

IGARRS 2011, Vancouver, Canada

Session: TH2.T05.3 ASTER (Thursday, July 28, 10:20 - 12:00)

Characteristics of ASTER GDEM Version 2

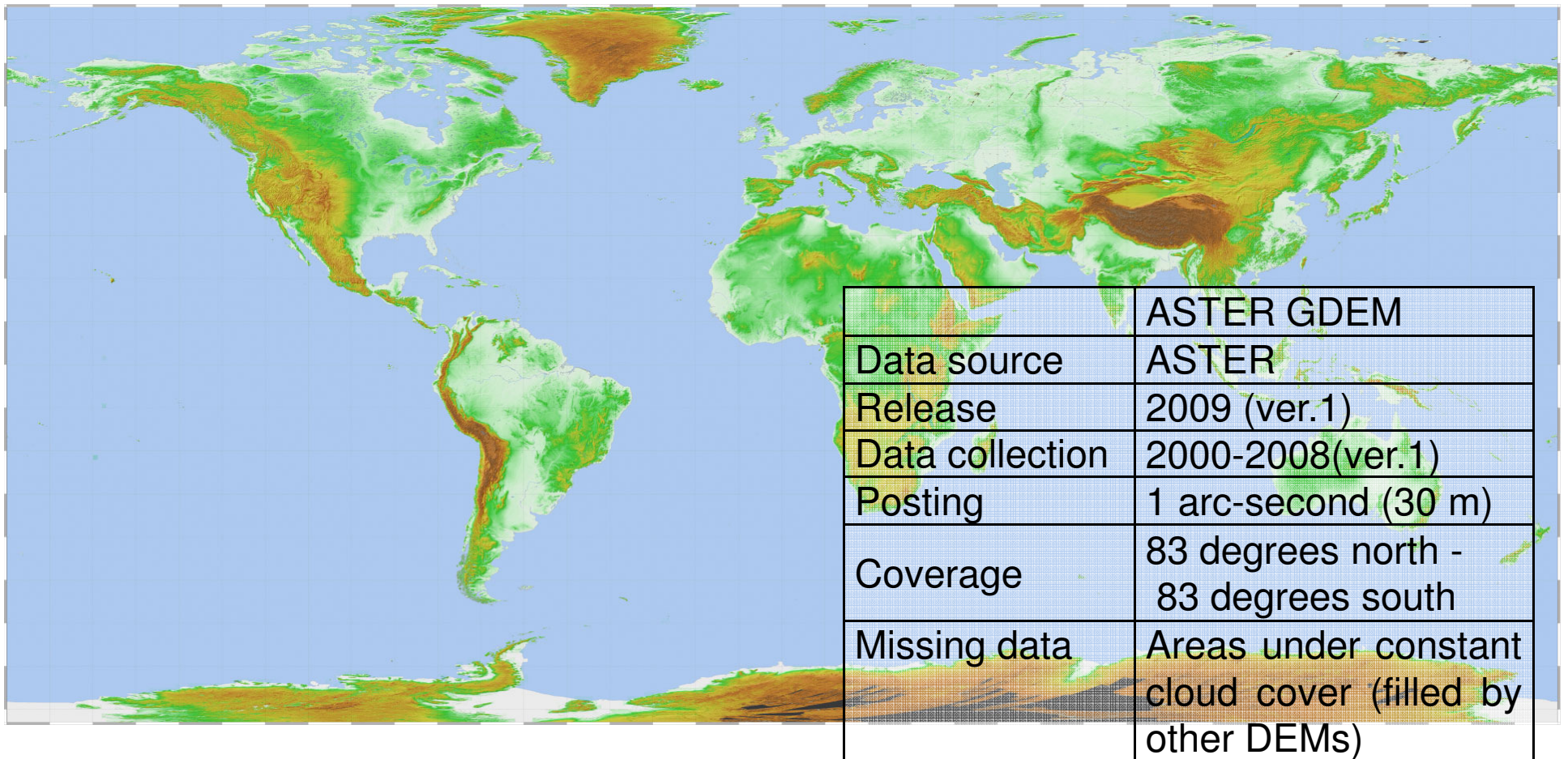
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1 Earth Remote Sensing Data Analysis Center (ERSDAC),
2 Mitsubishi Material Techno Corp., 3 University of Tokyo



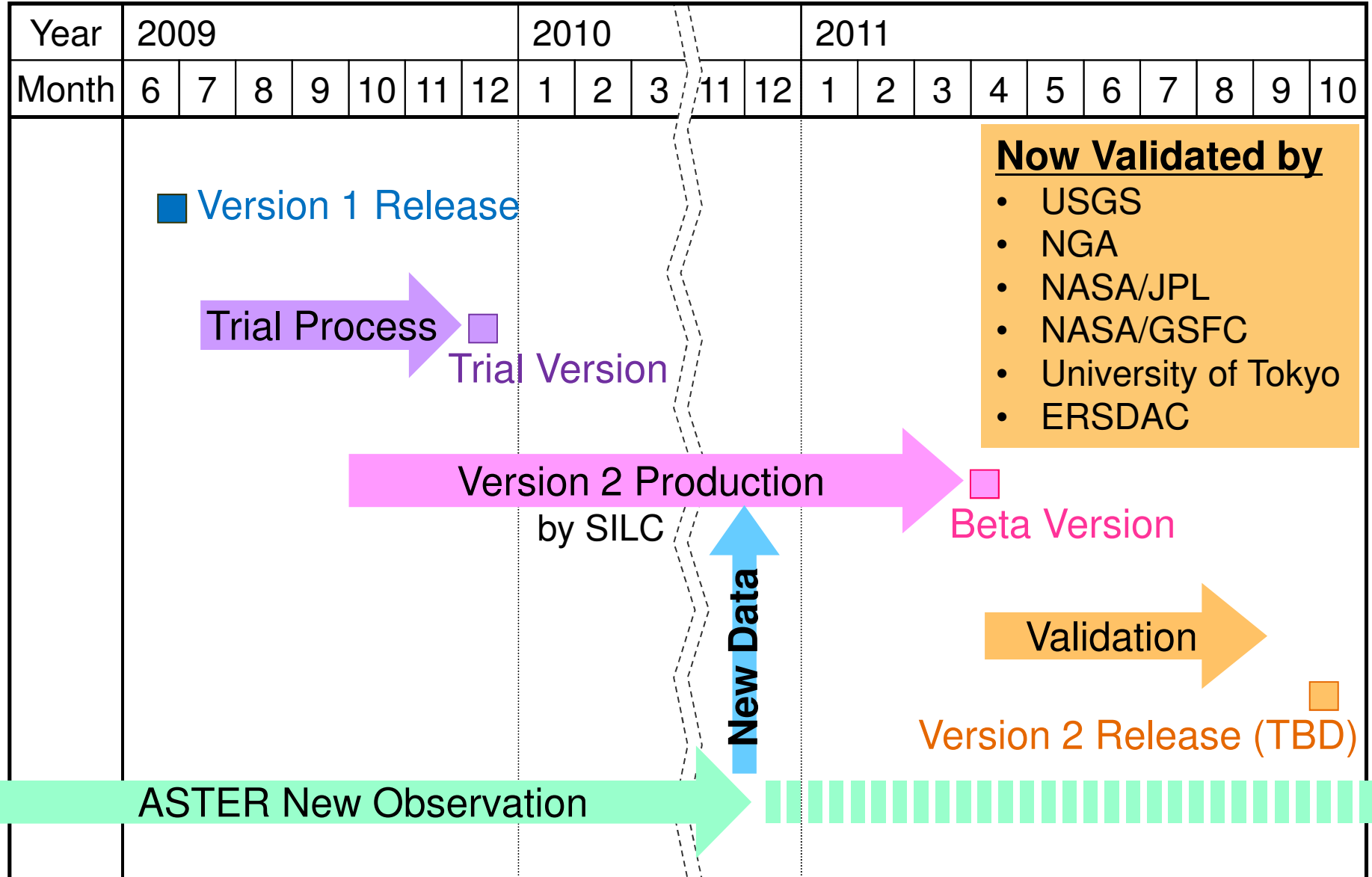
ASTER GDEM Project

**METI/Japan and NASA/USA in conjunction
with ERSDAC and LPDAAC**





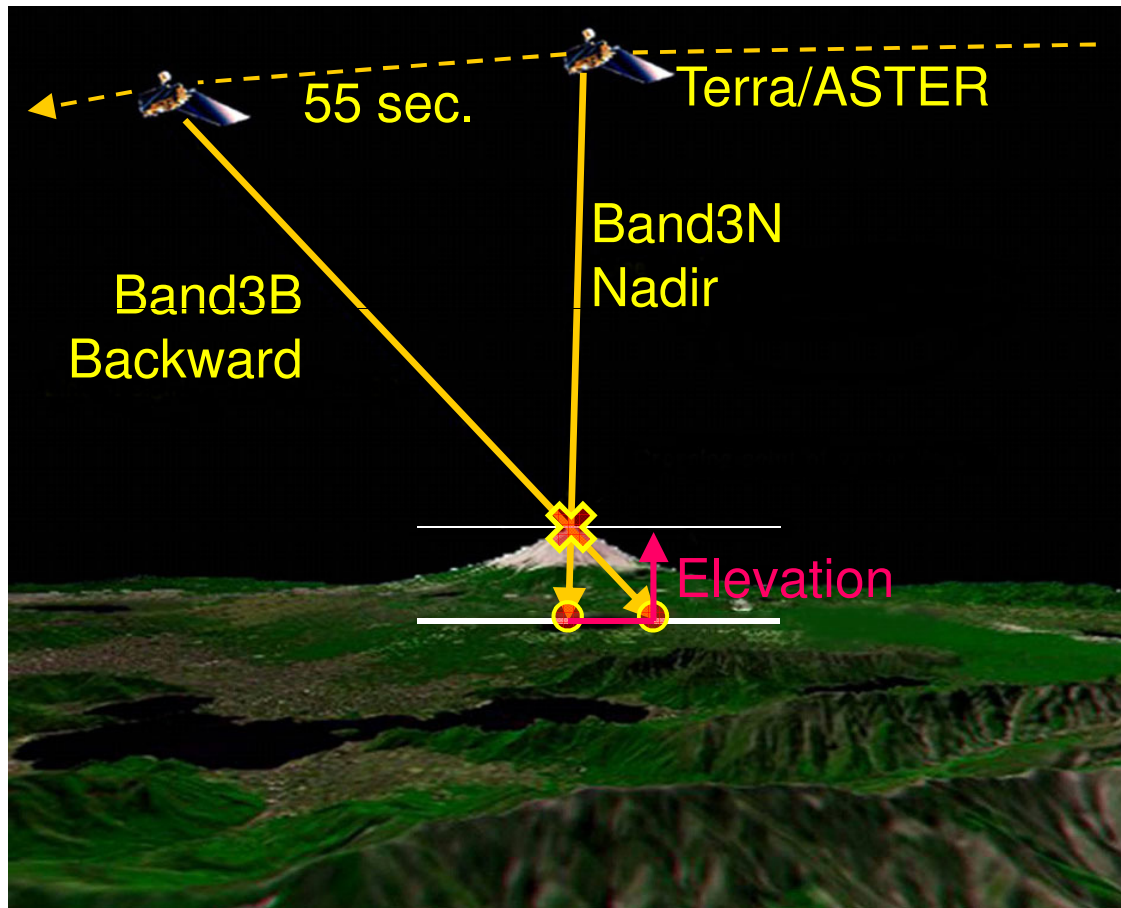
Status of GDEM Version 2





ASTER Stereo Observation

ASTER nadir- and backward-looking telescopes (Band3, NIR band) allow acquisition of stereo image pairs



