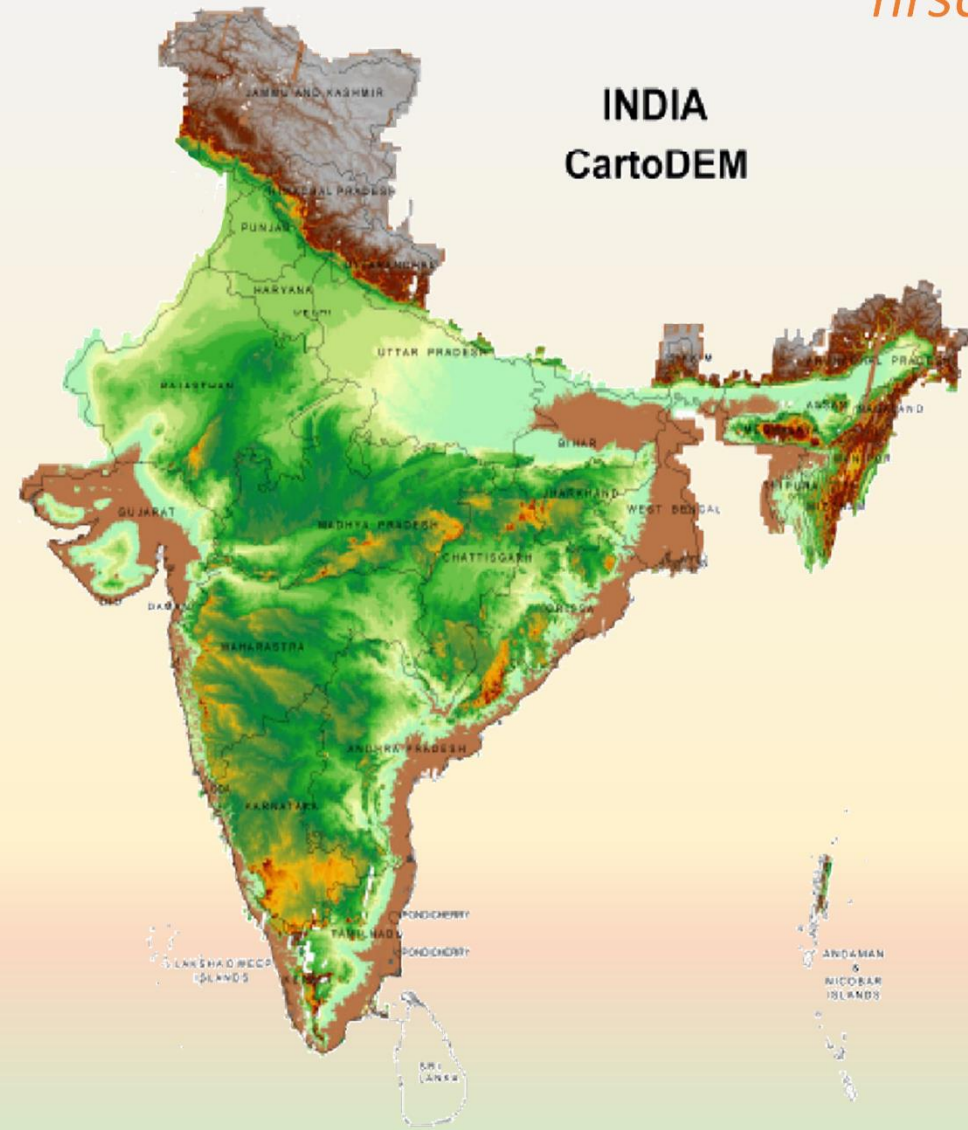


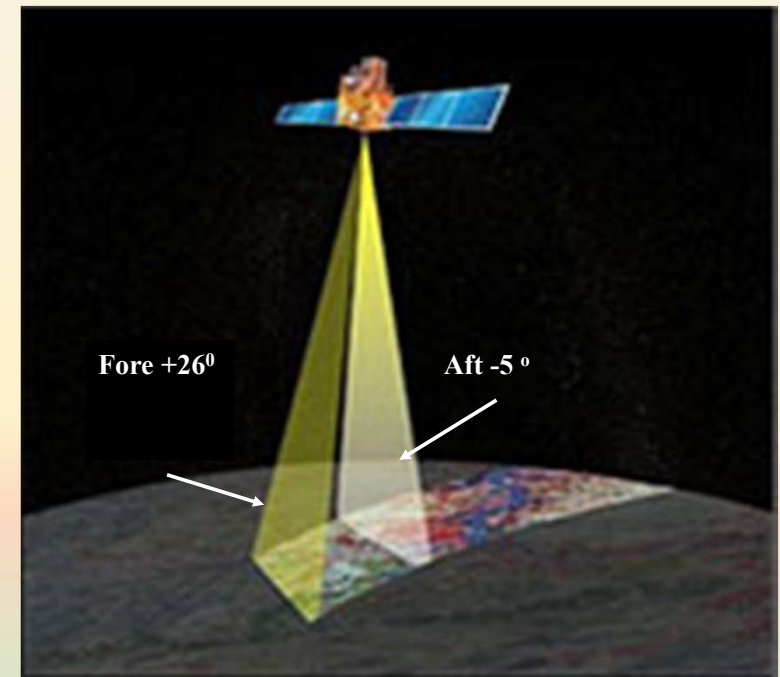
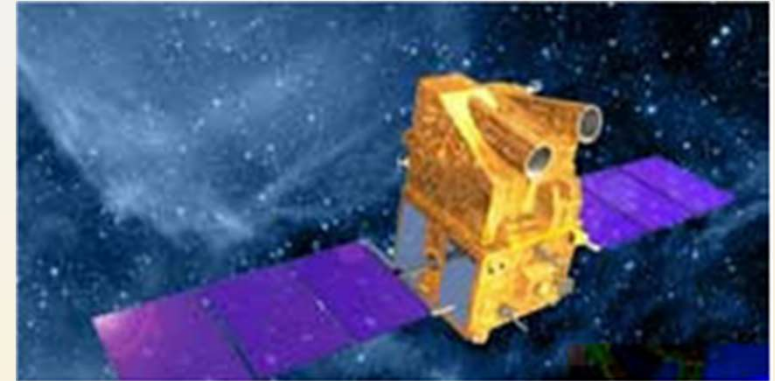
High Resolution Cartosat-1 DSM

R.V.G.Anjaneyulu, GH,SPFPG



CARTOSAT-1 (INDIA)

- First stereo mission providing data @ 2.5m
- Provide wide swath of 27km with along the track photogrammetric stereo imagery (Aft-5deg and Fore-26deg) with high geometric fidelity to meet the national and global needs of topographic mapping.
- Capable to provide 3m to 4m positional & height accuracy for all terrain types
- Standard stereo product is provided with generic sensor model (RPCs) .

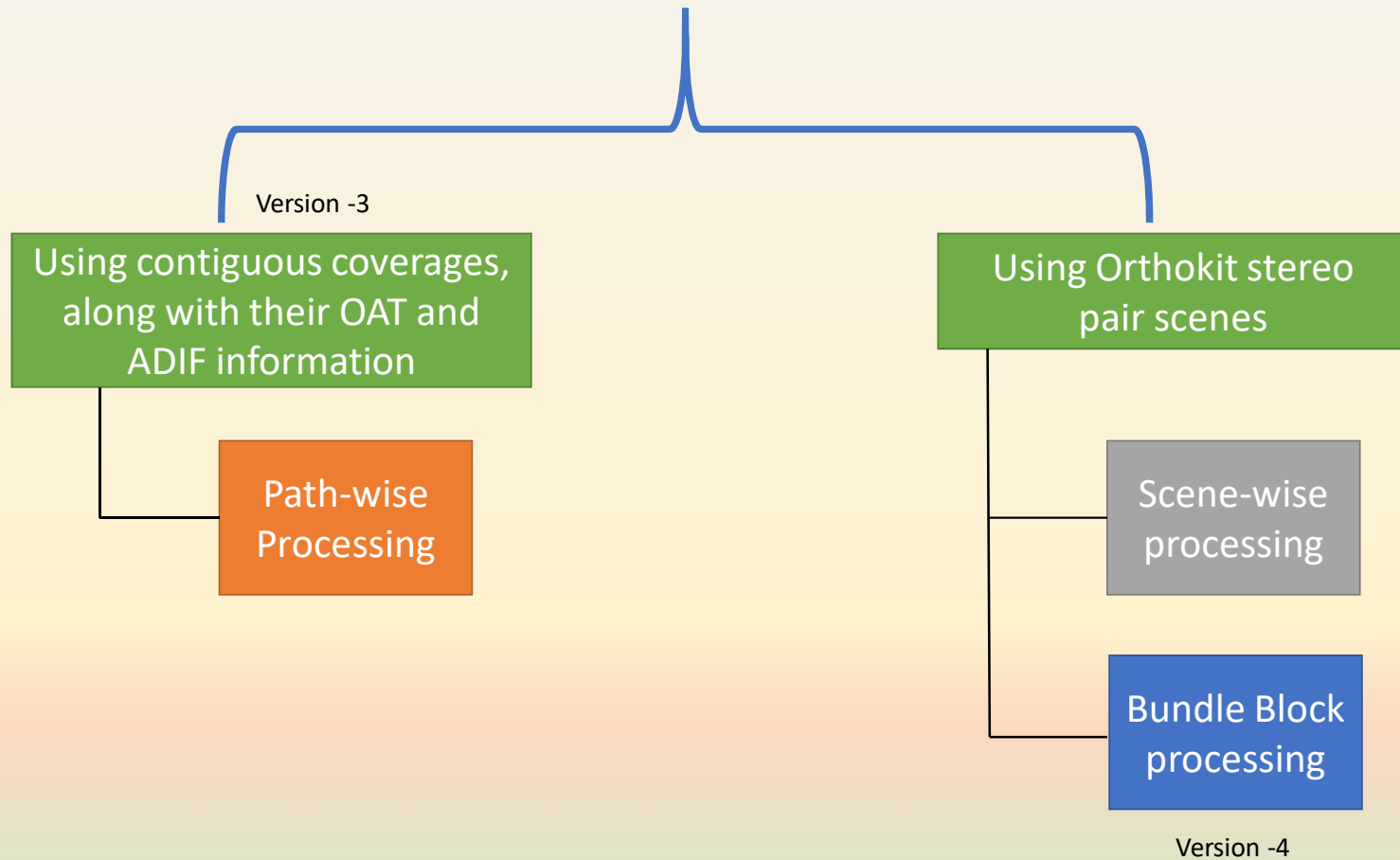


CartoDEM

A National Digital Elevation Model from Cartosat-1 stereo data

- One of its mission goals of Cartosat-1 is to generate a Digital Elevation Model (DEM) and corresponding ortho-image for the entire country to facilitate large scale mapping and terrain modelling applications.
- The DEM was generated to meet the laid out specification with the set procedures using Augmented Stereo Strip Triangulation (ASST) software using specific guidelines.
- The evolution of cartoDEM has taken place over the years starting from 2008. Till now three versions of the DEM for India has been generated and populated.
- After the experts committee satisfactory evaluation, meeting the requirements of applications it was cleared for dissemination to users

