Application and Assimilation of Shuttle Radar Topography Mission Data for High Resolution Dust Modeling

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PHAiRS

Public Health Applications in Remote Sensing

- **Overview of PHAiRS & SRTM**
- **Statement of the problem**
- **Review of elevation models**
- **Methods**
- **Verification and Validation**

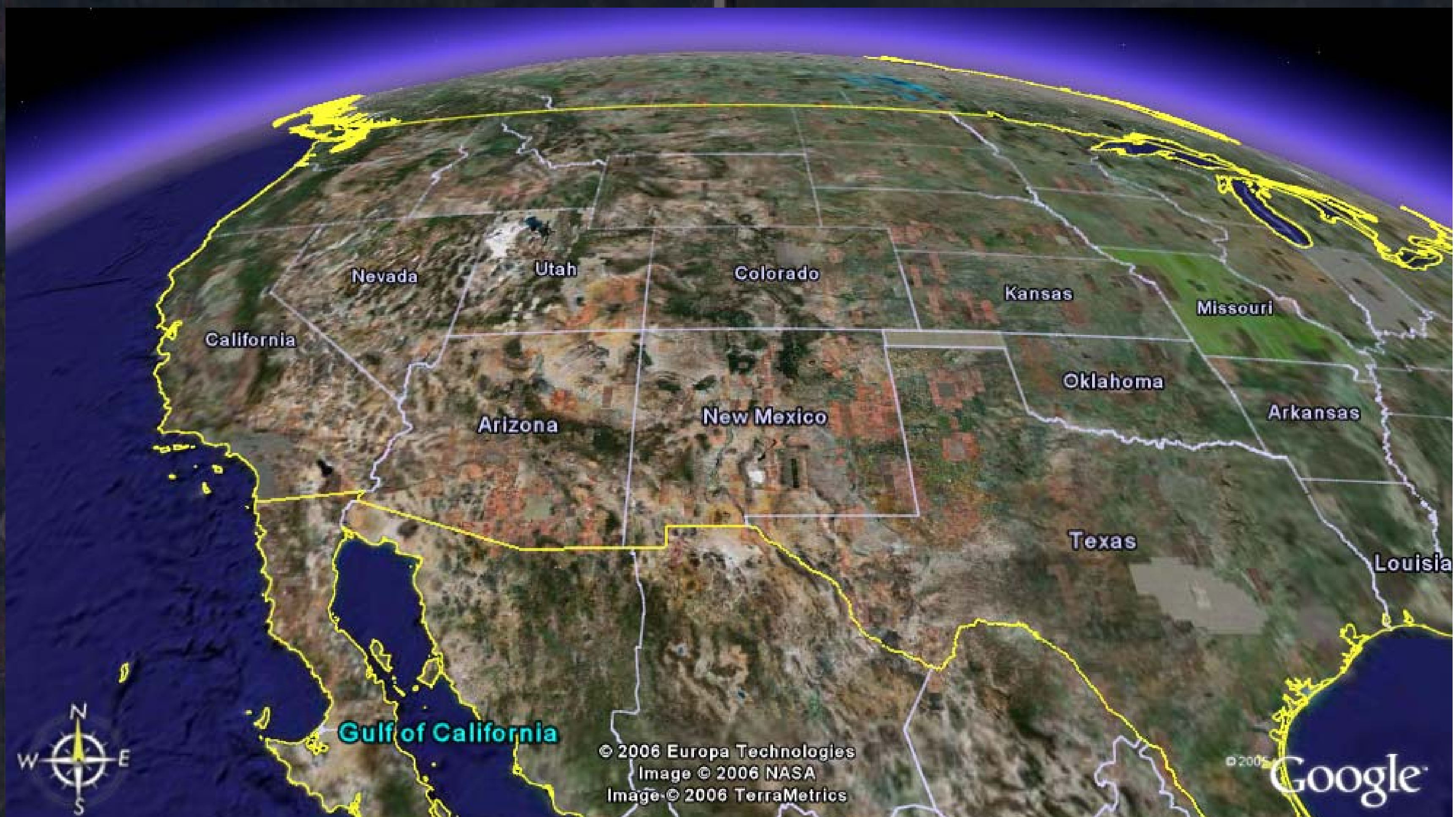
Public Health Applications in Remote Sensing

Project Goals

1. To assimilate remotely sensed satellite data into a regional weather forecasting model (DREAM).
2. Improve performance of this model through the use of high resolution data.
3. Create partnerships with health care and public health authorities to verify and validate the Earth system science coupling mechanisms between environmental and public health.
4. Benchmark by quantitative means the benefits to science and society.

Dust REgional Atmospheric Model (DREAM)

