Accuracy of surface elevation derived from ASIRAS

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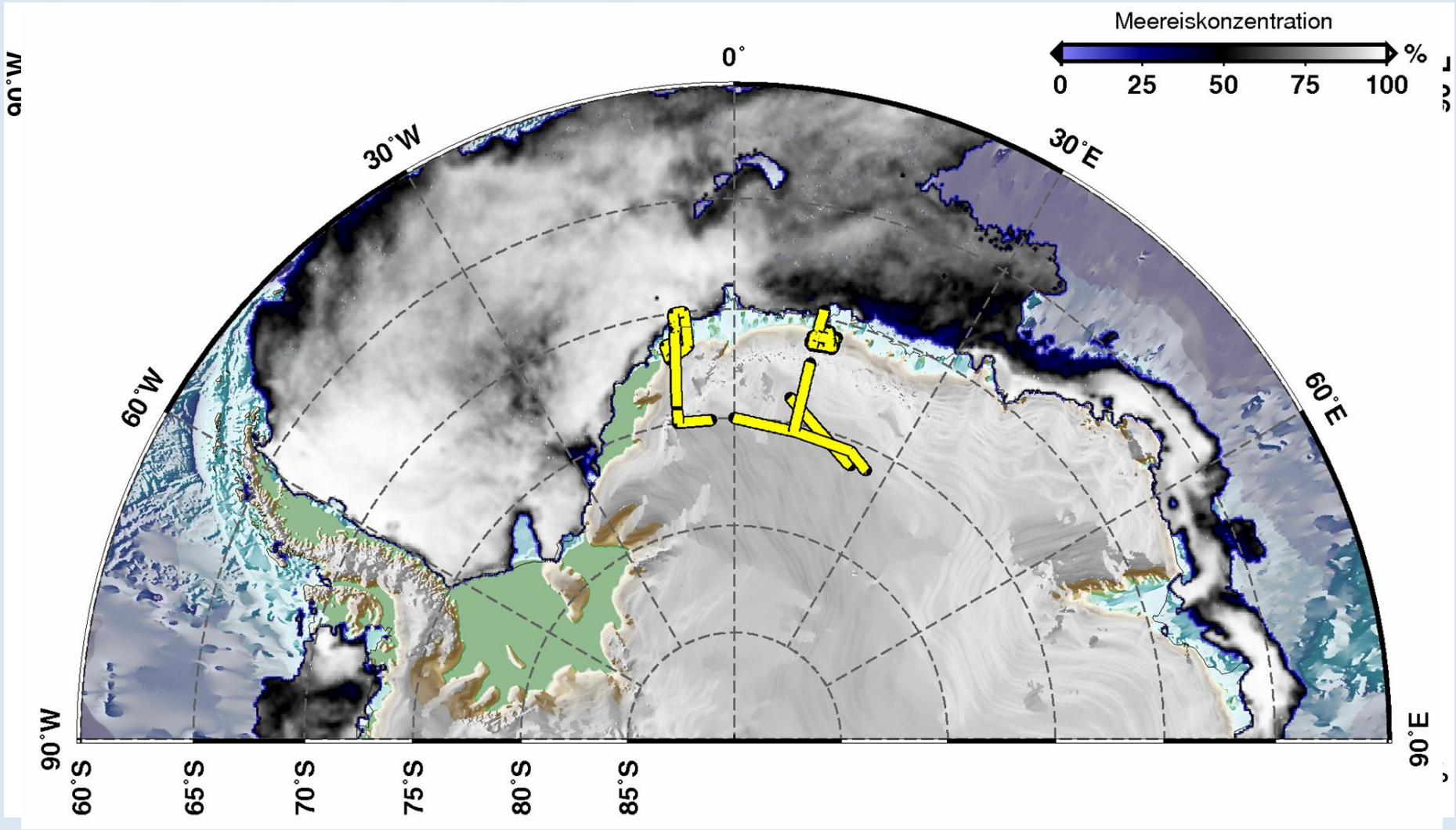
Airborne campaigns from 2004 to 2009



