



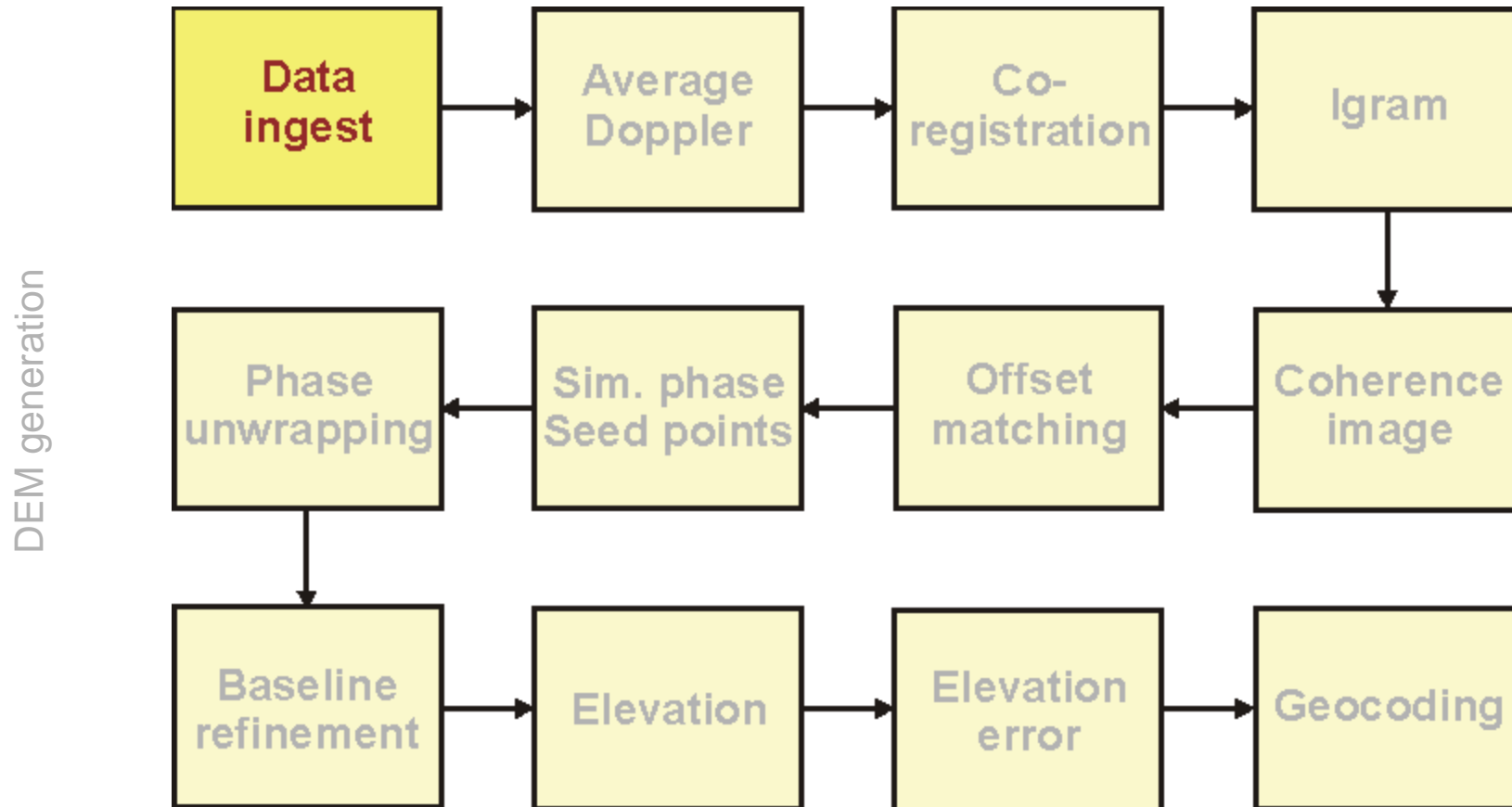
DEM generation

Rüdiger Gens





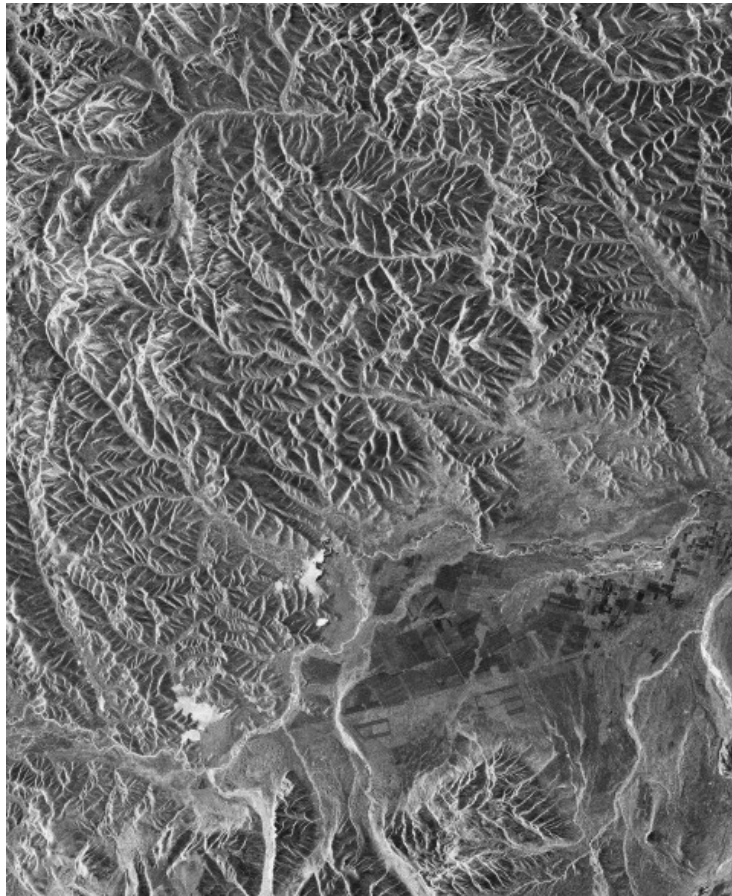
InSAR processing





Data ingest

DEM generation



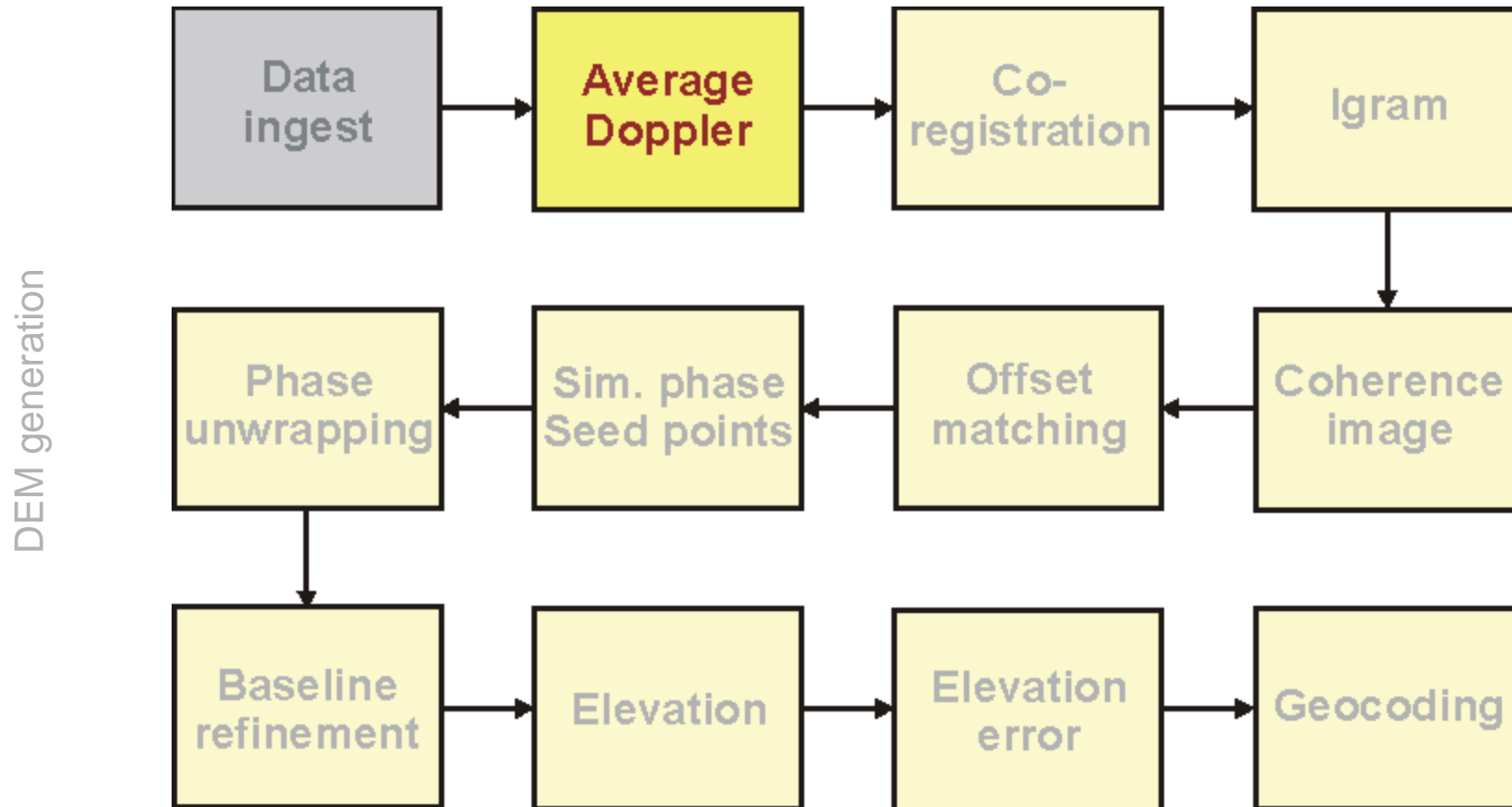
64.5°

63.5°

- ingest of STF data
- can handle precision state vectors for ERS data
- allows latitude constraint