DEM generation strategies using Satellite stereo data





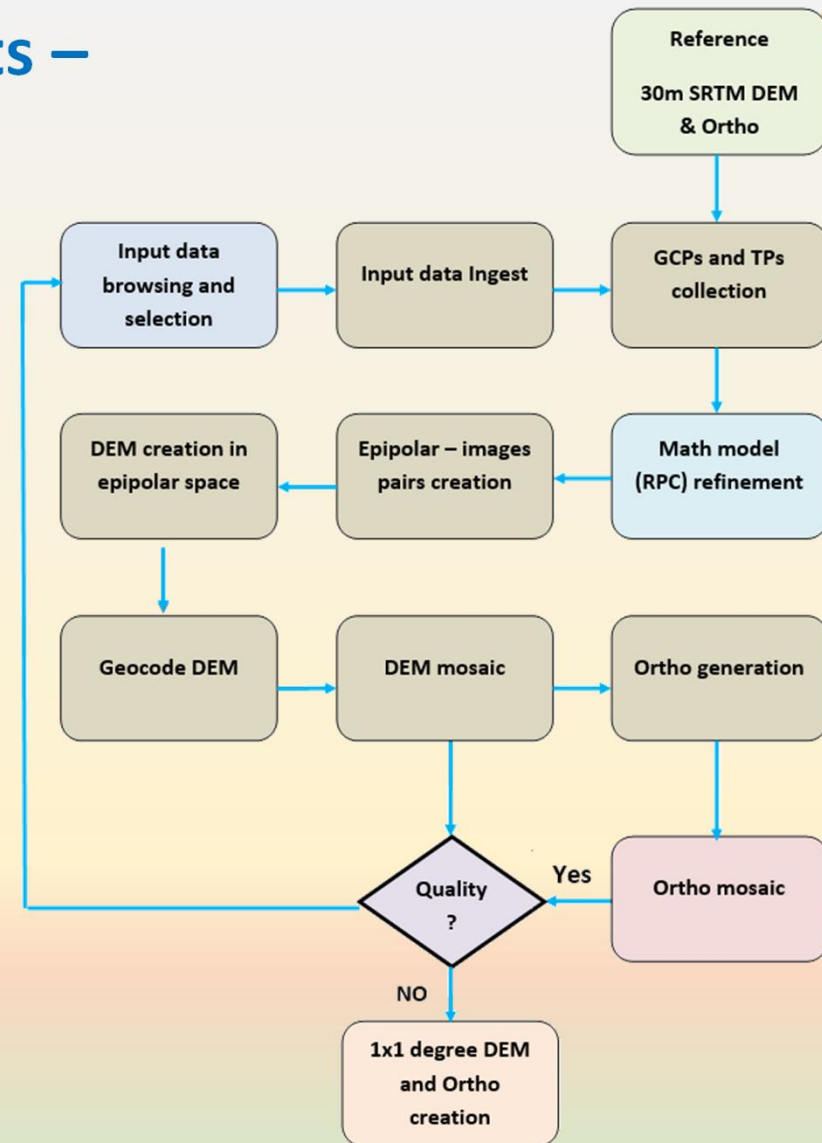
Using Scene wise stereo orthokits – Bundle block adjustment

Inputs:

- Cartosat-1 Stereo RAD ortho kit products covering the required area of 1 degree x 1degree (36 to 60 scenes).
- Mosaiced 30m SRTM DEM covering entire INDIA.
- CartoDEM 3X3 degree Ortho tiles. These tiles are mosaiced using CartoDEM version – 3 orhto tiles for planimetric reference

Outputs:

- DEM and Ortho 1 x 1 degree tiles.

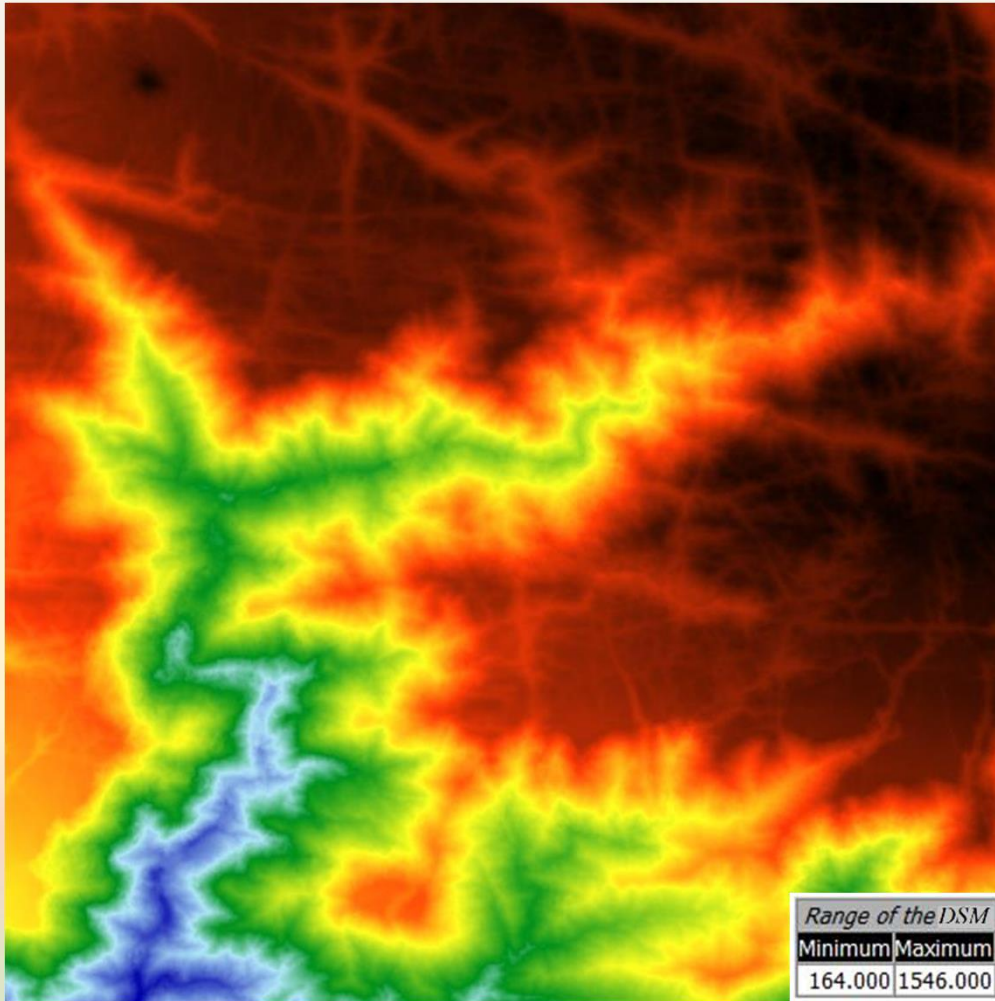


Specifications of CartoDEM – 2.5m

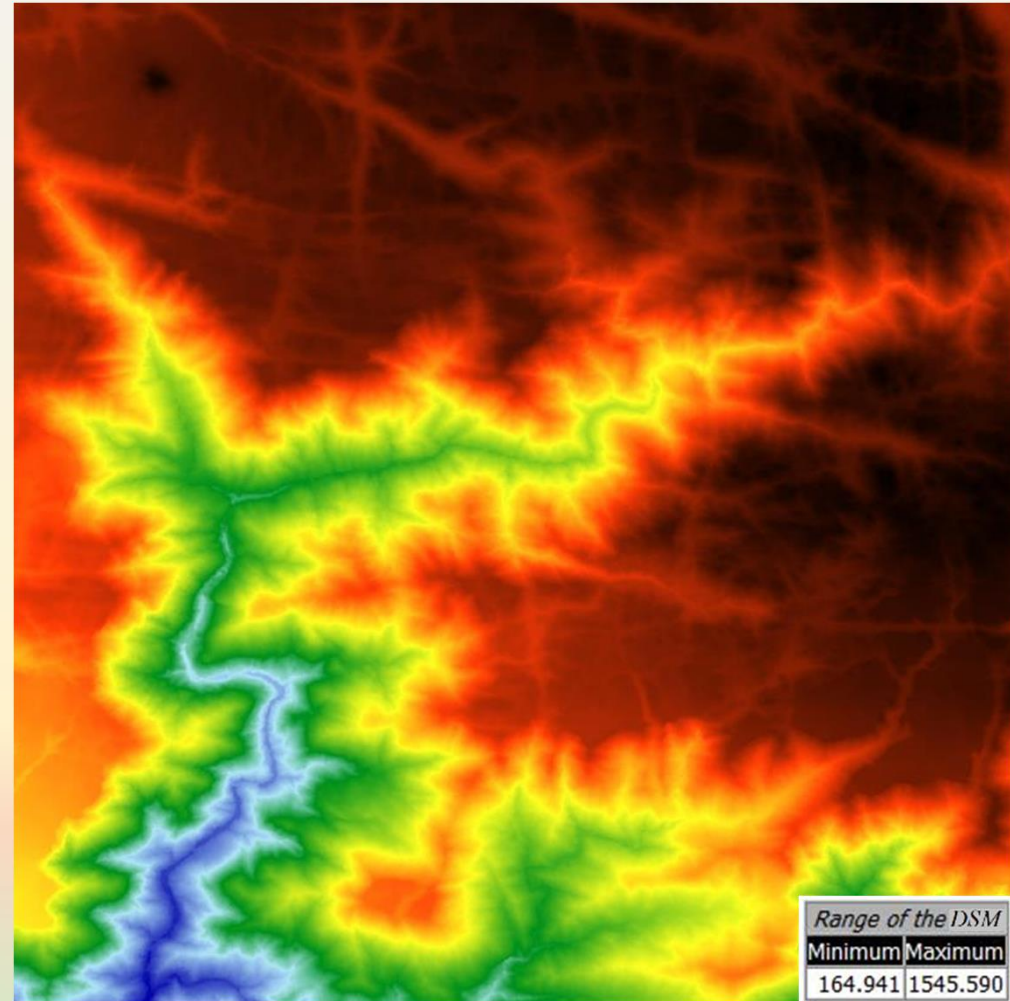
Parameter	Specifications
Image Format	Geo-Tiff
Data type (DEM)	Signed short (2 bytes)
Data type (Ortho-image)	Unsigned short (2 bytes)
Datum (planimetric and height)	WGS 84
Projection	Geographic & EGM2008
Ortho Image Resolution	1/12 arc sec – 2.5m
Posting	1/12 arc sec – 2.5m
DEM Type	Digital Surface Model (DSM)
Absolute accuracy (Planimetric)	15m (CE90)
Absolute accuracy (vertical)	8m (LE90)
Relative accuracy (vertical)	>5m (LE90)
Ellipsoidal height units	Meters
Tile extents (size)	1 Deg x 1 Deg