Outline

Calibration of the Laserscanner

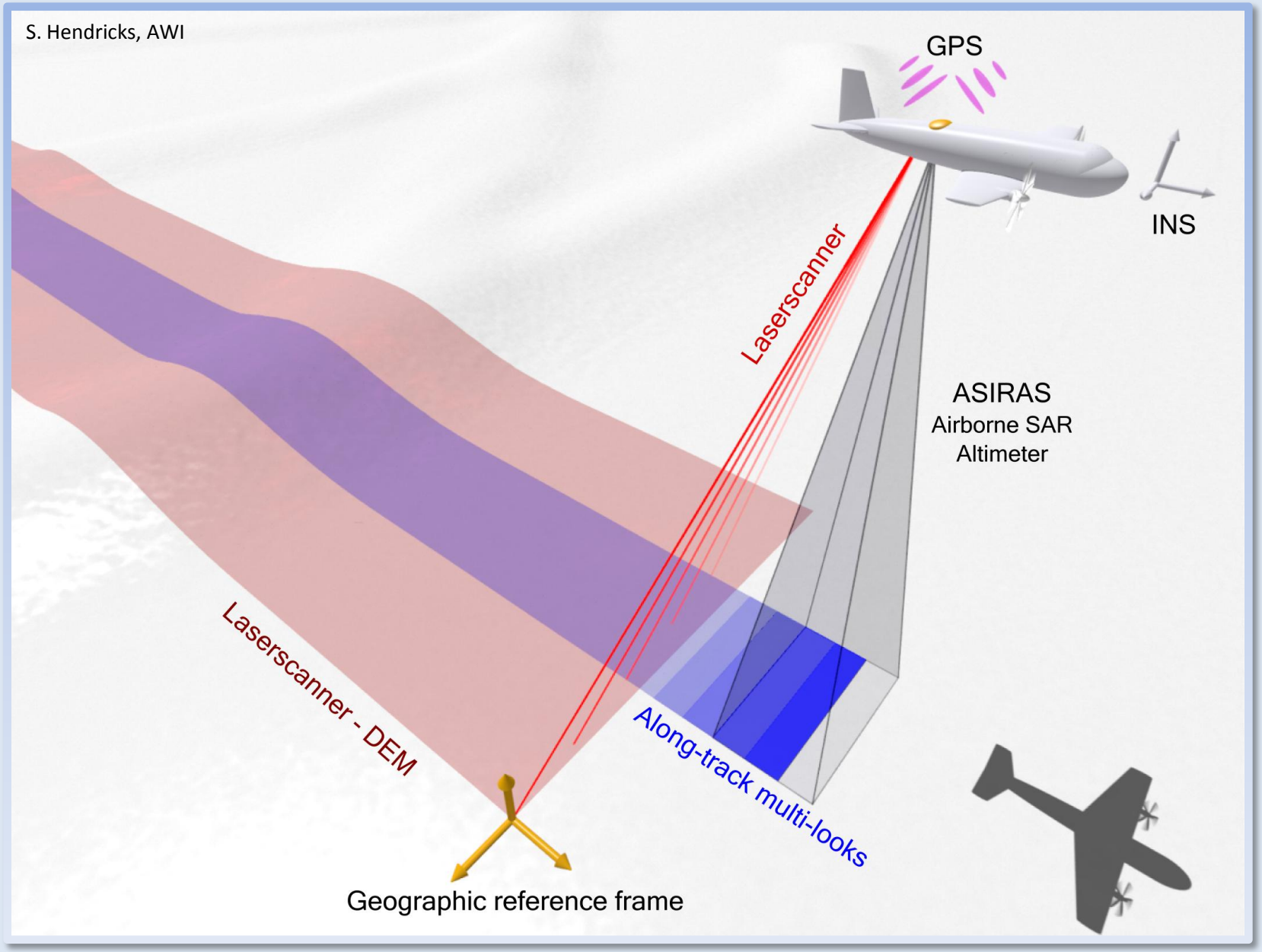
Calibration of ASIRAS over runway

Comparison of Laser DEM with GPS

Accuracy of ASIRAS elevation measurements

Comparison with ALS DEM	Comparison with GPS	Accuracy of SAR and LRM

