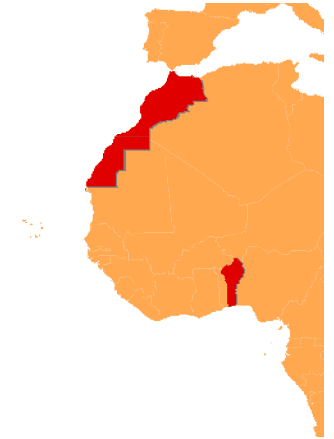




Generation of a high resolution DEM with ASTER Stereo Data for the river Draa Catchment in Morocco



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Why generating a DEM from satellite data?

The goal of IMPETUS is to set up a management plan for the use of fresh water

- DEM is needed to determine the catchment area, run off, etc.

The only existing data was the USGS GTOPO30

- Resolution of ~ 1 km is very coarse

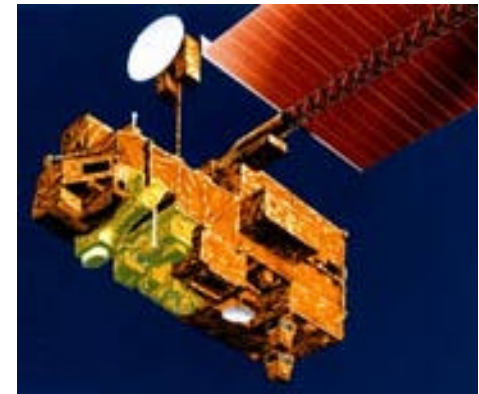
A better resolution could potentially be achieved by

- digitizing topographical maps
- extracting height information from aerial photos
- extracting height information from satellite data

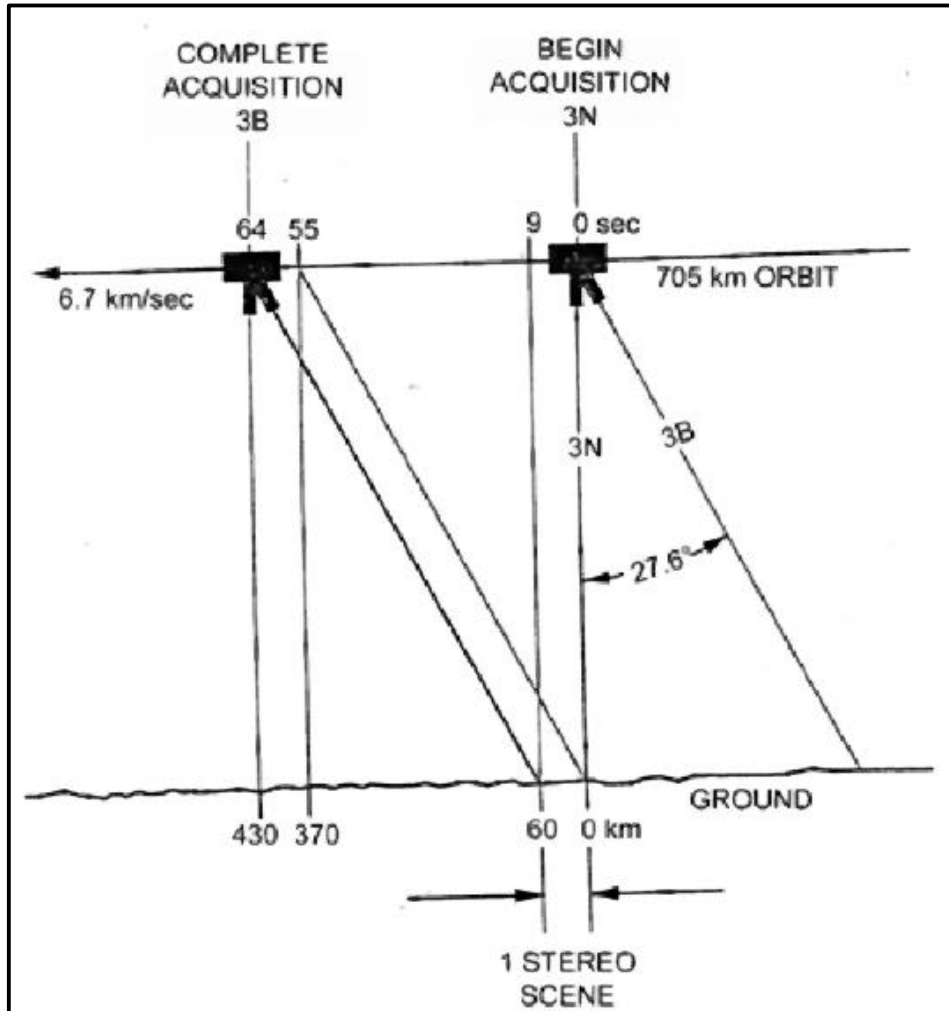
=> **ASTER**

The ASTER Instrument

- The ASTER-instrument is flying on the TERRA-satellite
- Implemented to make high spatial resolution data in 14 bands available
 - ⇒ Three subsystems
 - (1) VNIR with 15m resolution
 - (2) SWIR with 60m resolution
 - (3) TIR with 90m resolution
 - VNIR-system consists of two telescopes
 - ⇒ Three bands are recorded nadir looking
 - ⇒ Third band is also recorded backward looking (0,76-0,86 μ m)



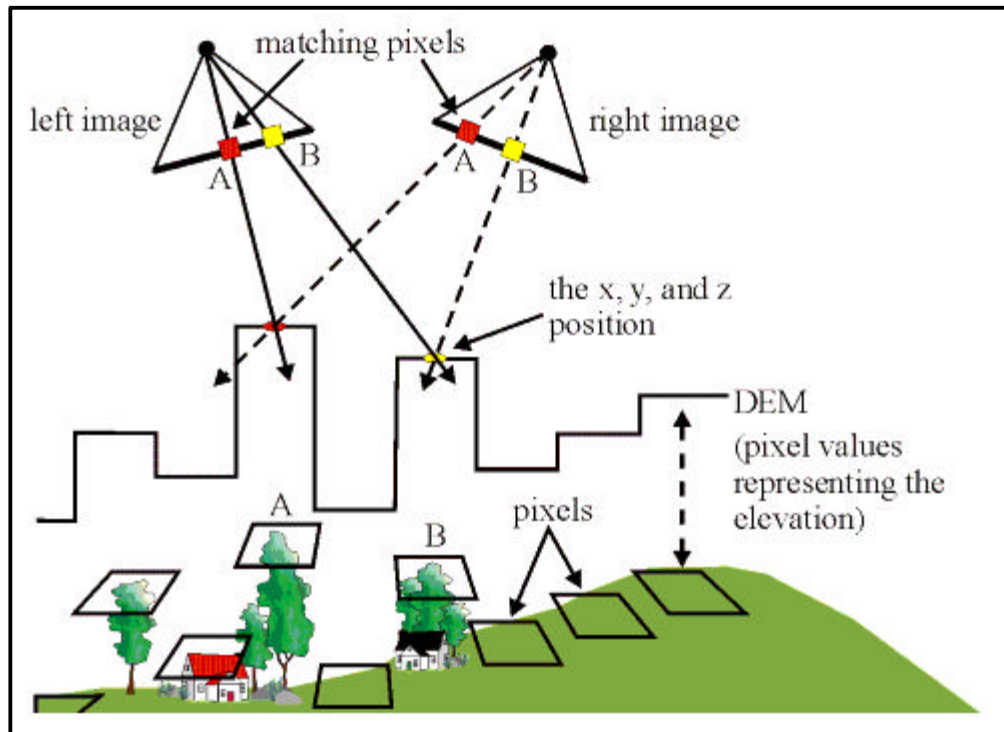
The ASTER Instrument



Source: Lang, H.R. & Welch, R., 1999.