Shillong surroundings

10m DEM



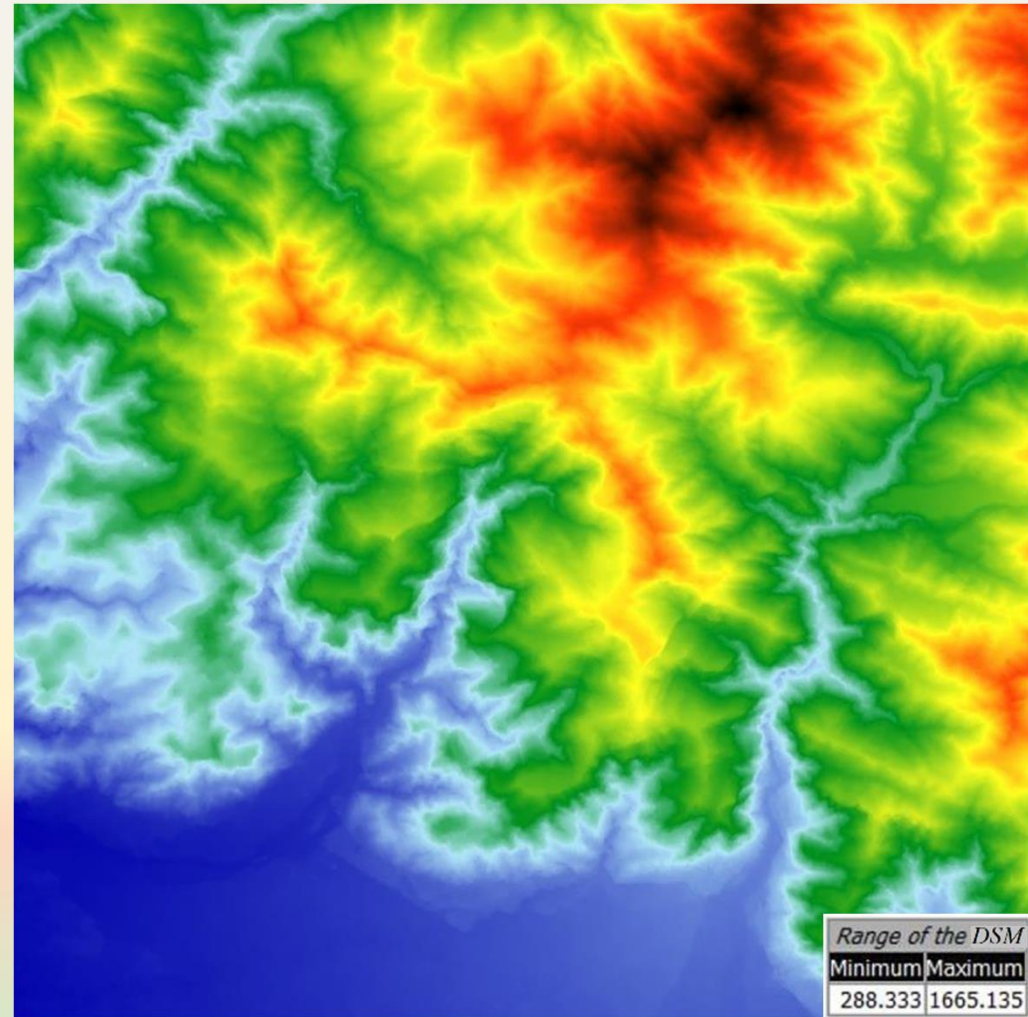
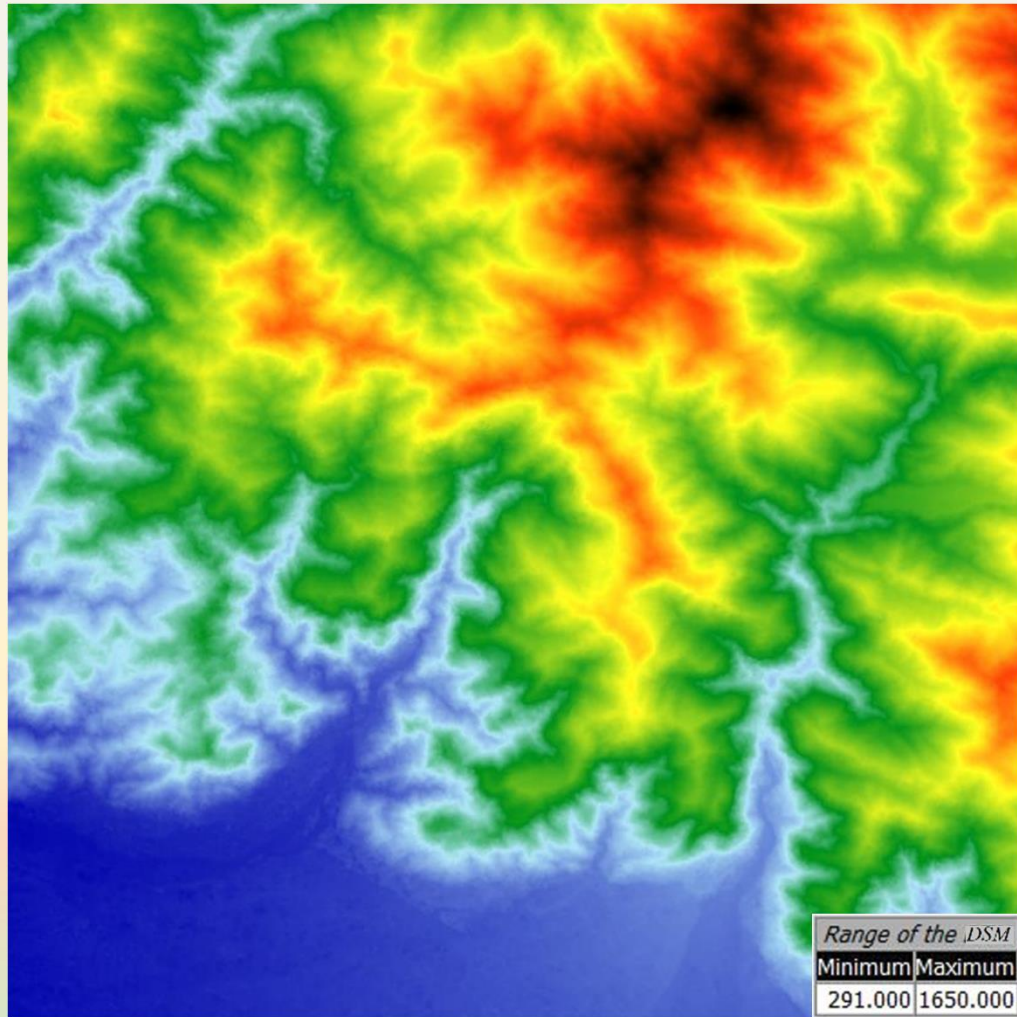
2.5m DEM