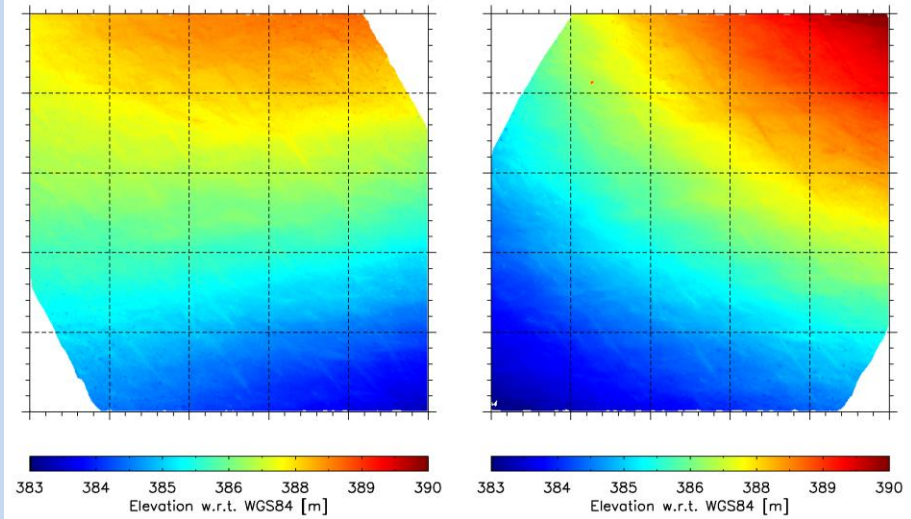
Aircraft Instrumentation

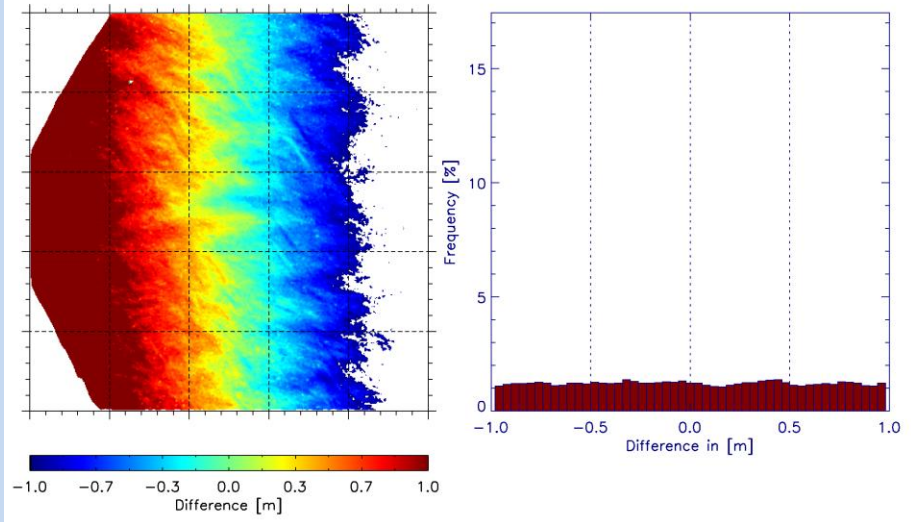


Calibration of the laser scanner

- Uncorrected

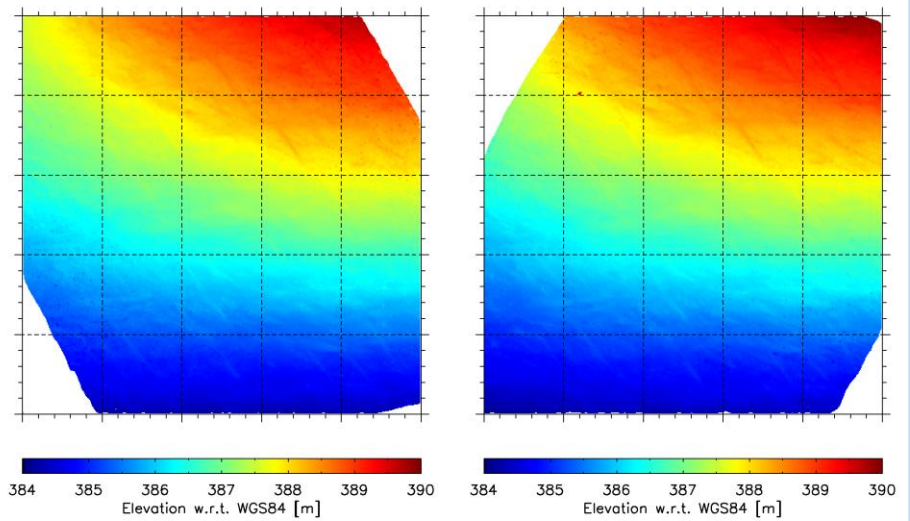
  Difference: 0.01 +/- 2.76 m

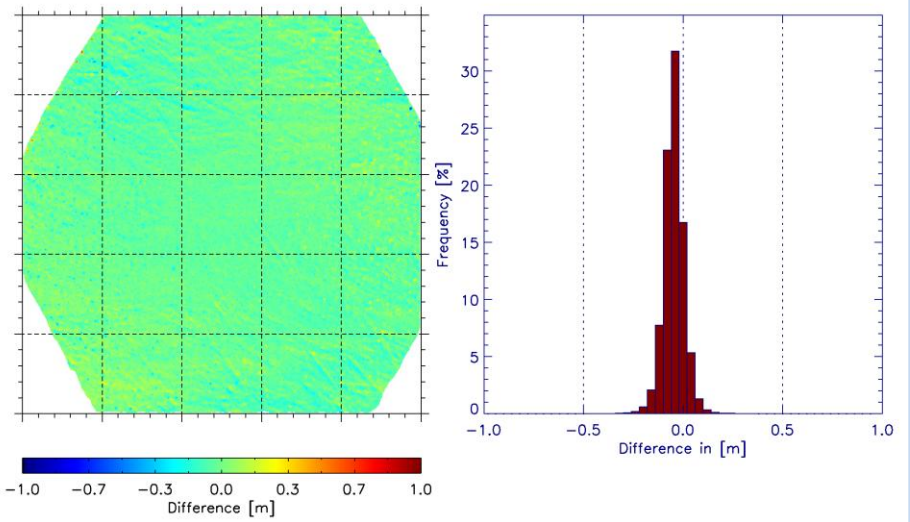