InSAR processing





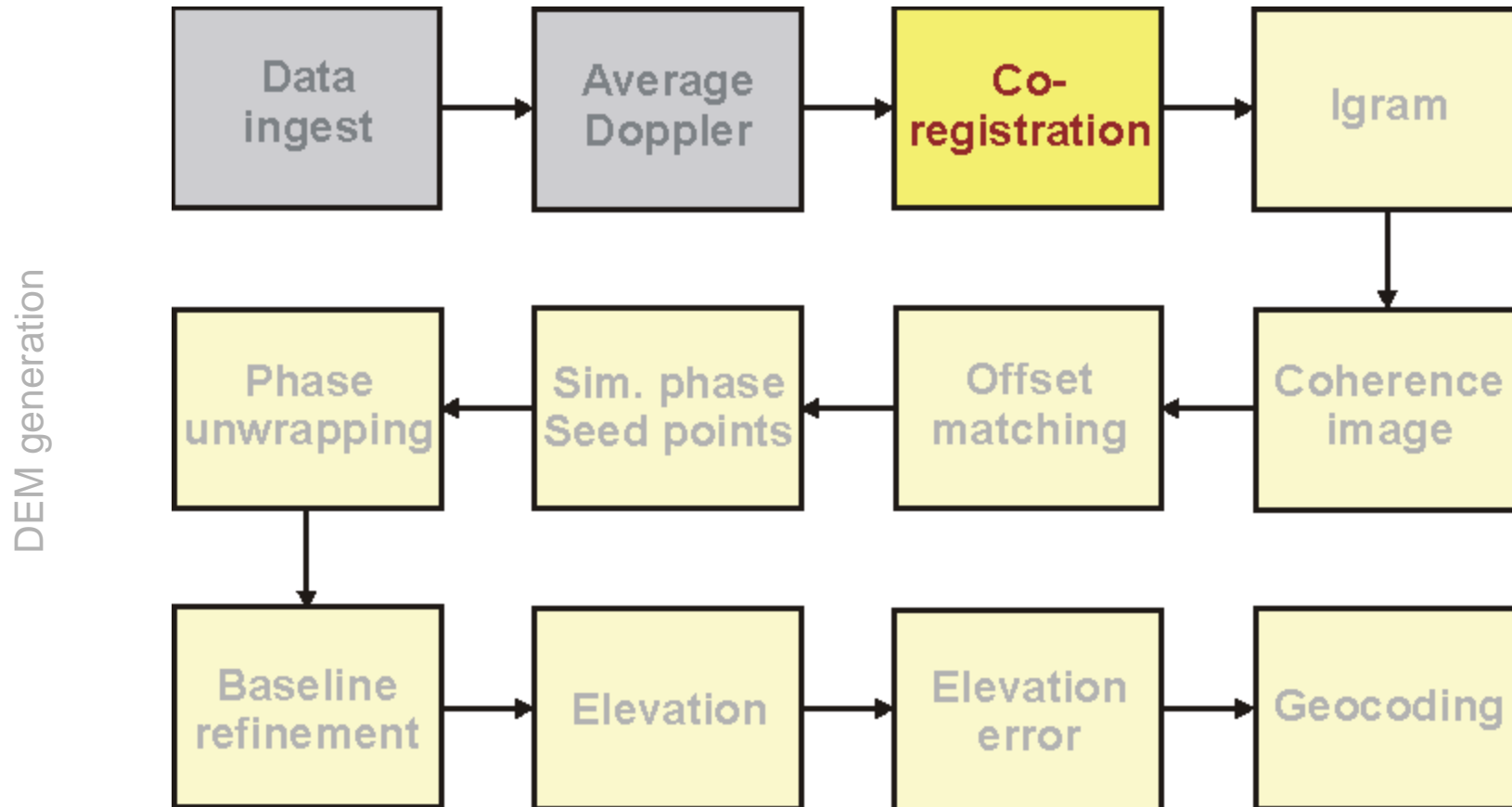
Average Doppler

- getting both images into the same geometry
- works fine for ERS imagery
- Radarsat imagery requires zero Doppler processing (currently under development)