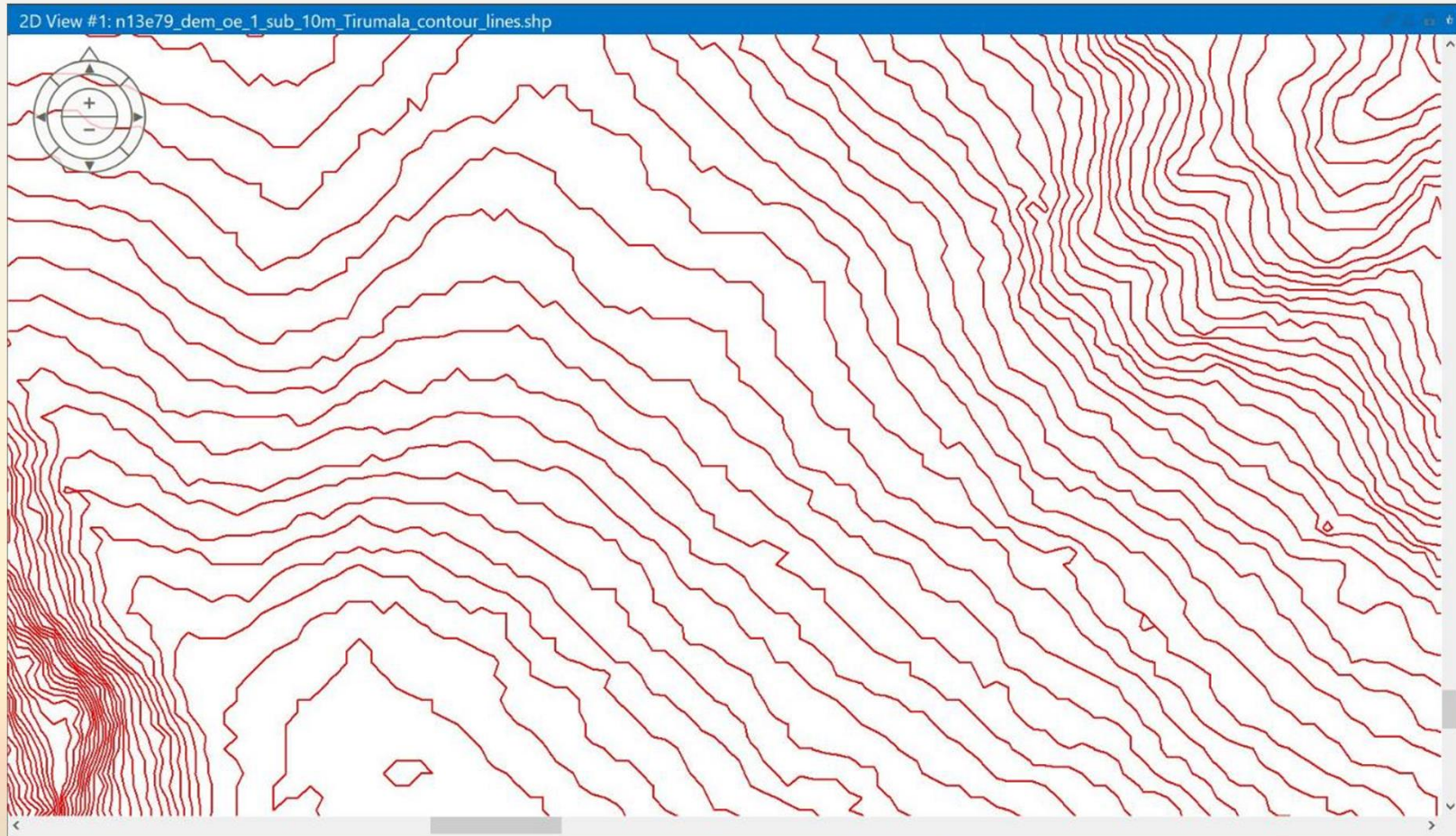
Uttarakhand surroundings

10m DEM

2.5m DEM



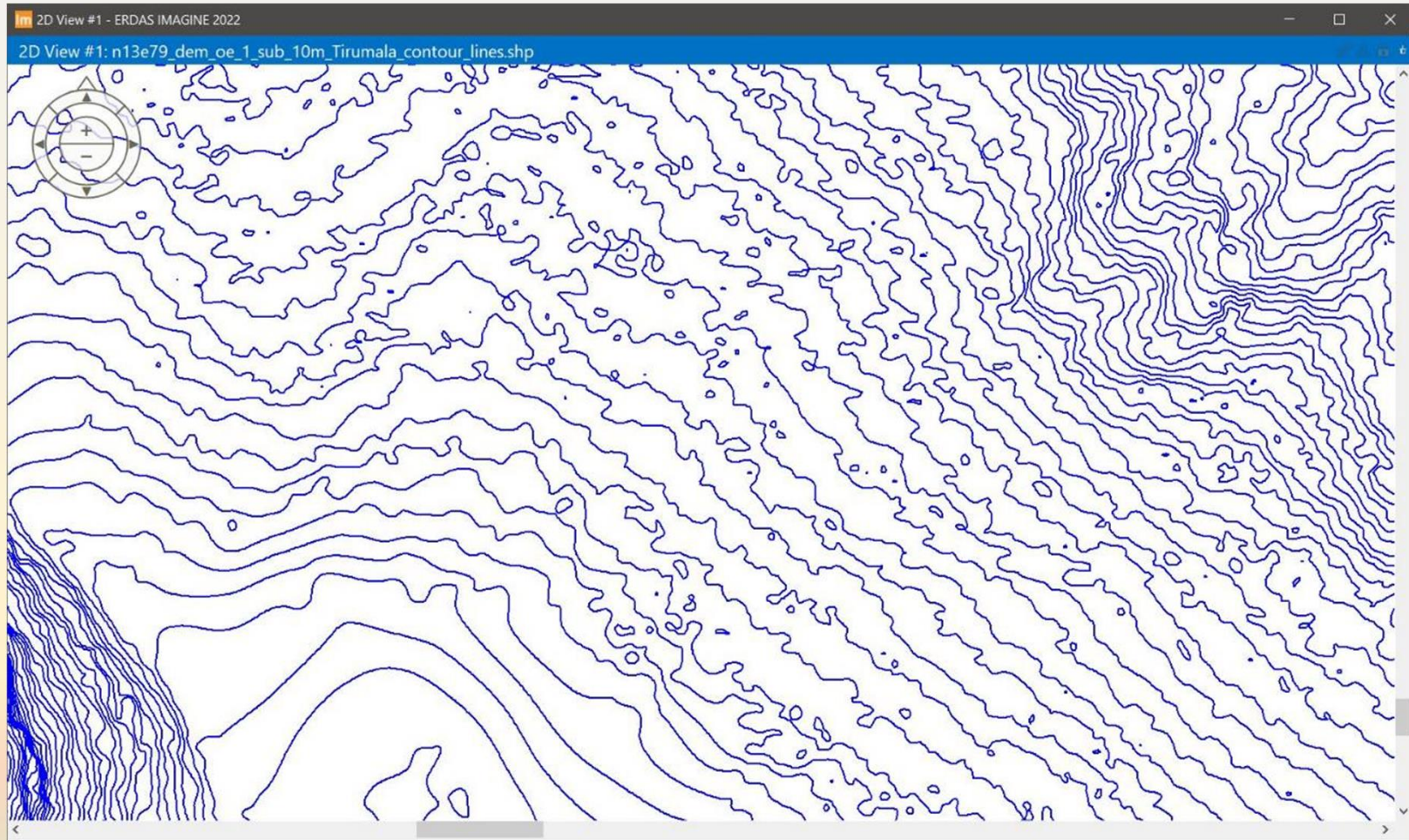
Contours at 5m interval – Tirumala Area



10m DEM

Range of the DSM	
Minimum	Maximum
83.000	870.000

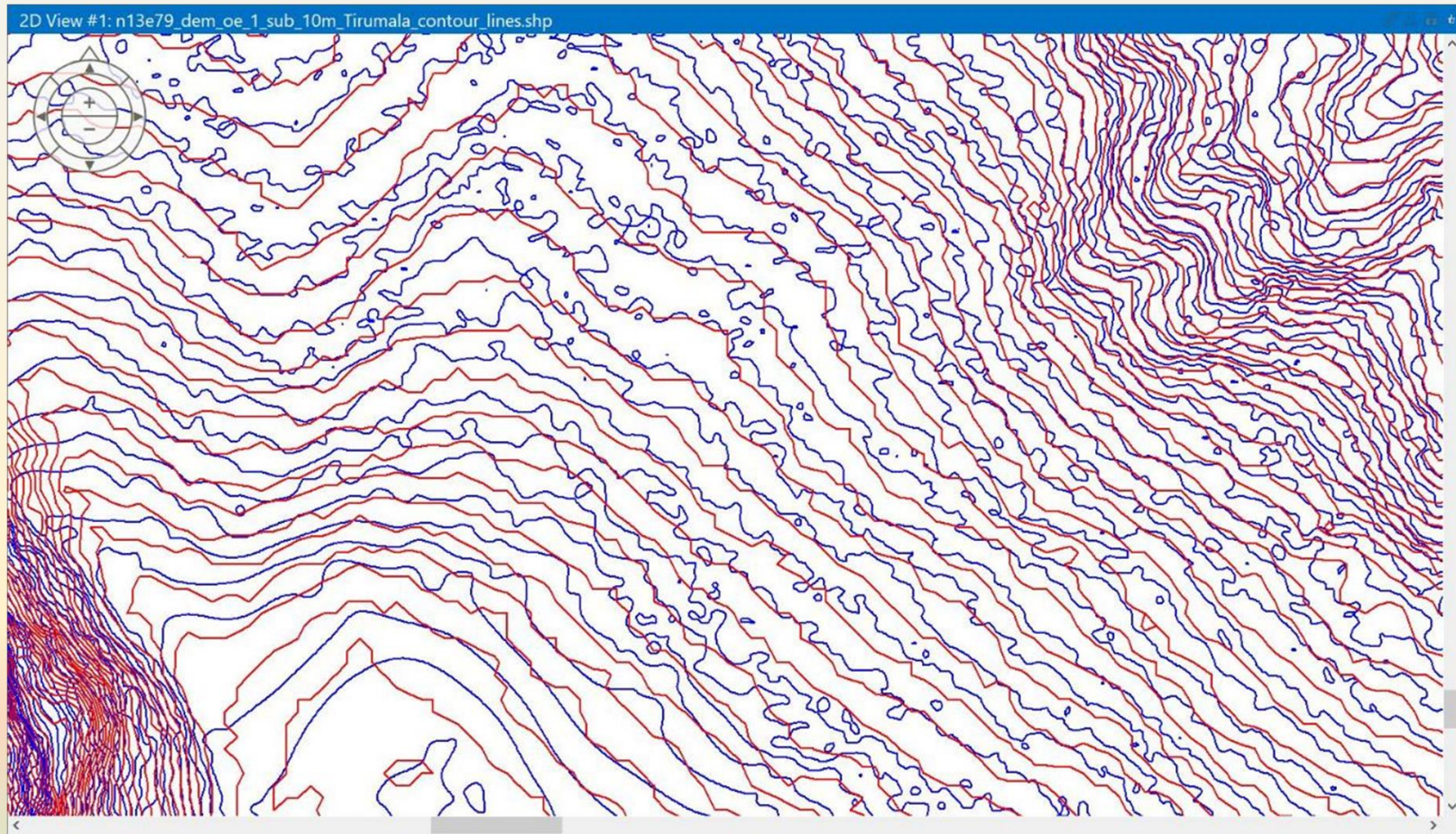
Contours at 5m interval – Tirumala area



2.5m DEM

Range of the DSM	
Minimum	Maximum
100.253	869.034

Contours at 5m interval – Tirumala area

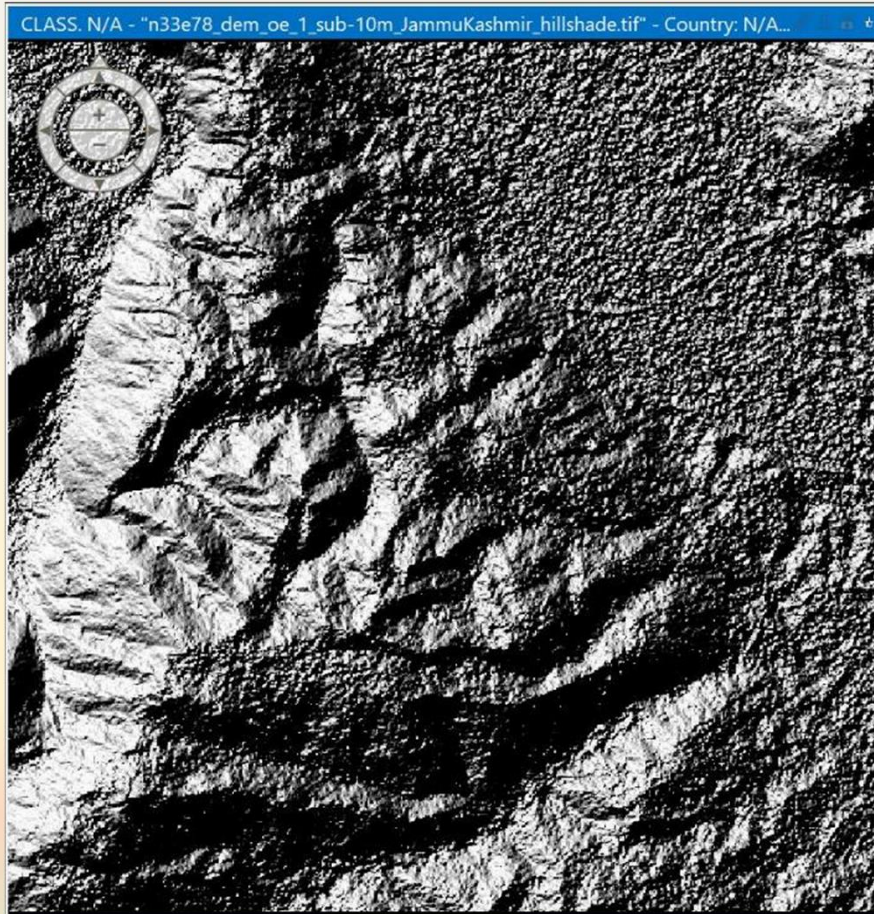


Combined

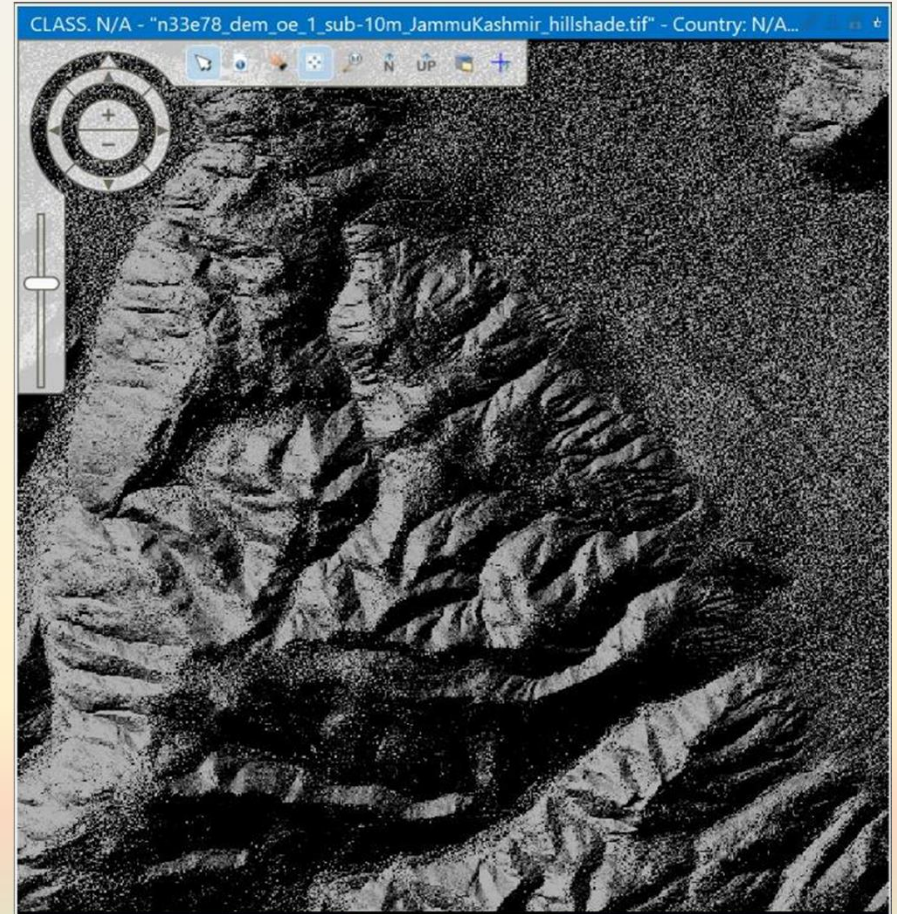
Hill Shade analysis – J&K Area