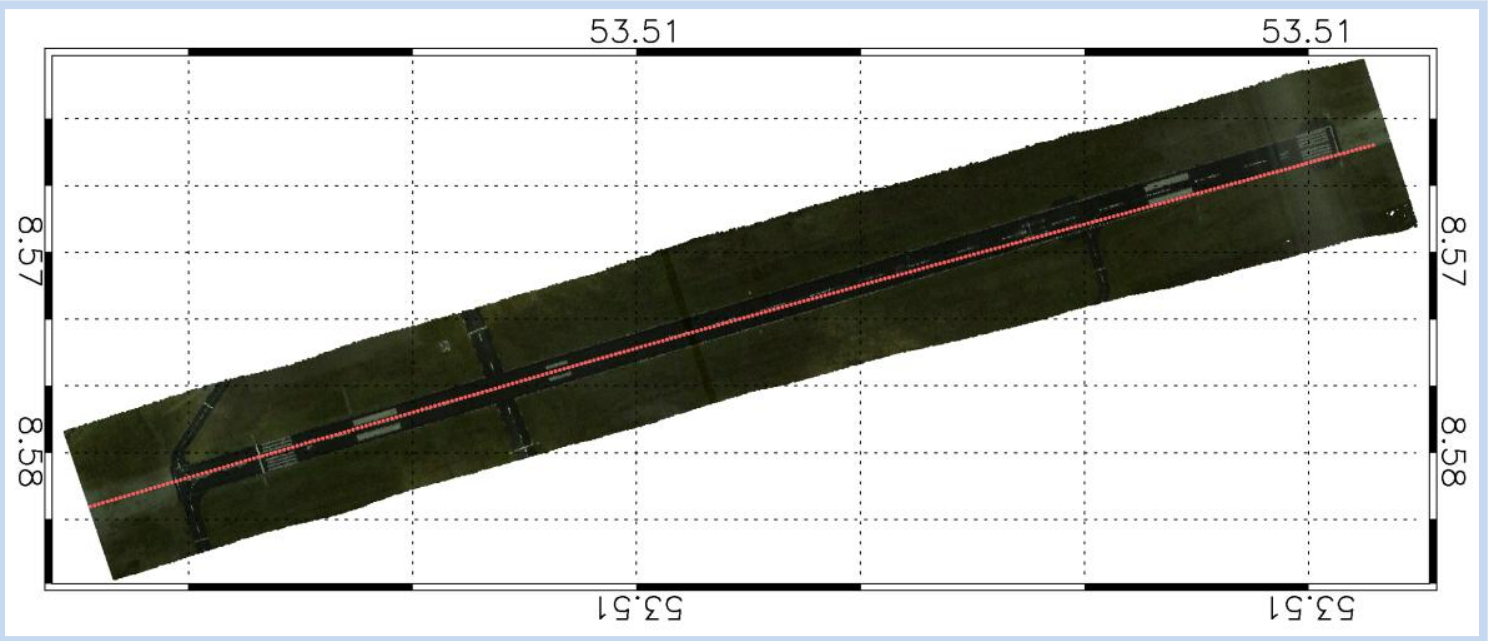
- Squint angle corrected

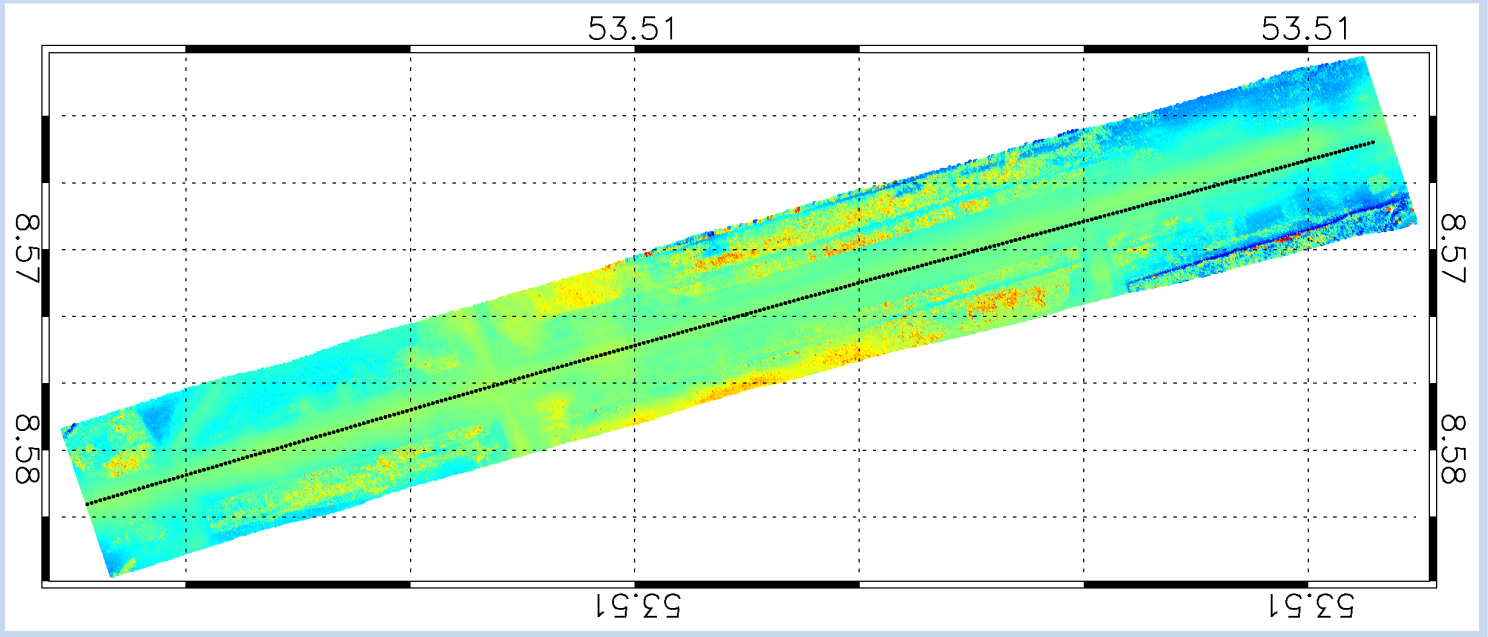
  Difference: 0.03 +/- 0.05 m



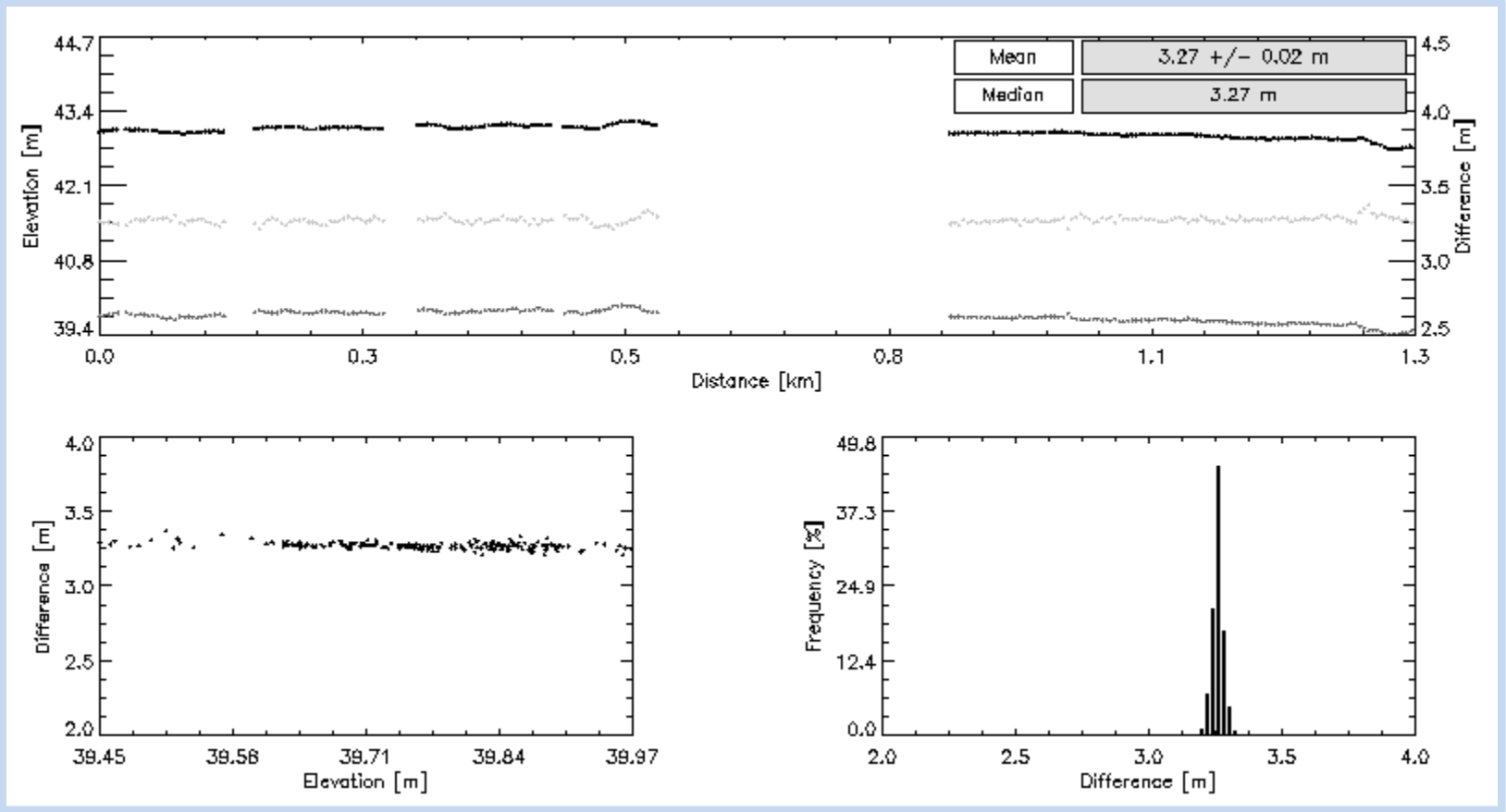


Calibration of ASIRAS over runway



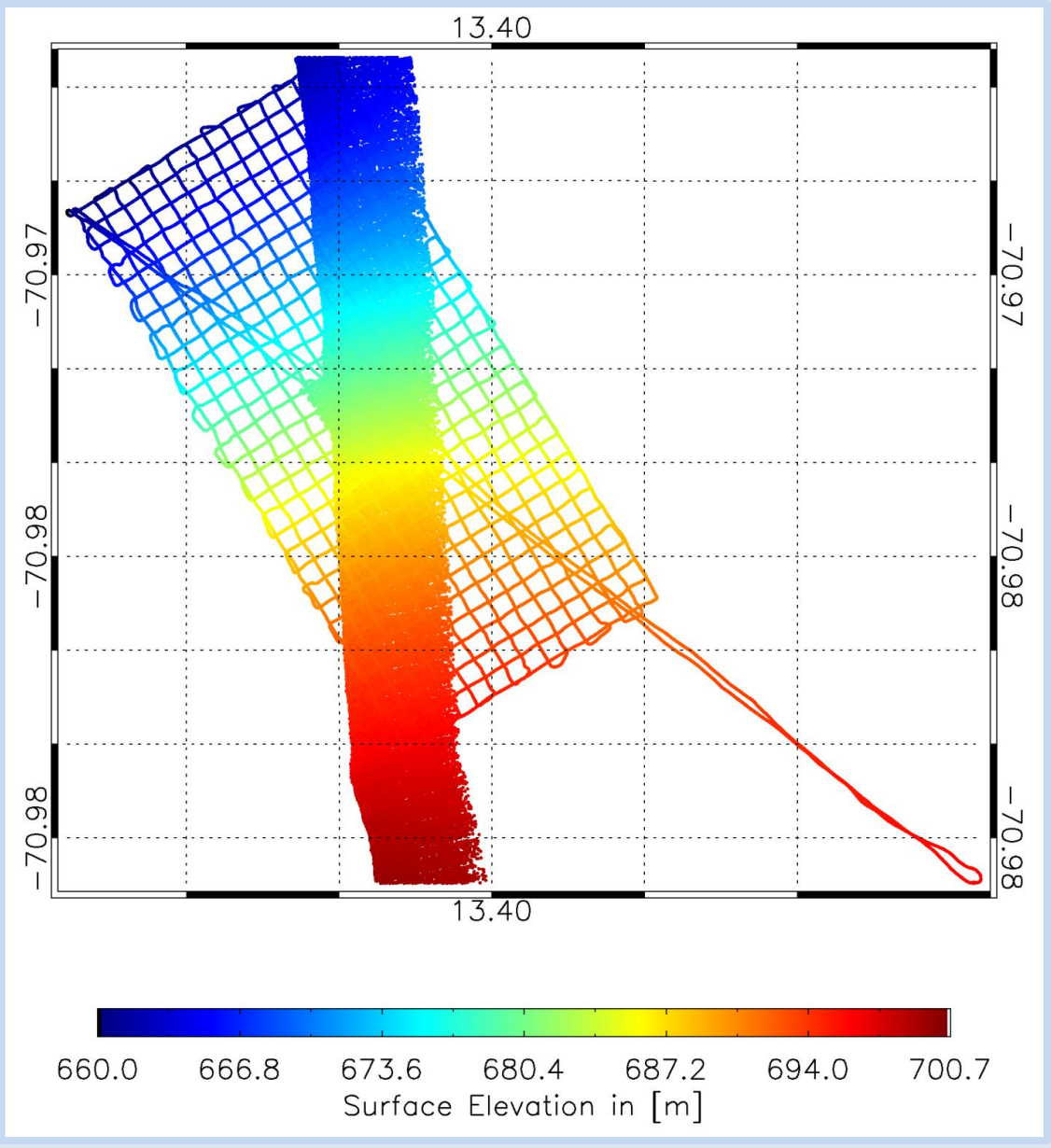


ASIRAS calibration over runway