Model Domain

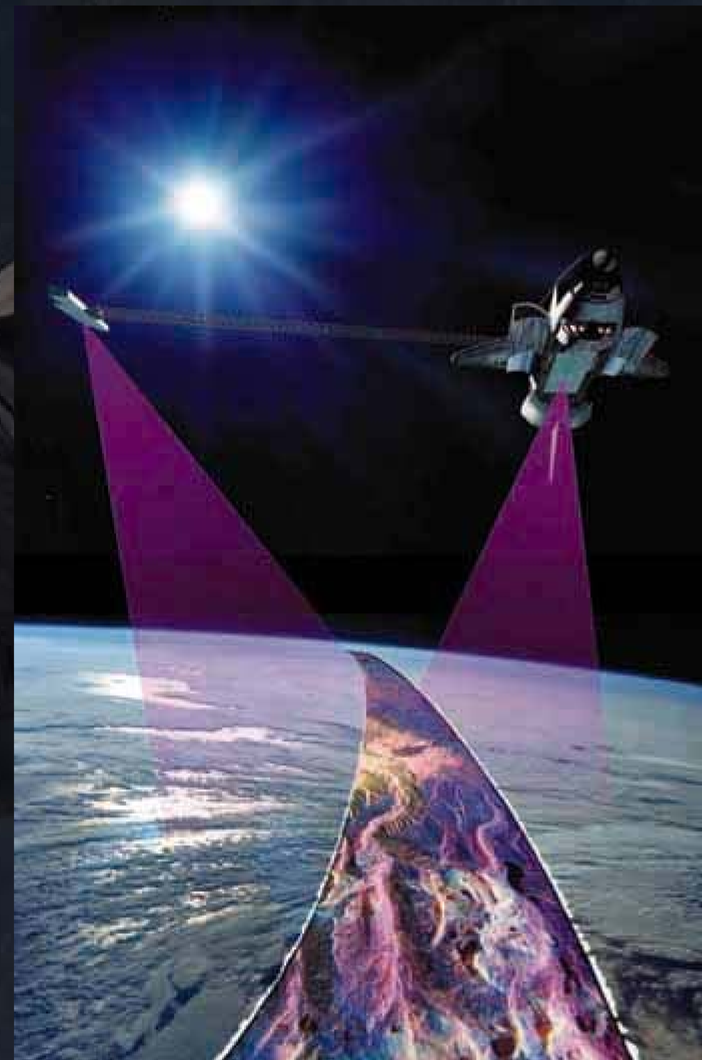


Shuttle Radar Topography Mission (STS-99)

- Mission flight: February 2000 – 11 day mission
- Covered most all of the Earth’s populated areas
- Created a high resolution 3-D map of the globe
- Utilized Cross Track Radar Interferometry
- Highly successful mission

The mission utilized two antennae – one in the cargo bay (with the transmitter) and one at the end of a 60 meter mast.

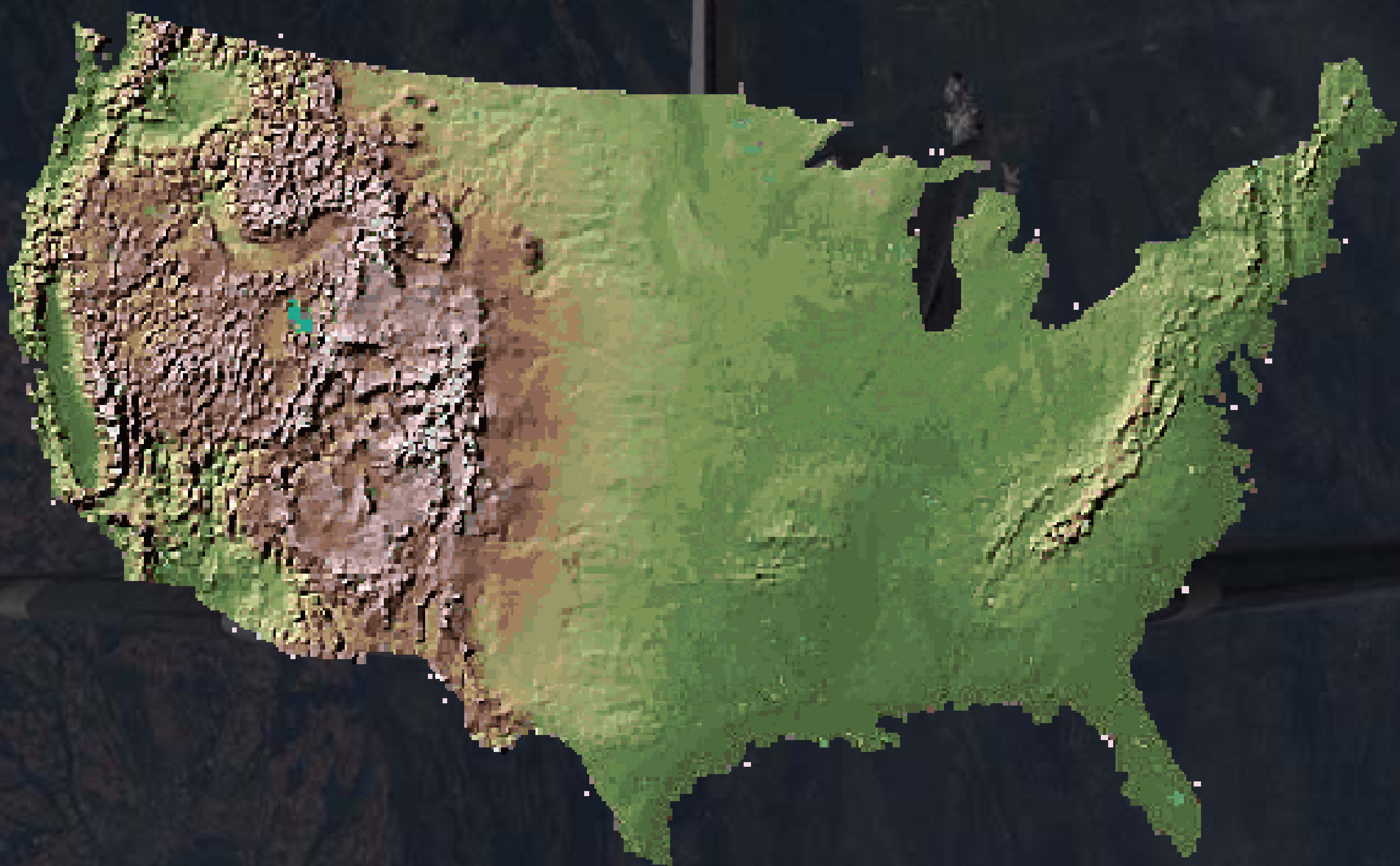
These different angles effectively imaged the Earth in stereo allowing for very accurate elevation readings.