10m DEM

2.5m DEM



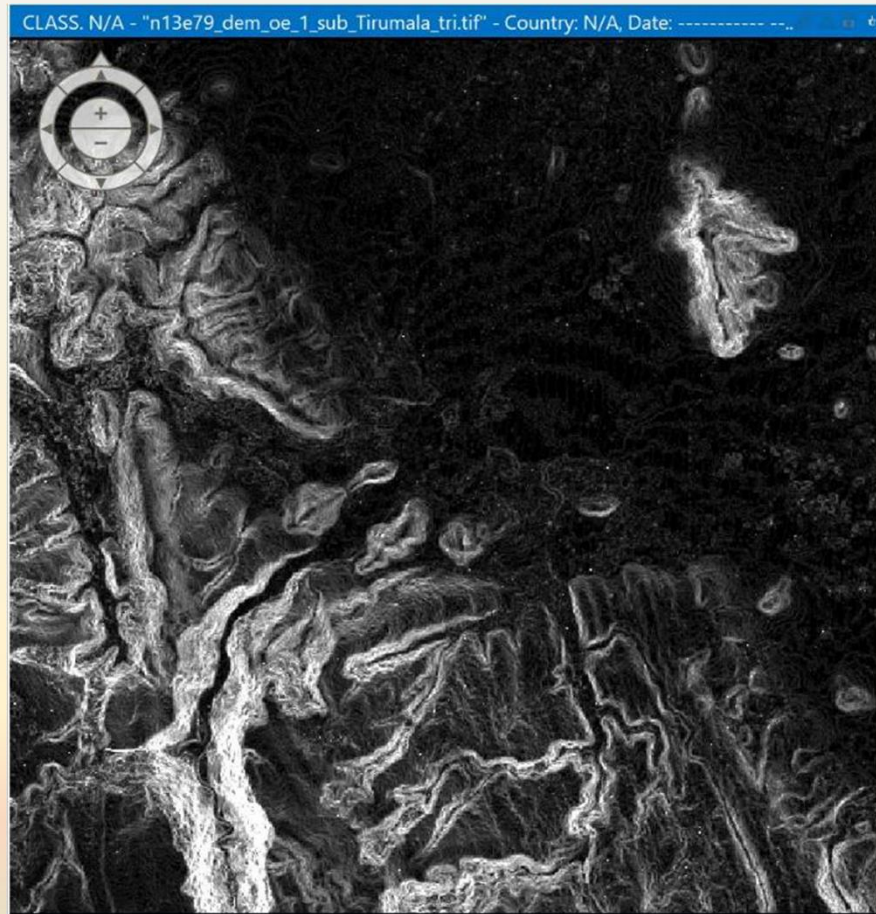
Range of the DSM	
Minimum	Maximum
4234.000	5581.000



Range of the DSM	
Minimum	Maximum
4274.596	5575.379

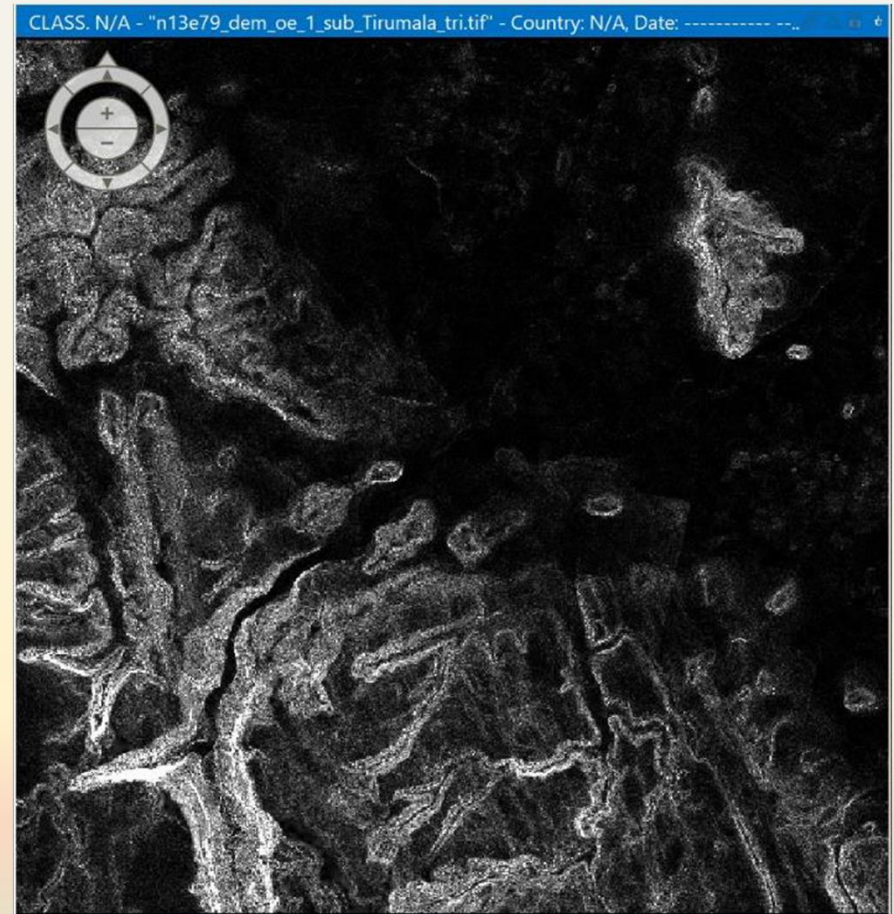
Terrain Roughness Index – Tirumala Area

10m DEM



Range of the DSM	
Minimum	Maximum
83.000	870.000

2.5m DEM



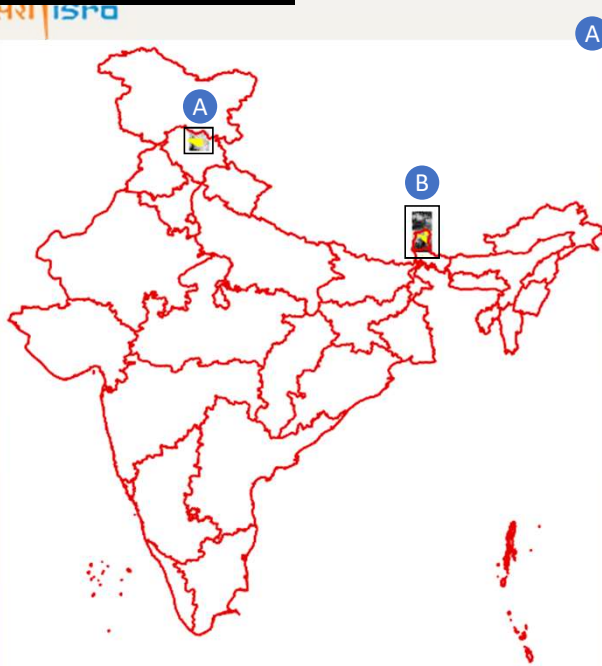
Range of the DSM	
Minimum	Maximum
100.253	869.034

Comparative Evaluation of Cartosat DEM and Tandem-X DEM for Hydrological and Hydrodynamic Modelling Applications