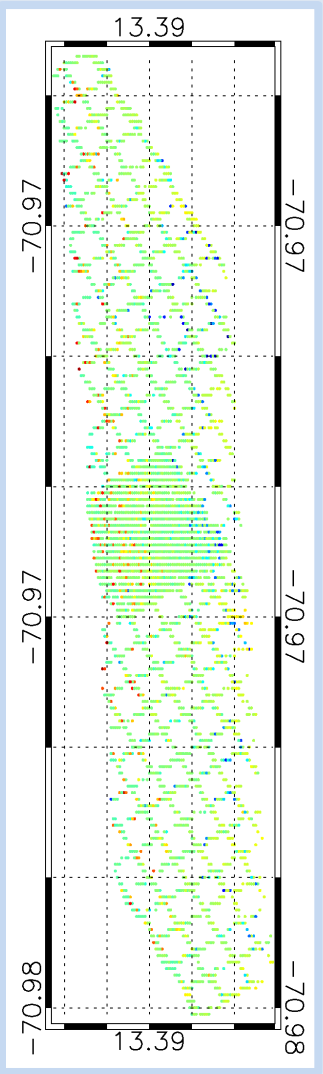


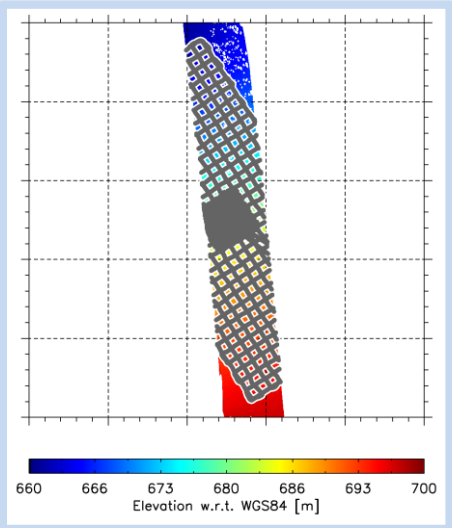
Profile	Tshift [s]	Difference [m]	Stddv [m]	Retracker
A070929_03	0.0	**3.25**	0.03	TSRA
A070929_04	0.0	**3.27**	0.02	TSRA
A070929_03	0.0	**3.51**	0.03	OCOG
A070929_04	0.0	**3.53**	0.02	OCOG