Automated processing

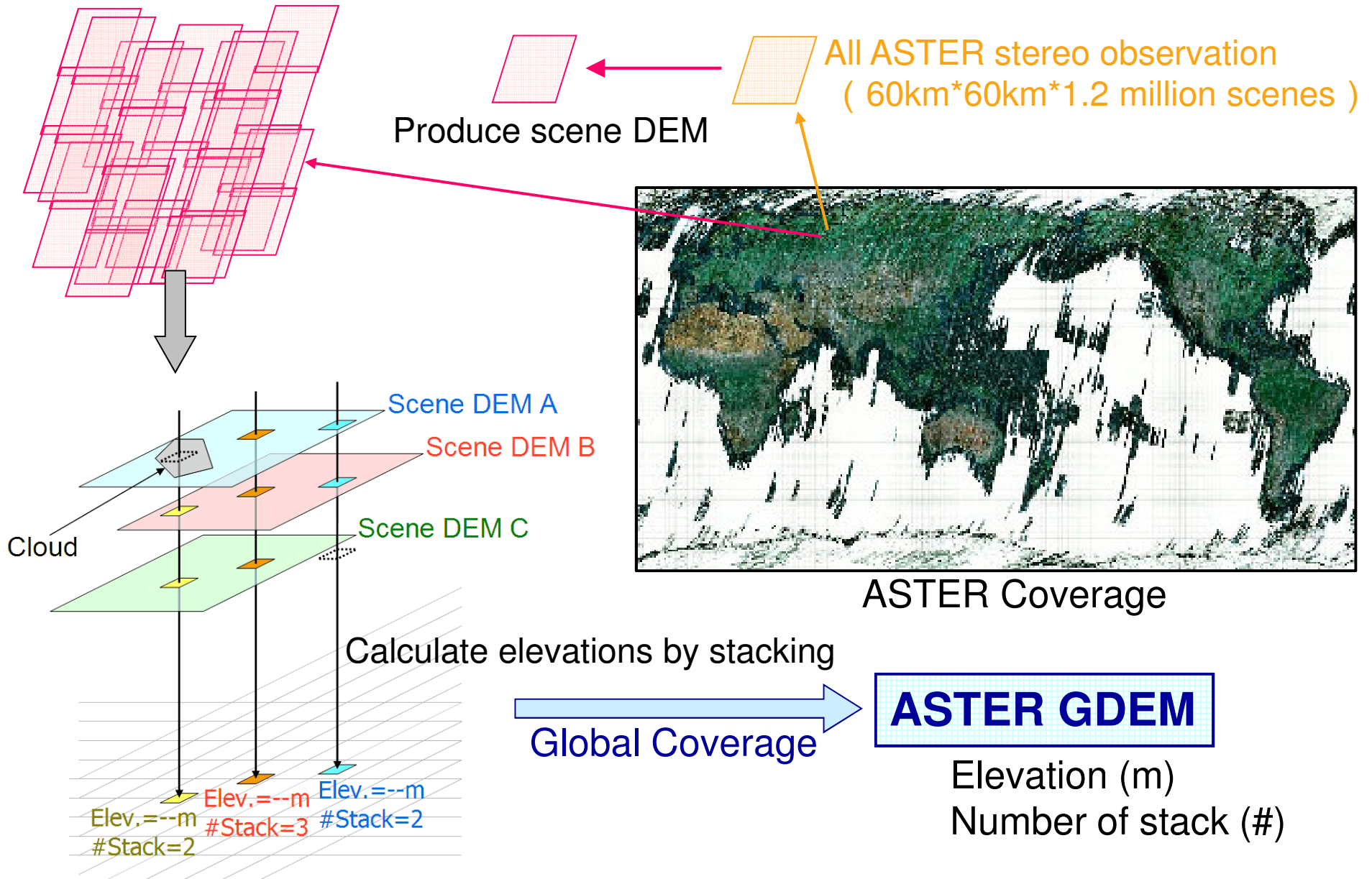
Image correlation
matching between
Band 3N and Band 3B

Determination of
geolocation at the
corresponding point for
Band 3N and Band 3B

Calculation of elevation



ASTER GDEM Production





Updates in GDEM Version2

■ New algorithm

□ Finer horizontal resolution

The elevation is calculated by image matching of ASTER stereo pair. The kernel size for image correlation matching is changed to 5 by 5 pixel from 9 by 9 pixel.

□ Offset adjustment

Every calculated scene DEM has elevation offset of -5m. This offset (-5m) is adjusted.

□ Water body detection

GDEM version 1 could detect lakes larger than about 12km². This improves to 1km² in version 2.

■ New observed data

GDEM version 2 incorporates new ASTER data observed after September 2008. The voids and artifacts caused by lack of ASTER data will be improved.

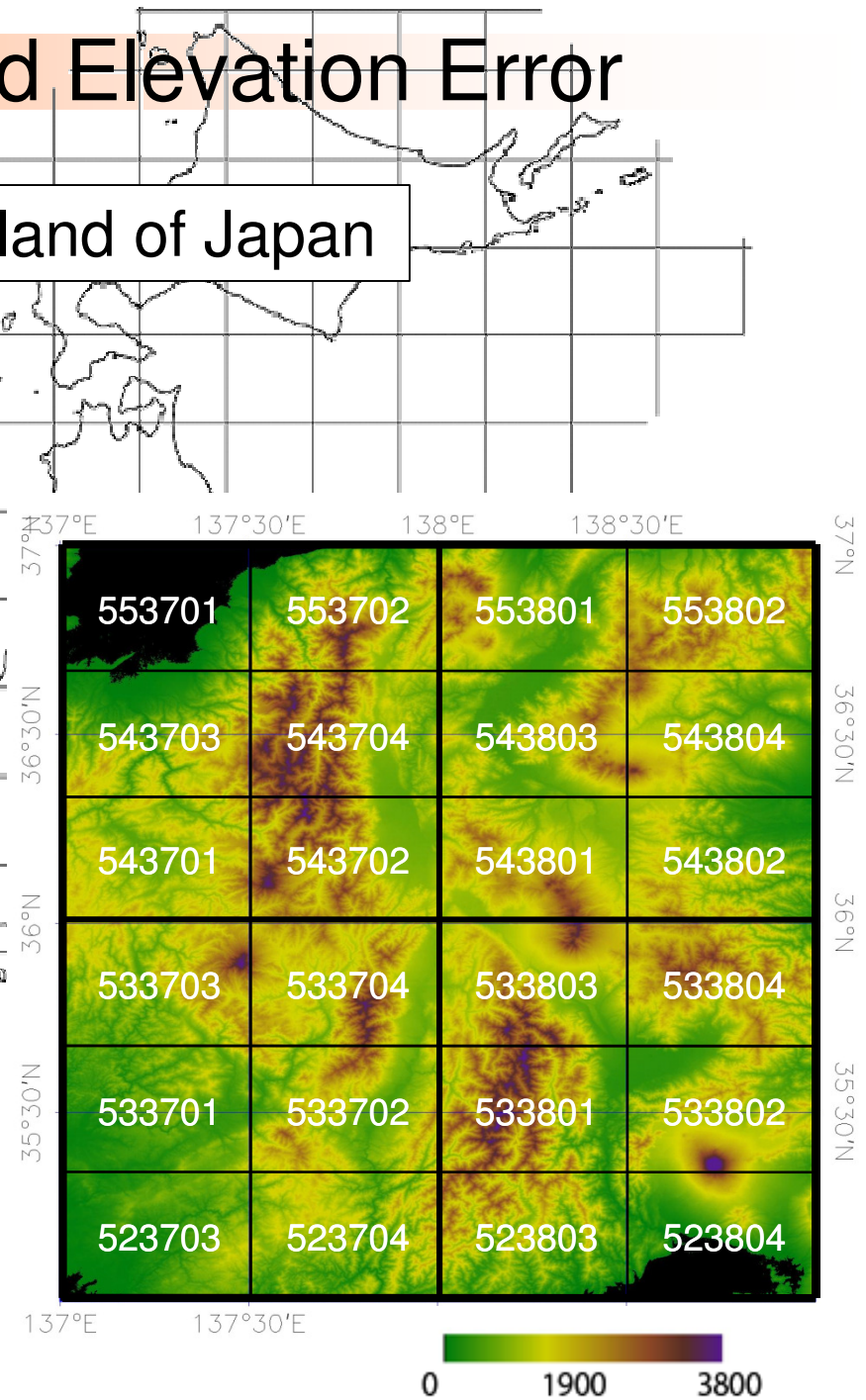
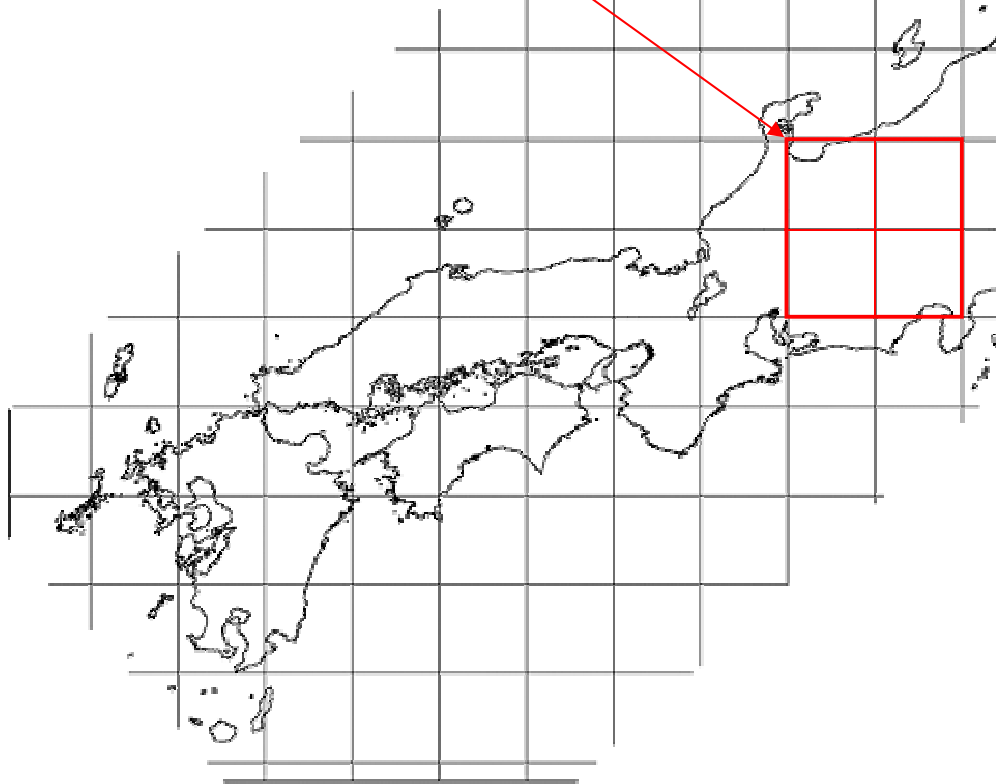