- 3N and 3B compose along-track stereopair
- $B/H \sim 0.6$
- Recording at different angles
=> The same object has different image positions (parallax)

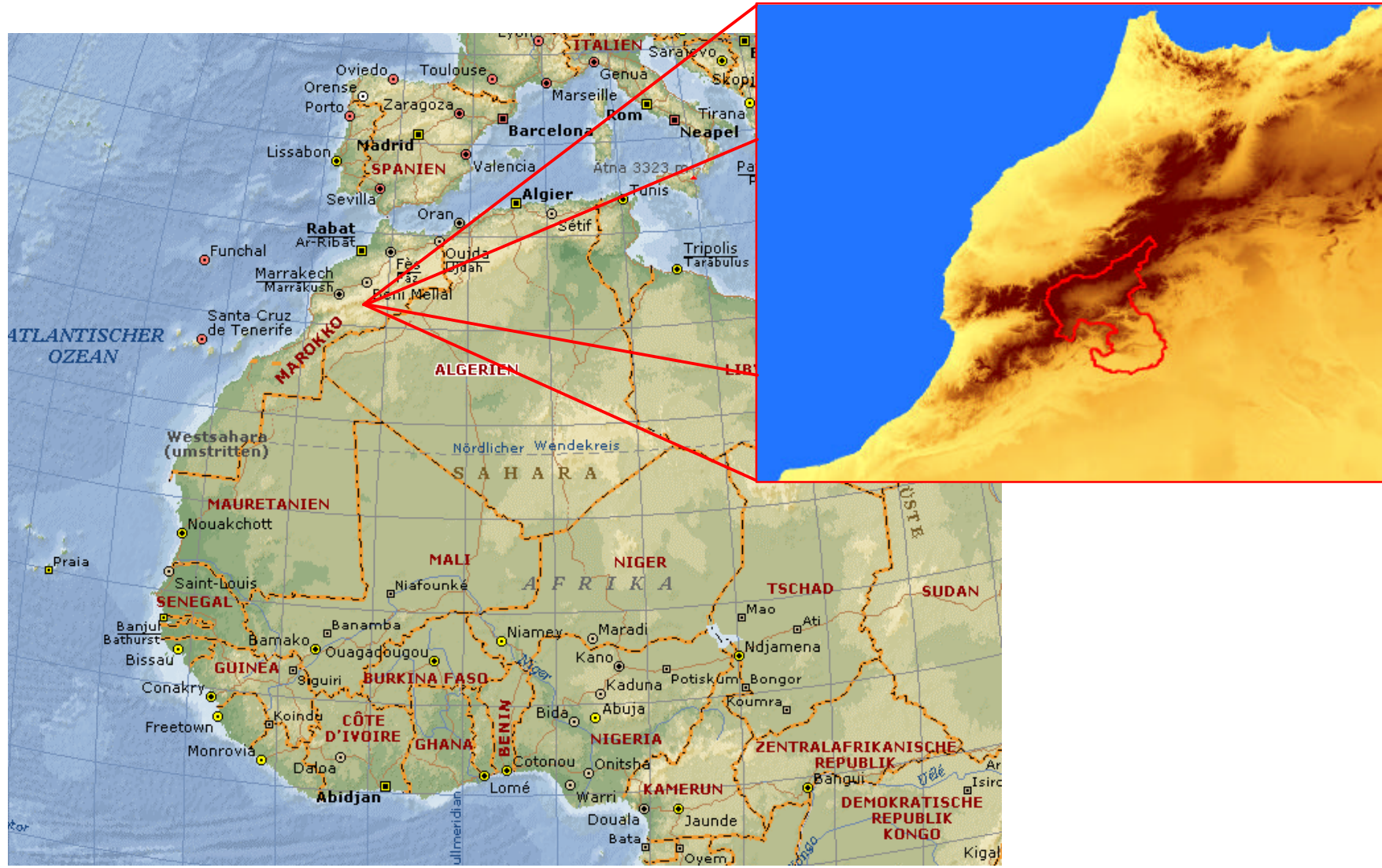
The ASTER Instrument



Source: OrthoEngine User Guide, 2003.

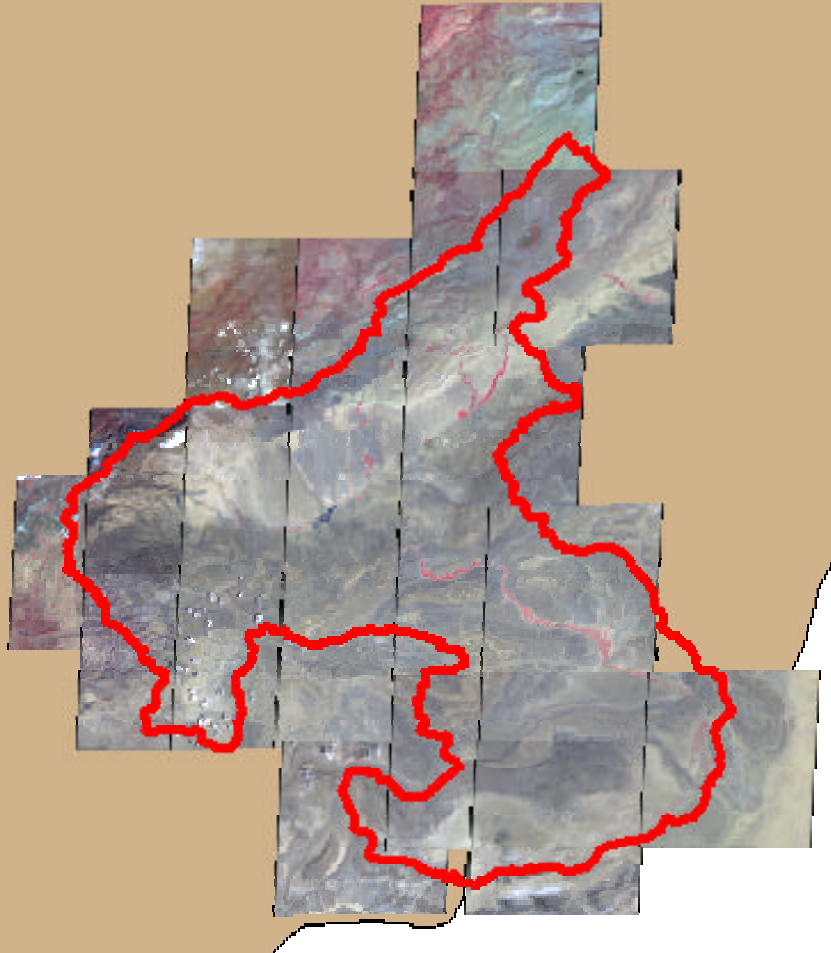
- 3N and 3B compose „along-track“ Stereopair
- $B/H \sim 0,6$
- Recording in different angles
 - ⇒ The same object has different image positions (parallax)
- The higher the elevation, the larger the parallax
 - ⇒ Calculation of the elevation of objects (Pixel)
 - ⇒ Generation of DEM

