FIG Working Week 2024
19-24 May
Accra, Ghana
Your World, Our World: Resilient Environment and Sustainable Resource Management for All

Assessing Vertical Accuracy of Digital Elevation Model Using Actual Flood Line as Reference

Paper ID 12500

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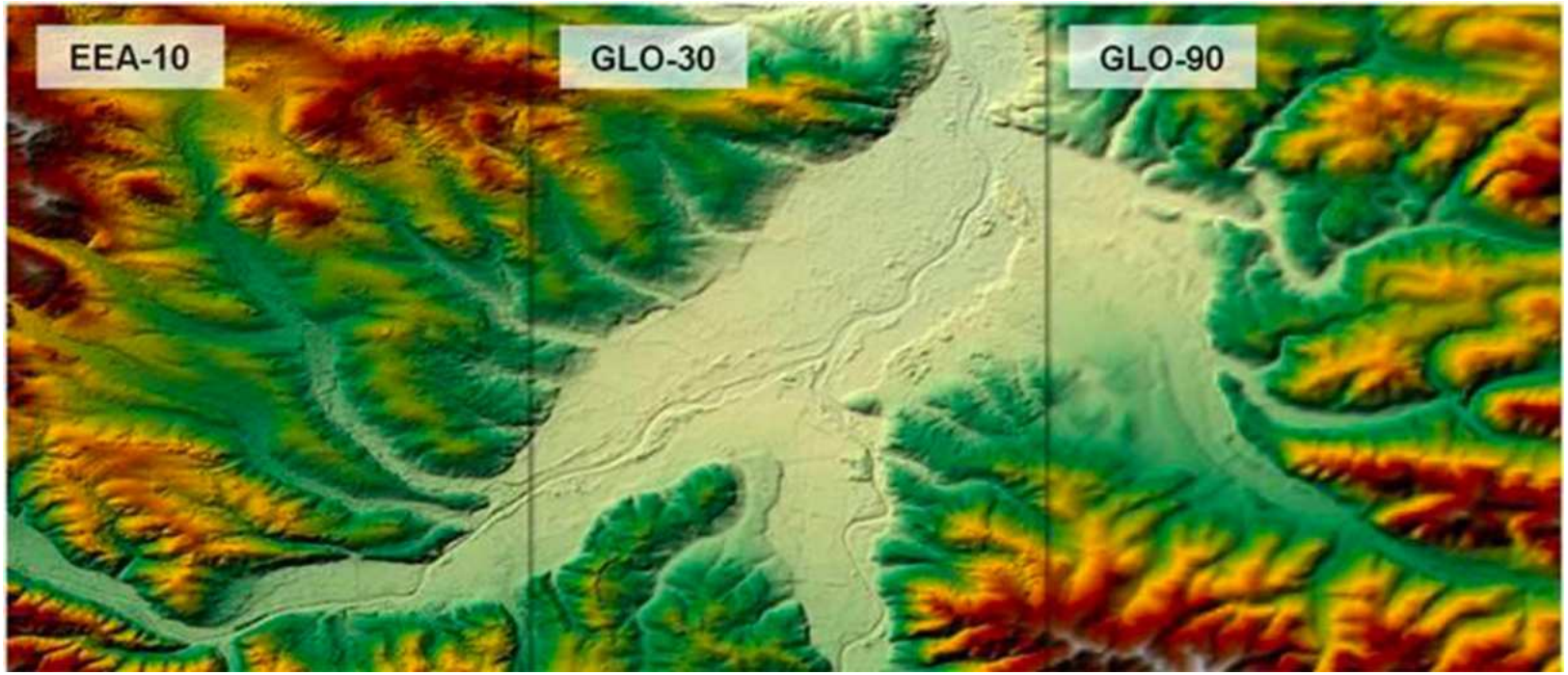
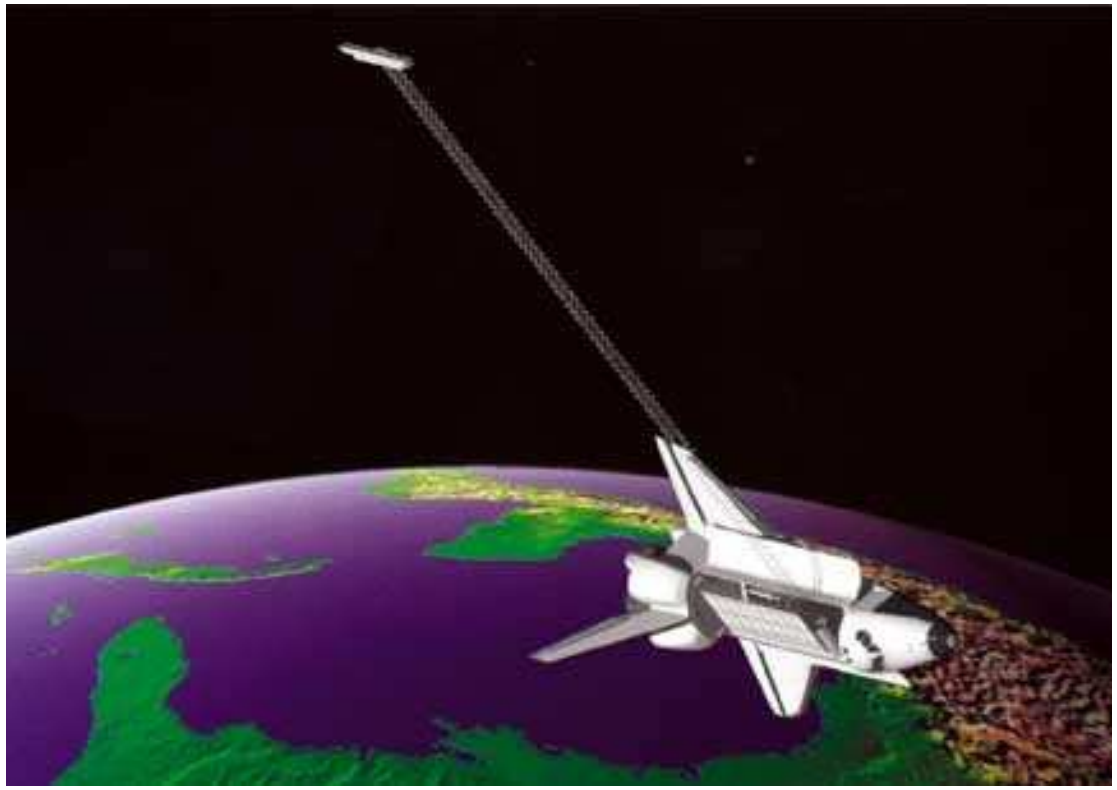
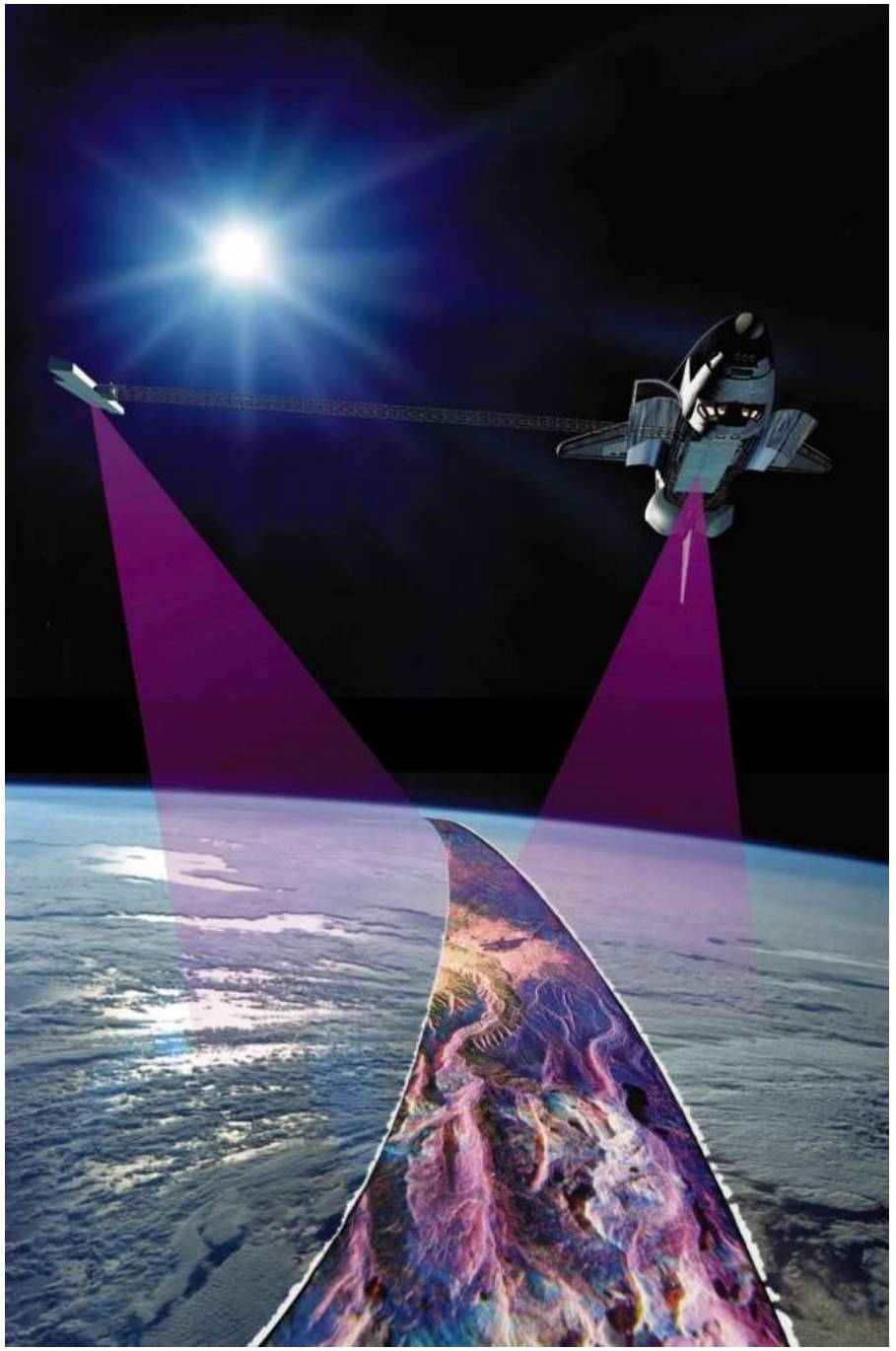
Global Digital Elevation Models