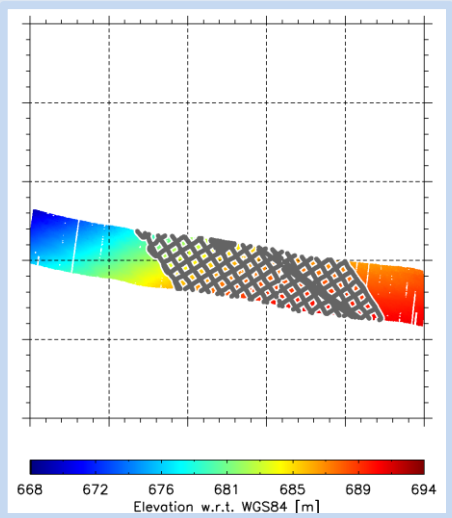
Comparison of laser DEM with GPS



Comparison of Laser DEM with GPS

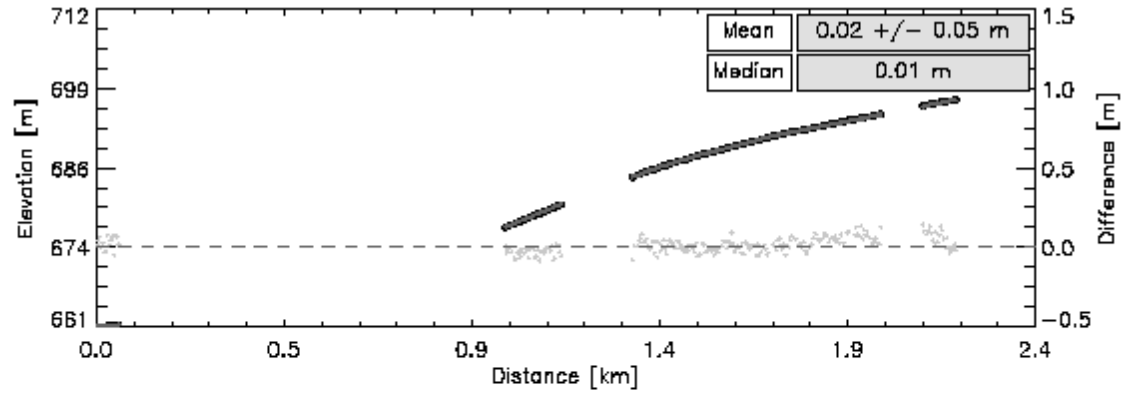


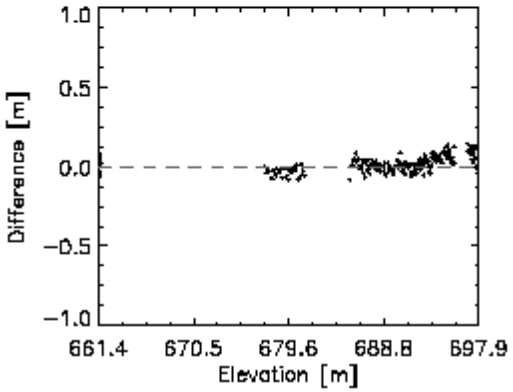


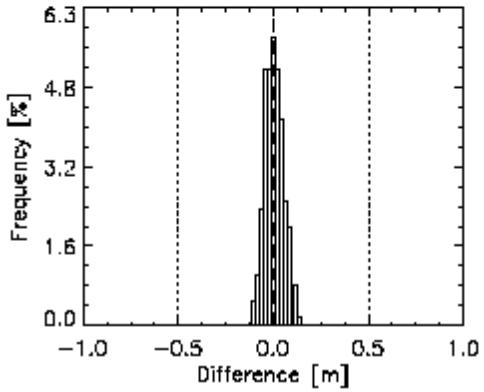


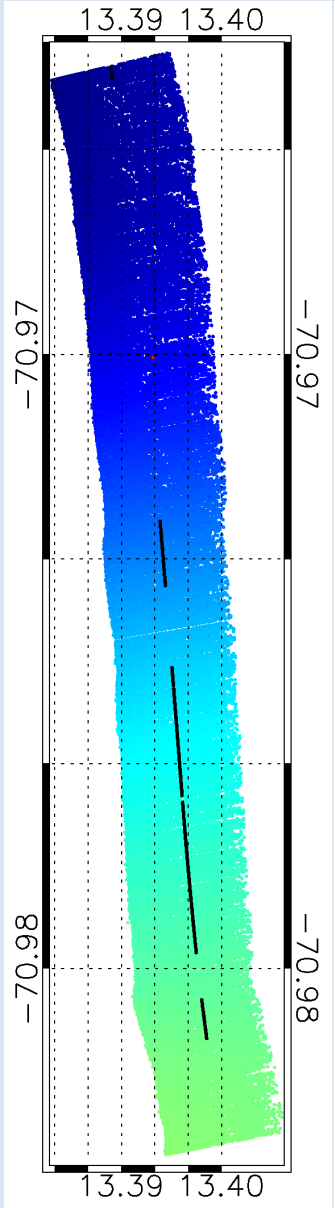
Median GMT CP Error [m]	-0.04	-0.18
Stddev GMT CP Error [m]	0.21	0.25
Median DEM – GPSDifference [m]	-0.06	-0.20
Stddev DEM – GPSDifference [m]	0.09	0.09