DEM generation



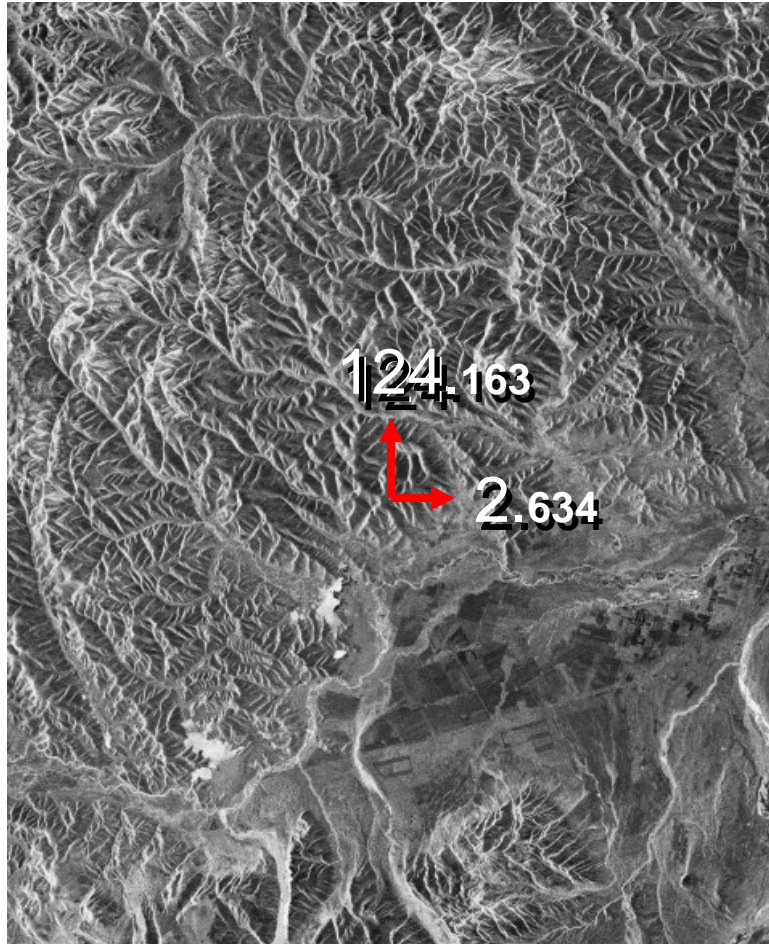
InSAR processing





Co-registration

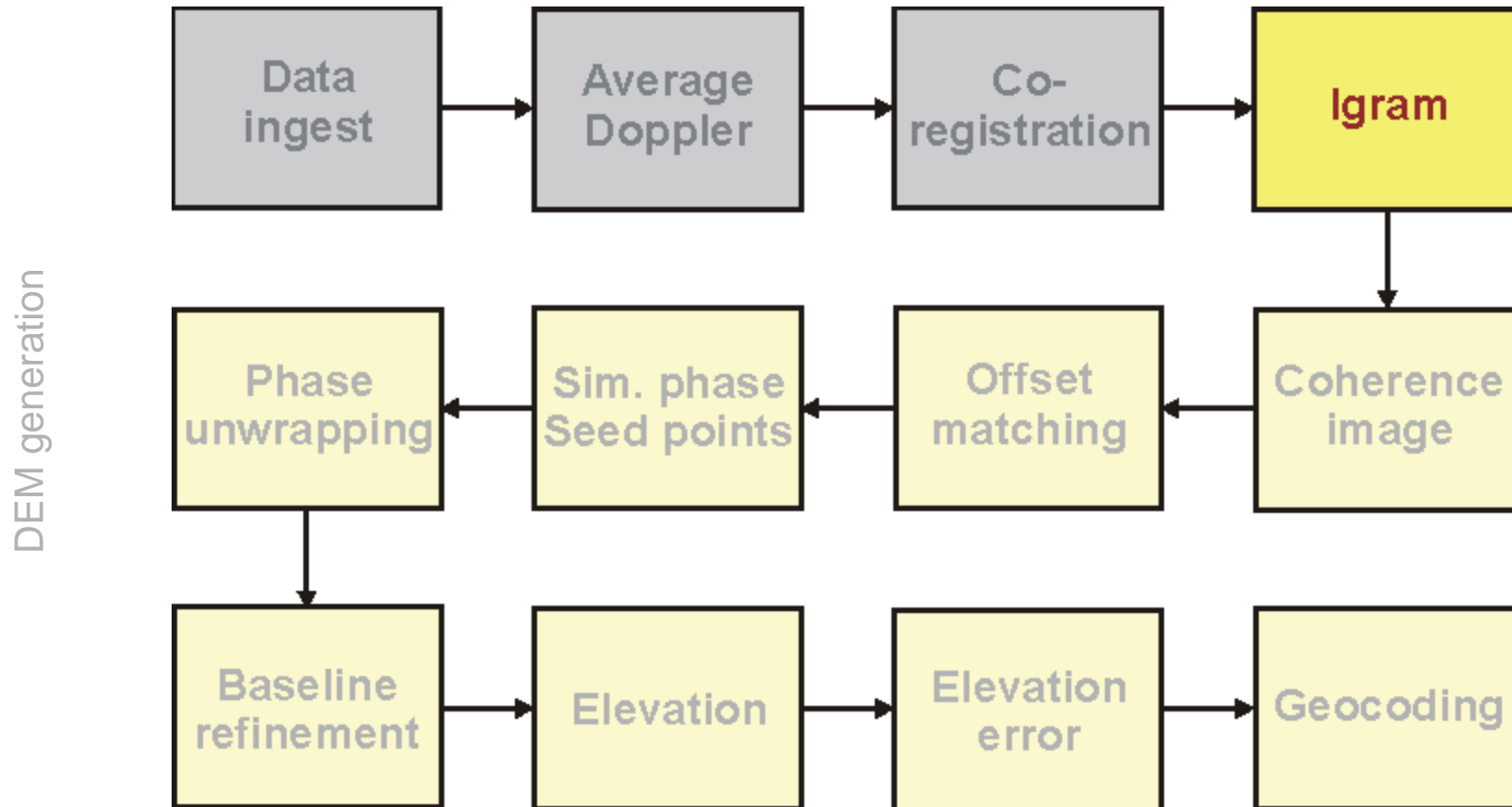
DEM generation



- initial offset estimated from state vectors (pixels)
- fine co-registration for sub-pixel accuracy
- baseline estimate as side product
 $B_n = -61.829628$
 $B_p = 19.505440$
- exit condition with maximum offset (default 3 pixels)



InSAR processing





Interferogram

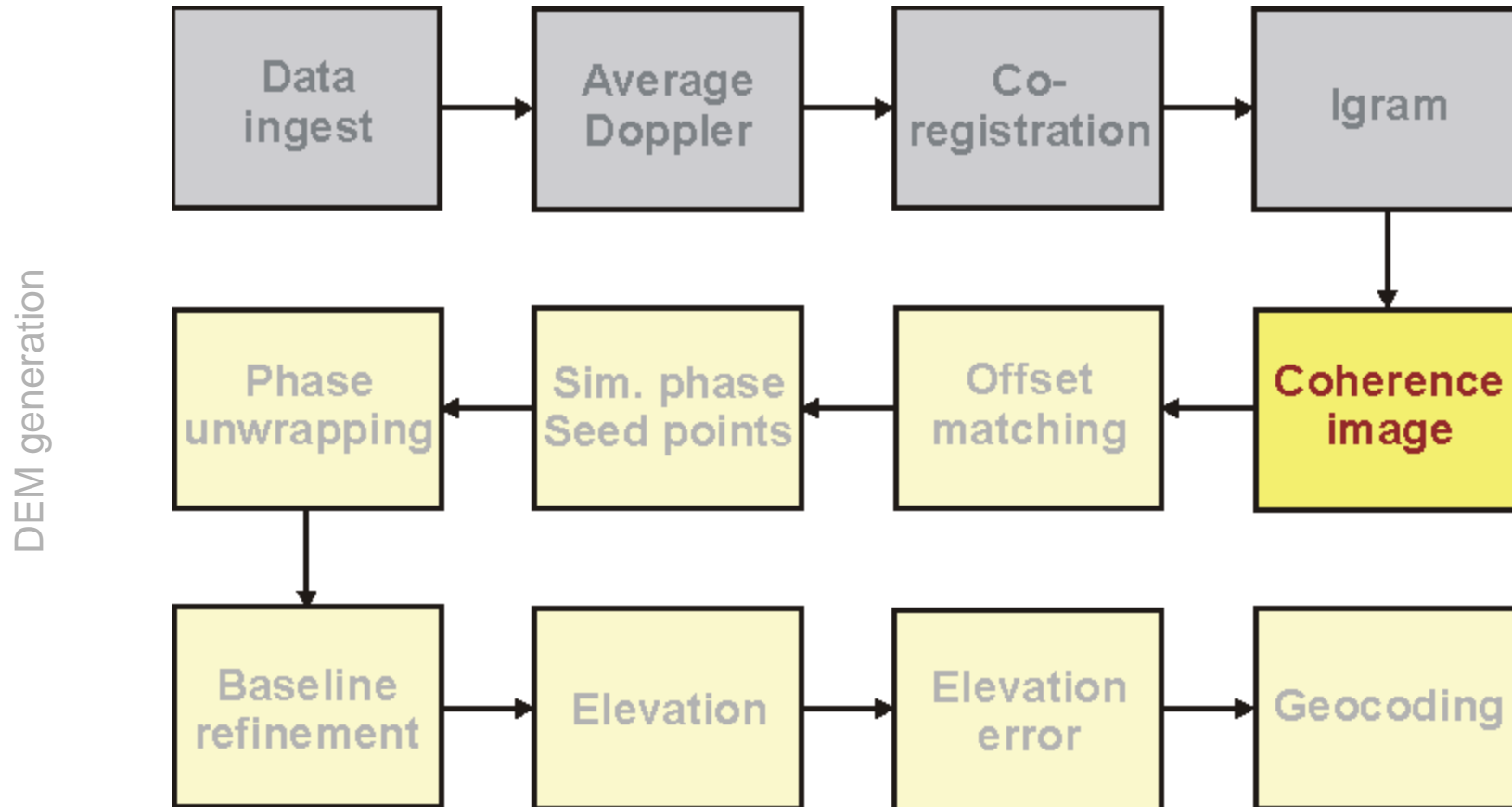
DEM generation



- single-look interferogram
- color-coded multilooked interferogram



InSAR processing





Coherence image

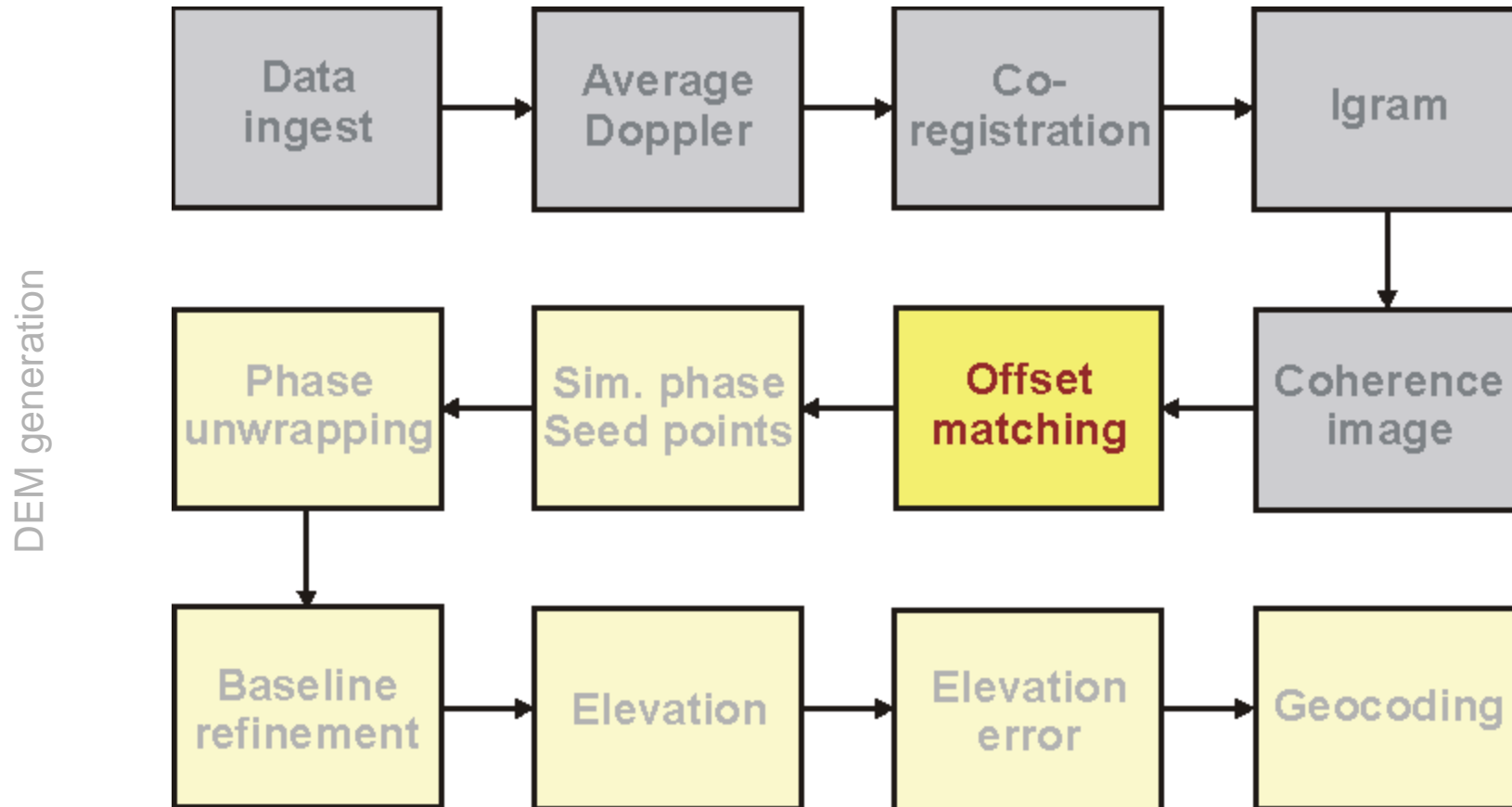
DEM generation



- exit condition with minimum coherence level (default value: 0.3)
- statistics
 - maximum: 0.975
 - average: 0.747