- **SRTM** – Shuttle Radar Topography Mission. Pixel 1” (ok. 30 m at the Equator).
- **Copernicus** - Horizontal resolution: EEA-10; GLO-30; GLO-90.
- Absolute VA: <4m;
  Relative VA <2m for:
  slopes <=20% (11°);
  < 4m slopes >20% (11°)



Shuttle Radar Topography Mission (SRTM)





Who was Copernicus?
A few dates from the life of Nicolaus Copernicus

Nicolaus Copernicus was born on 19 February 1473 in Toruń, Poland

Studied in Cracow, Bologna and Padua

- Lived in Lidzbark Warmiński, Olsztyn, Frombork.
- Nicolaus Copernicus, was not only an outstanding astronomer, but also a **geodesist** and **cartographer**.

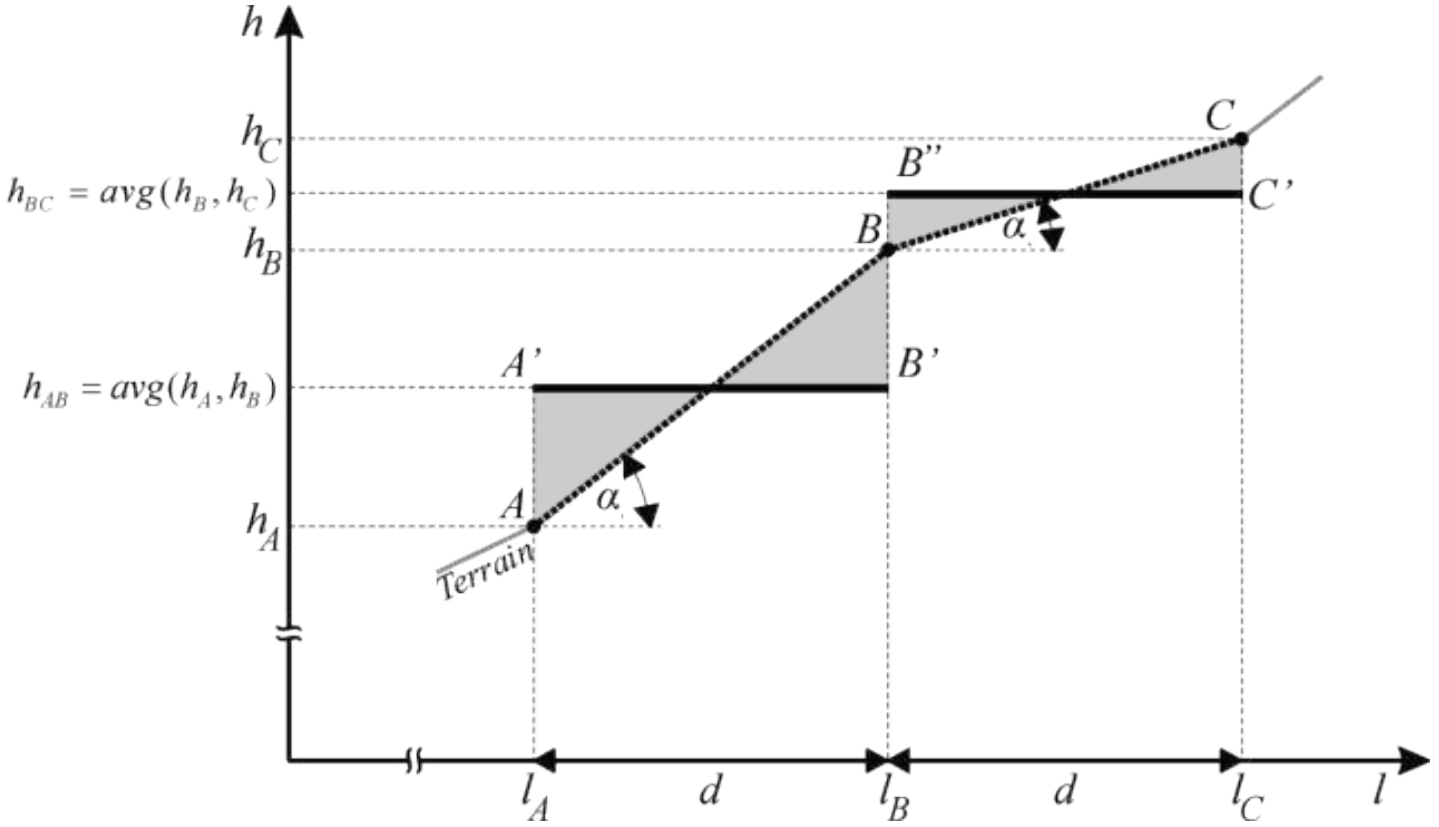
Three Error Sources of Digital Elevation Models

1. Instrument-induced errors (I),
2. Instrument-induced errors (E),
3. Target-induced or geometry error (G)

Hence, the variation of the DEM error is:

$$\sigma^2_{DEM} = \sigma^2_I + \sigma^2_E + \sigma^2_G$$

3. Target-induced or Geometry Error



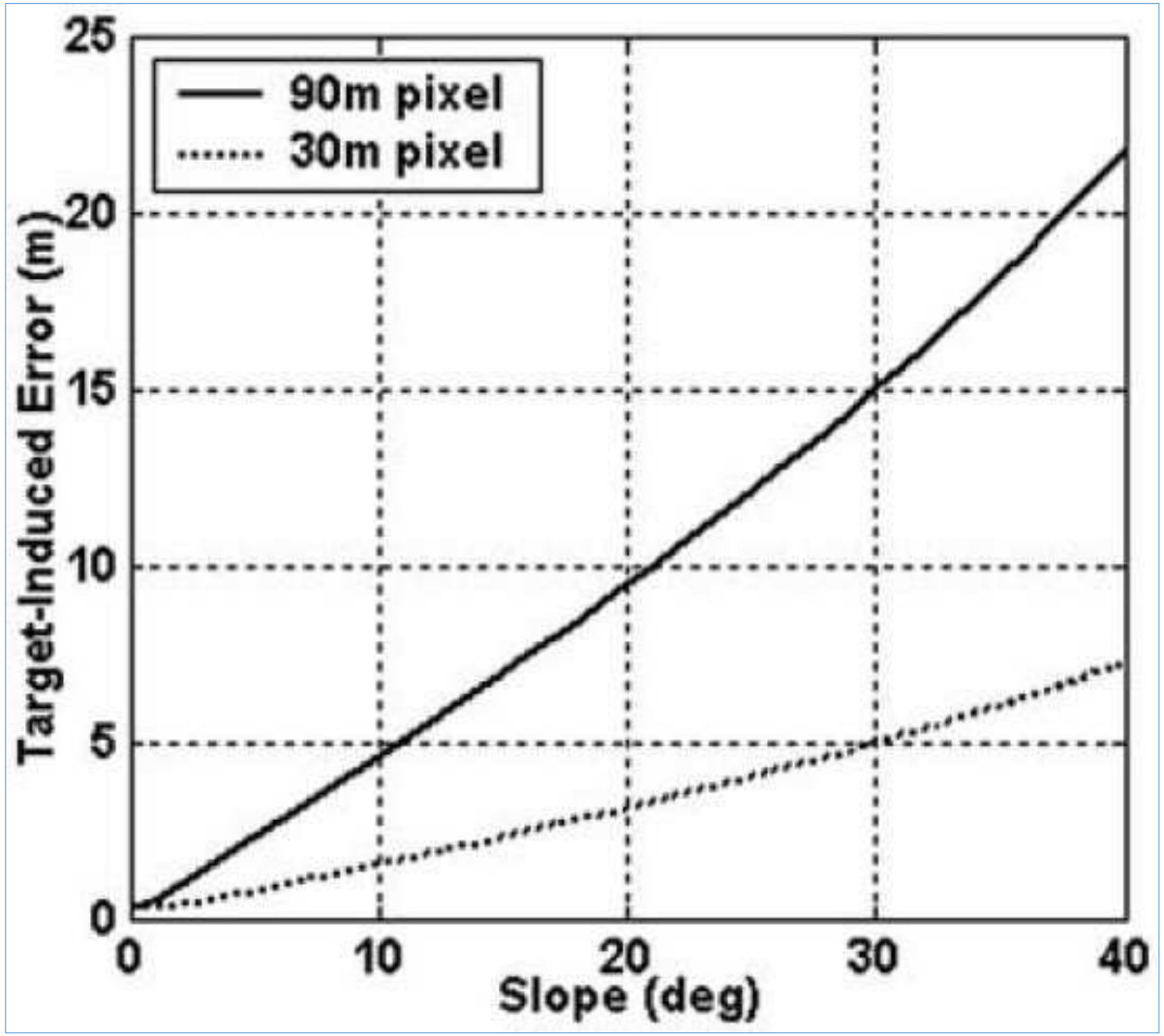
$=p(x)\,dx$

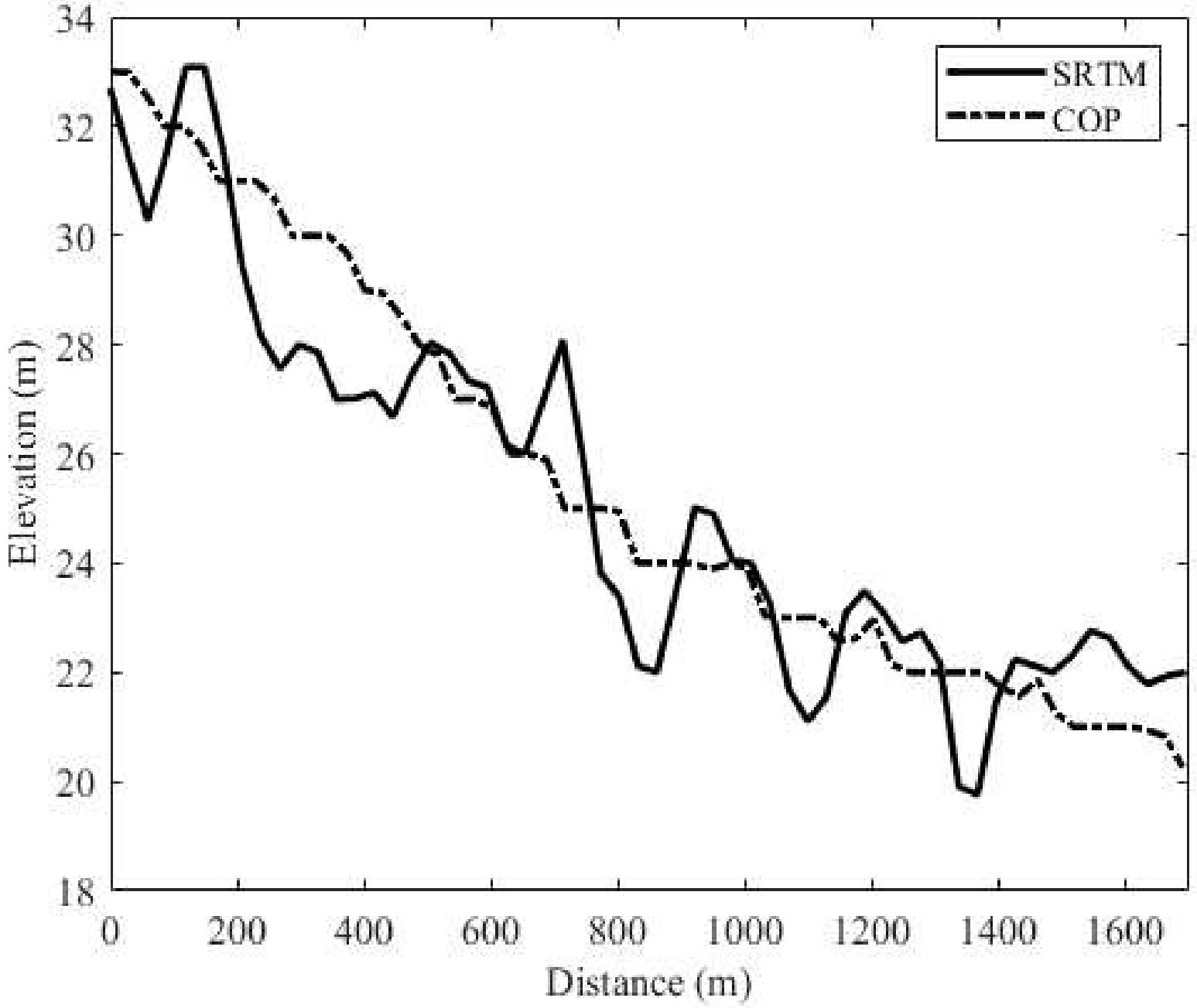
- **It depends on the slope (*α*) and pixel size – (*d*)**