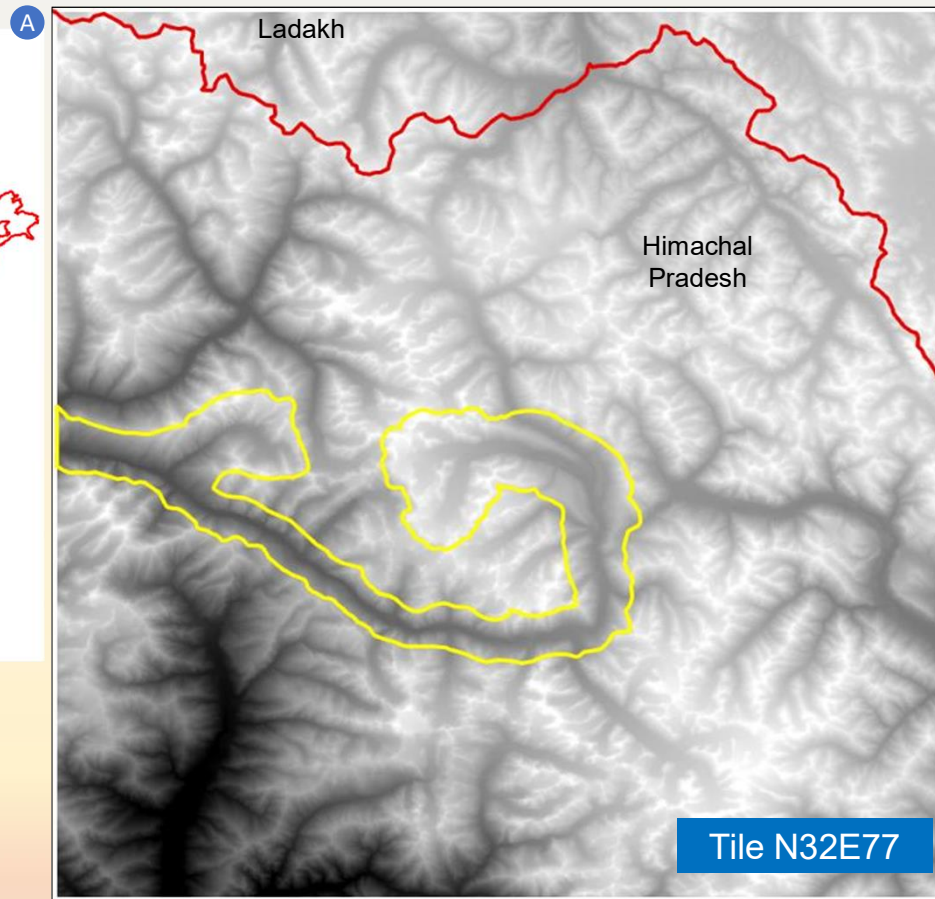
Water Resources Assessment Division (WRAD)
Water Resources Group (WRG)
Remote Sensing Applications Area (RSAA)
NRSC

STUDY AREA

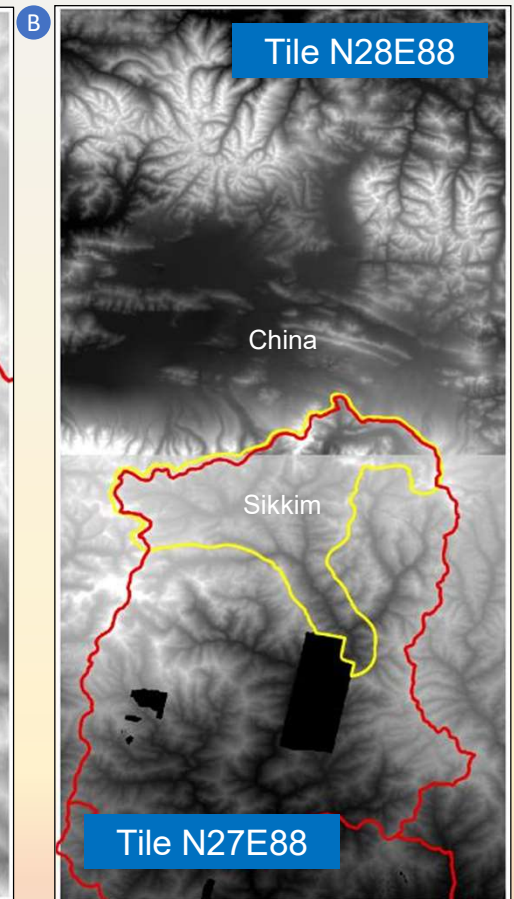
CartoSAT 2.5 m DEM Tiles



- Study Area Boundary
- State/UT Boundary



- **Study Area:** Ghepang Ghat and Samudra Tapu lakes and their downstream area
- **State:** Himachal Pradesh
- **Basin:** Indus



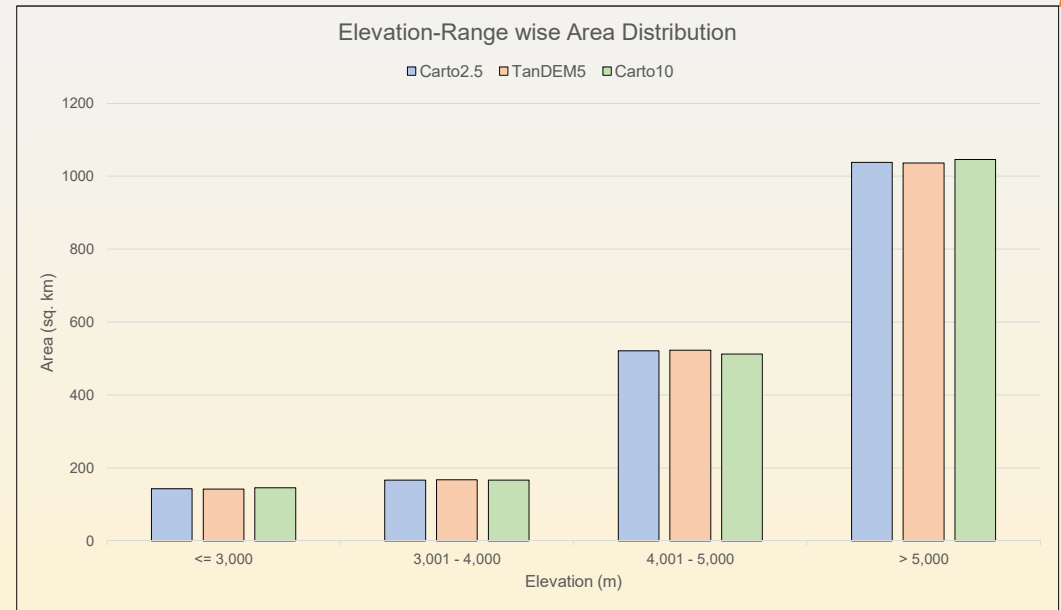
- **Study Area:** South Lhonak Lake and its downstream
- **State:** Sikkim
- **Basin:** Brahmaputra

South Lhonak Glacial Lake, Sikkim

Comparison of the DEMs for the South Lhonak Study Area

DEM Statistics Comparison

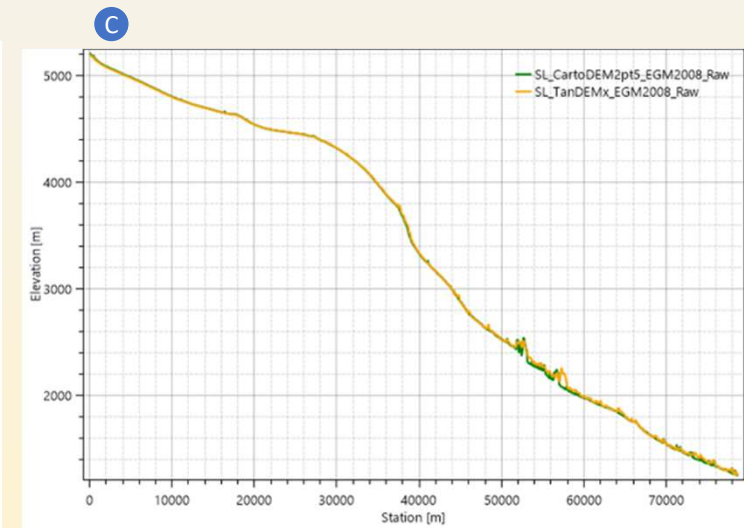
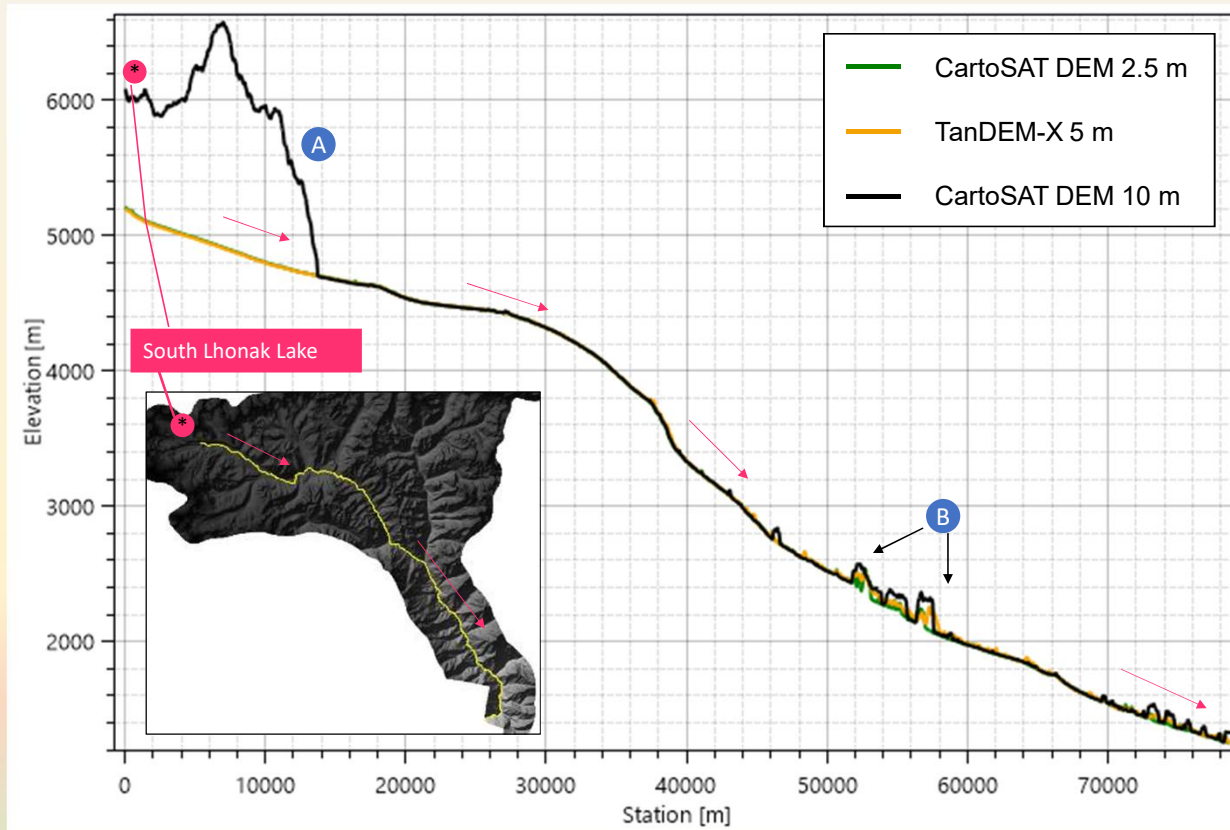
S. No.	Attributes	CartoSAT DEM 2.5 m	TanDEM-X 5 m	CartoSAT DEM 10 m
1	Min. Elevation (m)	1,248	1,271	1,254
2	Max. Elevation (m)	7,468	7,457	7,435
3	Mean Elevation (m)	4,839	4,836	4,878
4	Std. Deviation	992	988	1,038