Estimate Horizontal and Elevation Error

GSI 10m-grid DEM covers all the land of Japan

GSI (The Geospatial Information Authority of Japan)

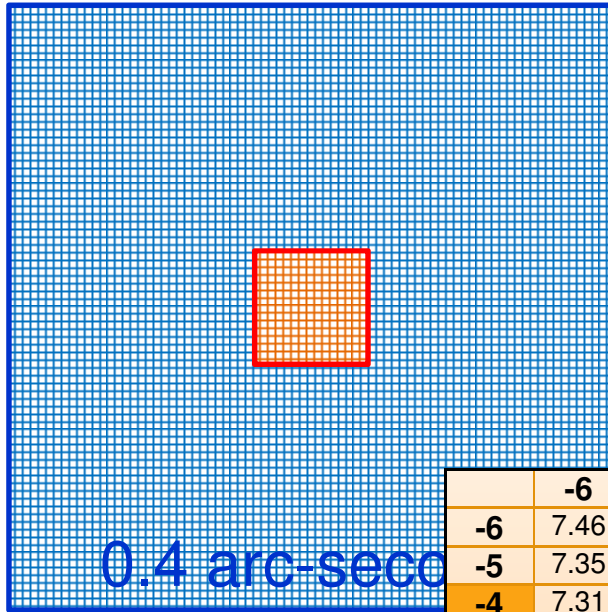
N36E137	N36E138
N35E137	N35E138





Method to Estimate Horizontal Error

ASTER GDEM

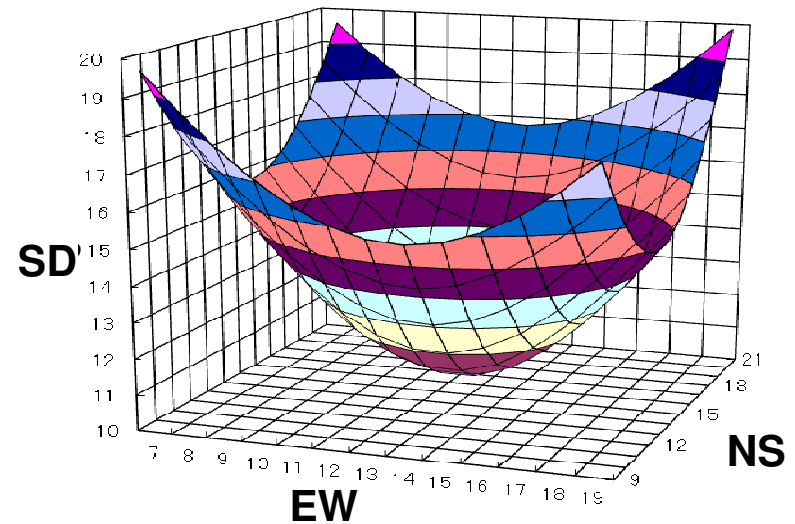


0.4 arc-second

GSI 10m-grid
DEM

- 13 grid square = 169 grids
- 169 grids of elevation error (m)
- SD of elevation errors (m)
- Move 13 grid square and repeat
- 2 dimensional mapping
- Calculate the lowest location

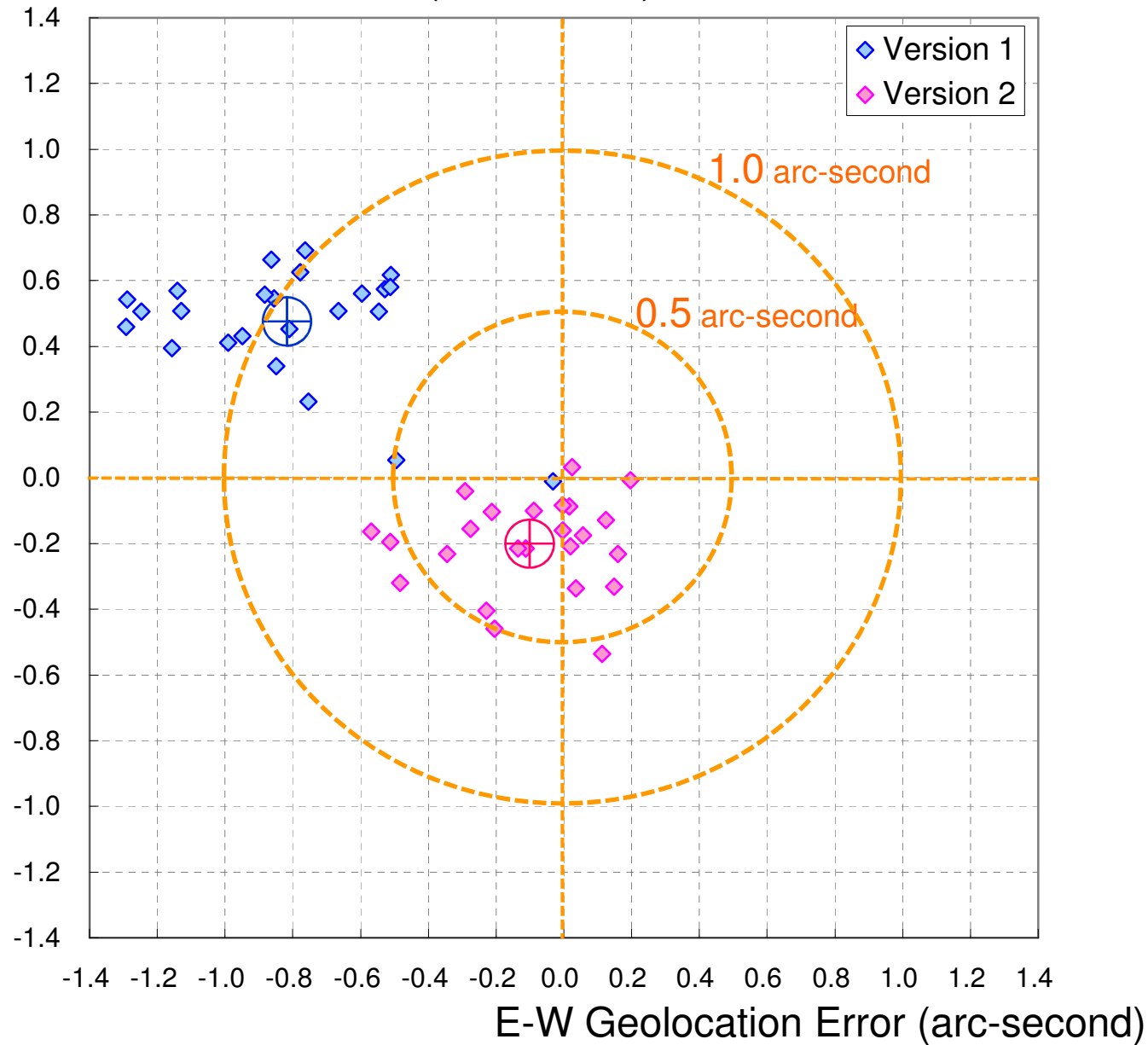
	-6	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6
-6	7.46	7.36	7.31	7.29	7.31	7.37	7.46	7.60	7.76	7.95	8.17	8.42	8.69
-5	7.35	7.26	7.21	7.20	7.23								
-4	7.31	7.23	7.19	7.18	7.21								
-3	7.34	7.26	7.22	7.22	7.26								
-2	7.43	7.36	7.32	7.33	7.37								
-1	7.58	7.52	7.49	7.50	7.55								
0	7.79	7.74	7.72	7.73	7.78								
+1	8.06	8.01	7.99	8.01	8.07								
+2	8.36	8.32	8.32	8.34	8.40								
+3	8.71	8.68	8.68	8.71	8.76								
+4	9.10	9.07	9.07	9.10	9.16								
+5	9.51	9.49	9.50	9.53	9.59								
+6	9.95	9.93	9.94	9.98	10.0								





Horizontal Error

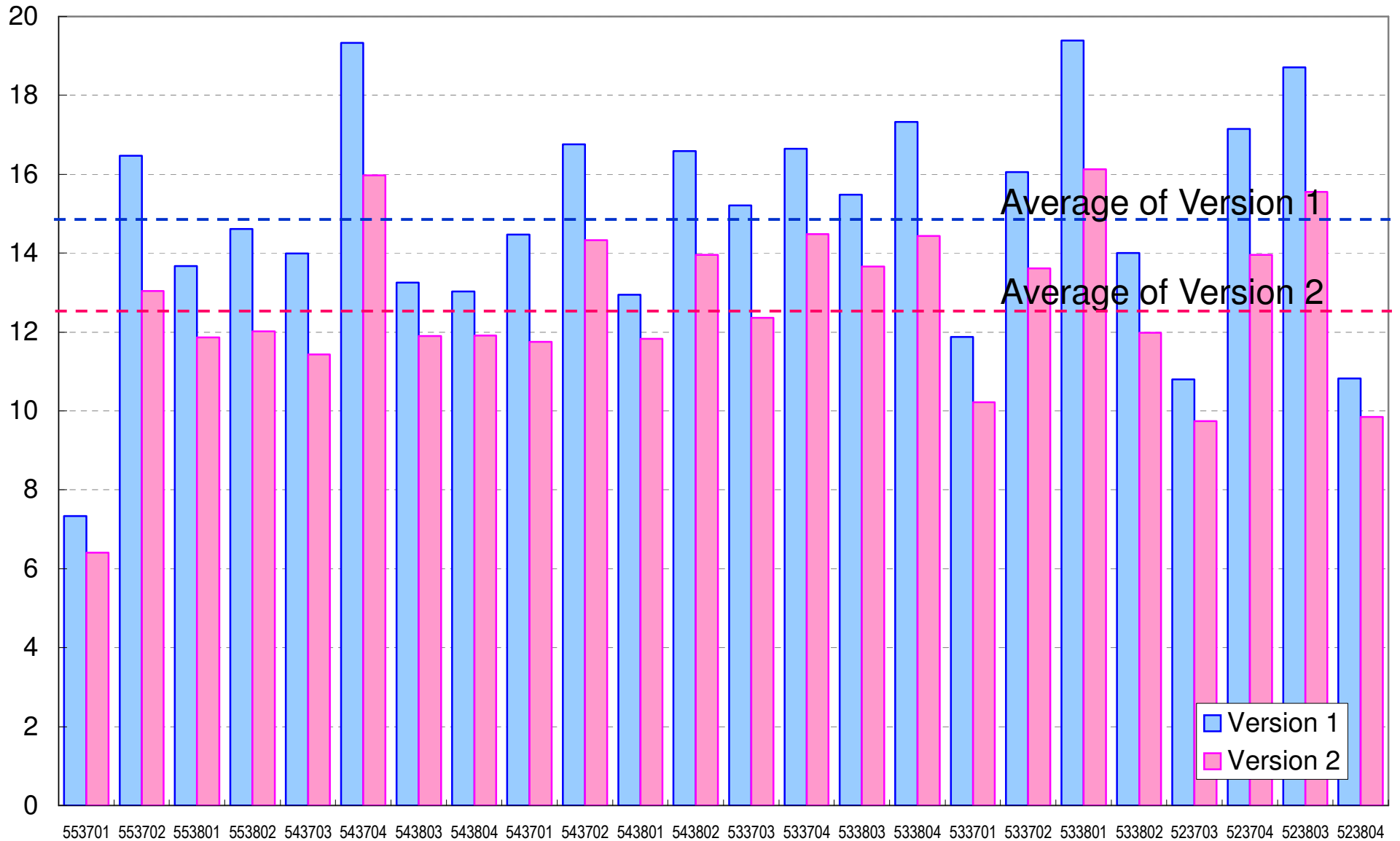
N-S Geolocation Error (arc-second)