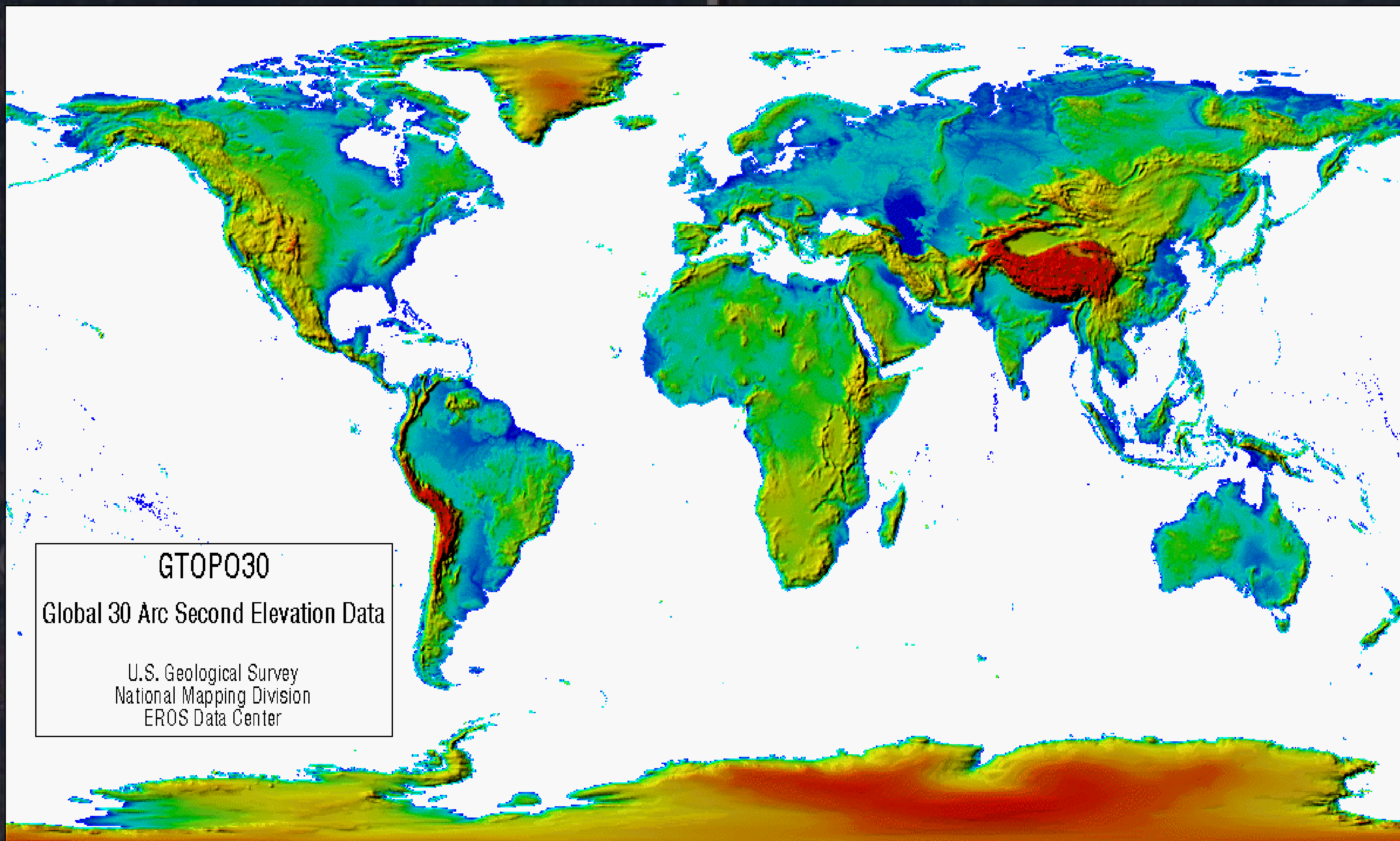
Remote Sensing and Elevation Models

USGS Topographic Maps

National Elevation Dataset (NED)



GTOPO30


GTOPO30
Global 30 Arc Second Elevation Data
U.S. Geological Survey
National Mapping Division
EROS Data Center

Issues with Digital Elevation Models (DEMs)

Issues with Digital Elevation Models (DEMs)

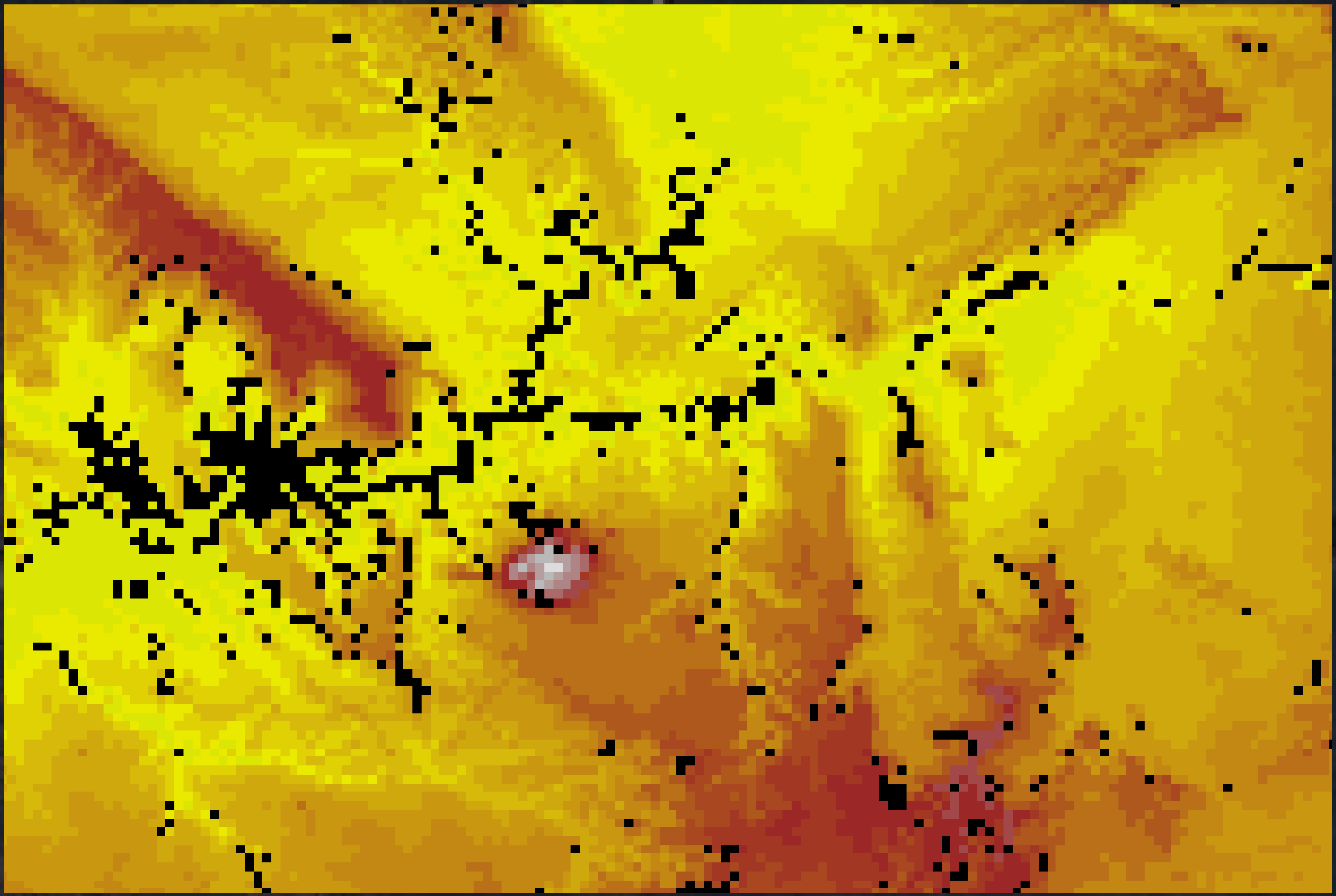
DEMs created from topographic maps often include “operator errors” such as striping.