InSAR processing





Offset matching

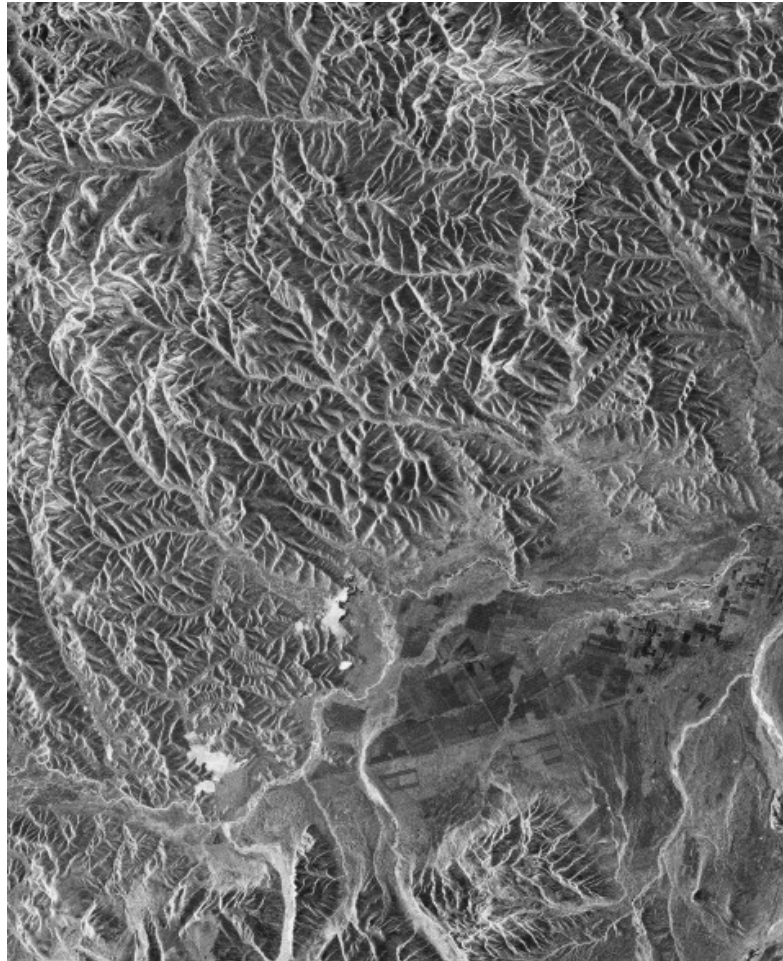
- improves geolocation by refining shifts in time and range
- matches real and simulated amplitude (derived from reference DEM) until no offset can be measured

DEM generation

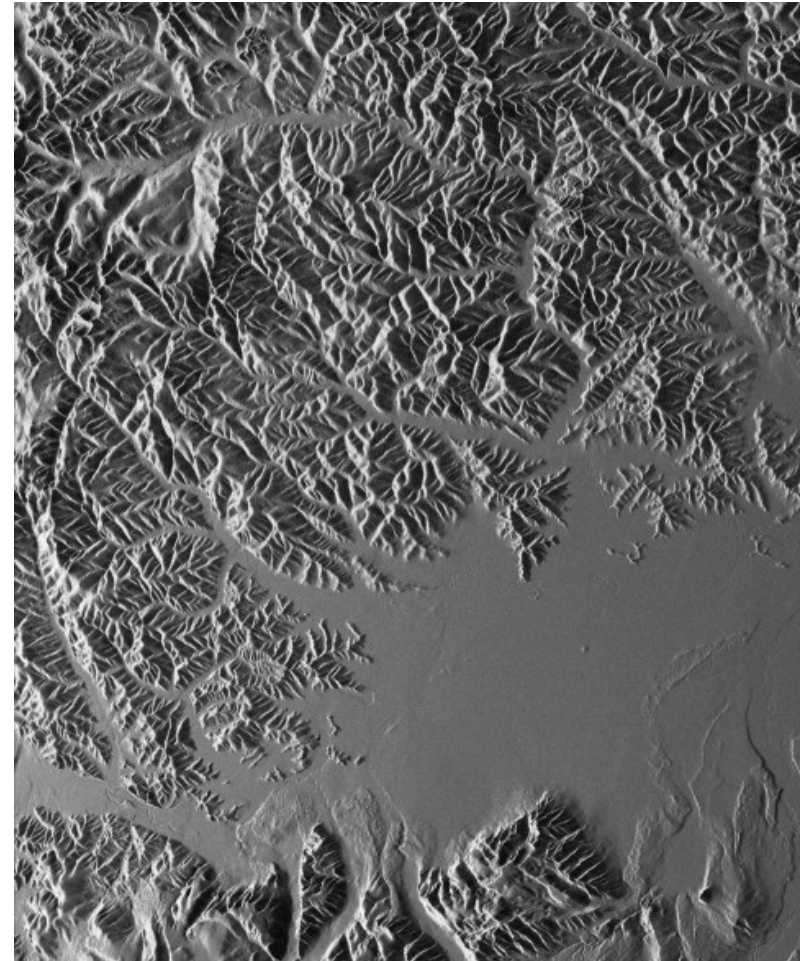


Offset matching

DEM generation



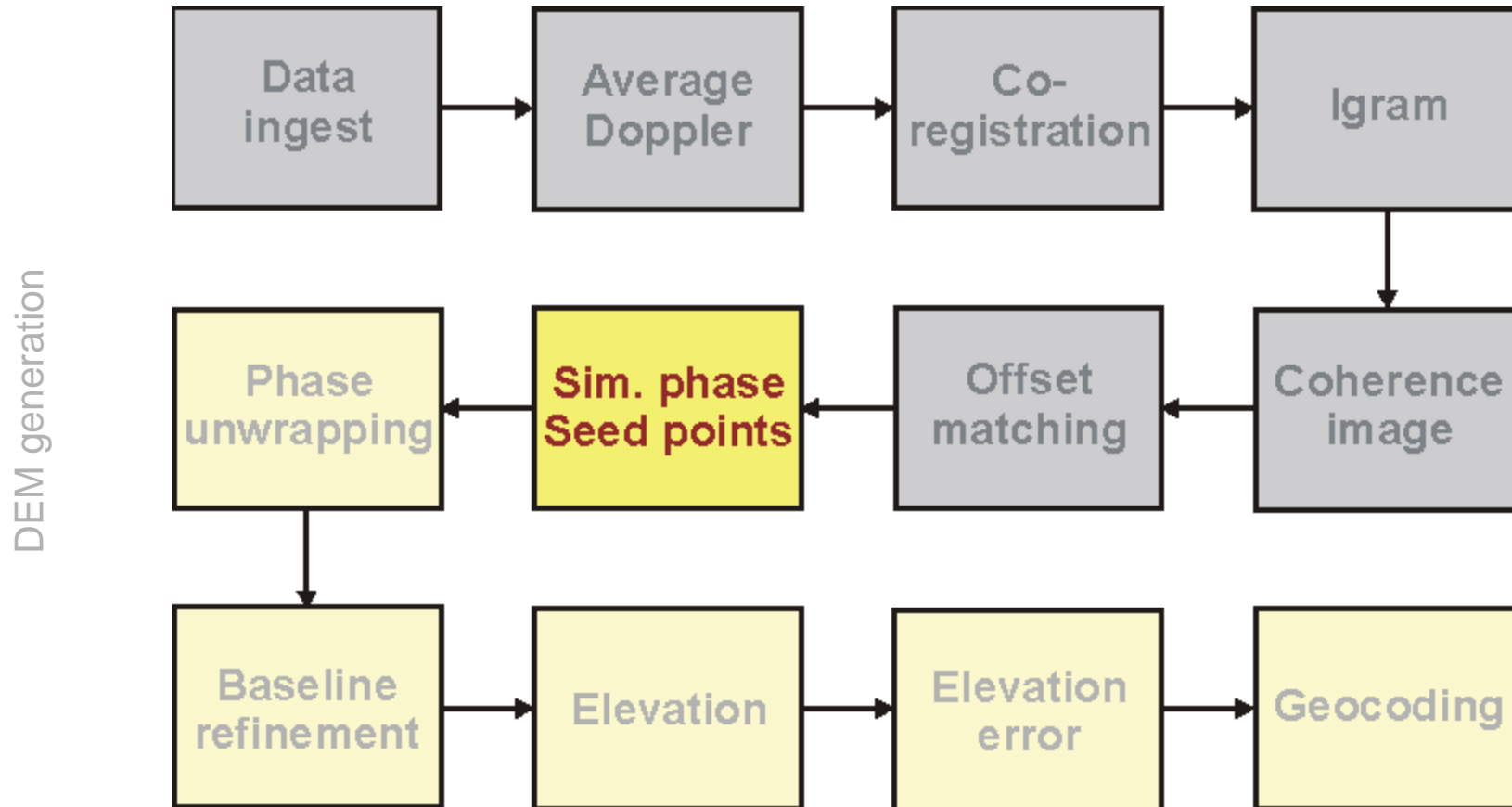
real amplitude



simulated amplitude



InSAR processing





Simulated phase / seeds points

DEM generation

- derived from reference DEM
- simulated phase
 - used for removal of topographic phase (optional)
- seed points
 - equally distributed
 - selection criteria: minimum slope in reference DEM
 - potential seed points: 10000
 - final number of seed points: 2321