Elevation (m)	CartoDEM 2.5 m			Tandem-X 5 m			CartoDEM 10 m		
	Pixel Count	Area (sq. km)	% Of Total	Pixel Count	Area (sq. km)	% Of Total	Pixel Count	Area (sq. km)	% Of Total
<= 3,000	2,37,72,488	143.56	7.67	57,10,032	142.8	7.63	14,55,227	145.5	7.78
3,001 - 4,000	2,76,78,698	167.15	8.94	67,10,000	167.8	8.97	16,64,949	166.5	8.9
4,001 - 5,000	8,62,79,501	521.03	27.9	2,09,37,910	523.5	28	51,22,835	512.2	27.4
> 5,000	17,19,50,058	1038.39	55.5	4,14,44,948	1036	55.4	1,04,62,267	1046	55.9
Total	30,96,80,745	1,870	100	7,48,02,890	1,870	100	1,87,05,278	1,870	100

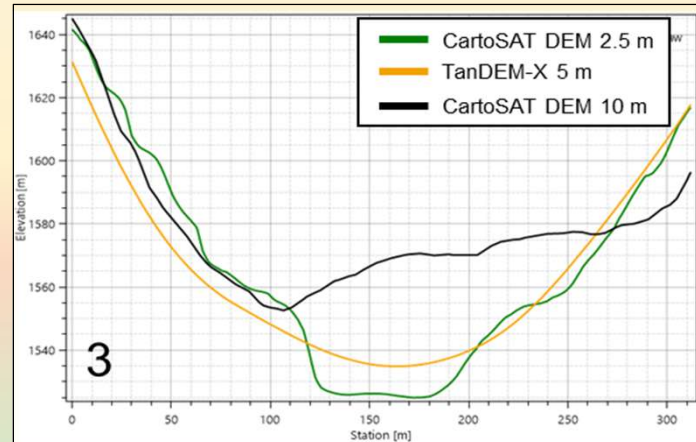
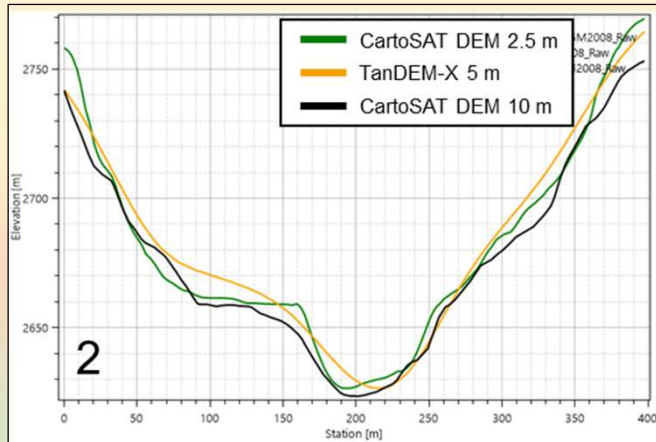
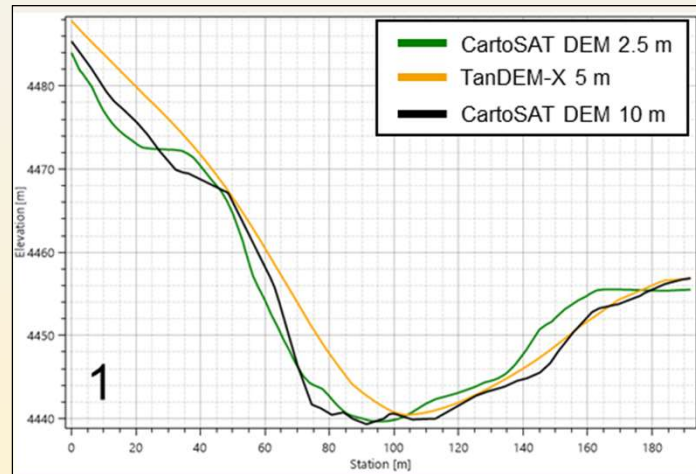
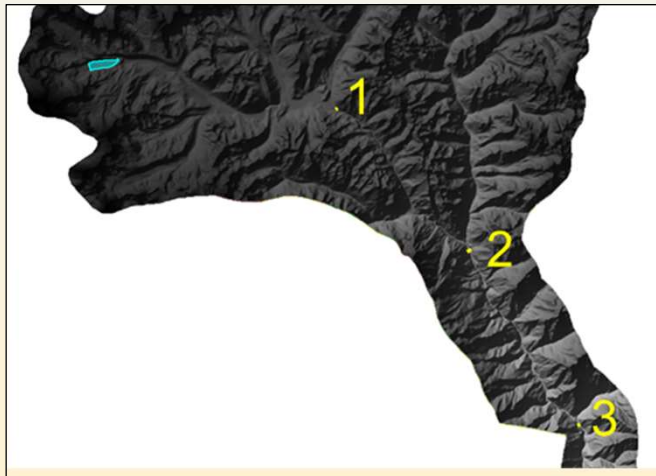
Comparison of the DEMs for the South Lhonak Study Area

□ Longitudinal Profile Comparison



Comparison of the DEMs for the South Lhonak Study Area

□ Cross-Section plots at downstream locations

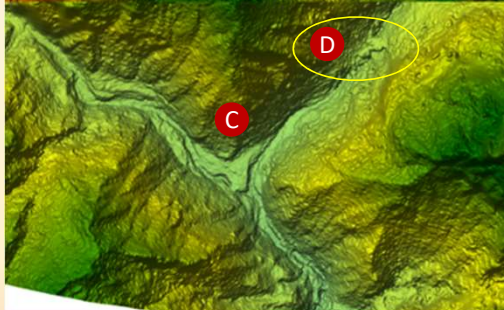
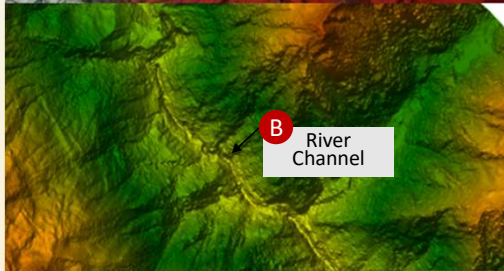
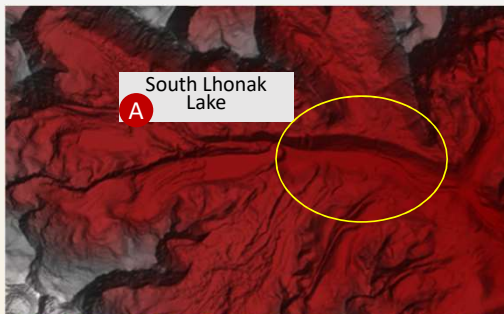


Observations:

1. CartoSAT DEM 2.5m and TanDEM-X 5m cross section profile is similar and comparable
2. CartoSAT DEM 10m is showing incorrect elevation profile at different cross-sections

Artefacts

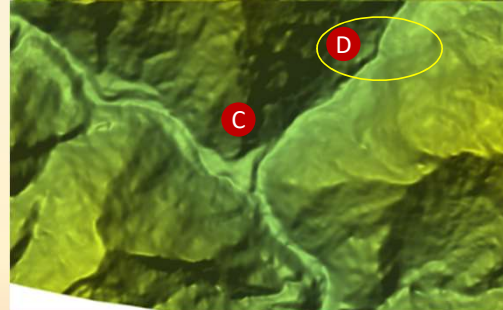
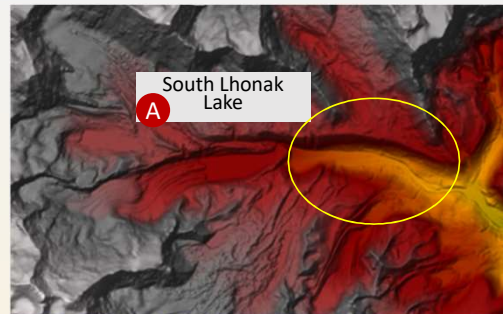
CartoDEM 2.5 m



Observations:

- A. Well-defined, detailed moraine and channel geometry
- B. Detailed River Channel
- C. Higher level of detail in DEM is seen
- D. Break in stream continuity

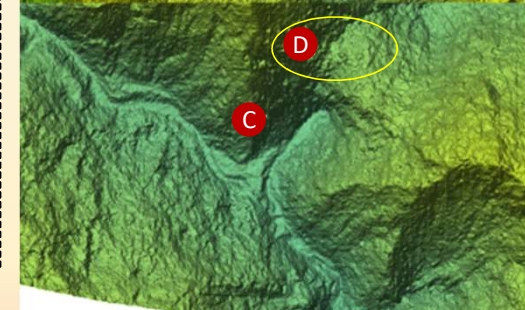
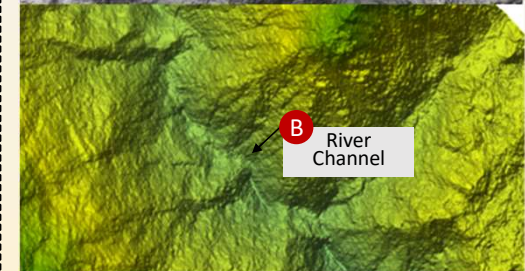
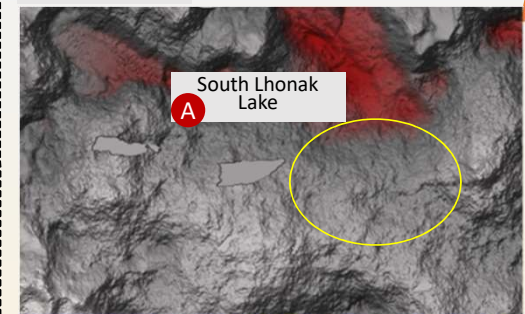
TanDEM-X 5 m



Observations:

- A. Well-defined moraine and channel geometry
- B. Smoothed River Channel
- C. Smoothed detail in DEM is seen
- D. Continuous River stream