DEM Coverage



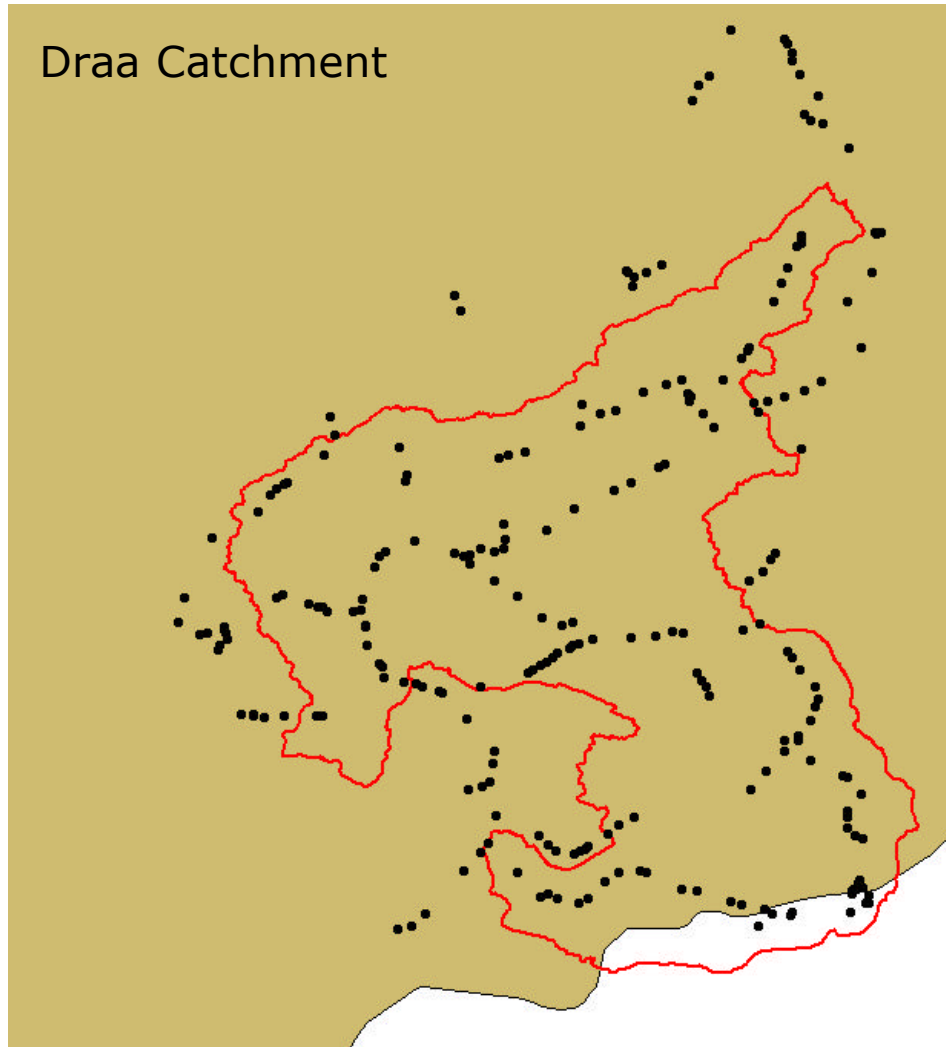
Data Acquisition

Draa Catchment



- 20 ASTER-Images
- Area/Image
~ 60 km x 60 km

Data Acquisition



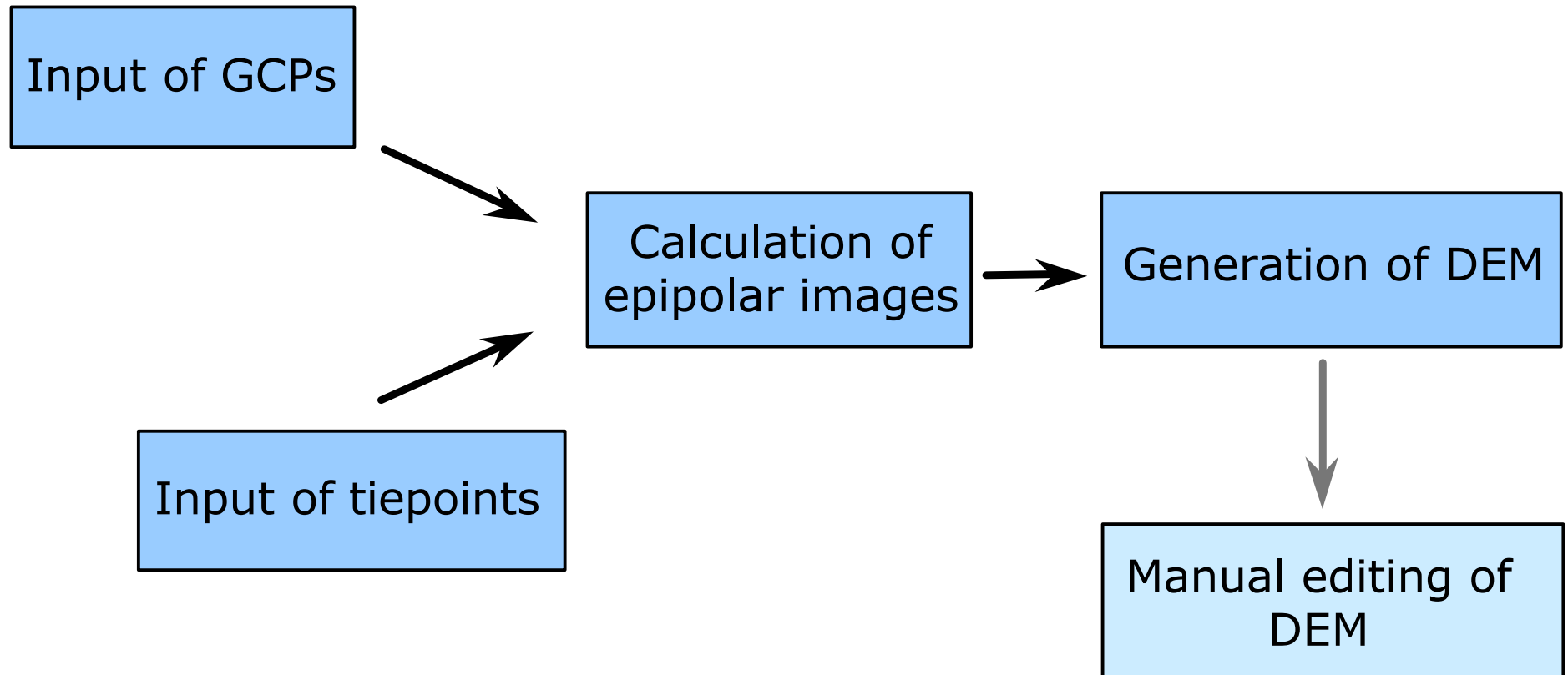
- 20 ASTER-Images
- Area/Image
~ 60 km x 60 km