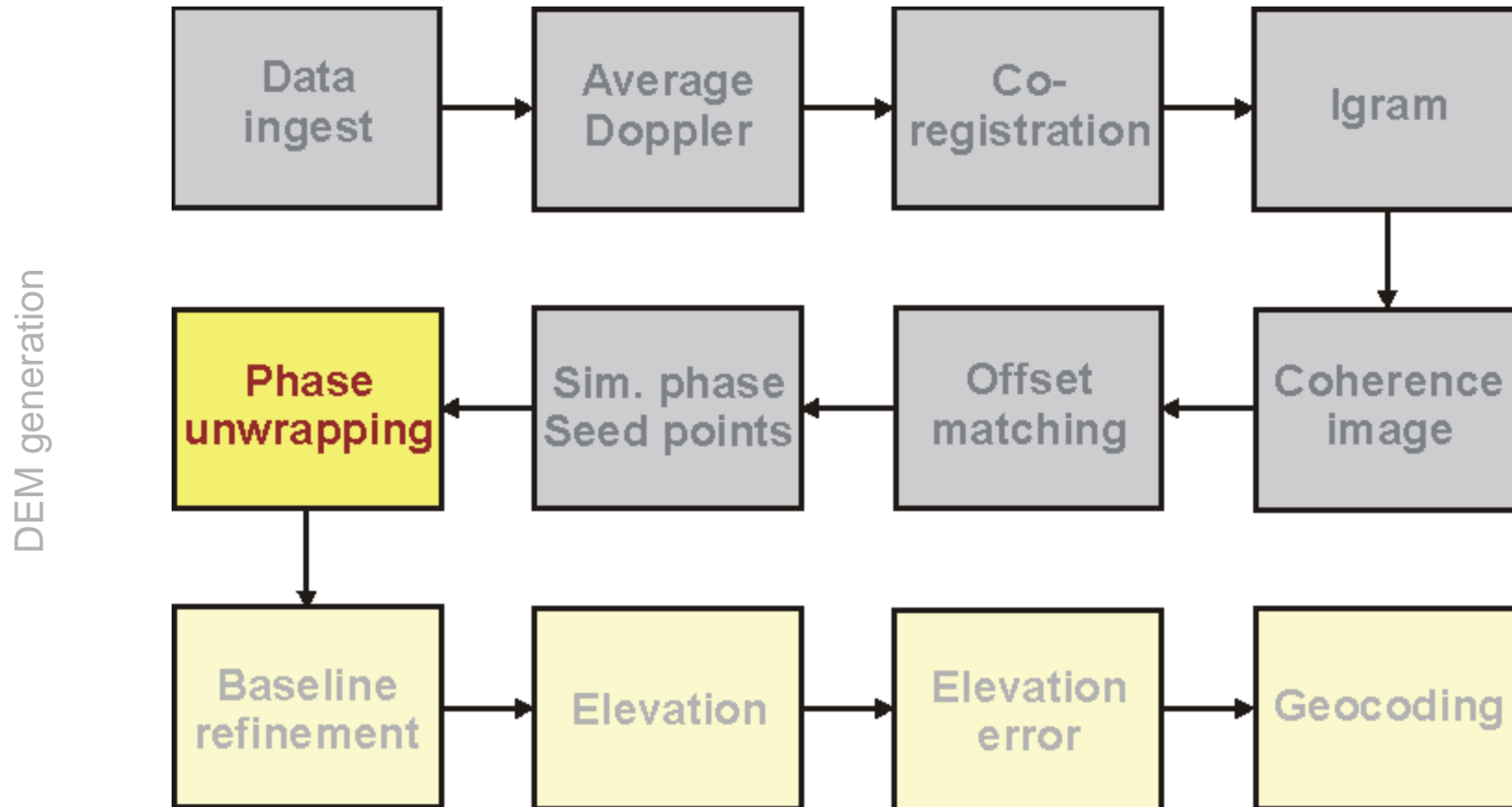
Seed point distribution

DEM generation

```
X  XXX  X  XXX  XX
  XXXXX      XXX
XX      XXX  XX
X  X      XX  X  X
      X  XX  XX
      X  X  XX  XX
      XXXXXXXXXXXX
X  XX      XXXXXXXX
XXXXXXXXXXXXXXXXXXXX
X  XXXXXXXXXXXXXXXX
  XXX XXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXX
XX XXXXXXXX  XXXX
XX XXXXXXXX  XXXX
```



InSAR processing





Phase unwrapping

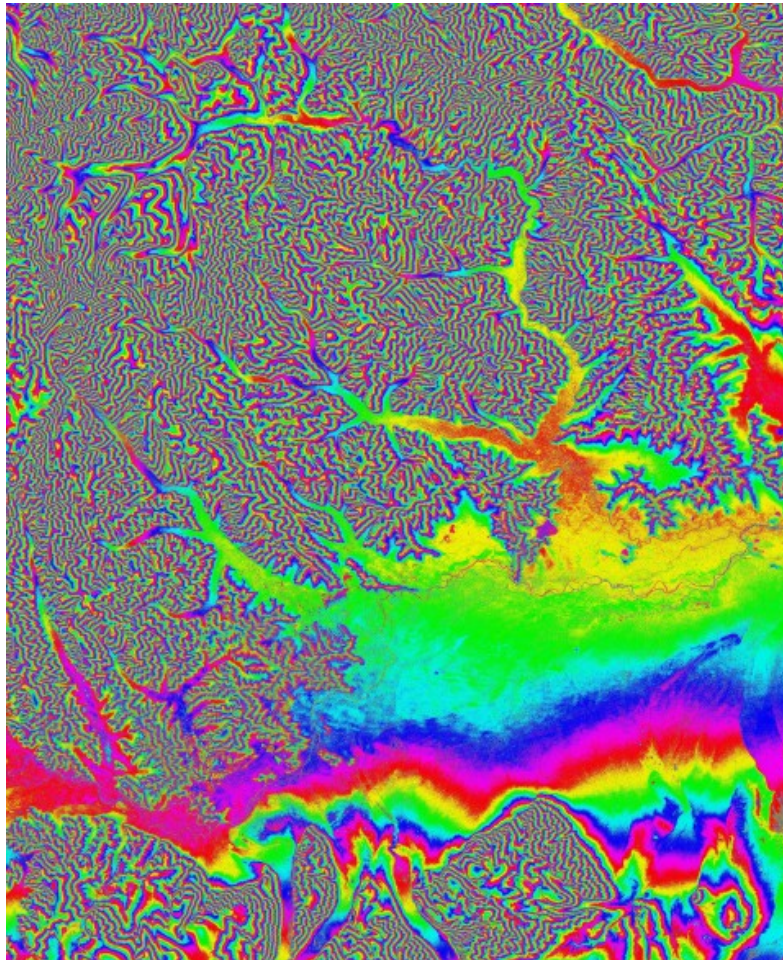
- multilooking of interferogram
- unwrapping with
 - escher (branch cut algorithm)
 - snaphu (minimum cost flow algorithm)
- unwrapped phase related to height