Merging two topographic maps often results in seams.

Global elevation data sets are often inconsistent – data varies from continent to continent.

Elevations derived from complex systems, such as Synthetic Aperture Radar (SAR), contain data voids and noise.

SRTM Data Voids



SRTM Data Voids

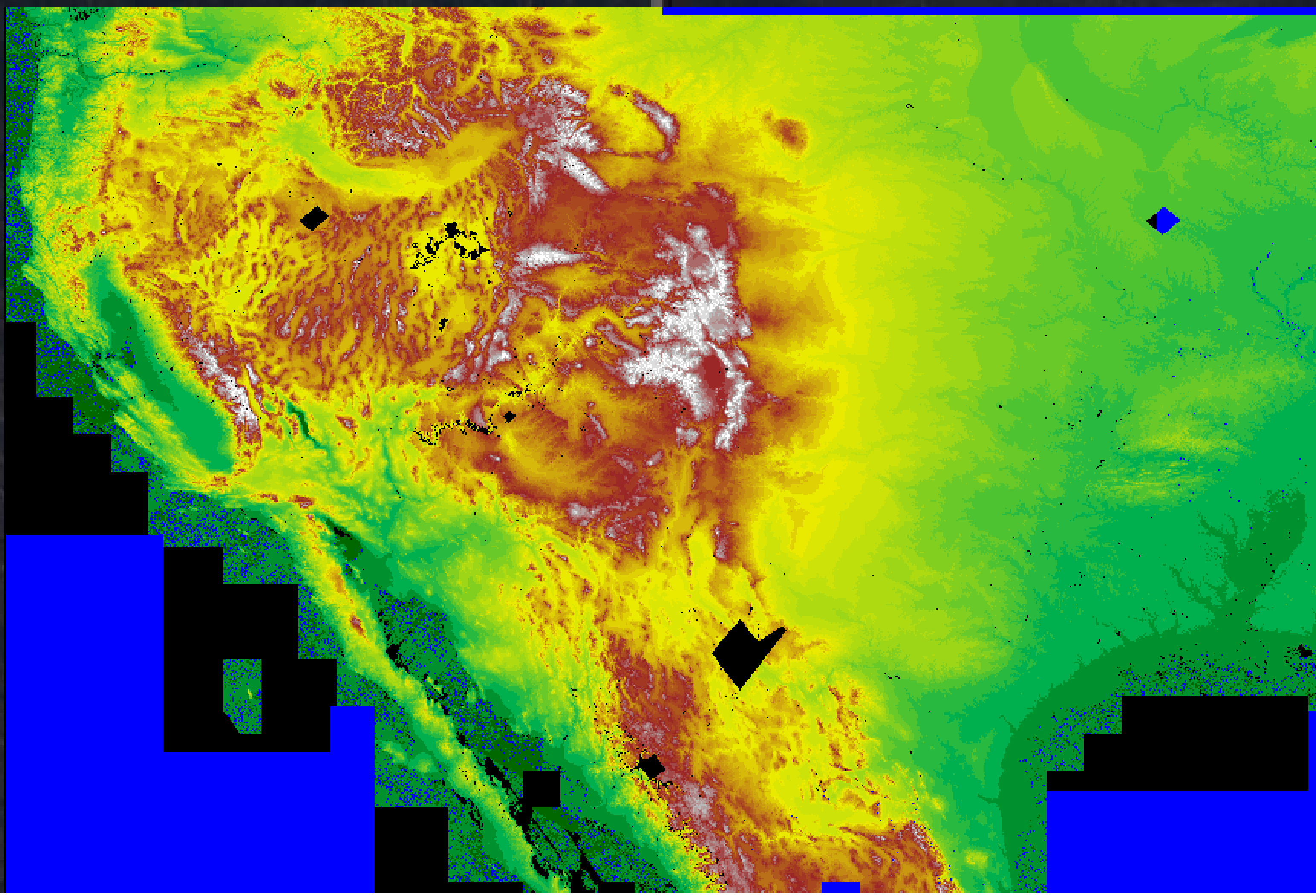
Boeing Intermap was contracted to process SRTM raw data for the National Geospatial-Intelligence Agency.

Initial processing of the data did not eliminate many data voids.

Programs written to eliminate voids:

- 3DEM (Visualization software)
- Landserf (Landserf)
- VTBuilder (Visual Terrain)
- Voidkiller (DG Advanced)
- Blackart (Terrainmap)
- SRTMfill Utility (3DNature)
- SURFACE (GMT)