Standard Deviation of Elevation Error

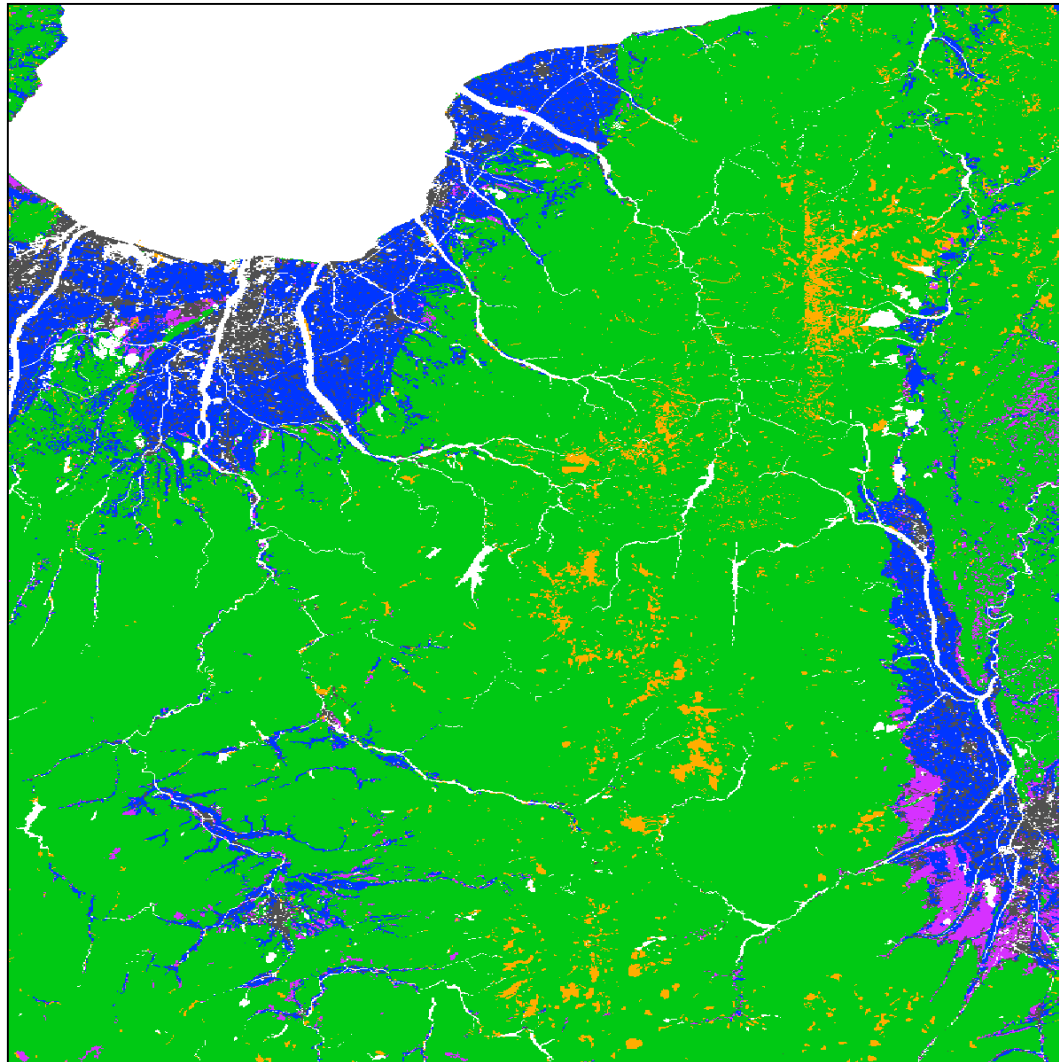
SD of Elevation Error (m)





Offset Estimation

Offset is estimated in 'Rice Farm' and 'Farm' as open area.



“Subdivision Land Use Data of Digital National Land Information”
produced by the GSI Japan.

Land Use
Rice Farm
Farm
Forest
Bare
Urban
Others



Offset Estimation

Offset is estimated as -0.7 m.

	Mean	Peak	SD	RMSE
Rice Farm	-1.32	-0.74	5.91	6.06
Farm	-1.09	-1.23	8.50	8.57
Forest	+8.68	+7.98	13.26	15.85