DEM generation

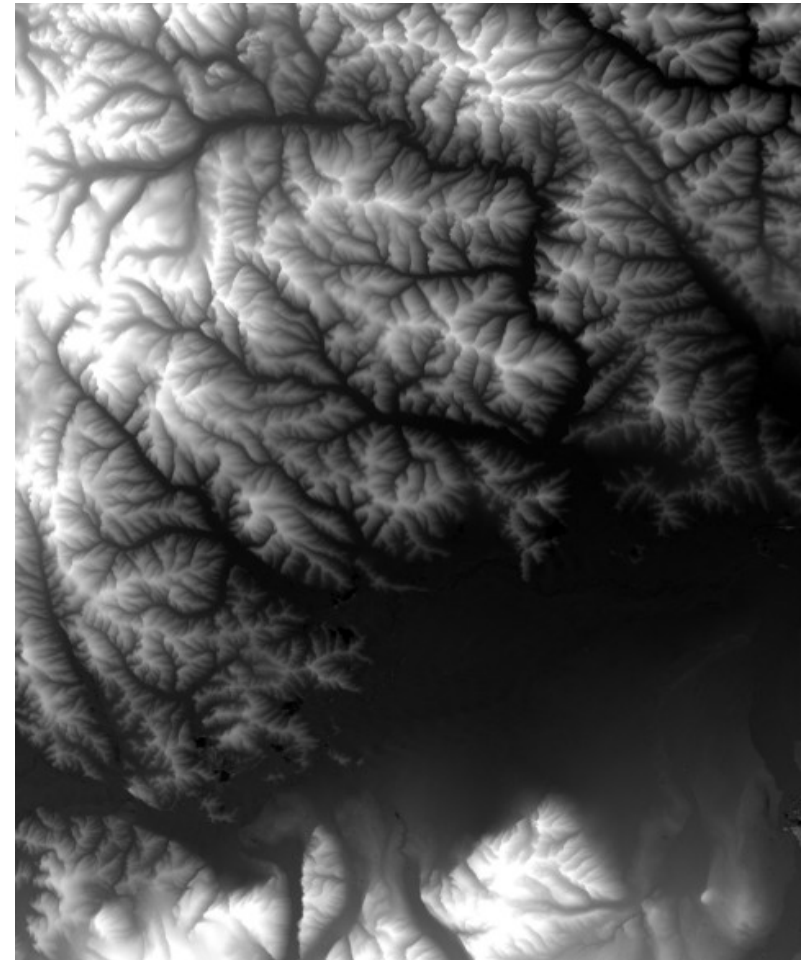


Phase unwrapping

DEM generation



wrapped phase

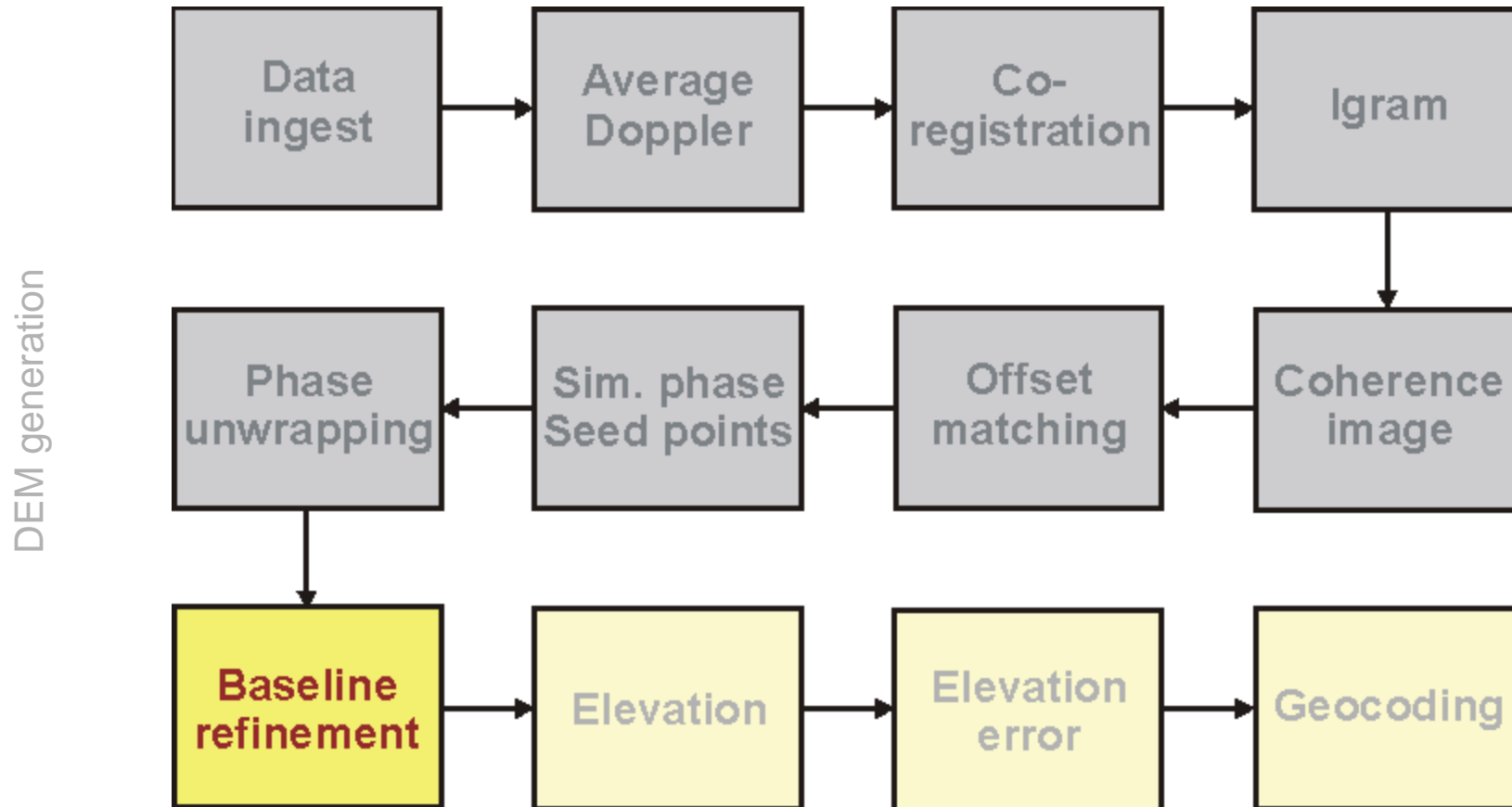


unwrapped phase





InSAR processing





Baseline refinement

- information used
 - unwrapped phase
 - baseline estimate
 - seed points

- iterative process

Bn: -61.829628, Δ : 5.643837, Bp: 19.505440, Δ : -2.099306

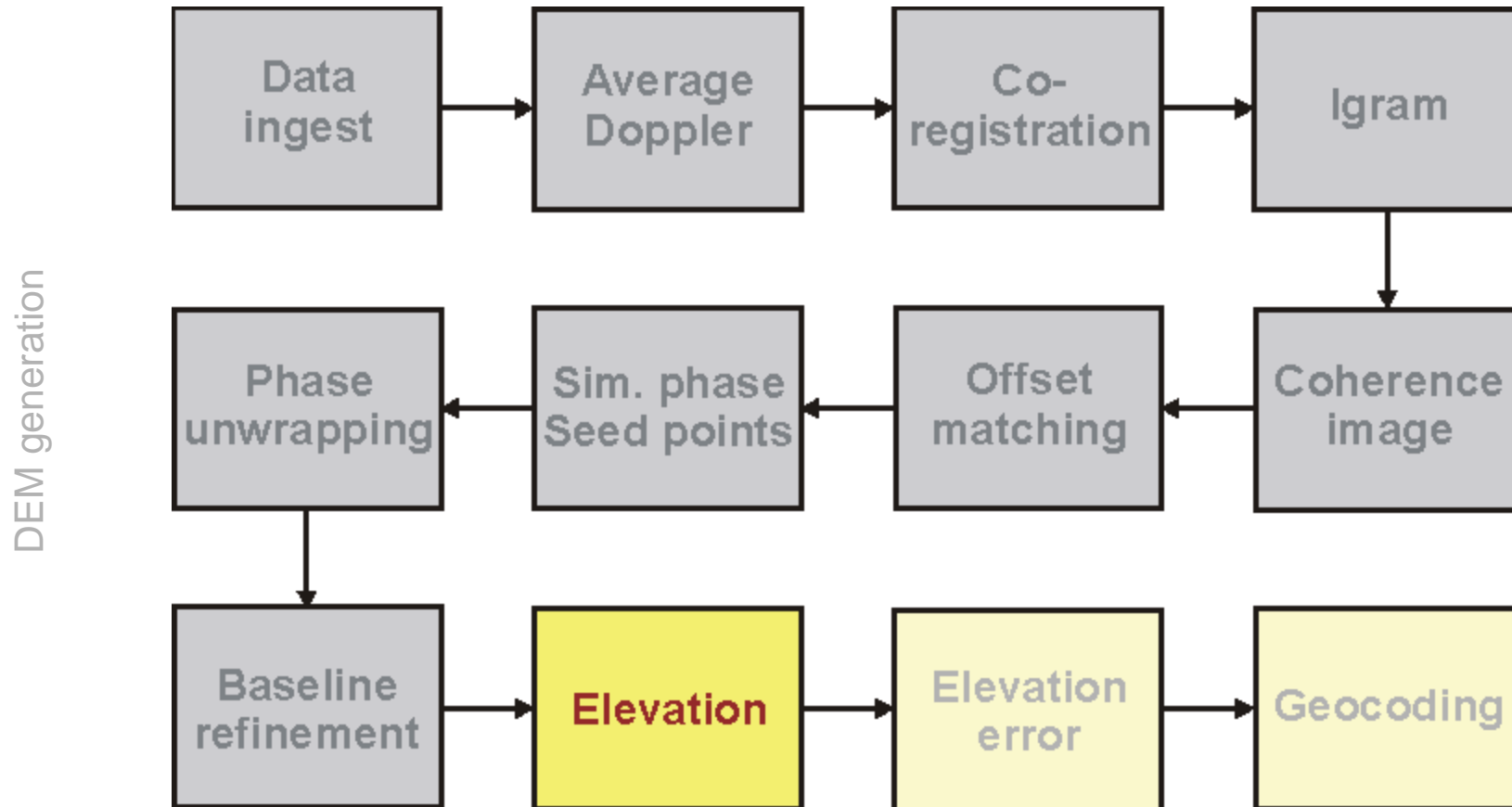
Bn: -61.527863, Δ : 5.565868, Bp: 19.777119, Δ : -2.117374