3. Target-induced or Geometry Error

$$\sigma^2 = \frac{d^2 tan^2(s)}{12}$$

d - pixel size, s – slope

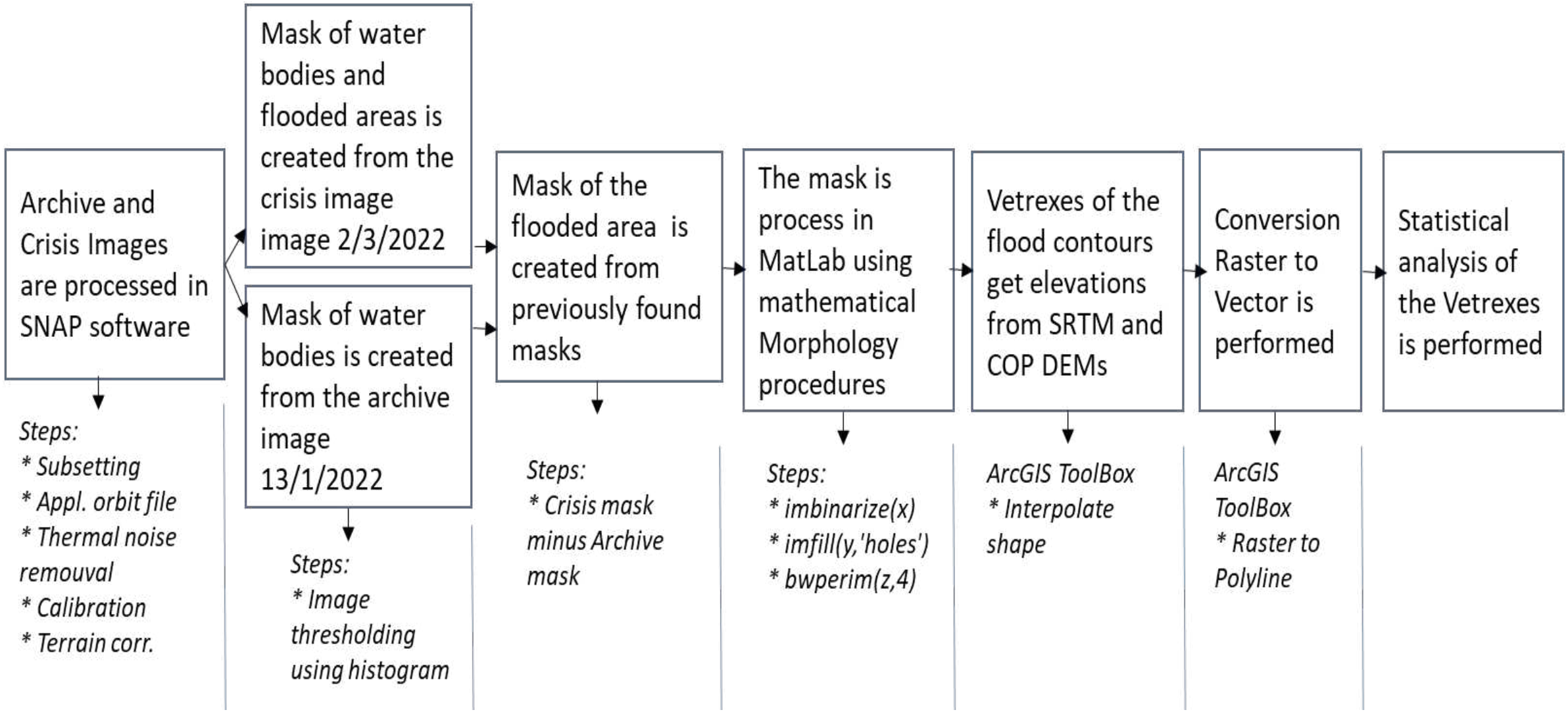




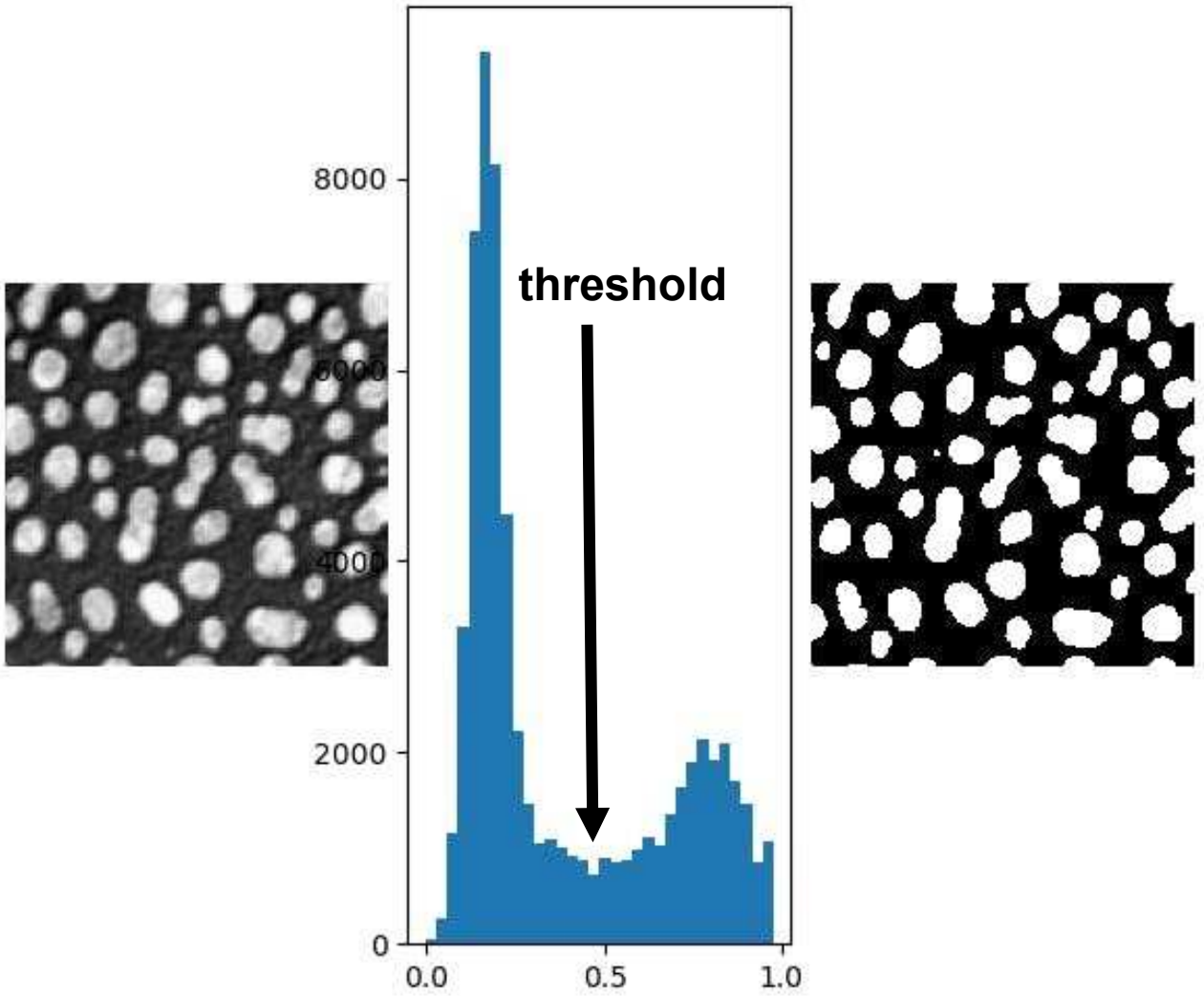
Profiles of the Grafton airport runway derived from the SRTM and COP models