Frequency

10%

9%

8%

7%

6%

5%

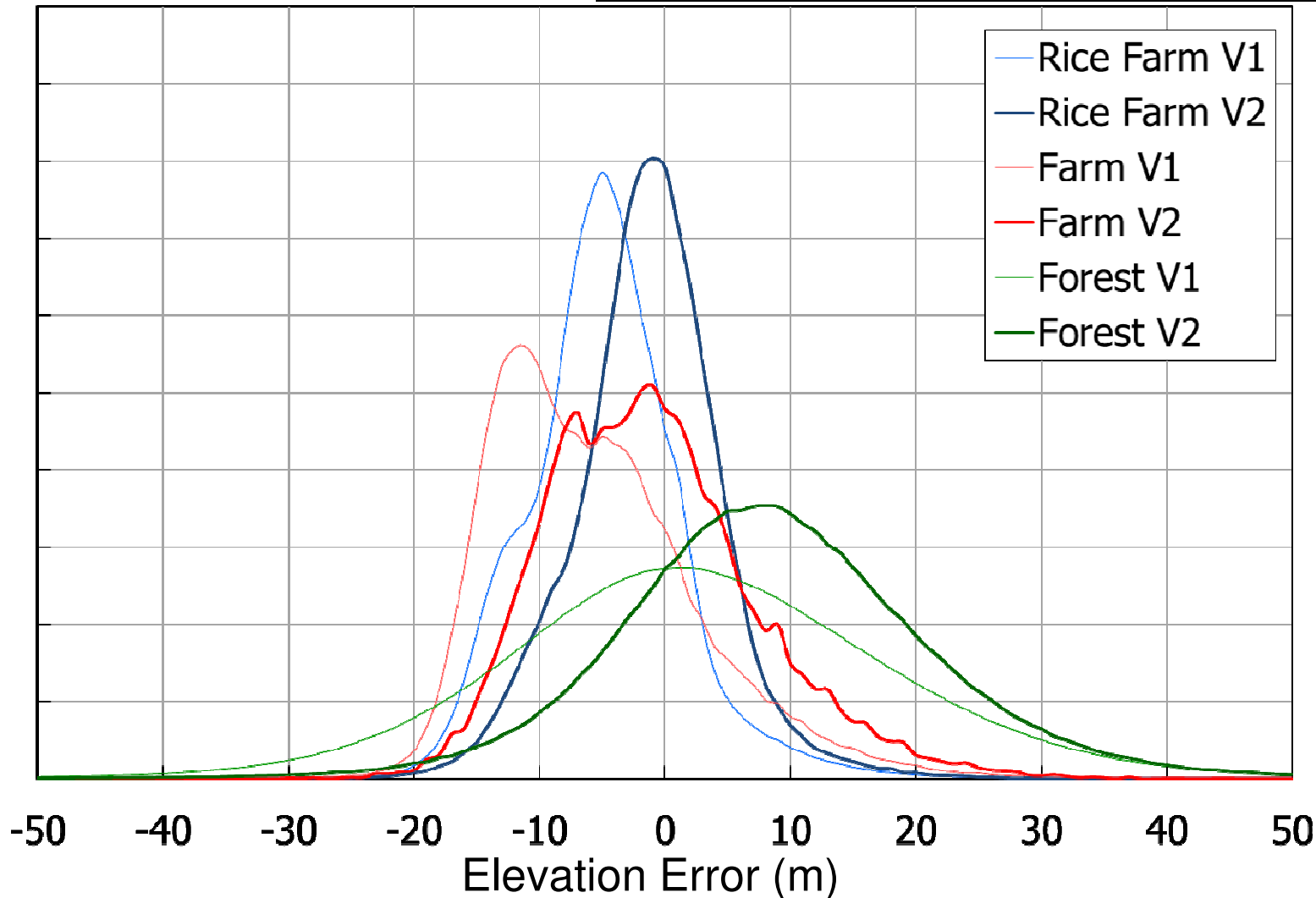
4%

3%

2%

1%

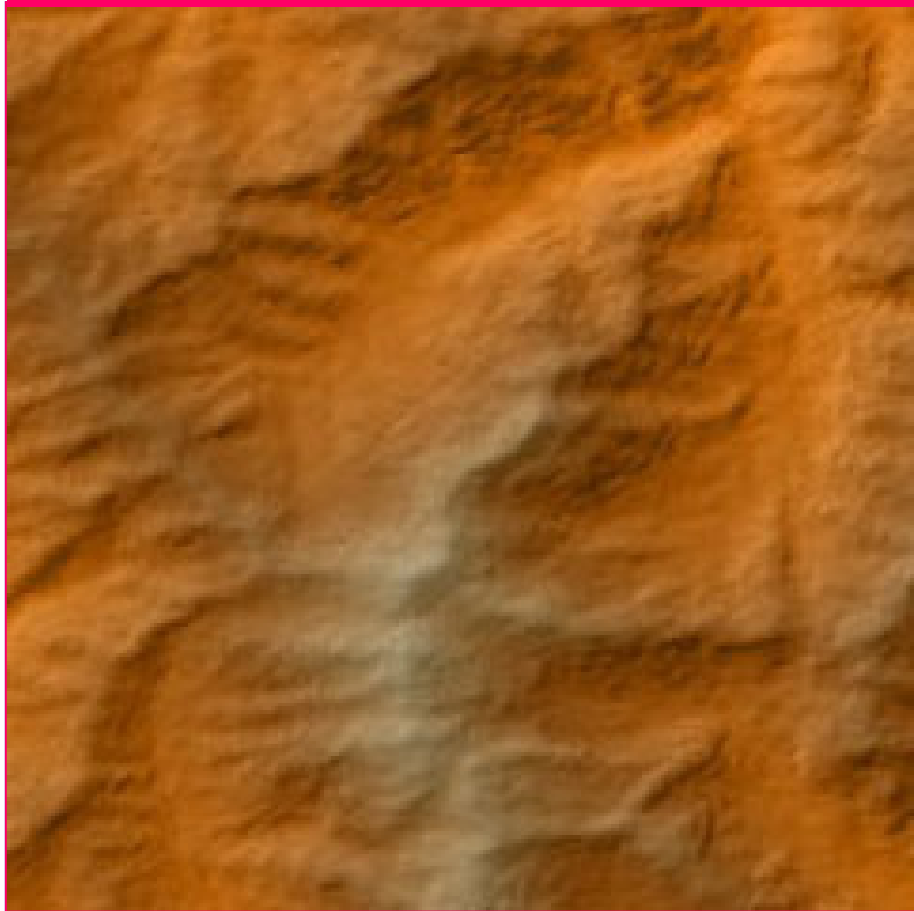
0%





Horizontal Resolution

Version 2



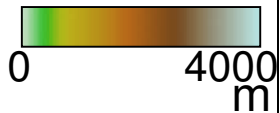
Version 1



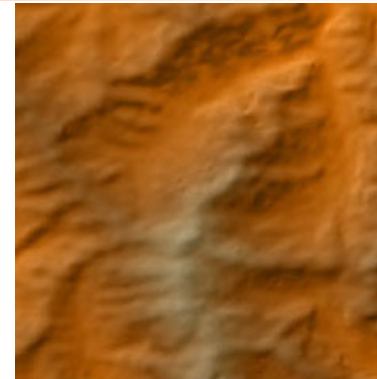
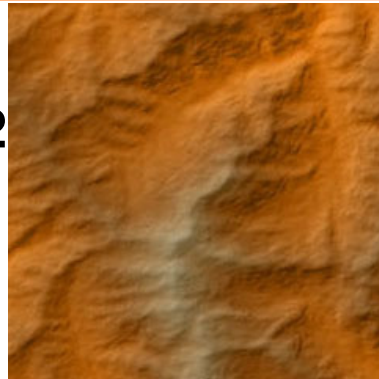


Method to Estimate Resolution

GDEM

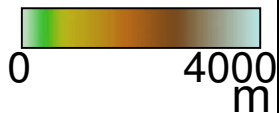


Version 2

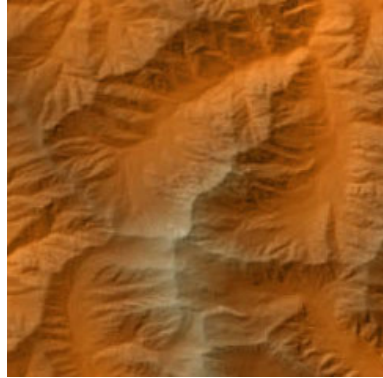


Version 1

**Reference
DEM
(Degraded
10m DEM)**



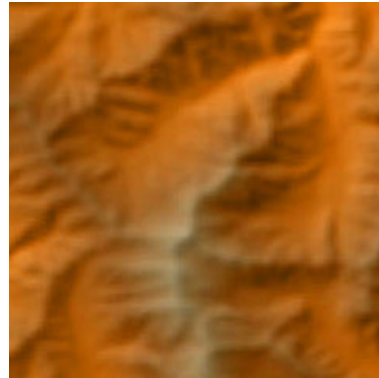
Resolution:1arc-sec



Resolution:2arc-sec



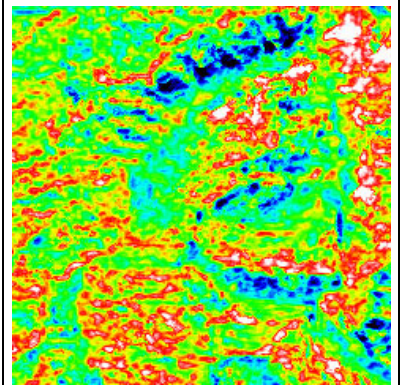
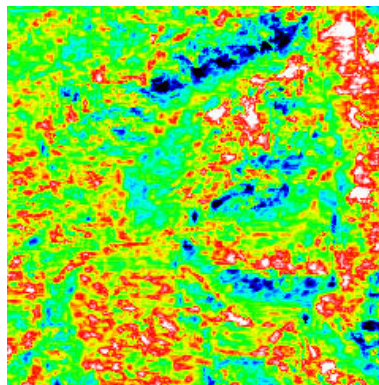
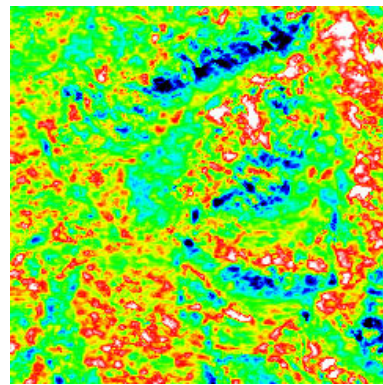
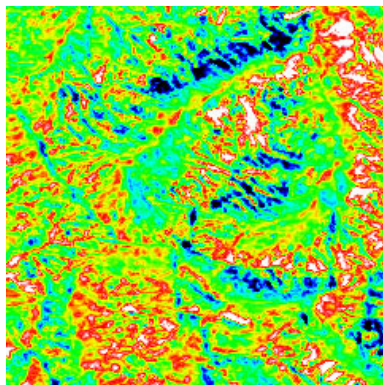
Resolution:3arc-sec



Resolution:4arc-sec



**Elevation
Error**



Standard Dev.

14.489

13.022

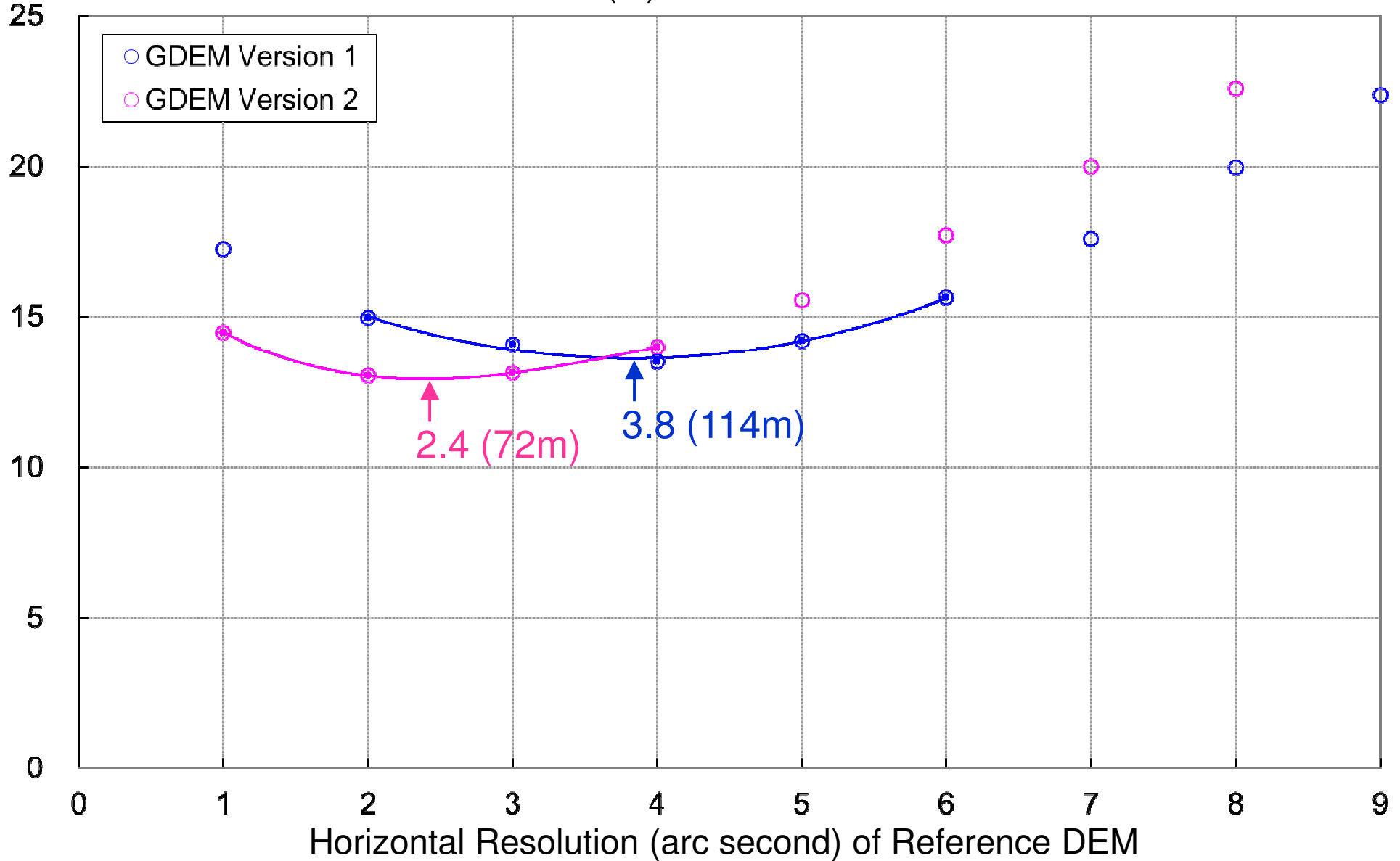
13.122

13.993



Estimated Resolution

Standard Deviation of Elevation Error (m)