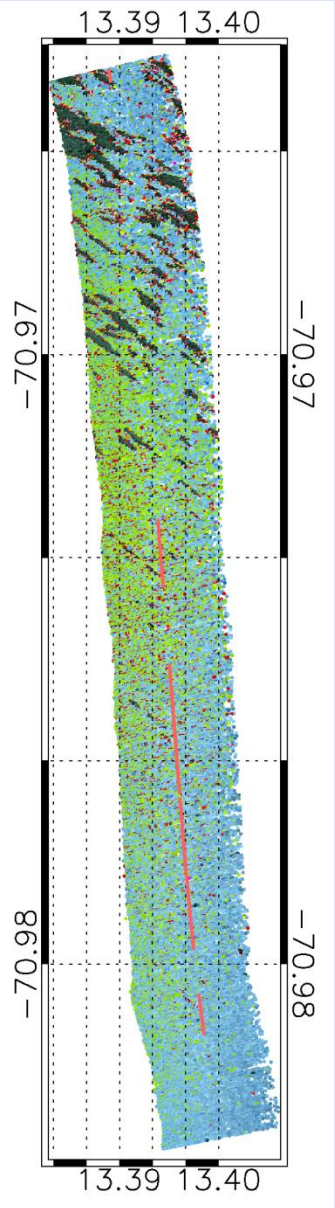
Comparison of ASIRAS with laser DEM



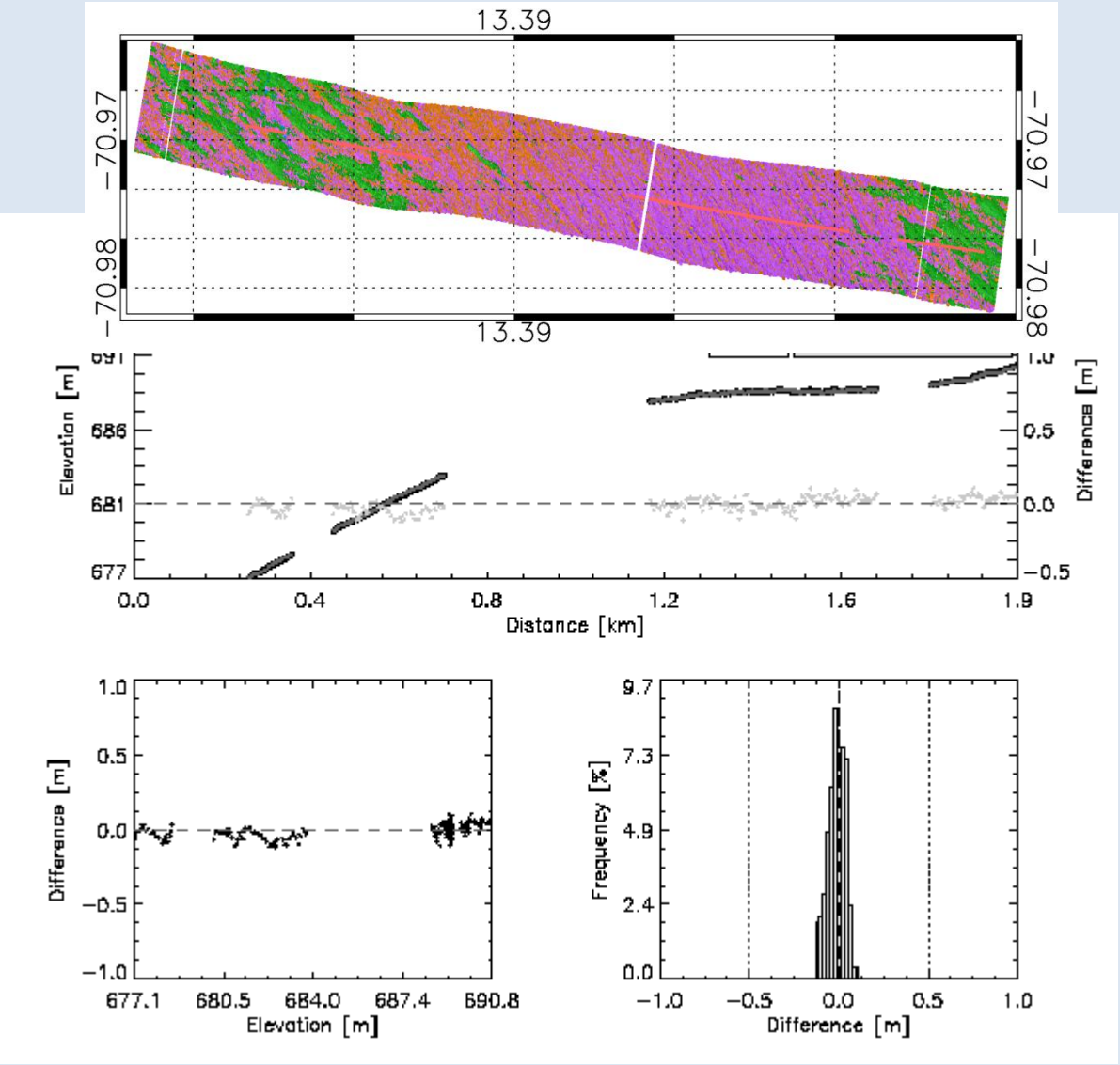






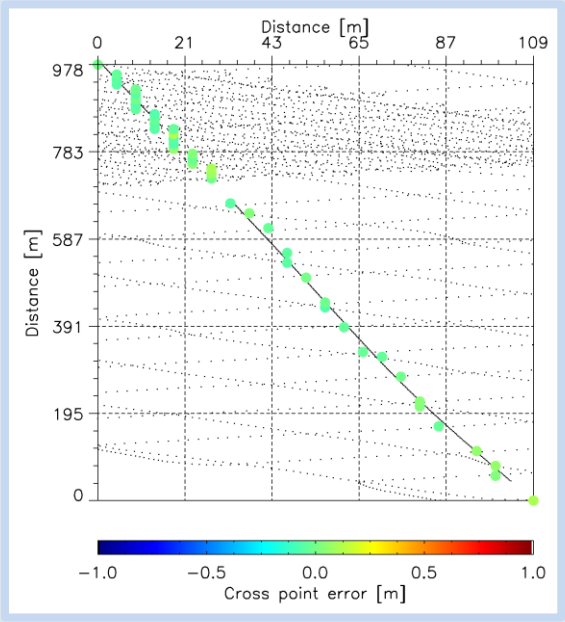


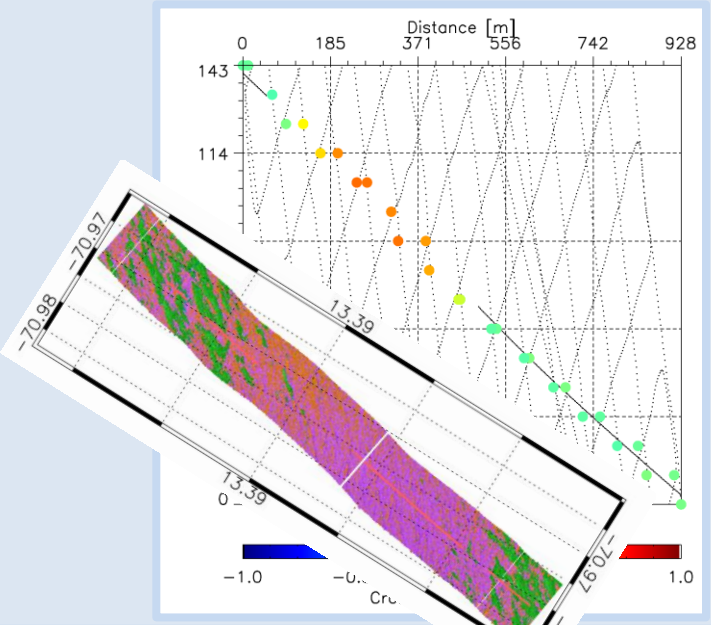
Difference of ASIRAS to ALS DEM in Blue ice (m)			
Median	Mean	Stddev	Roughness
0.01	0.02	0.05	0.07

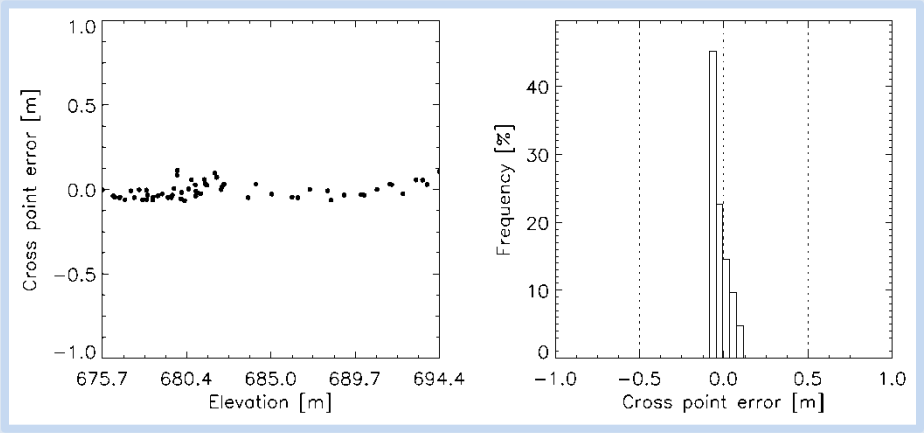


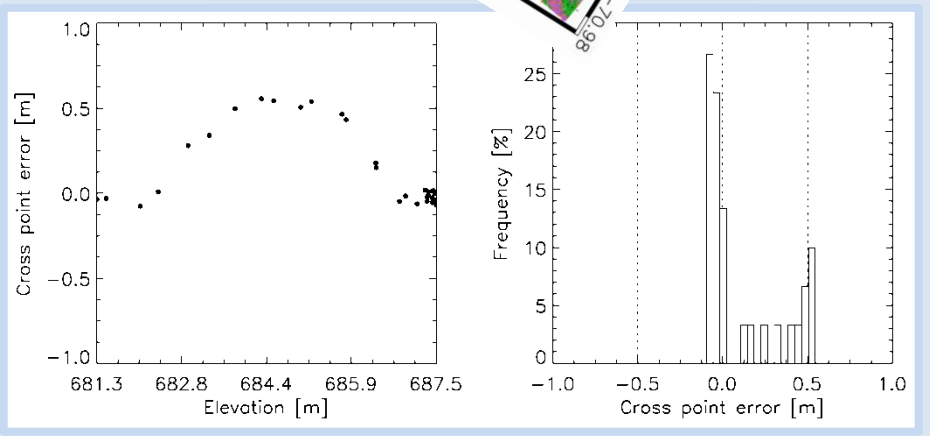
Difference of ASIRAS to ALS DEM in Blue ice partly covered by snow (m)			
Median	**Mean**	**Stddev**	**Roughness**
0.00	0.00	0.05	0.09