The Grafton Flood 2022

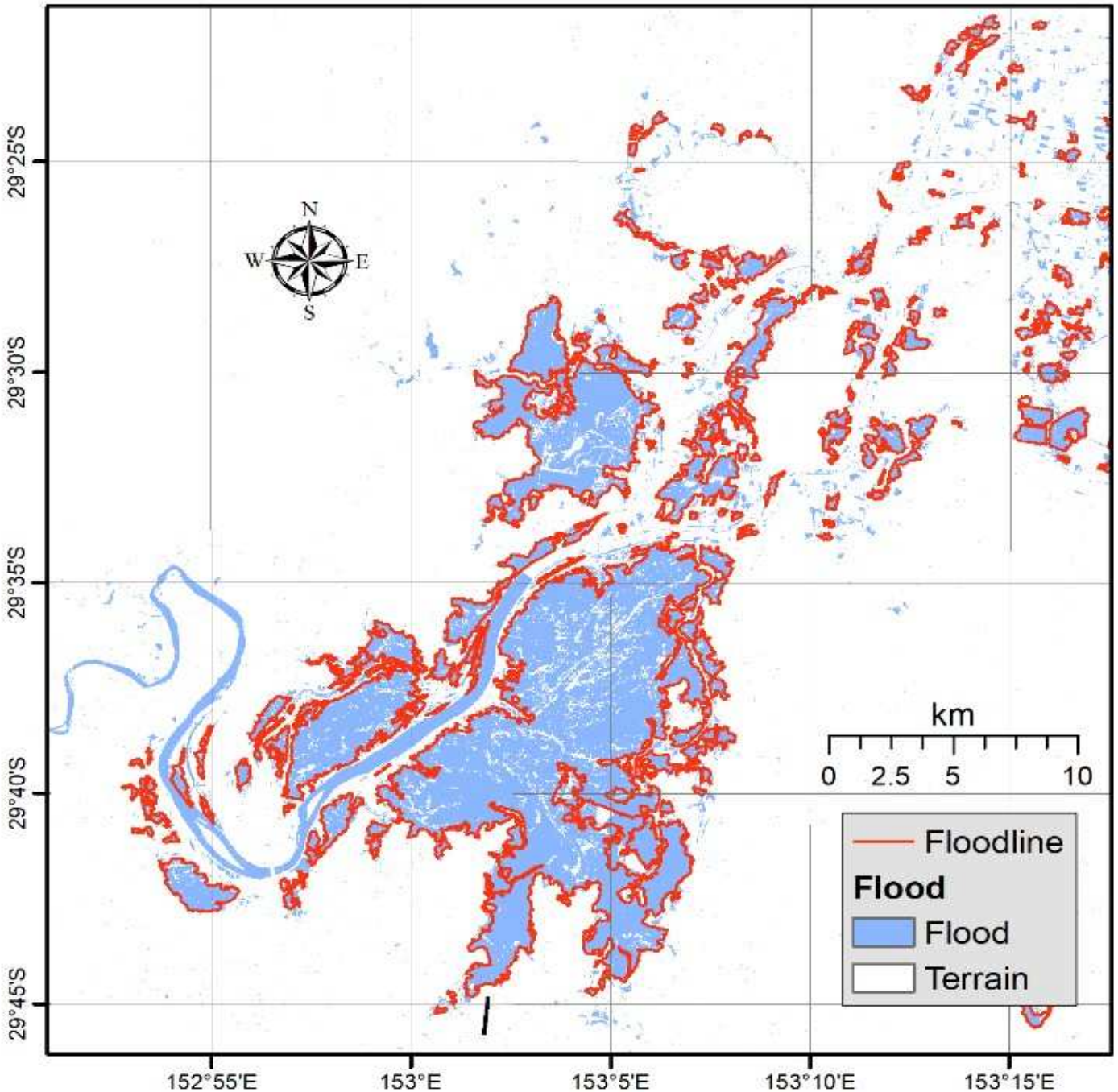
Data processing steps



Histogram thresholding

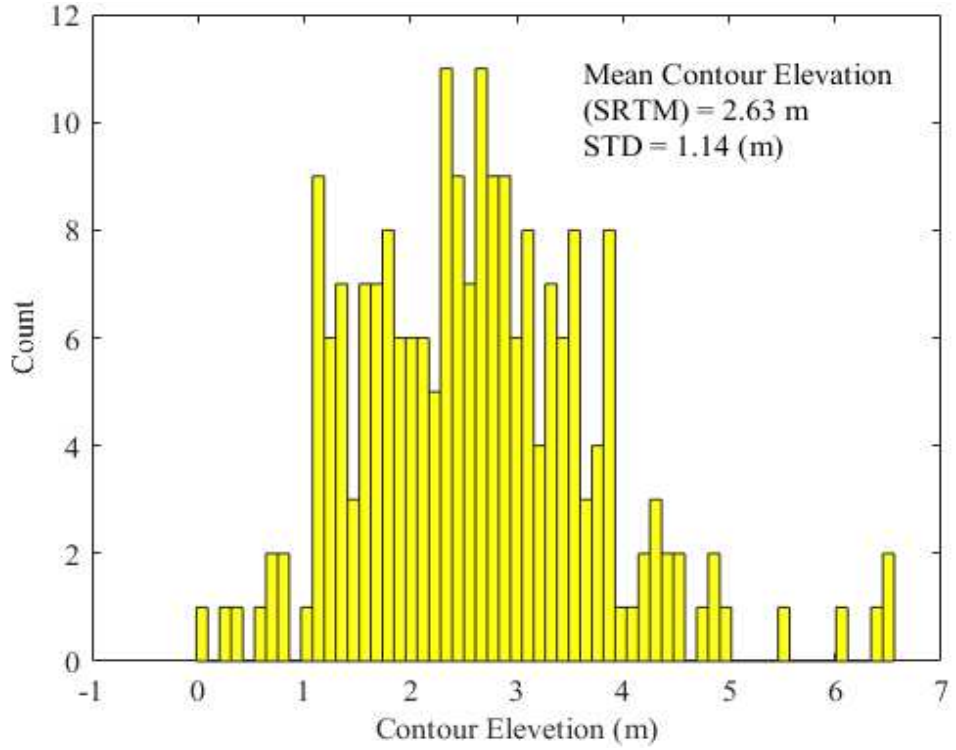