Error Estimation of Version 2

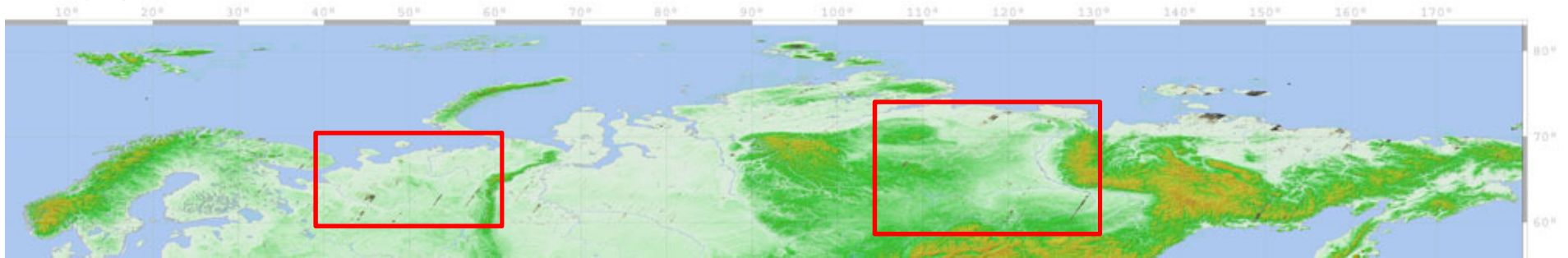
		<u>Version 1</u>	<u>Version 2</u>
Horizontal Error		0.82 arc-sec. to west 0.47 arc-sec. to south	0.11 arc-sec. to west 0.20 arc-sec. to north
Elevation Error	offset	-6m	-0.7m
	SD	14.8m	12.6m
Horizontal Resolution		3.8 arc-sec. (114m*)	2.4 arc-sec. (72m*)

*1 arc-second corresponds to 30m

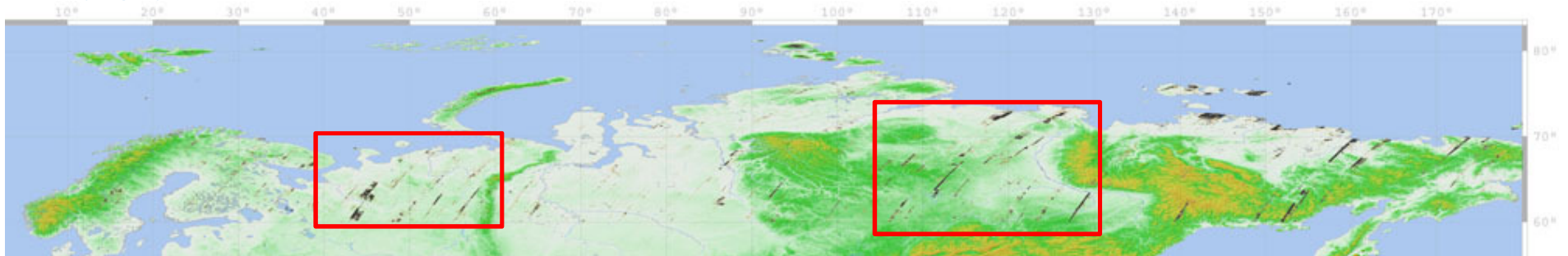


Improvement of Voids in Northern Area

Version 2



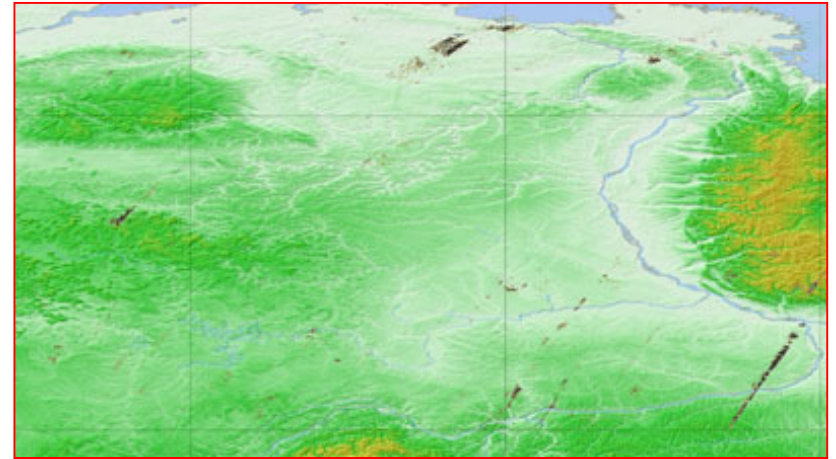
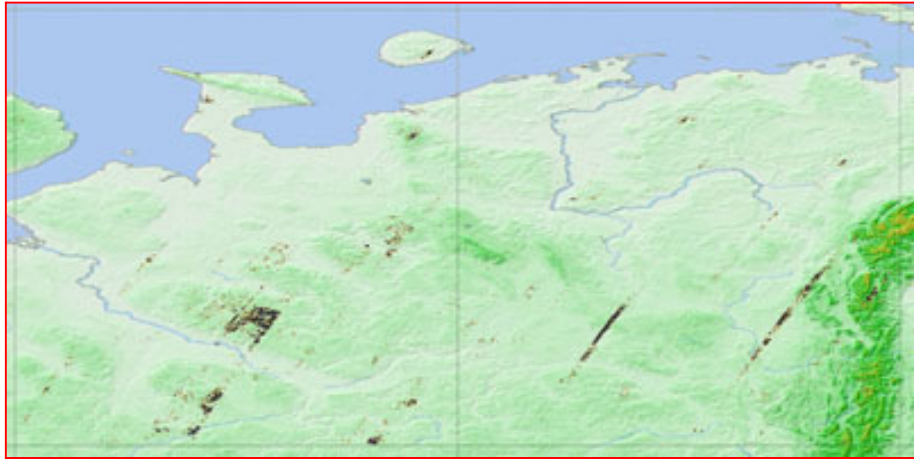
Version 1



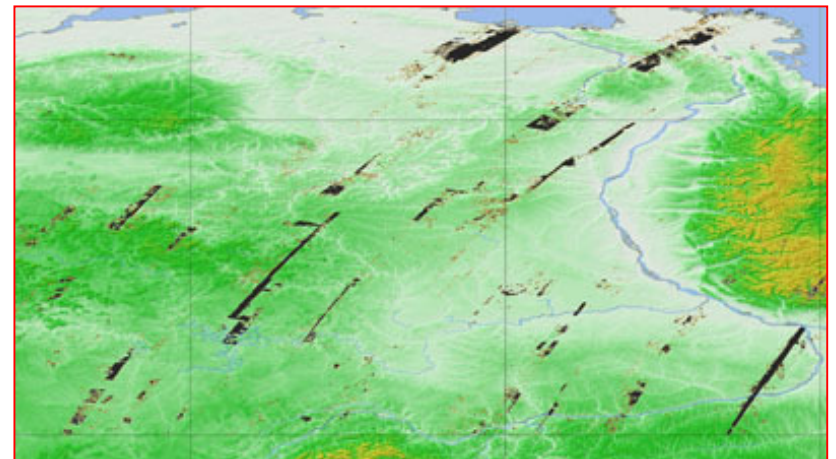
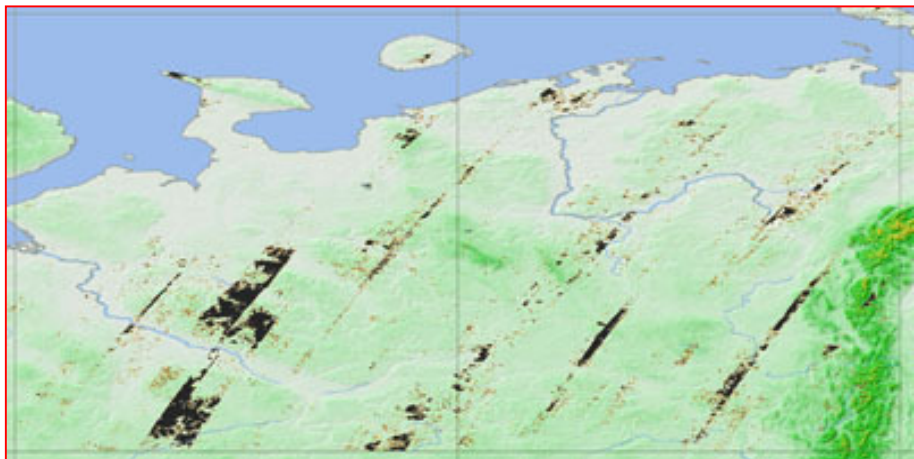


Improvement of Voids in Northern Area

Version 2



Version 1

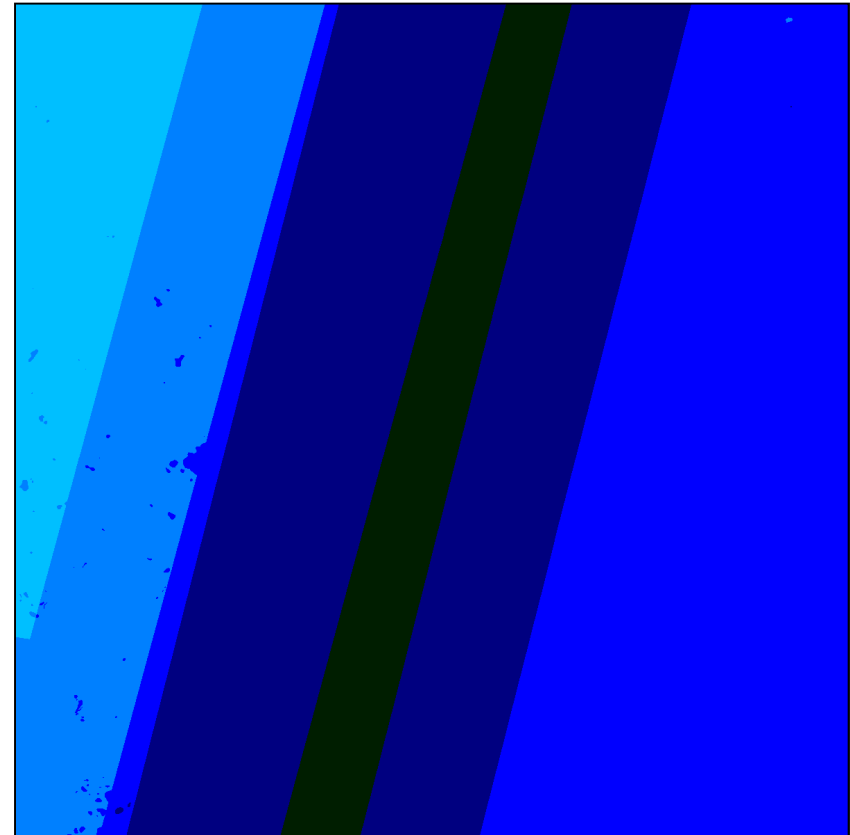
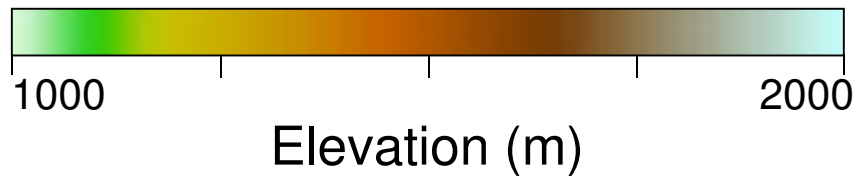
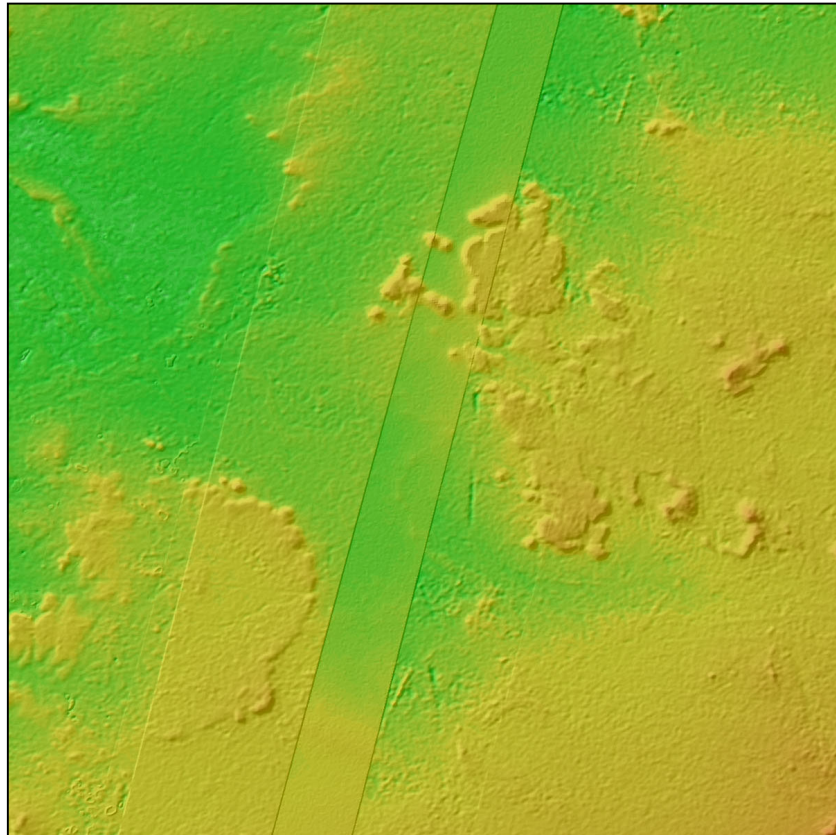