Generation of absolute
and geocoded DEM:

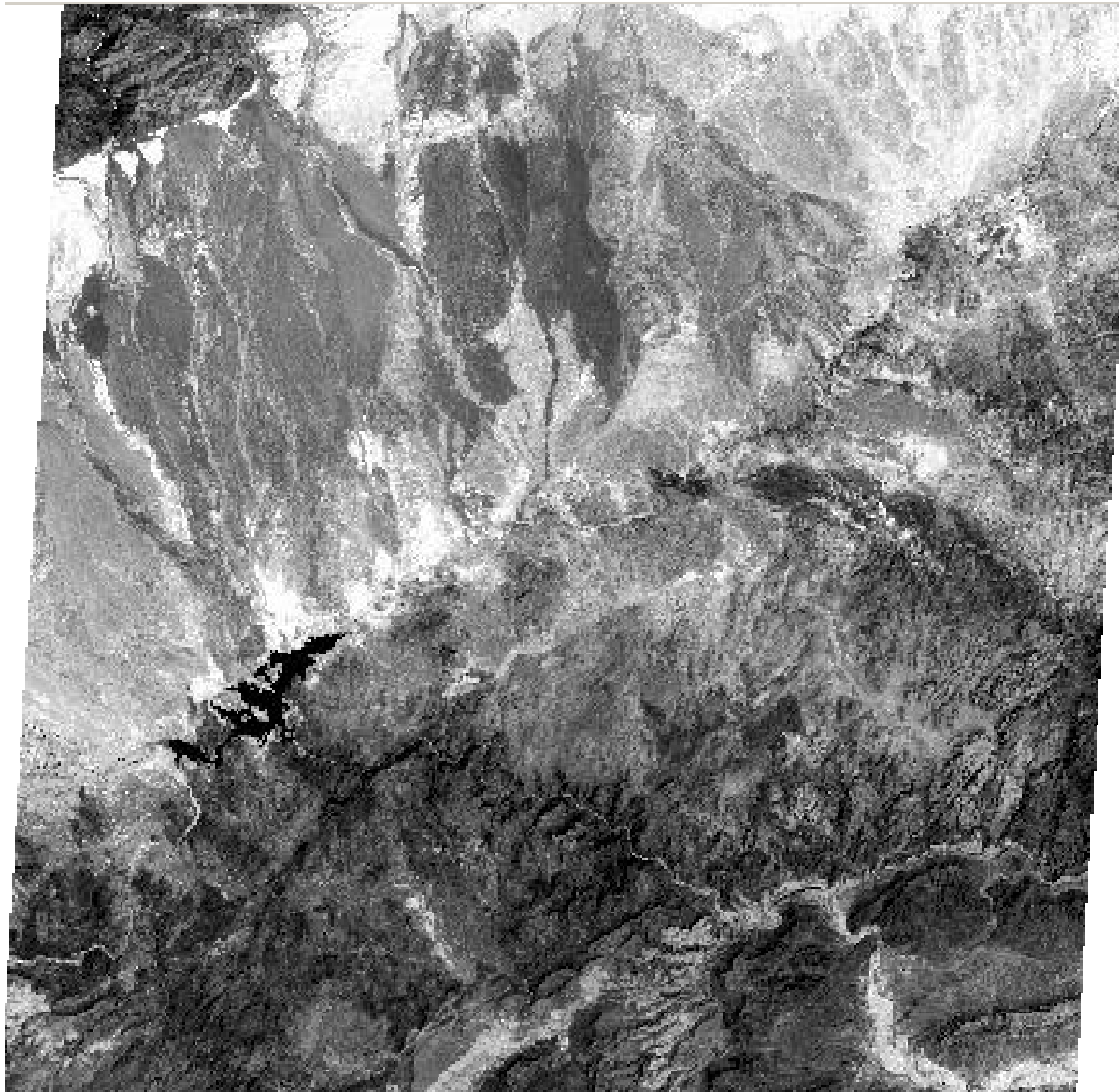
- Collection of 243 Ground Control Points (GCPs) with a differential GPS
- z-Accuracy of 1-5m
- GCPs are uniformly distributed over the catchment and in the images