SRTM Data Voids – Large Voids



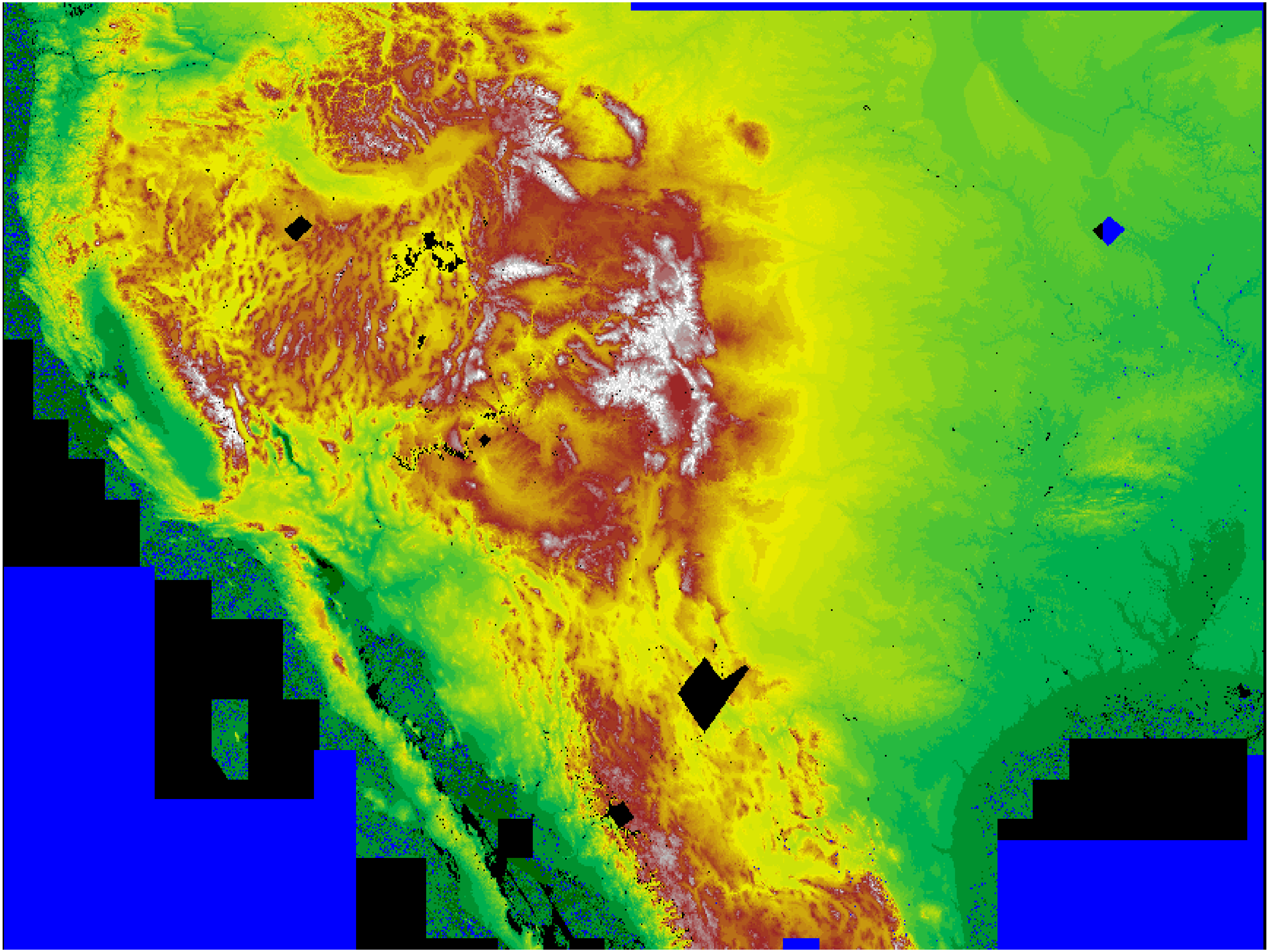
SRTM Data Voids – Large Voids

Data from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) has been utilized as ancillary data to fill in larger voids.

SRTM Data Cleanup - Methods

SRTM data contain numerous voids and data issues.

In order to be useful in modeling, the data set must be continuous with **no gaps or significant errors**.



SRTM Data Cleanup - Methods

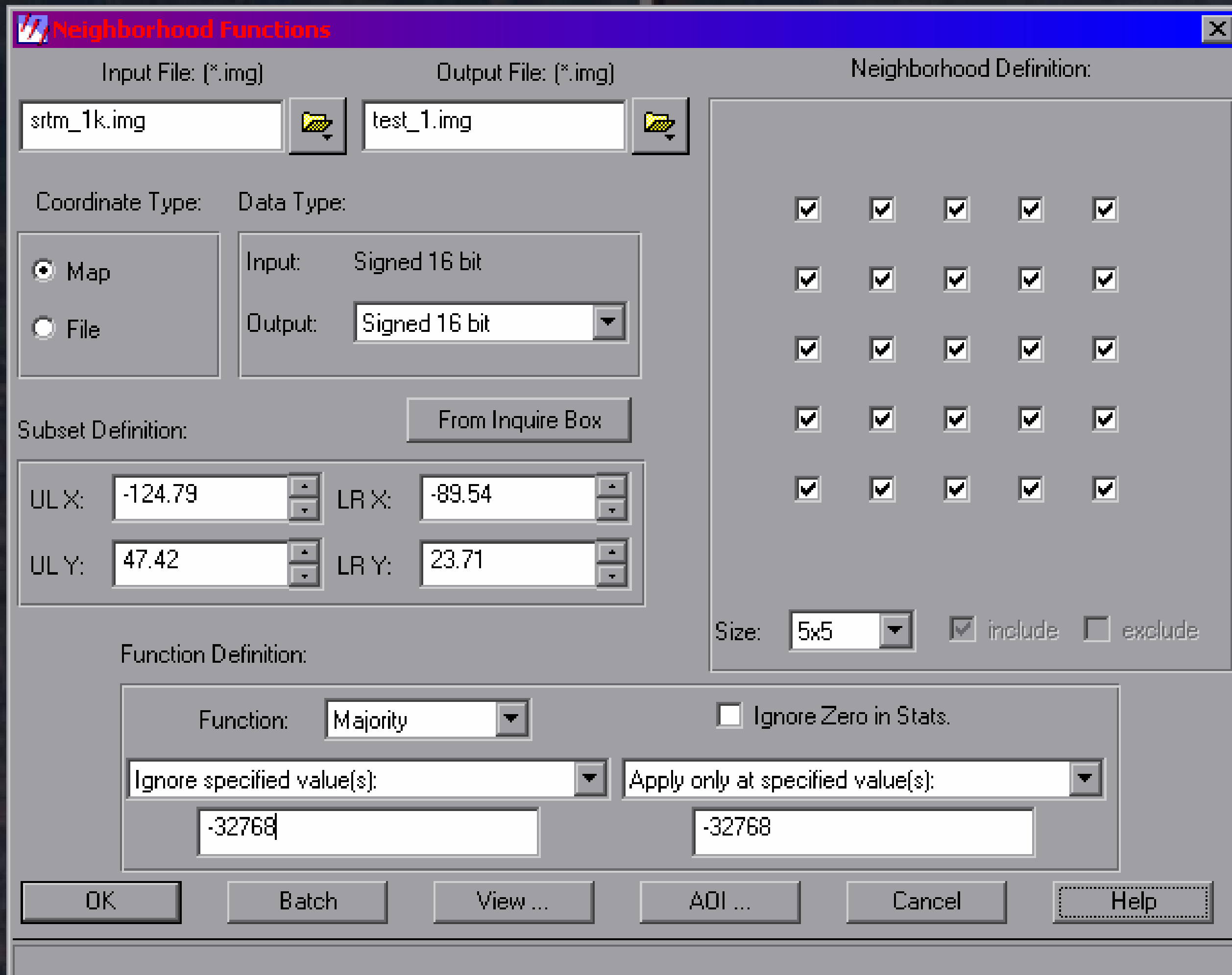
“Salt and pepper noise”