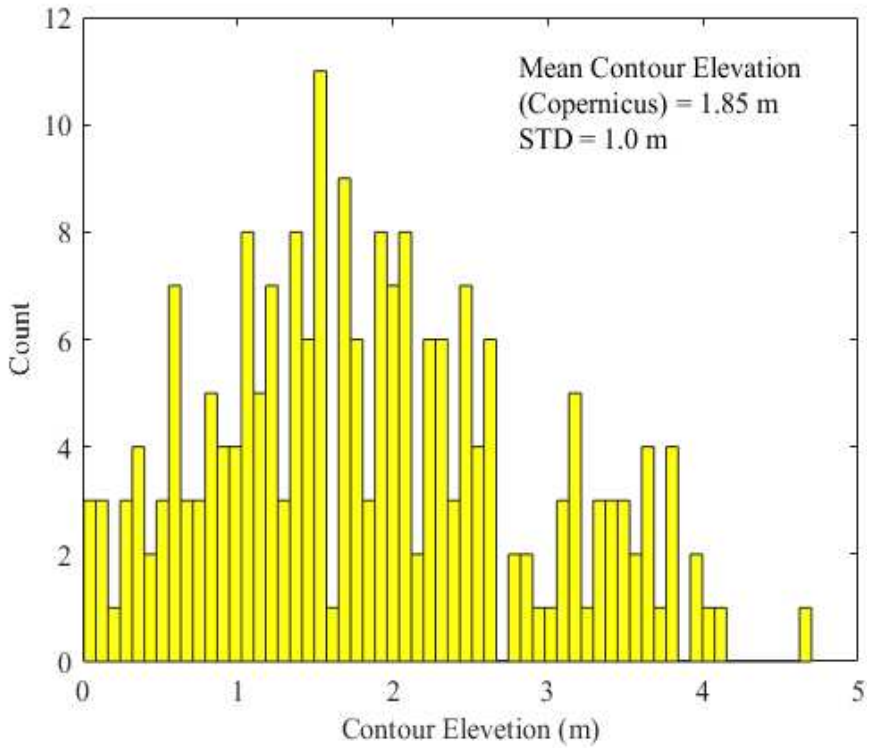
Source: https://encord.com/blog/image-thresholding-image-processing/