DEM Generation

- Elevation was extracted with the OrthoEngine of PCI



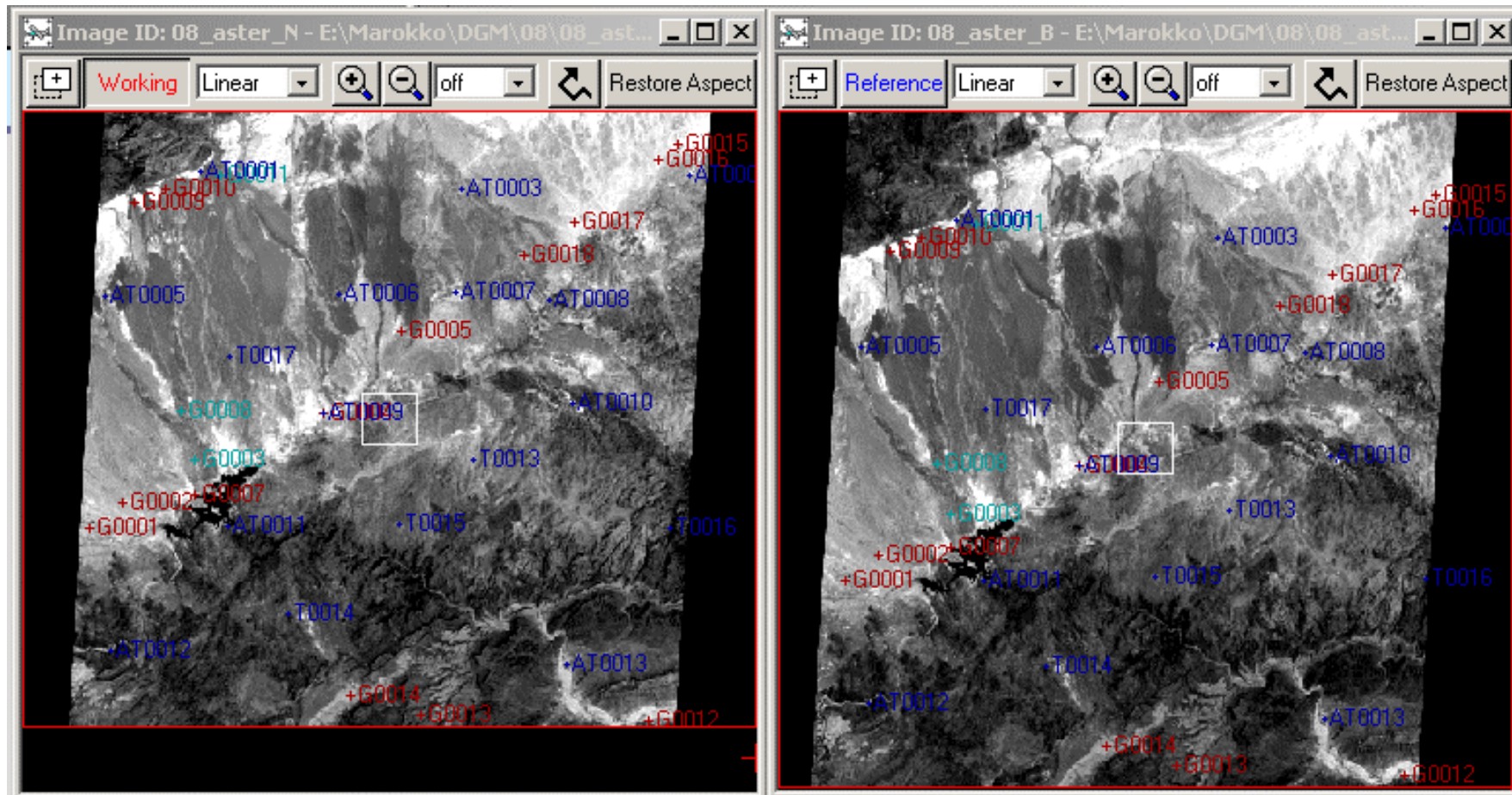
DEM Generation – Raw Image



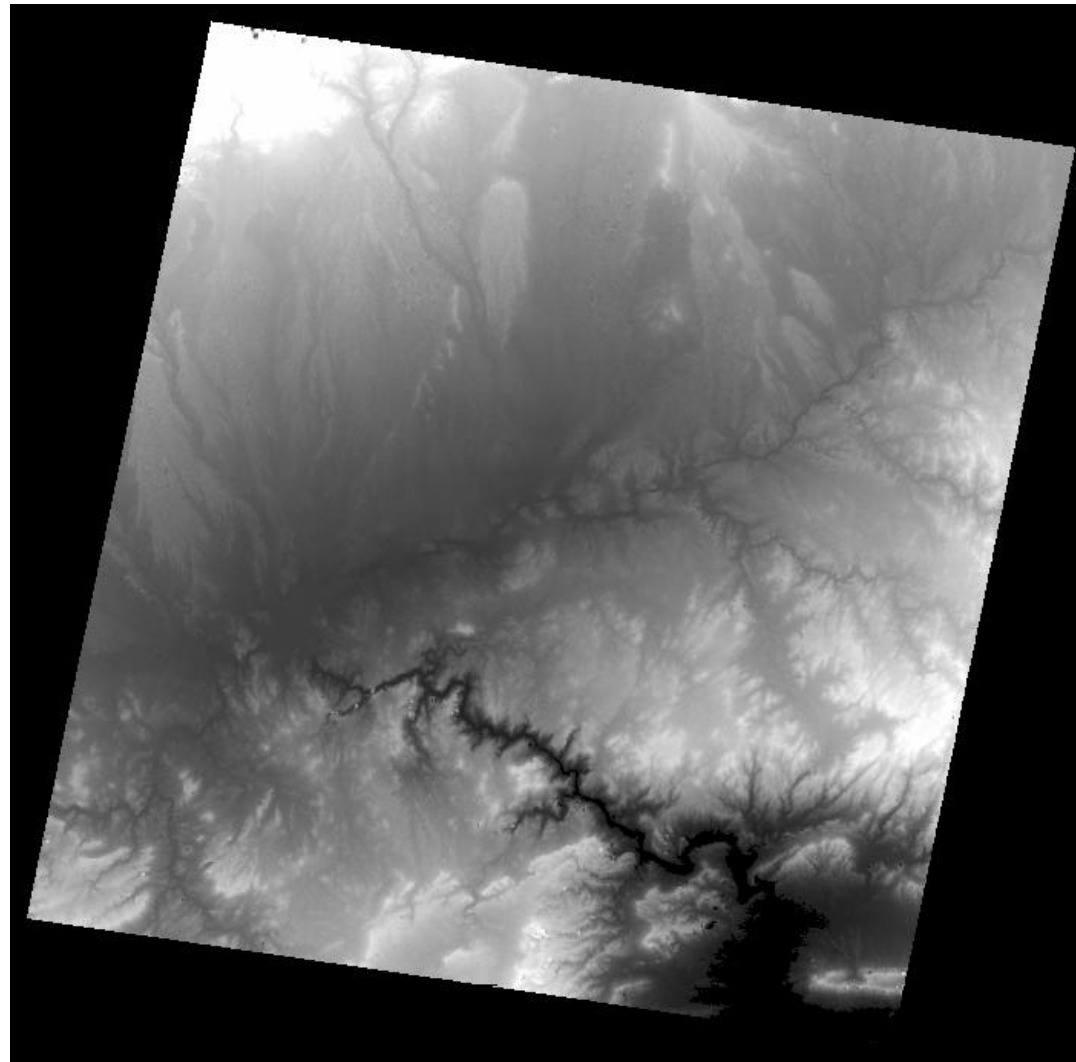
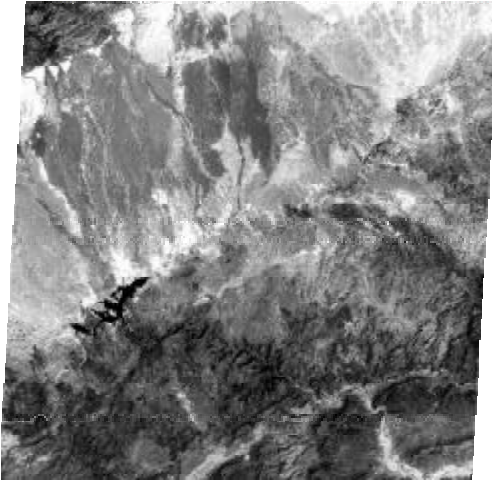
DEM Generation – Input of GCPs and Tiepoints