Large data voids

Coastal noise

Methods – Salt and Pepper Noise

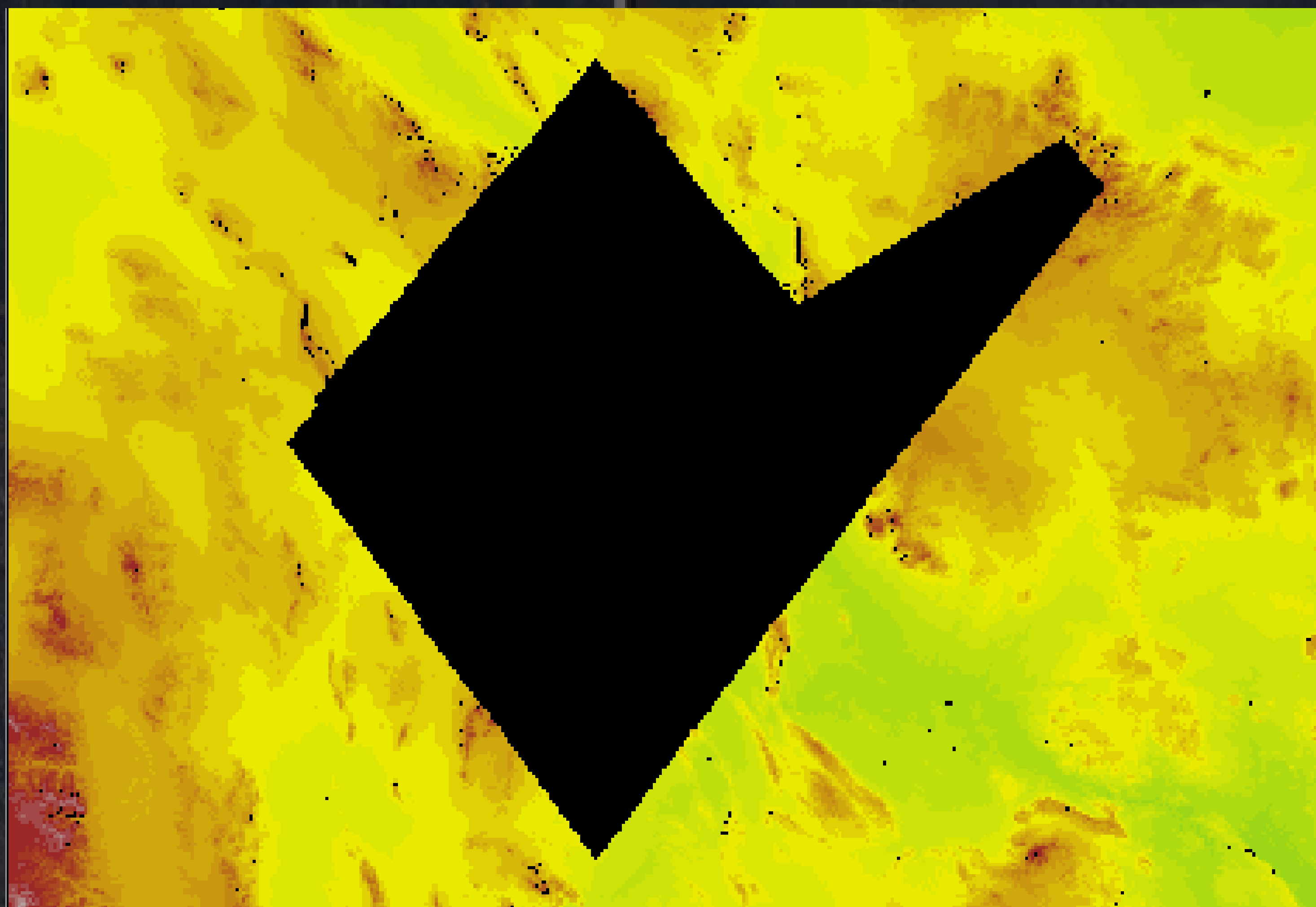
Targeted Neighborhood Filter



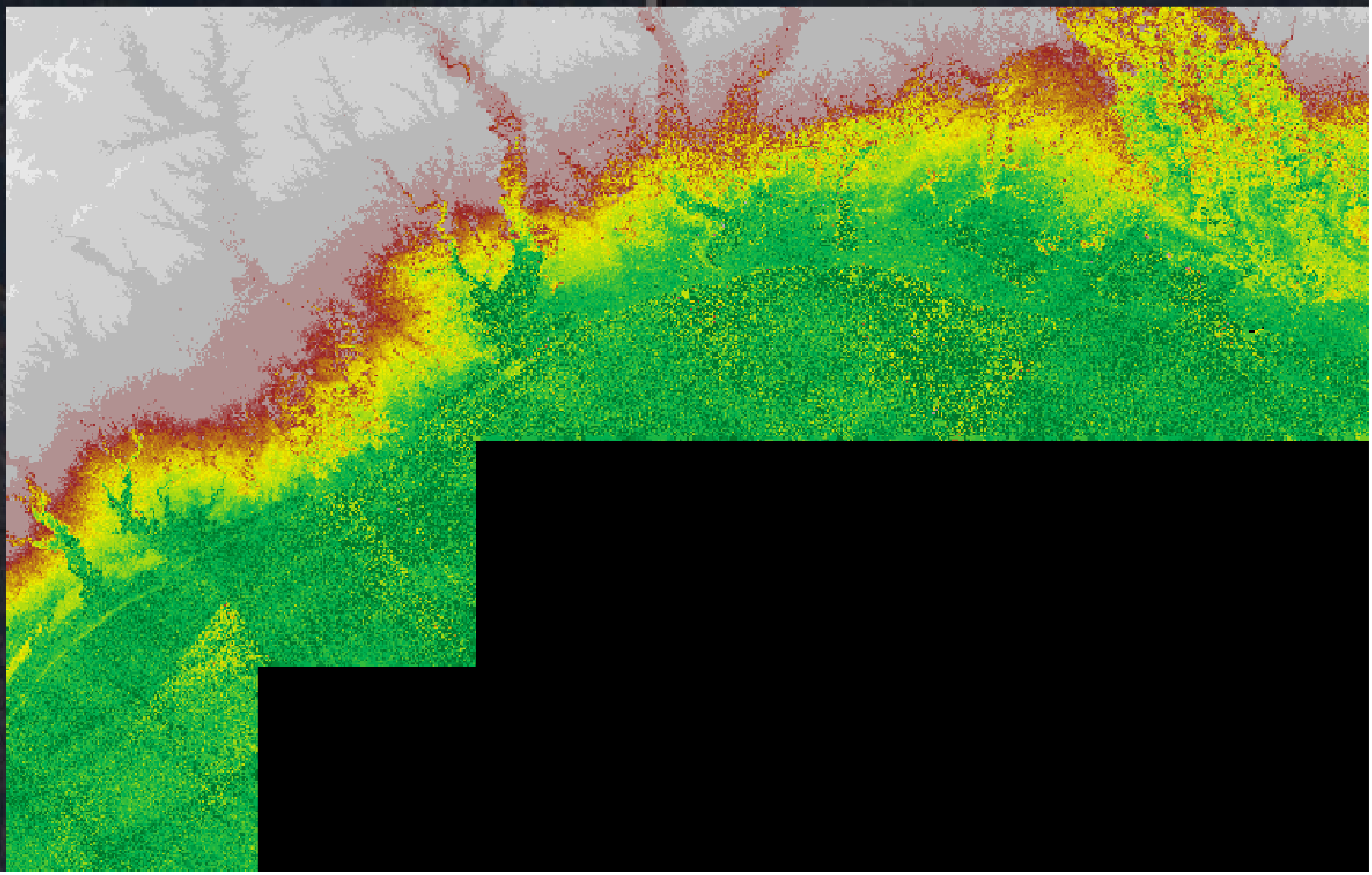
Methods – Salt and Pepper Noise

4	4	5	5	5
4	4	5	5	5
4	4		5	4
4	4	4	4	4
4	4	4	4	4

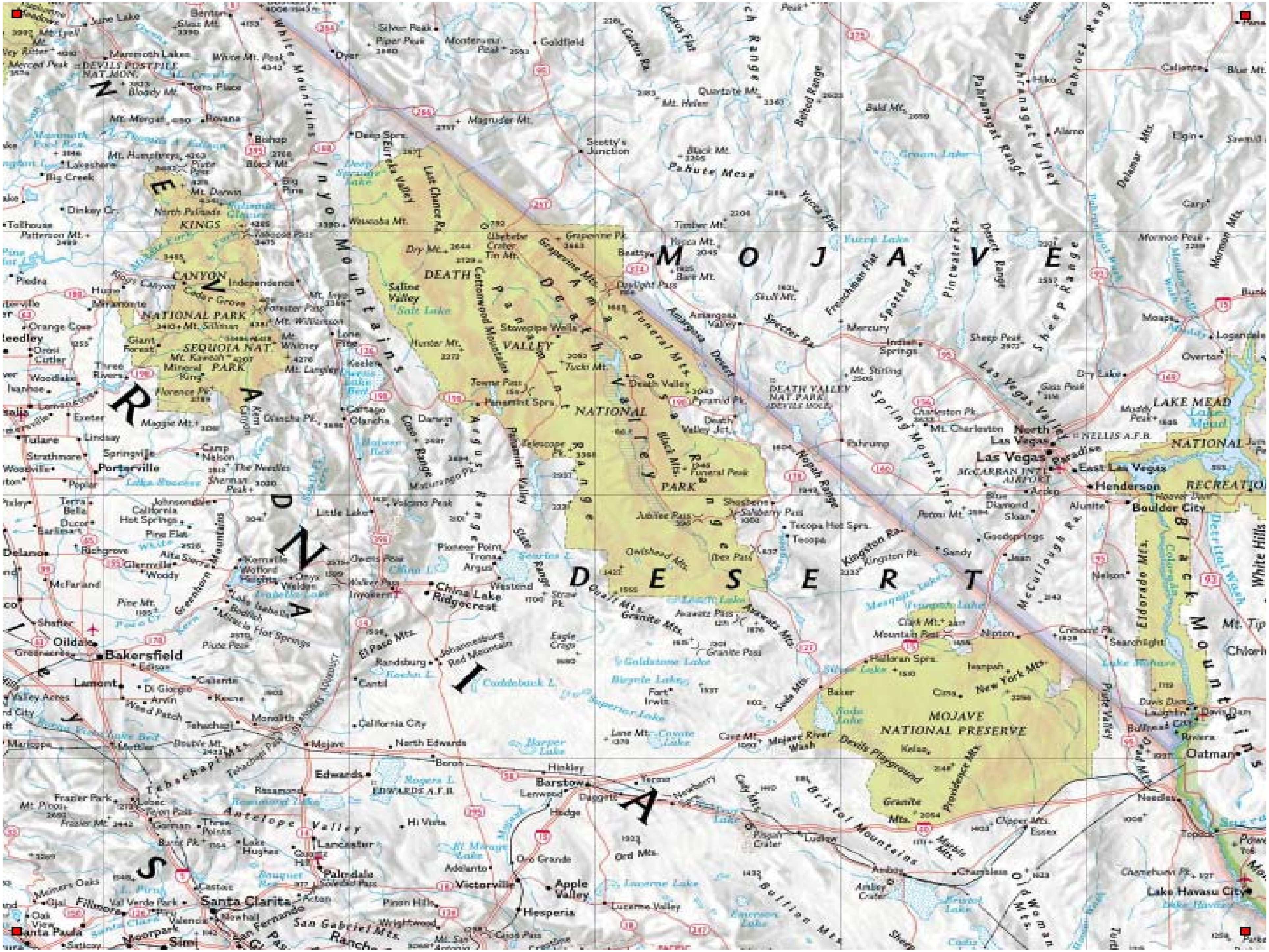
Methods – Large Data Voids



Methods – Coastal Noise

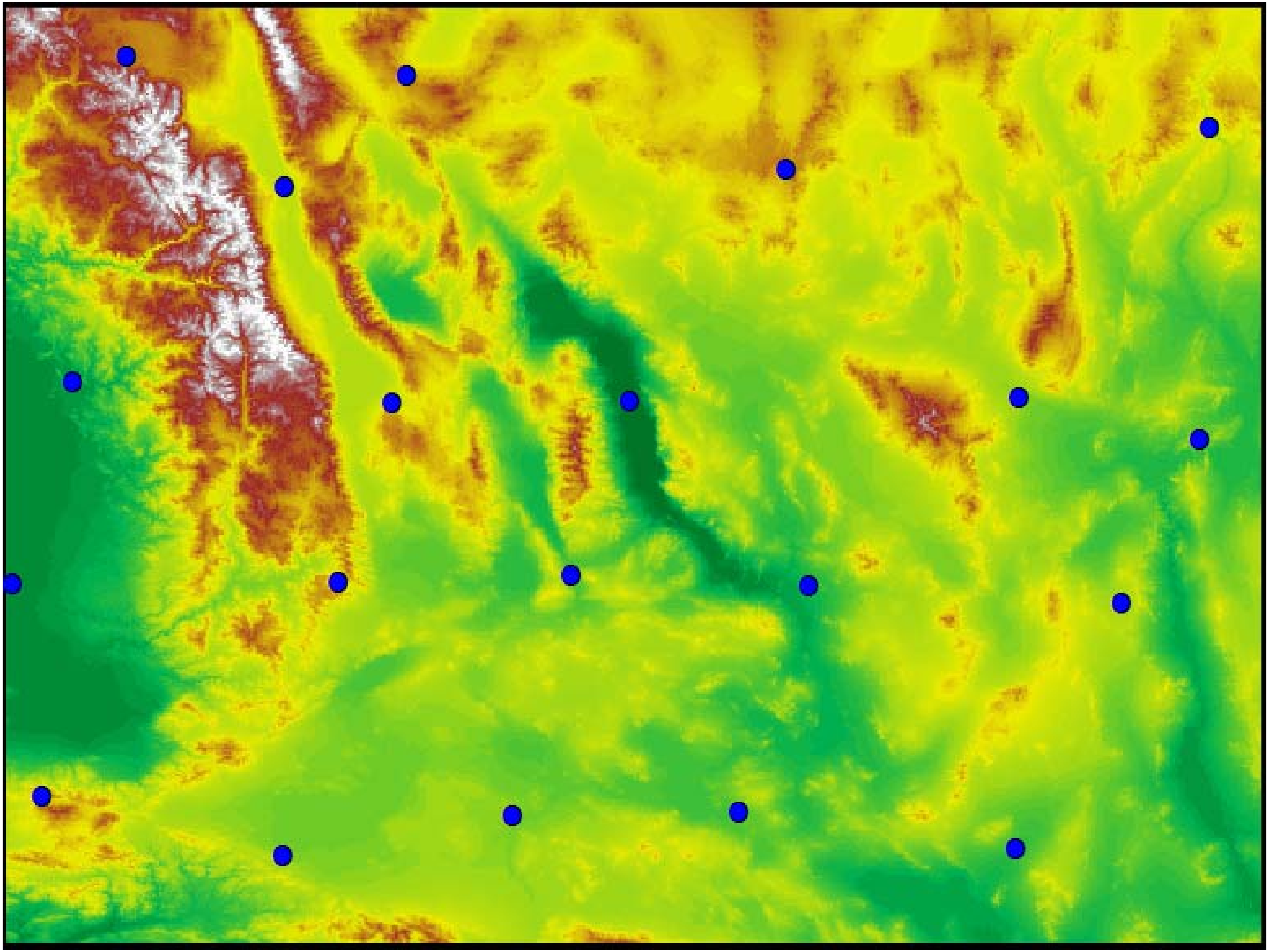


Verification and Validation


MOJAVE
DESERT
SIERRA NEVADA
DEATH VALLEY NATIONAL PARK
KINGS CANYON NATIONAL PARK
SEQUOIA NAT. PARK
MOJAVE NATIONAL PRESERVE
LAKE MEAD NATIONAL RECREATION
Amargosa Desert