Flood lines used in this study

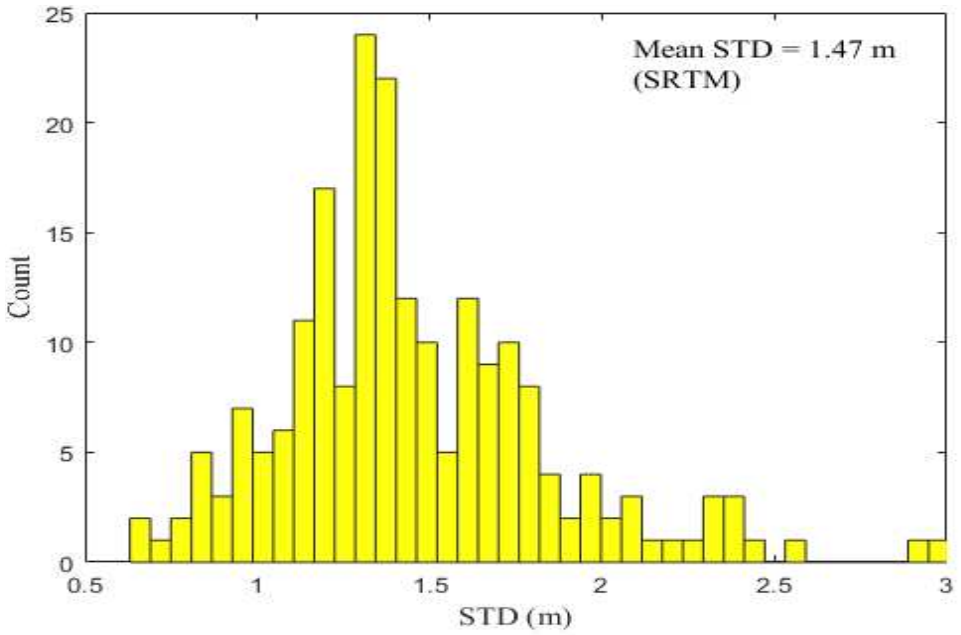
Histogram of flood lines elevation estimated from SRTM and COP

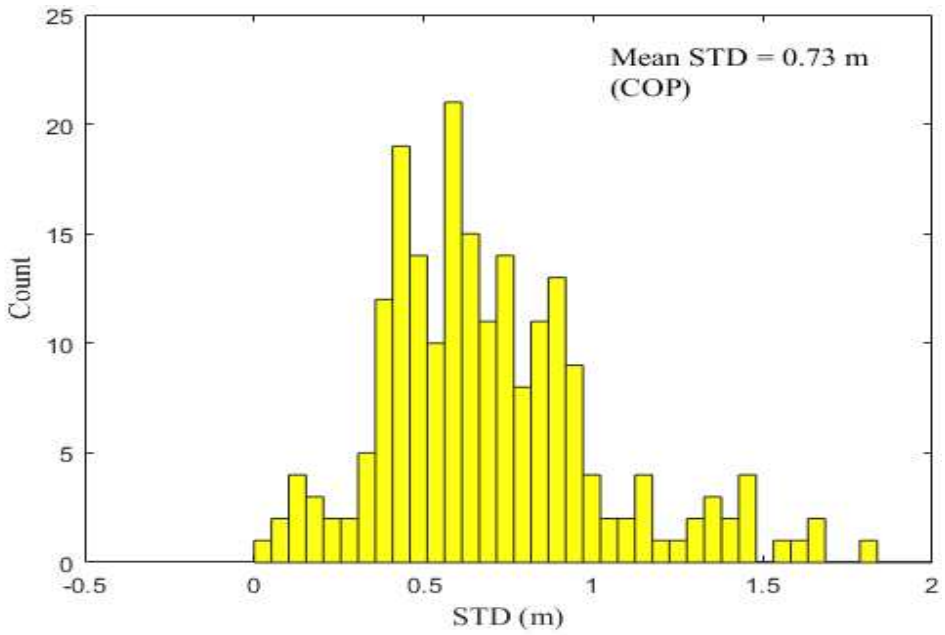




The average elevation of the SRTM-derived lines elevation is 2.63 m. while for the COP, it is 1.85 m. A vertical shift between SRTM and COP of 0.78 m is present.

Histograms of vertexes' elevation estimated from SRTM and COP





The relative vertical accuracy (one sigma) of SRTM is 1.47 m vs. COP is 0.73 m

Conclusions

- The proposed reference data derived from SAR images for assessing the vertical accuracy of DEMs of medium resolution (10 m to 90 m) produced comparable results with other methods.
- Floods or other water-related phenomena, e.g., salt lakes, frozen lakes, and glaciers, are easier to access than benchmarks or other global elevation datasets.
- Another feature of the method is that it does not require a priori knowledge of the elevation of the reference lines.
- The mathematical morphology of binary images available in MatLab allows for easy extraction of the flood lines.

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