Nadir Image

Backward Image



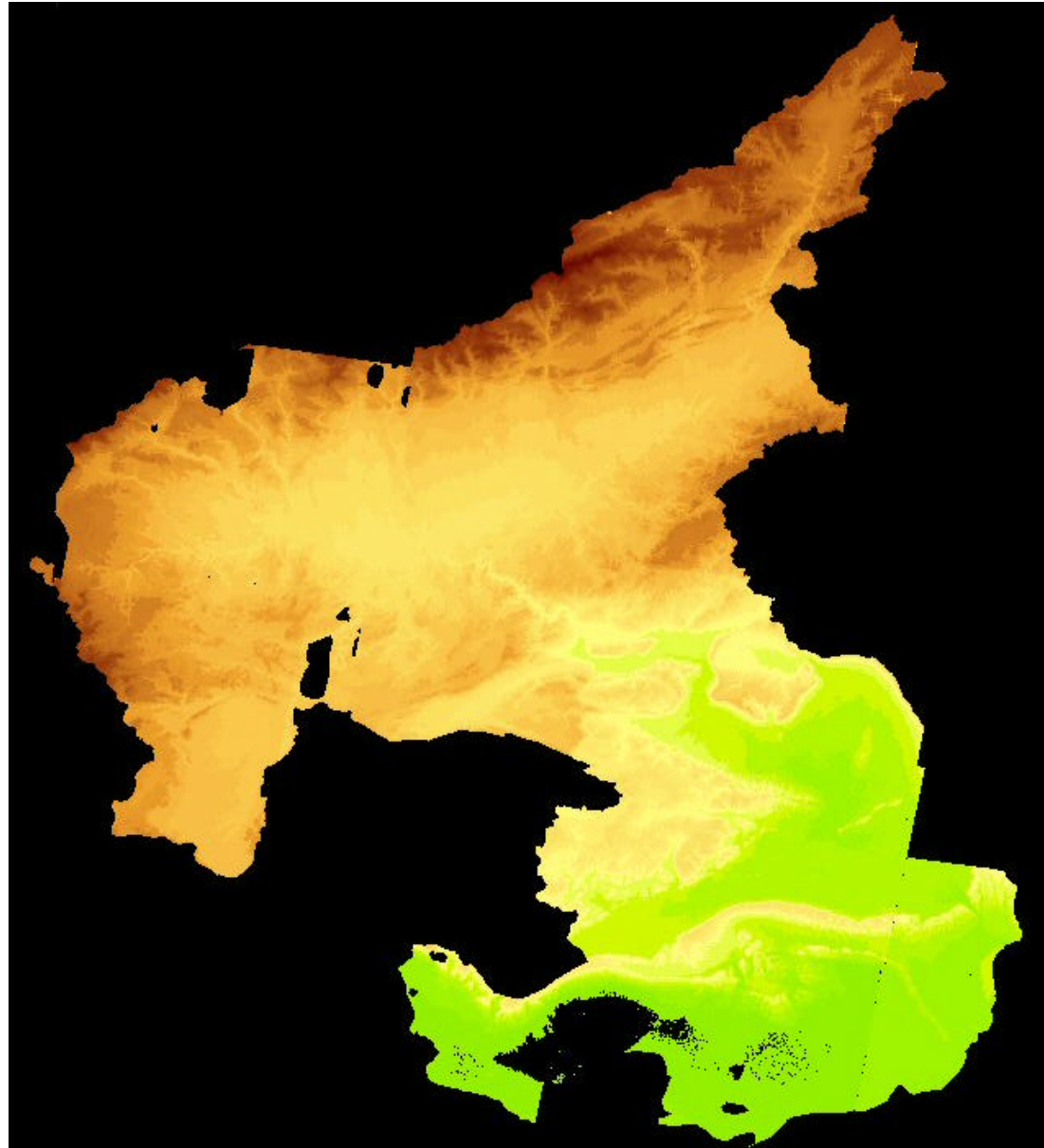
DEM Generation – Result



DEM Accuracy and Problems

- ASTER DEMs have a given *a priori* accuracy of $\sim 25\text{m}$ (z)
- Achieved accuracy of the used GCPs
 - => z-direction: RMSE: 8.8 – 30.8 m
Maximum Error: 15.4 – 59.1 m
 - => x-, y-direction: RMSE: 0.57 – 1.68 Pixel
- Accuracy of an independent dataset of DGPS-points
 - => z-direction: z-mean= 30.8m
Stddev. = 9.4 with LoC of 92
Maximum Error: 108m
- No Data values occurred in clouded or shaded areas
- False Data values occurred mainly at water bodies
- Mosaicking showed to be very complex