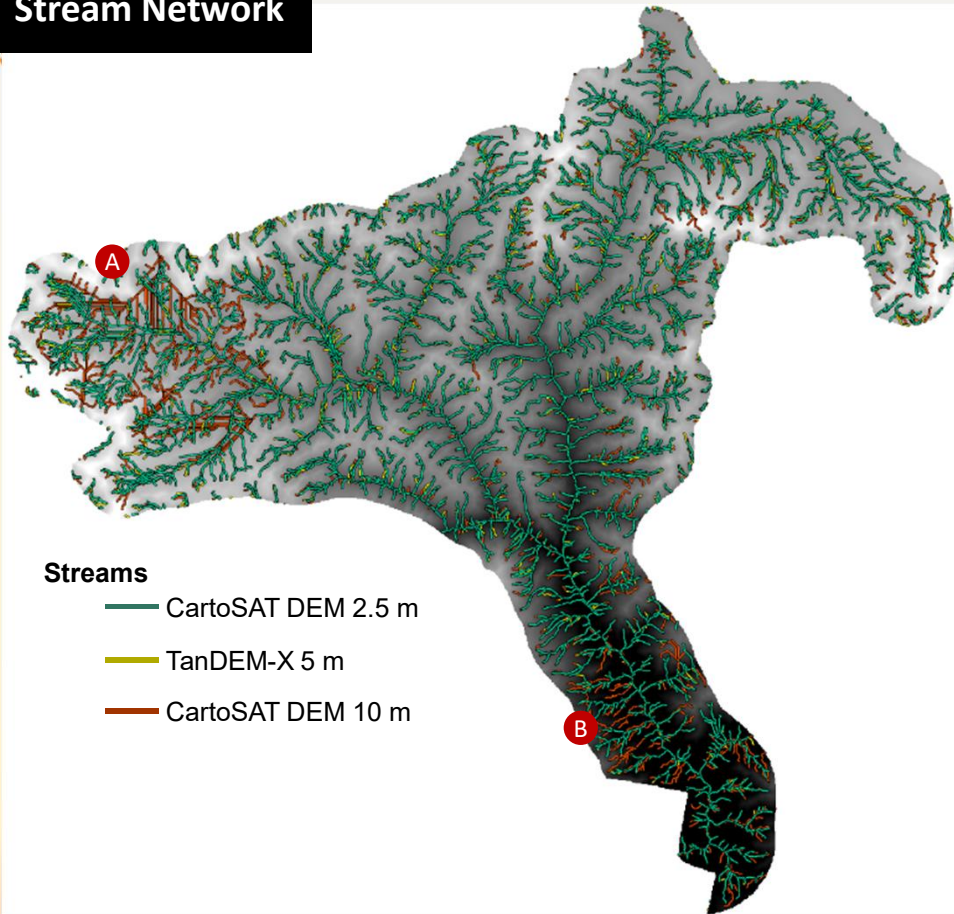
CartoDEM 10 m



Observations:

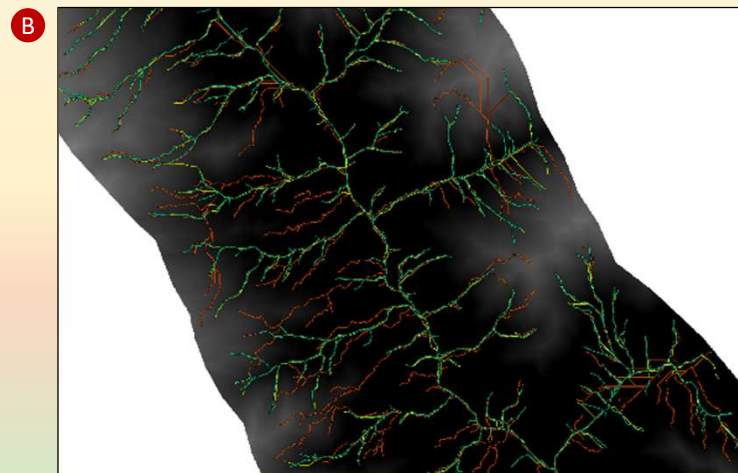
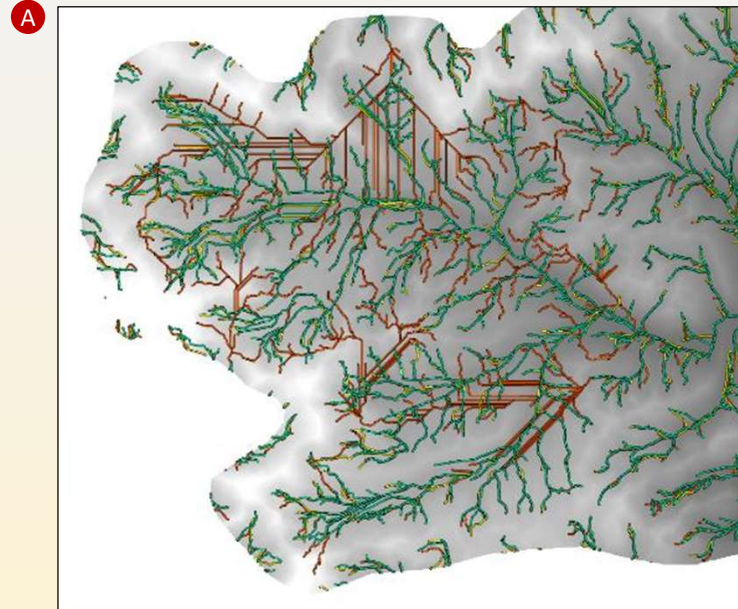
- A. Missing channel geometry
- B. Blocked River Channel
- C. Blocked River Channel
- D. Break in stream continuity

Stream Network

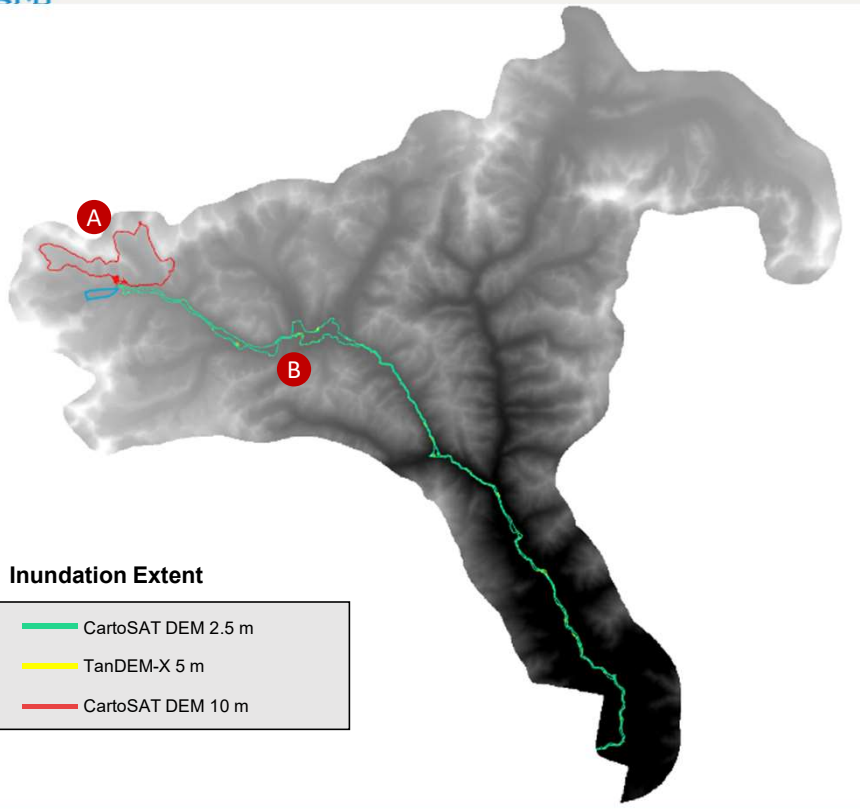


Observations:

1. CartoSAT DEM 2.5 m and TanDEM-X 5 m is giving similar stream network
2. CartoSAT DEM 10 m stream mismatch

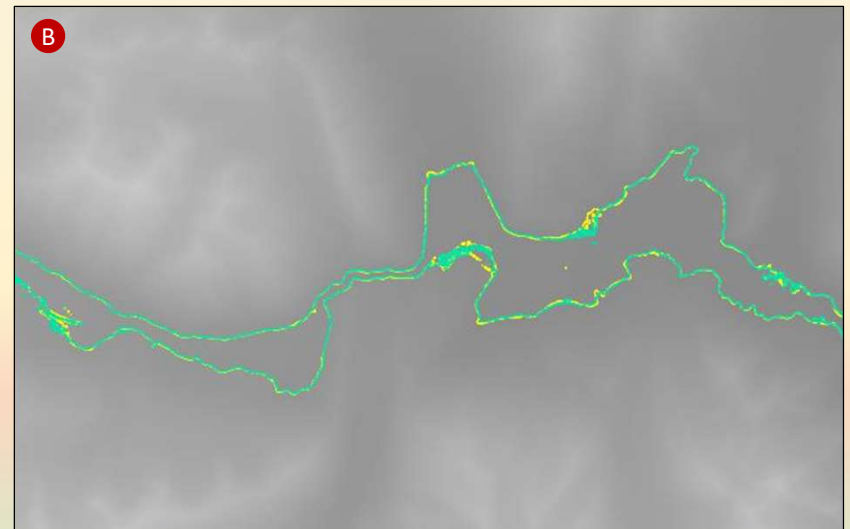
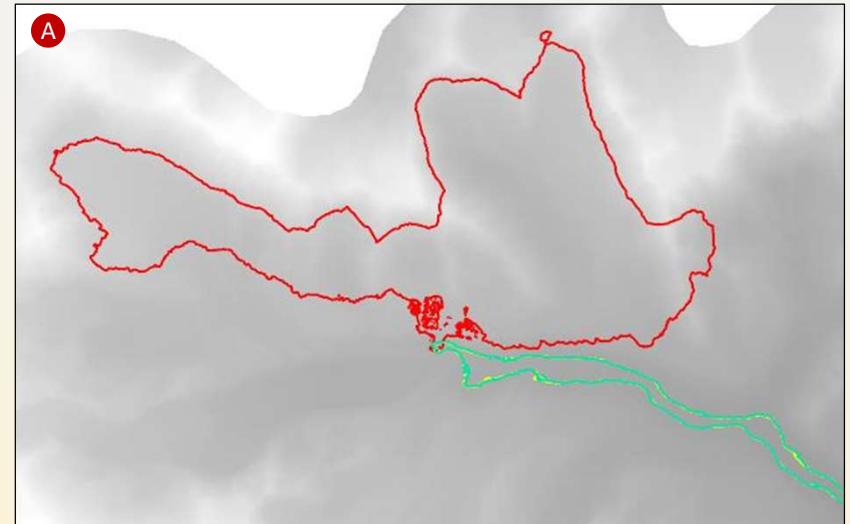


Inundation Extent



Observations:

- A. Flood inundation mismatch for simulation made using CartoSAT 10 m DEM



nrsc

Perspective View





nrsc

Perspective View



Fly over Tehri Dam & Surroundings

nrsc



Thank you