Improvement of Artifacts

Version 1

S31E023 1200x1200 arc-second

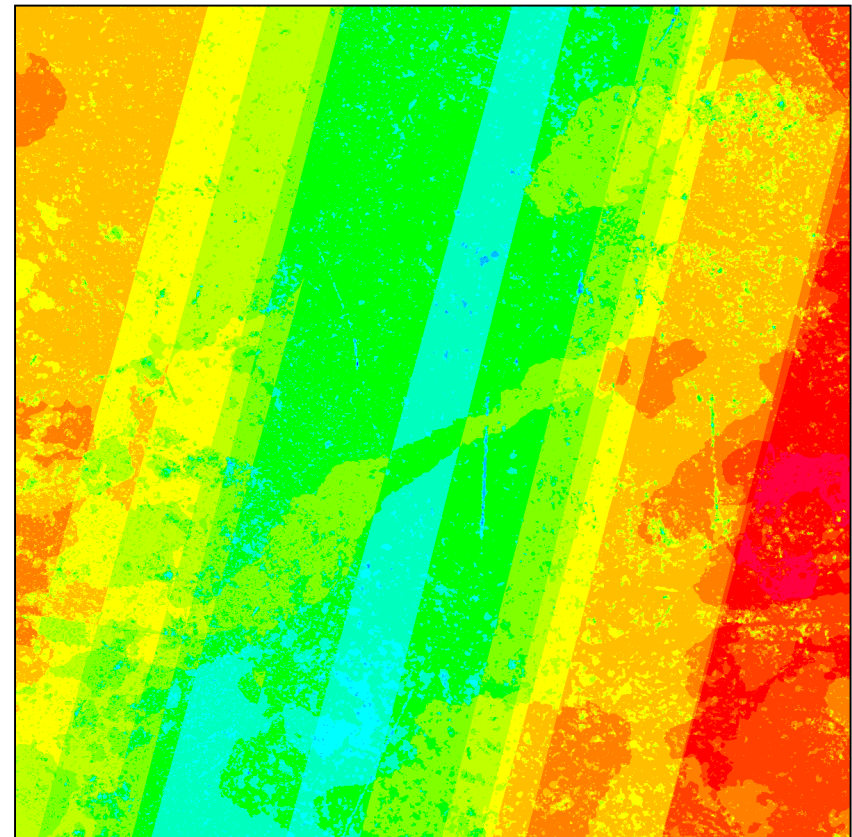
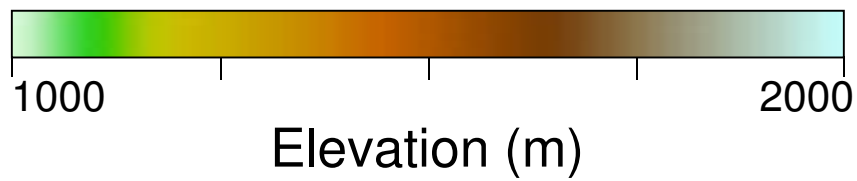
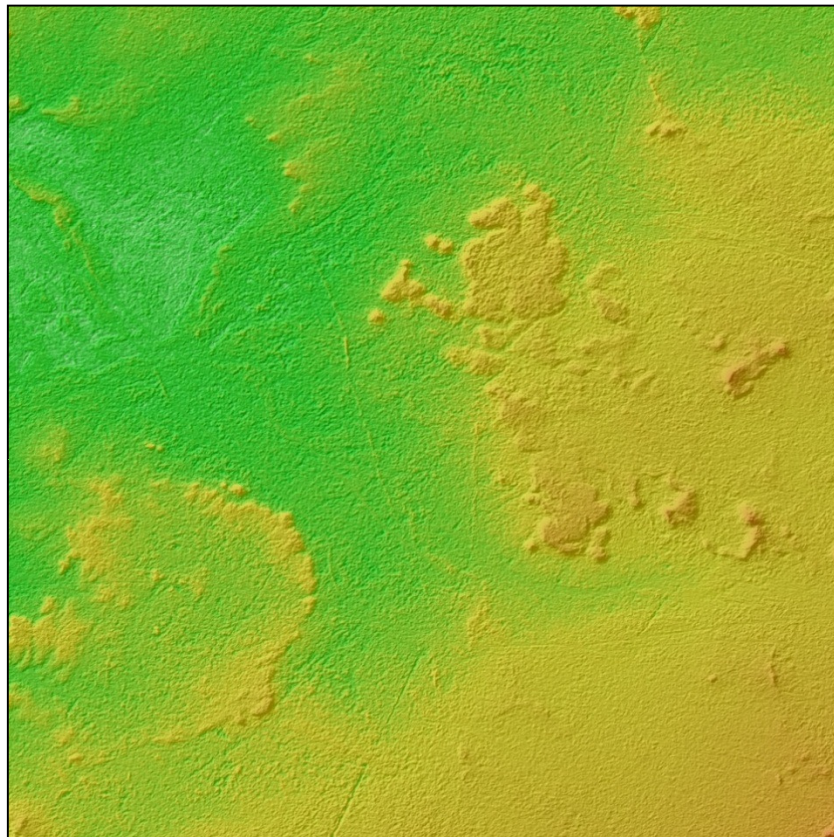