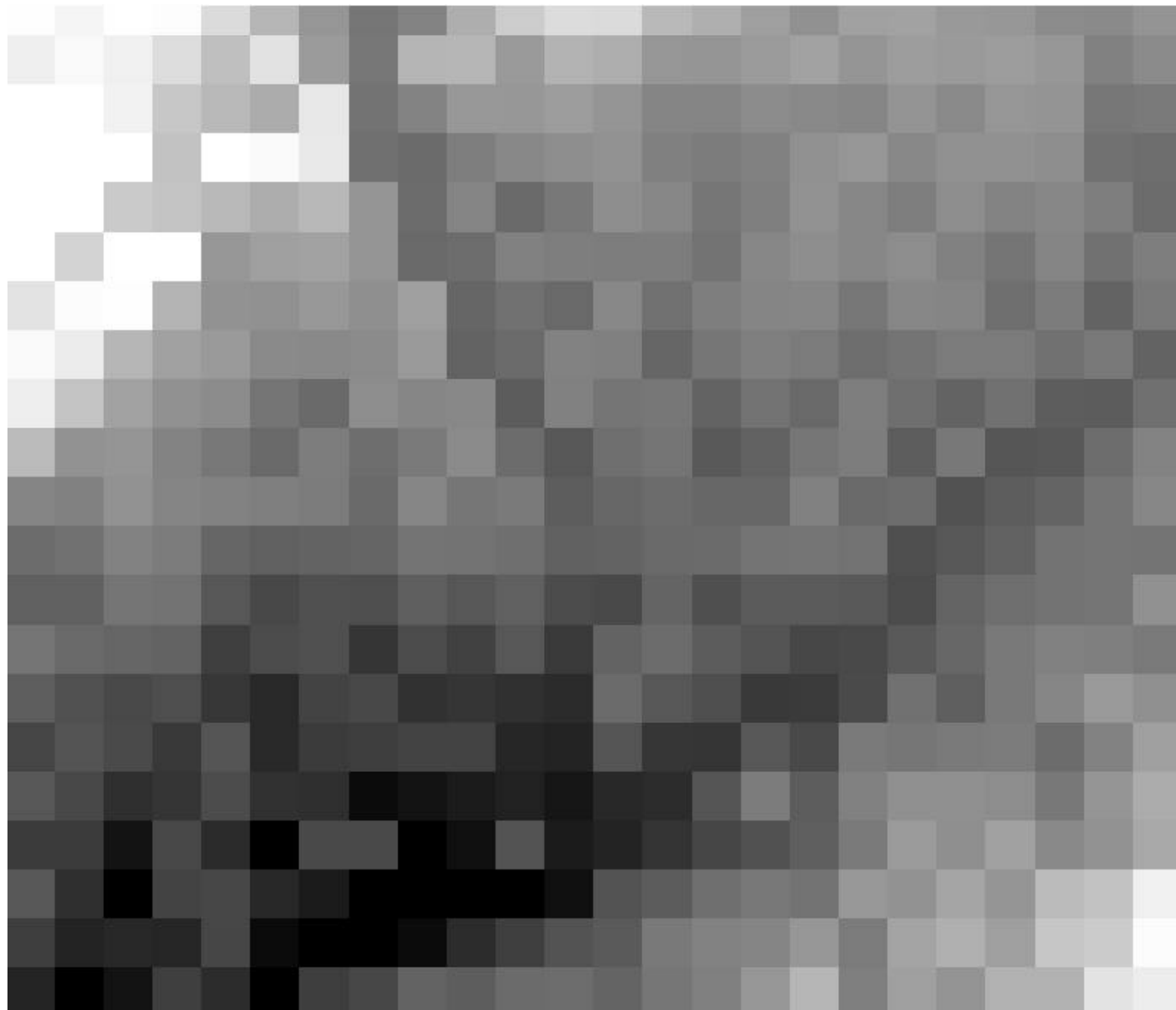
DEM Mosaic



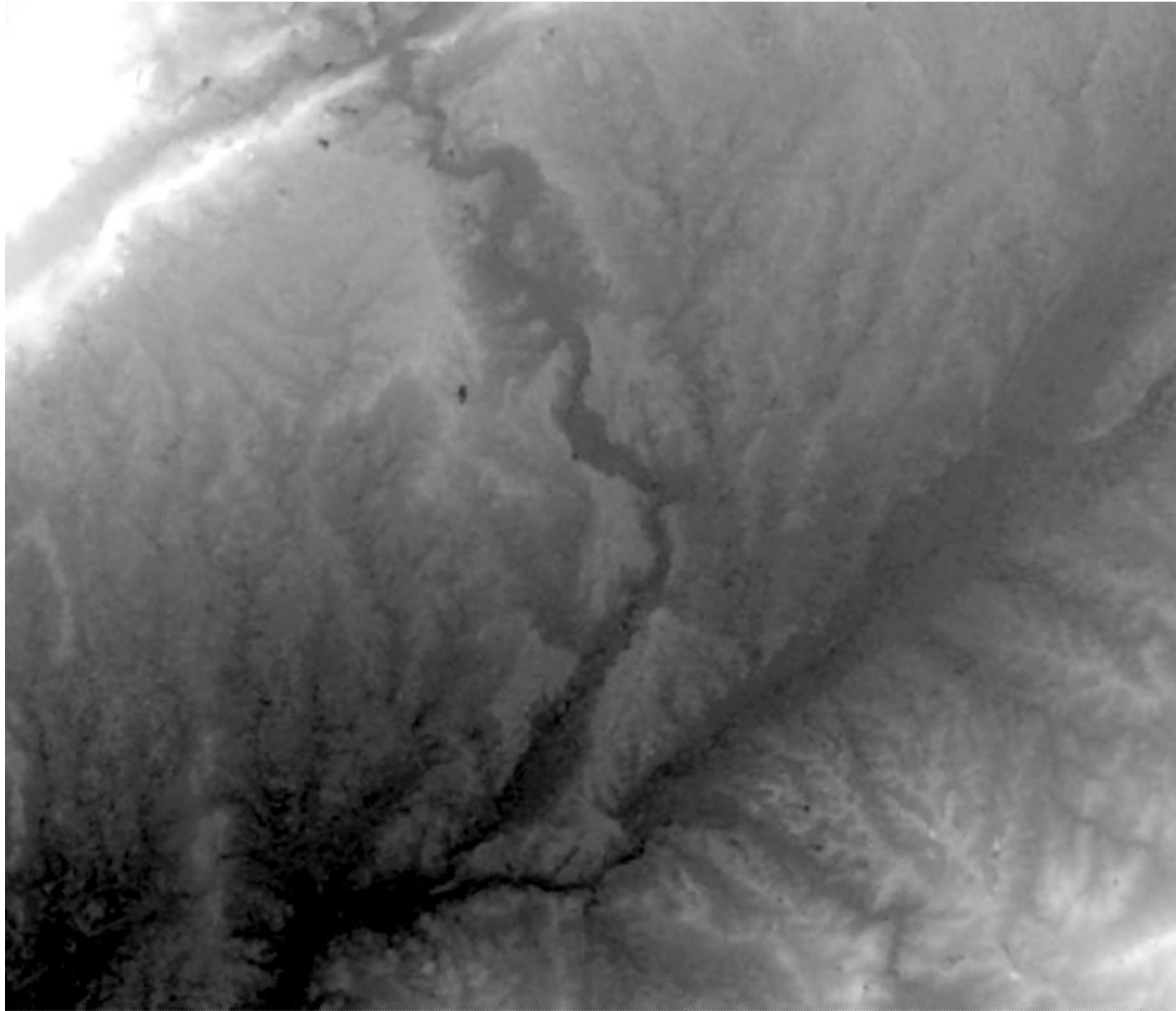
ASTER DEM Generation - Resume

- Time and money saving compared to other methods
- High Accuracy
- No additional data is needed
- Serves as an input for various applications
- Provides a resolution of 30 m

