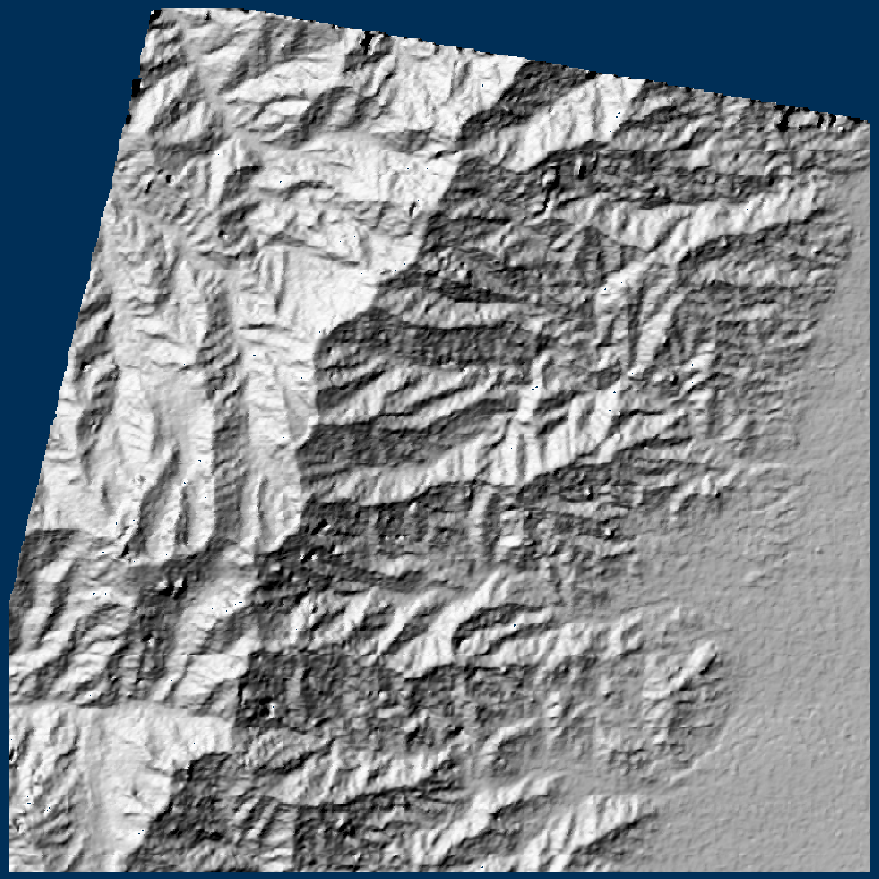
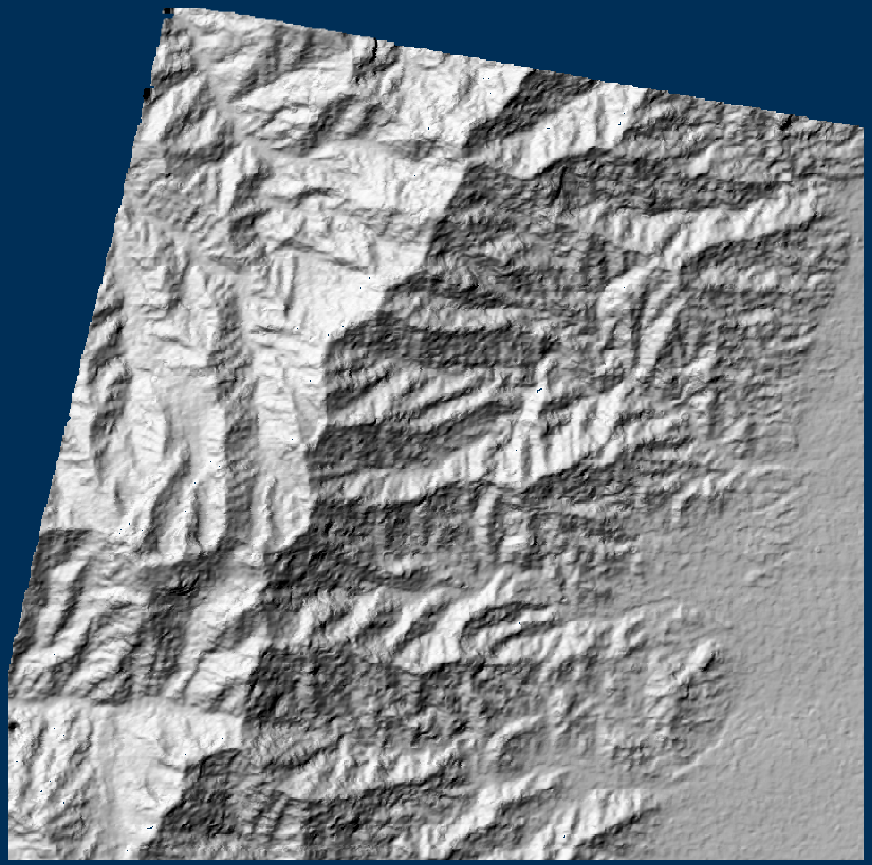
Solutions: Removing erroneous values





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Conclusions

- All of these factors make regional scale DEM production more difficult
- Holes can be filled by creating overlapping DEMs
- Mosaicing scenes, not merging them, removes seams
- Always review scene metadata and obtain scenes with low pointing angles
- Filter DEMs to remove erroneous values

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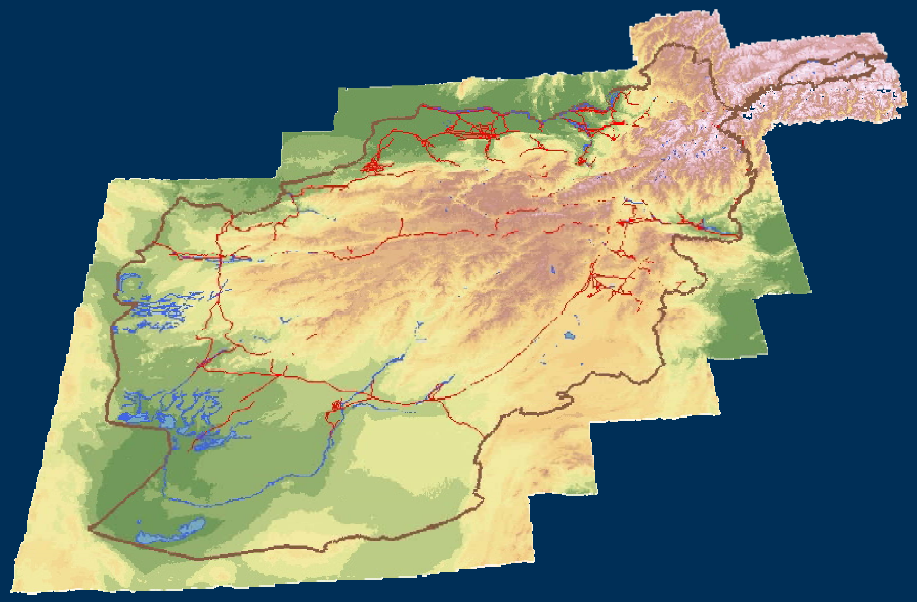
For more information on this project and others involving the applications of DEMs visit our website:
http://geology.er.usgs.gov/eespteam/terrainmodeling



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