Bn: -61.549664, Δ : 5.693950, Bp: 19.776737, Δ : -2.112025

DEM generation



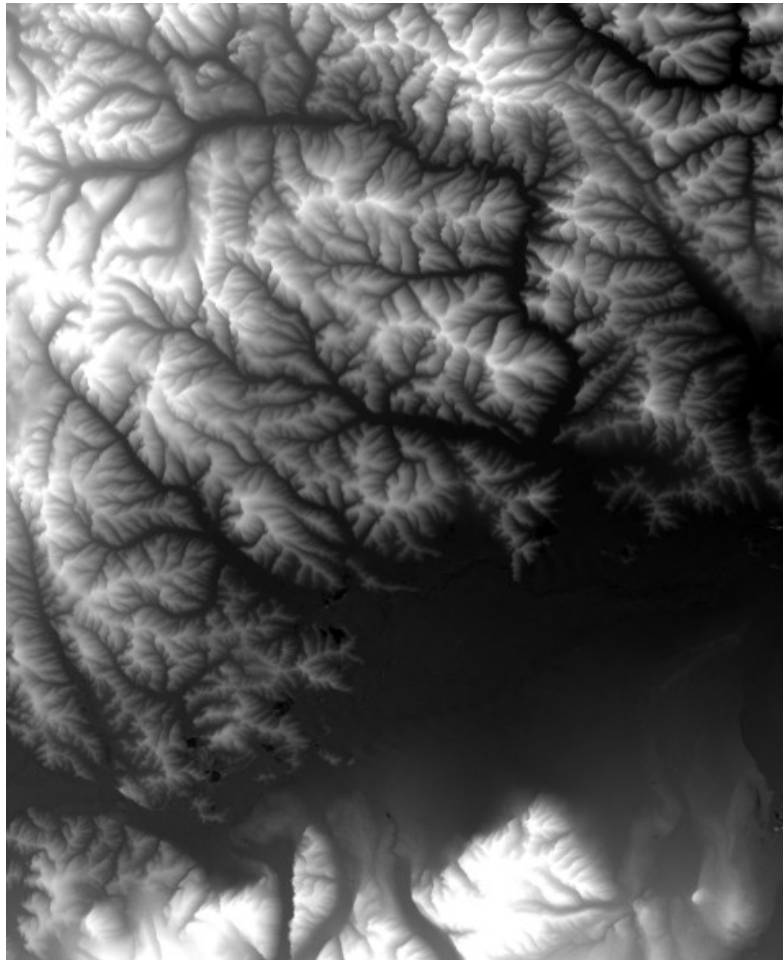
InSAR processing



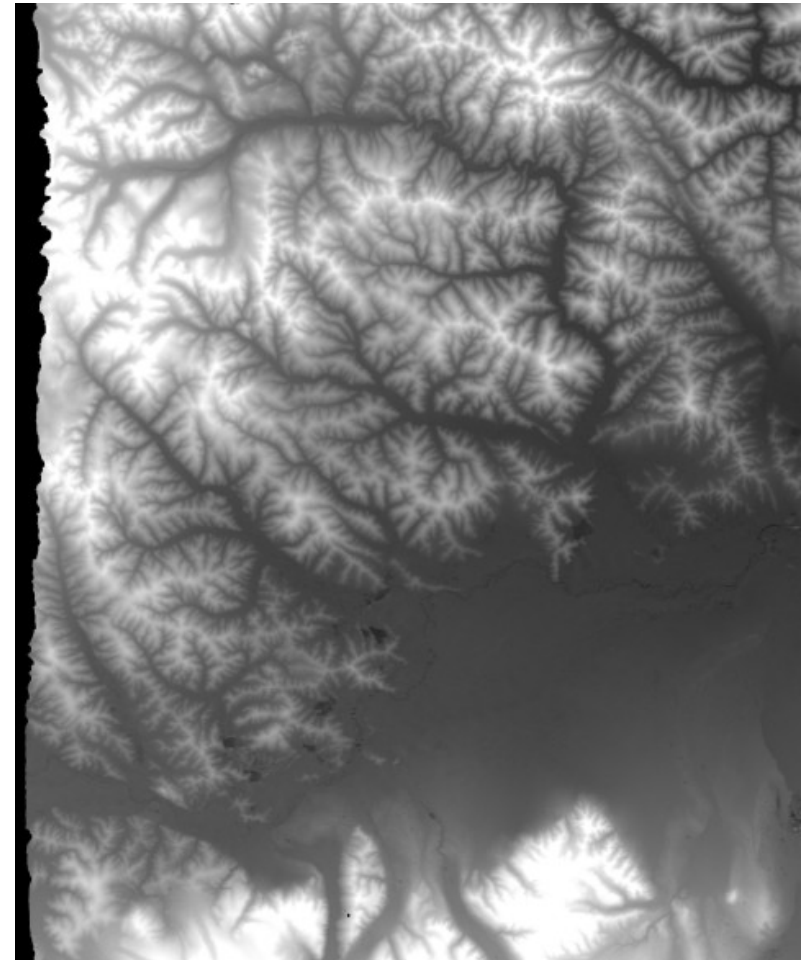


Elevation

DEM generation



Slant range elevation

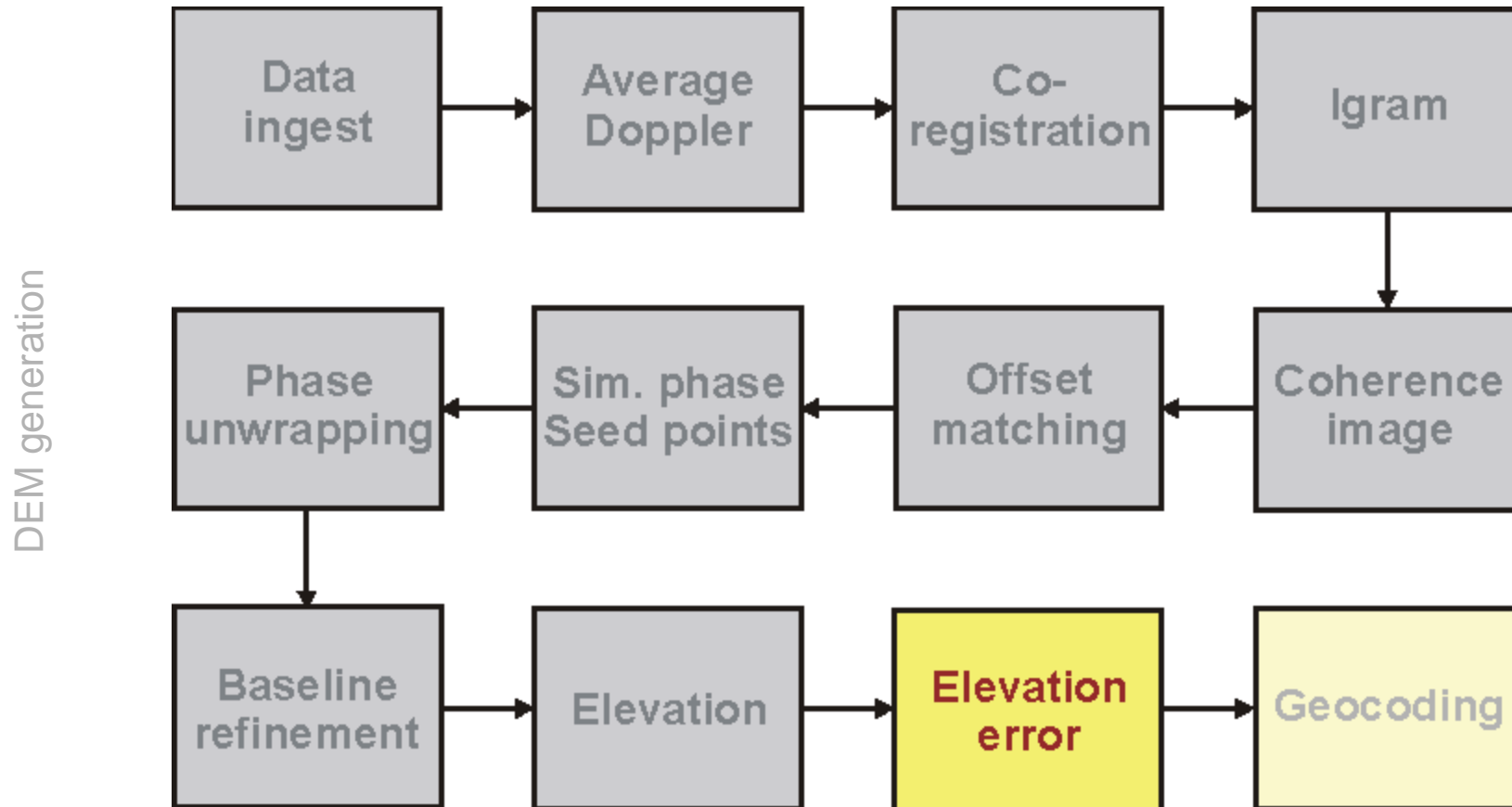


Ground range elevation





InSAR processing





Elevation error

DEM generation

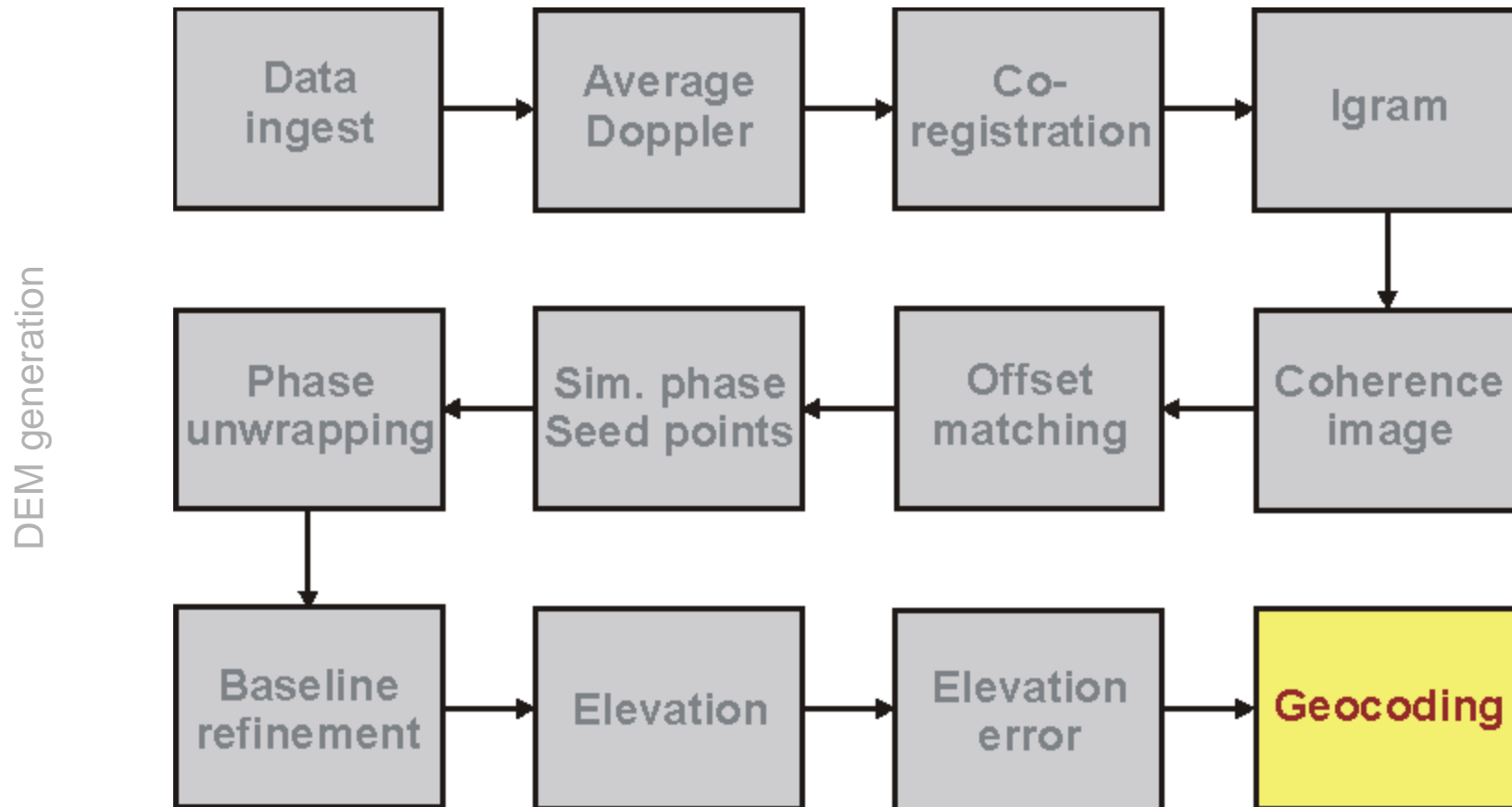


- estimate base on
 - initial height error estimate
 - baseline induced height
 - baseline
 - "flat earth" look deviation
 - coherence