ASTER DEM Generation - Resume



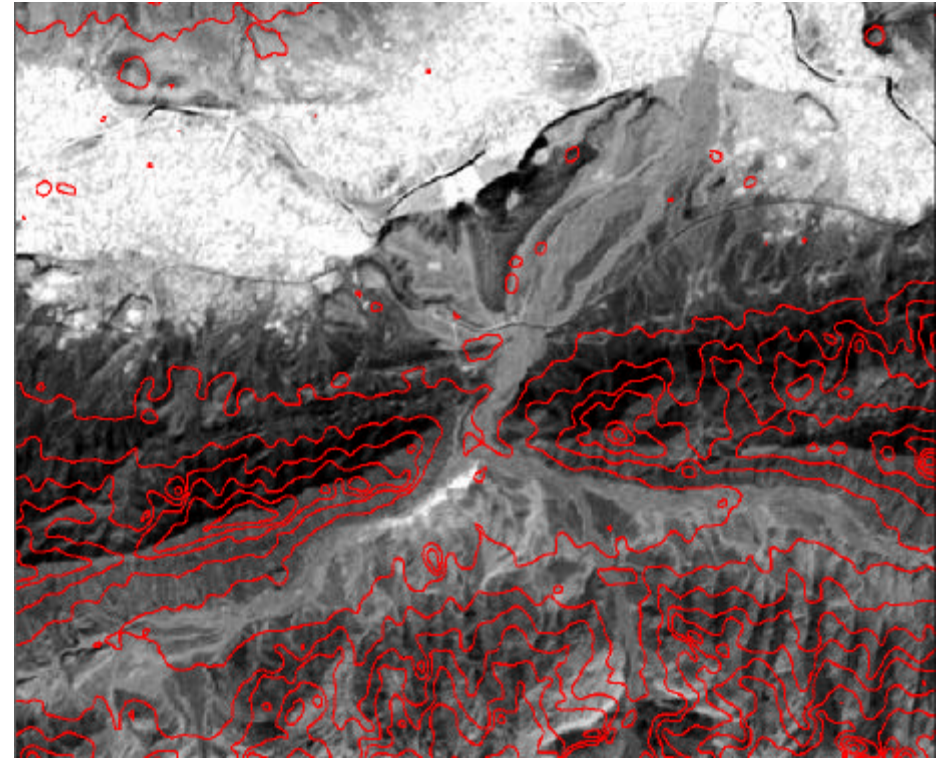
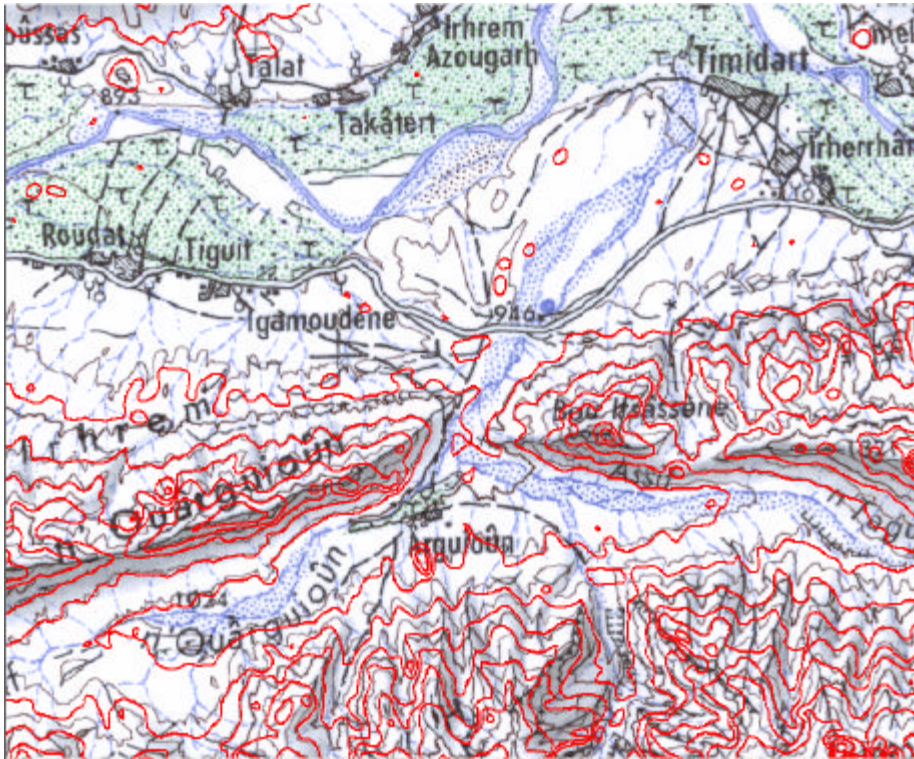
ASTER DEM Generation - Resume



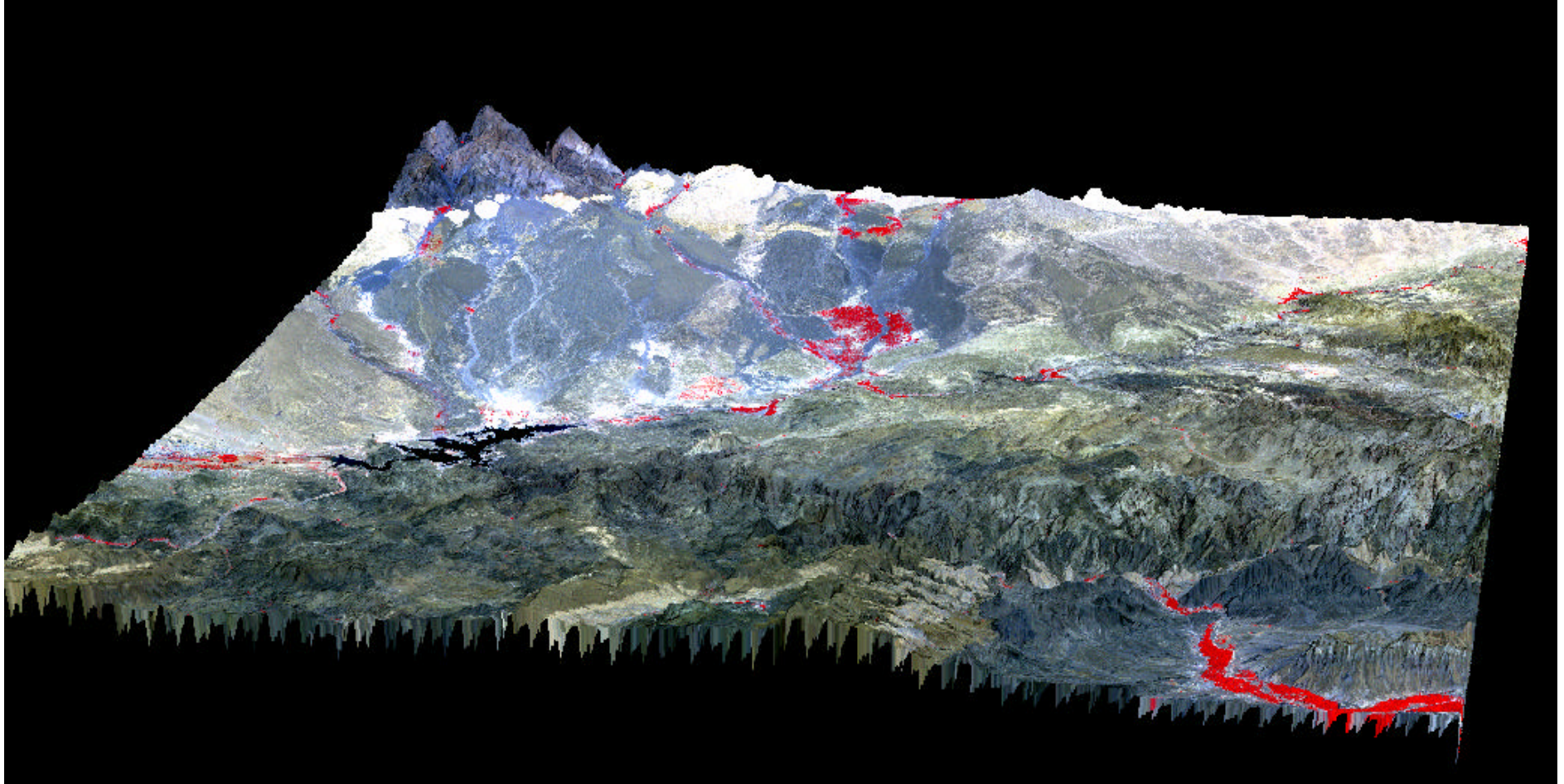
DEM Applications

- Calculation of morphometric parameters
 - ⇒ Slope
 - ⇒ Aspect
 - ⇒ Concavity
- Hydrologic modelling
 - ⇒ Delineation of Catchment areas
 - ⇒ Calculation of run off
- Generation of Orthomaps
 - ⇒ Map production
 - ⇒ Update existing maps
- Visualization of landscapes and 3D-Applications

Generation of Orthomaps



Visualization of landscapes



Visualization of landscapes