White Mountains
Inyo Mountains
Panamint Range
Amargosa Range
Argus Range
Spring Mountains
Black Mountains
Bristol Mountains
Antelope Valley
Las Vegas
North Las Vegas
Henderson
Boulder City
Paradise
Bakersfield
Barstow
Victorville
Apple Valley
Hesperia
Palmdale
Lancaster
Santa Clarita
China Lake
Ridgecrest
Porterville
Bishop
Independence
Lone Pine
Baker
Needles
Laughlin
Oatman
Lake Havasu City
Pahrump
Beatty
Tonopah
Goldfield
Mojave
Edwards
EDWARDS A.F.B.
Fort Irwin
Death Valley
Stovepipe Wells
Furnace Creek
Shoshone
Tecopa
Mercury
Indian Springs
Mammoth Lakes
Lake Mead

Verification and Validation

- Subset area for detailed study
- Comparison to GTOPO30
    - Generation of a “difference file”
    - Analysis of transects across the data set
- Comparison to National Geodetic Survey Markers



Conclusion

A method of correcting voids and coastal noise in SRTM elevation data is proposed

Utilization of commercial “off the shelf” software

Results will be checked against recognized standards in elevation mapping

Final product will be integrated into a high resolution dust model to improve forecast runs and public health alerts


SHUTTLE RADAR TOPOGRAPHY MISSION
SRTM
NIMA NASA JPL DLR ASI