Improvement of Artifacts

Version 2

S31E023 1200x1200 arc-second



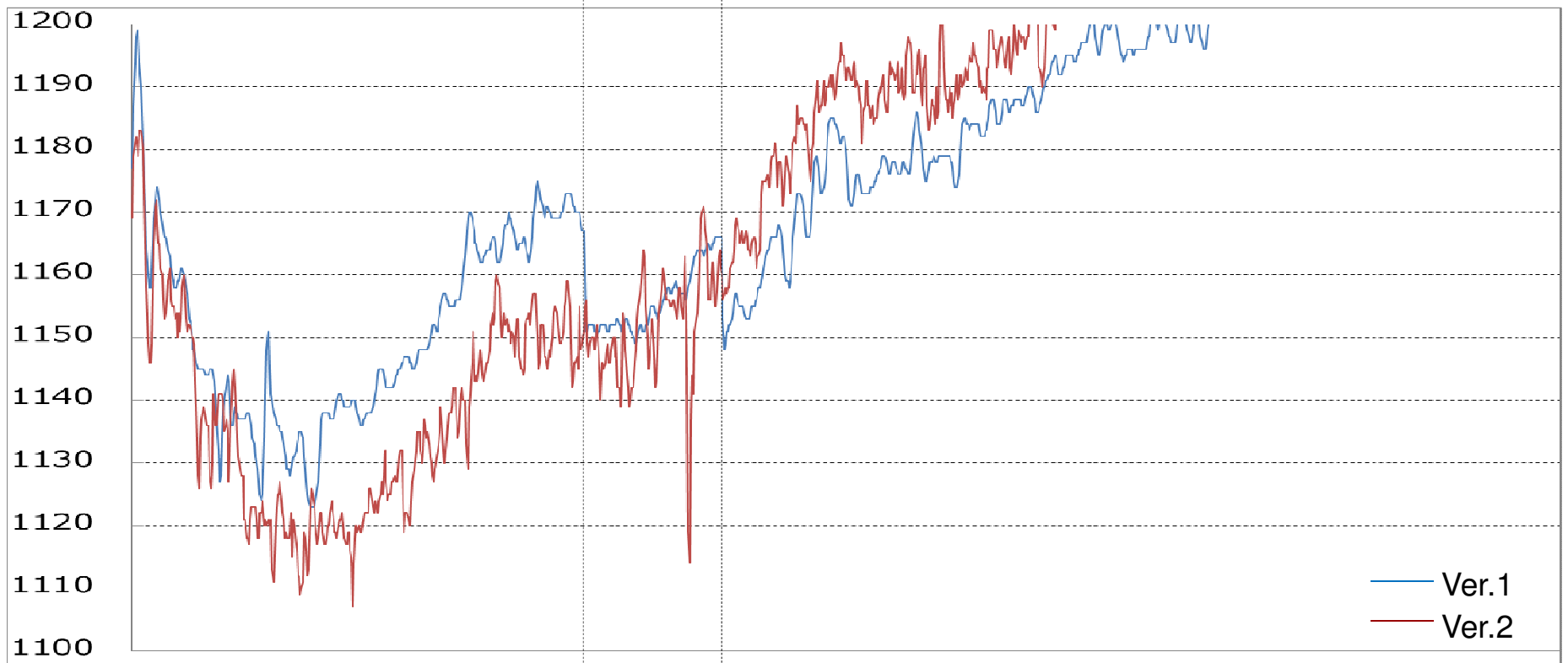


Improvement of Artifacts

Ver.2



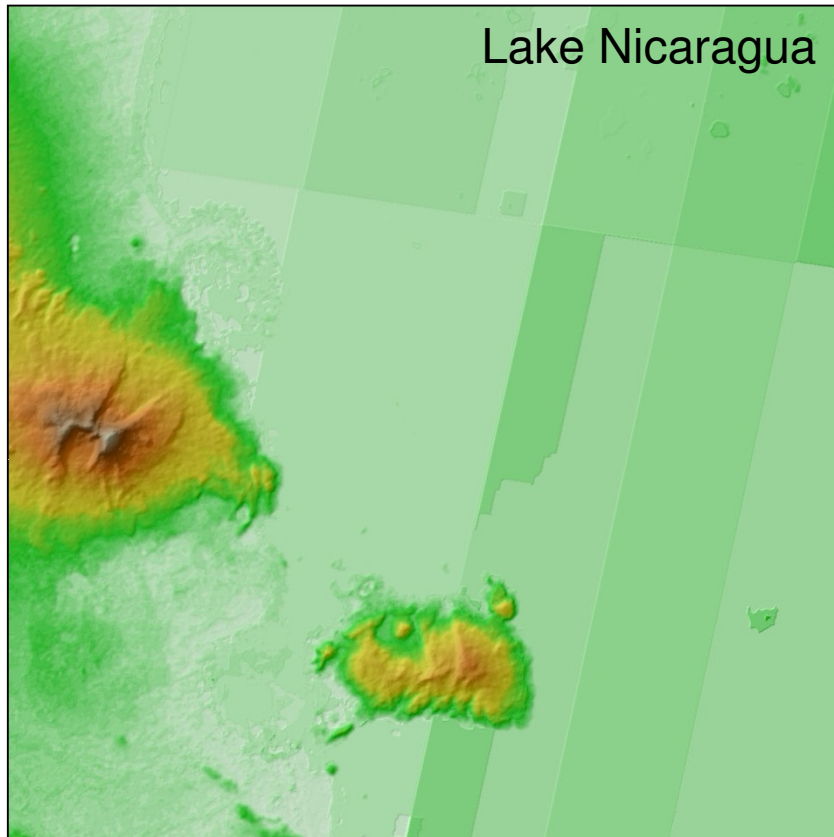
Ver.1



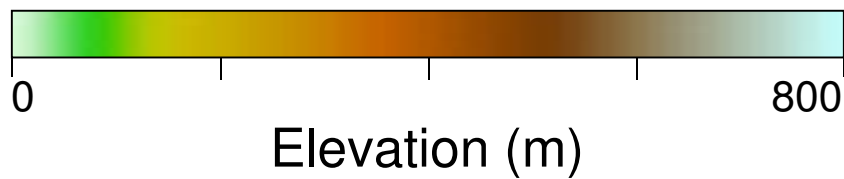
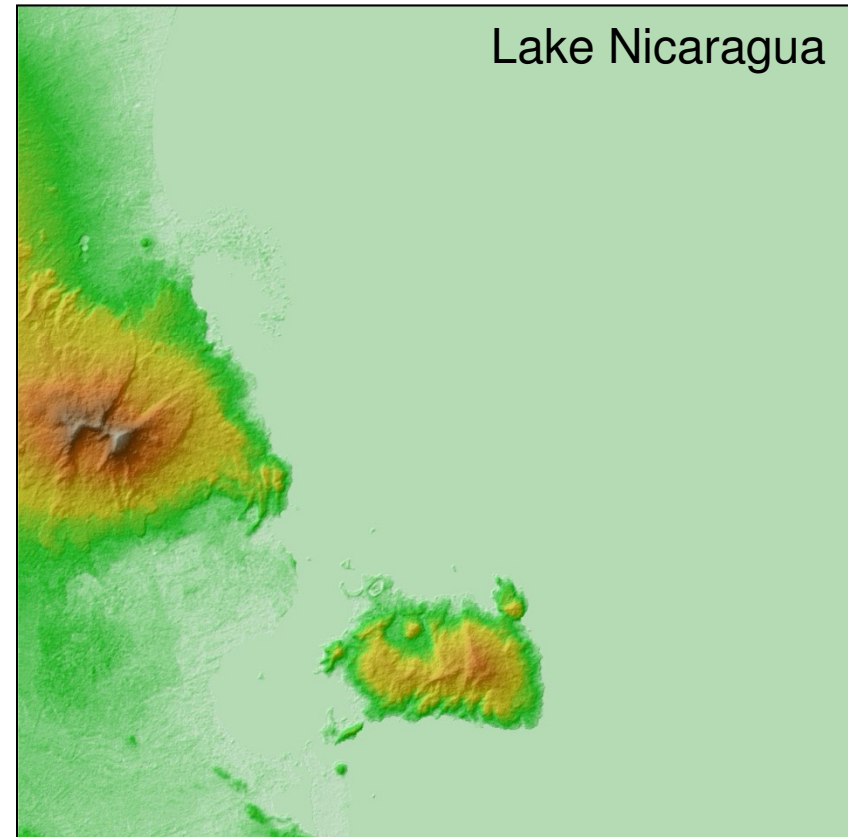


Improvement of Water Body

Version 1



Version 2



N11W086 1200x1200 arc-second

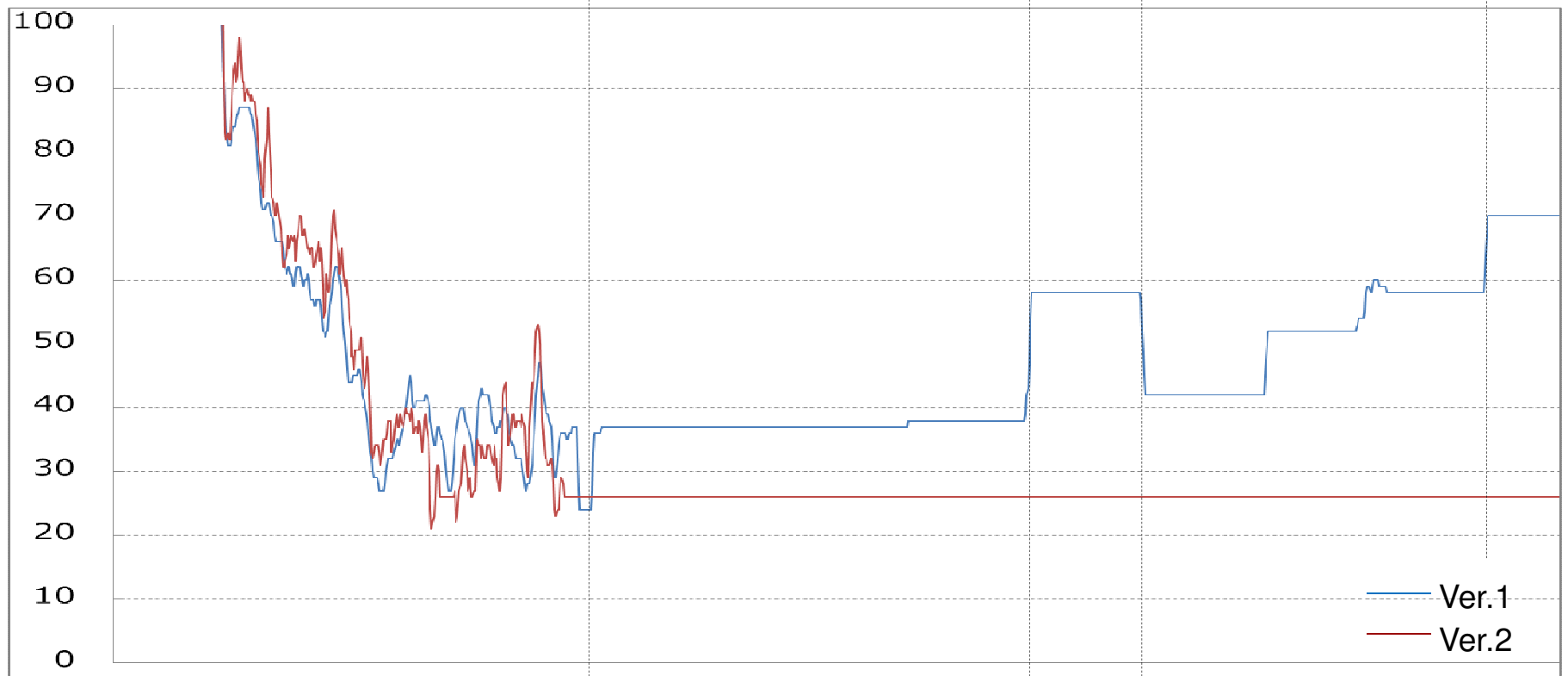


Improvement of Water Body

Ver.2



Ver.1

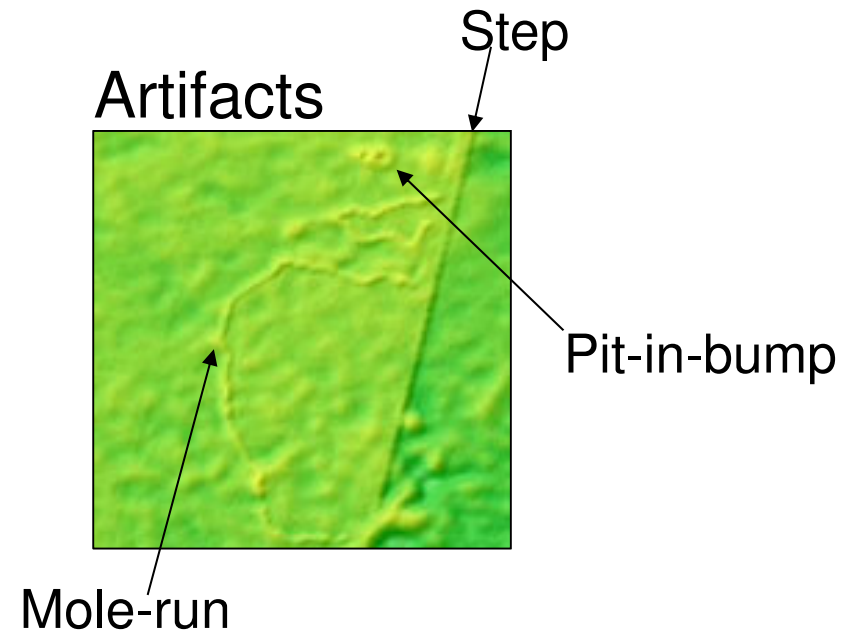




Improvements of Version 2

- #Stack increase to three or more in most of the lack area.
 - Voids in northern area
 - Decrease
 - Artifacts (step, Pit-in-bump, Mole-run, etc.)
 - Almost disappear

- New water body detection algorithm
 - Lakes are perfectly flat.





Summary

Main characteristics of ASTER GDEM version 2

- Resolution improves to 70m from 110m (version 1).
- Offset reduces to -0.7m from -6m (version 1).
- Voids in northern area decrease.
- Artifacts mostly disappear.
- Lakes are perfectly flat.