$$dH = \sqrt{dH_{init}^2 + \left(\frac{h_{baseline}}{-B_N \cdot \cos \theta - B_P \cdot \sin \theta} \cdot \sqrt{\frac{1-\gamma}{\gamma}} \right)^2}$$



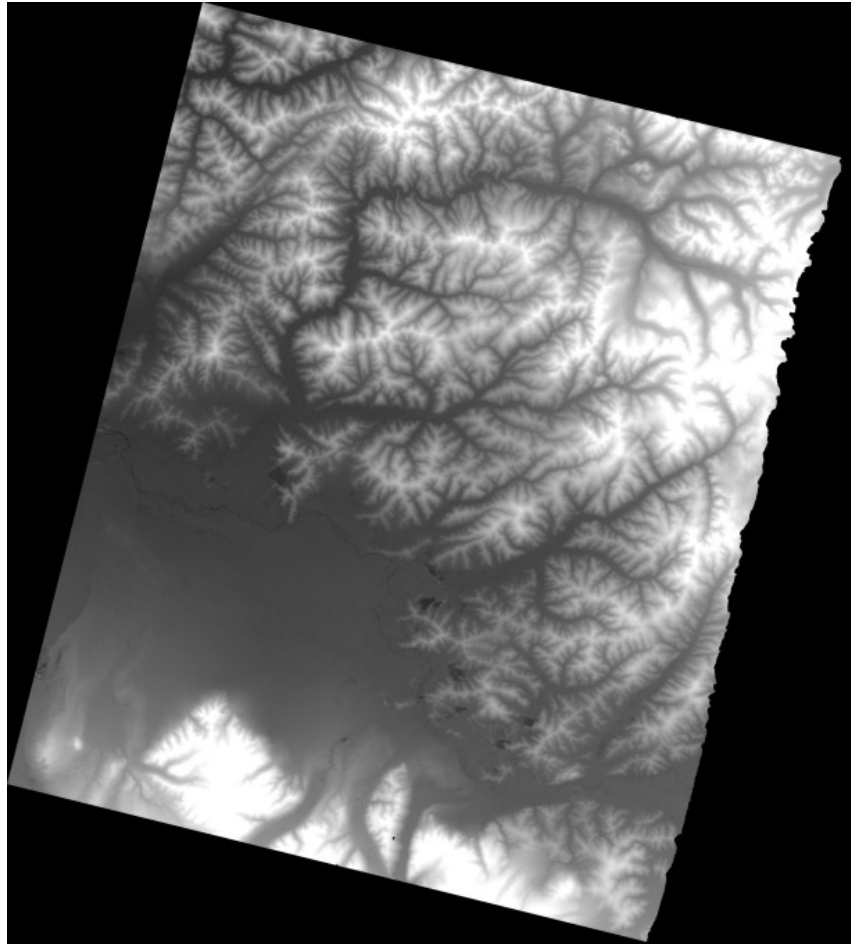
InSAR processing





Geocoding

DEM generation

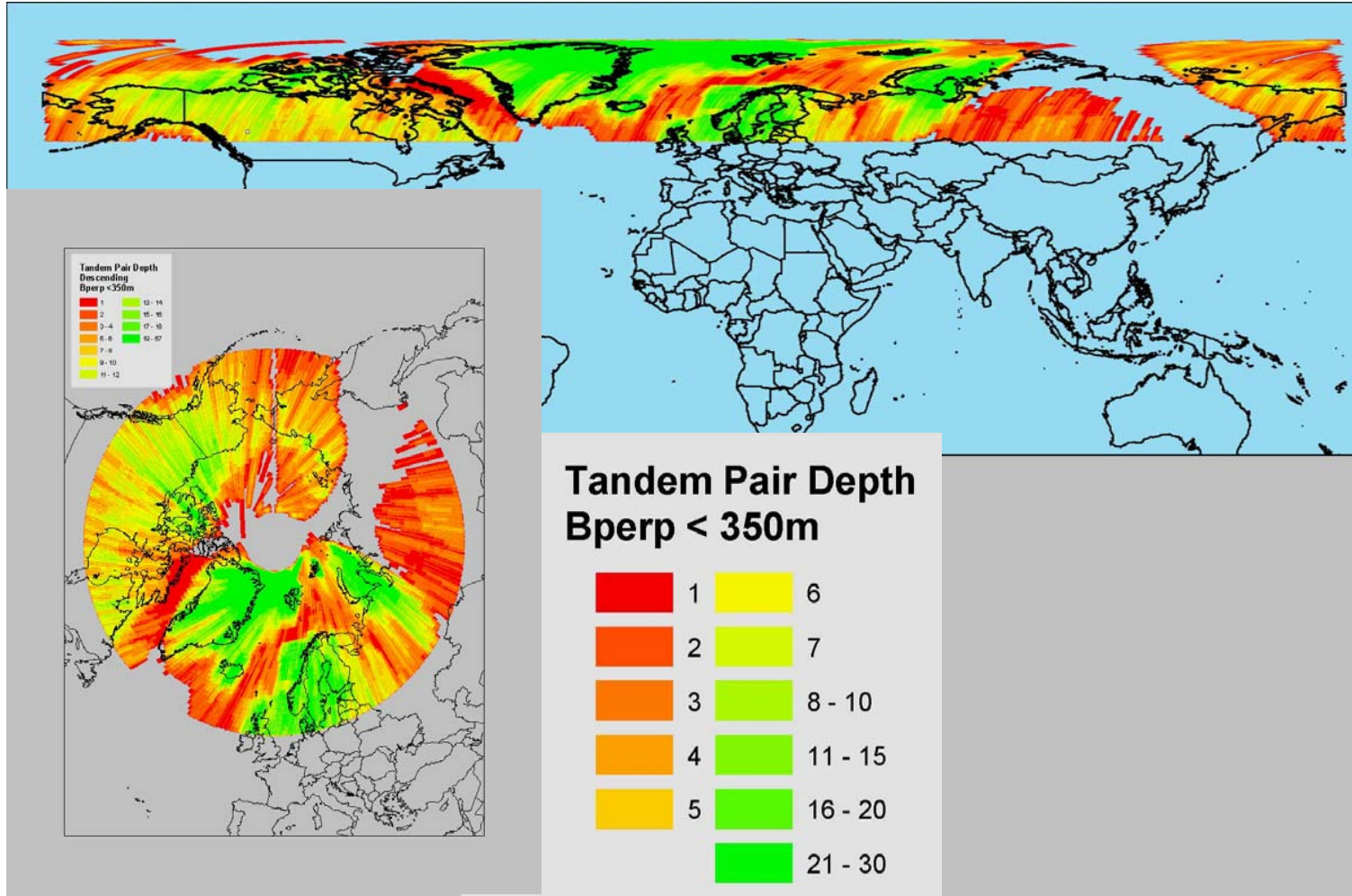


- final product
- map projected
 - Universal Transverse Mercator (UTM)
 - Albers Conic Equal Area
 - Polar Stereographic
 - Lambert Conformal Conic
 - Lambert Equal Area



ESA Tandem Mission: Descending Coverage

DEM generation





ESA Tandem Mission: Ascending Coverage

DEM generation