Comparison of ASIRAS with GPS





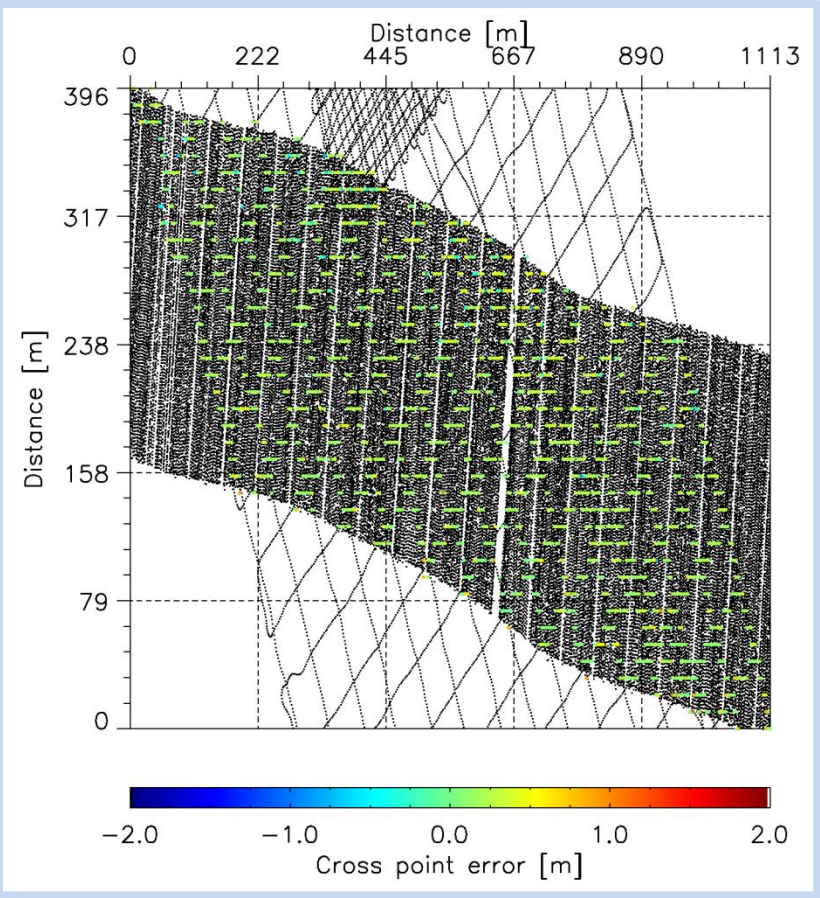


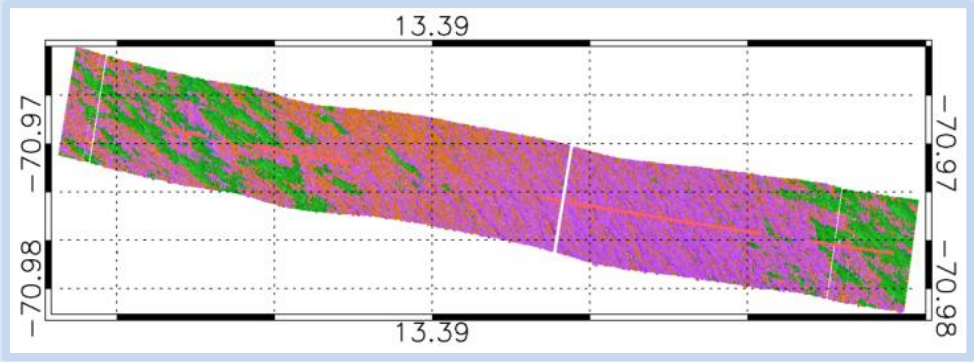


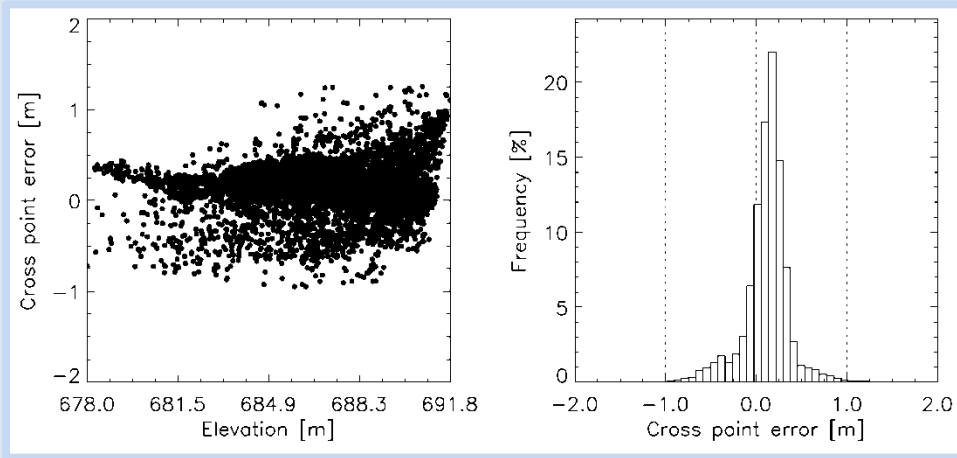
CP error of ASIRAS to GPS (m) – no snow patches		
Median	**Mean**	**Stddev**
-0.02	-0.05	0.05

CP error of ASIRAS to GPS (m) – snow patches		
Median	**Mean**	**Stddev**
-0.00	0.13	0.23

Cross point analysis of ALS and GPS

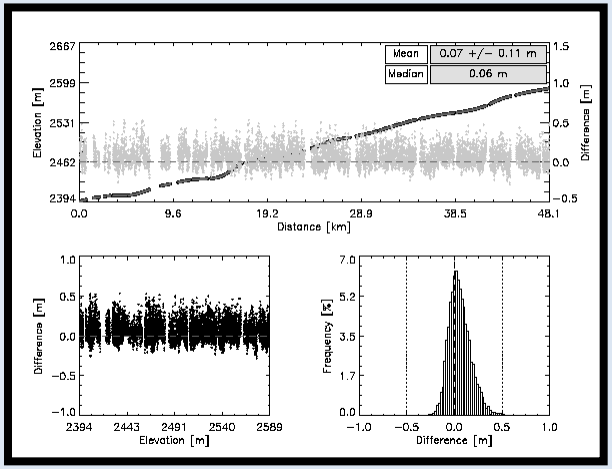




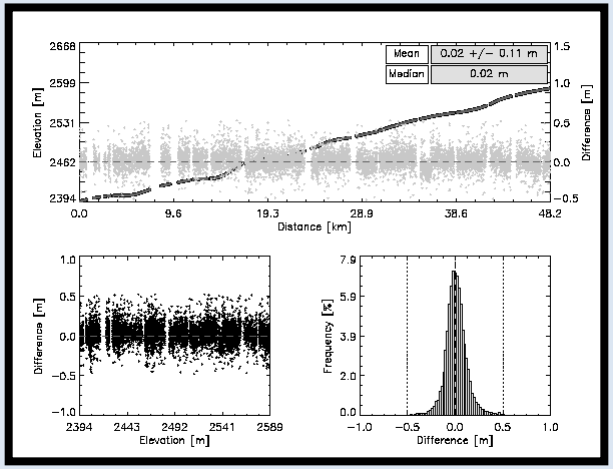


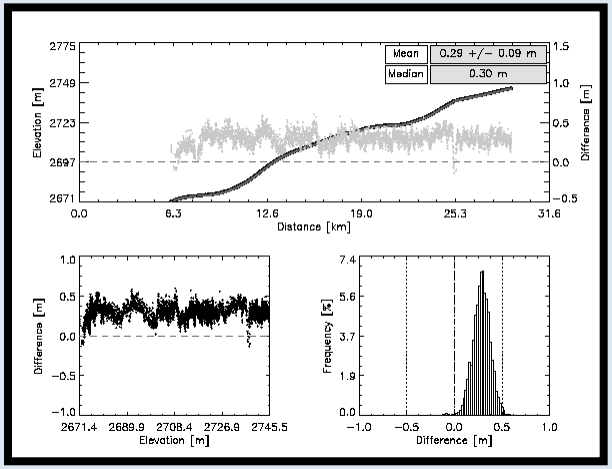
Cross Point error of ALS GPS comparison		
Median	**Mean**	**Stddev**
0.18	0.15	0.25

Comparison of ASIRAS with laser DEM

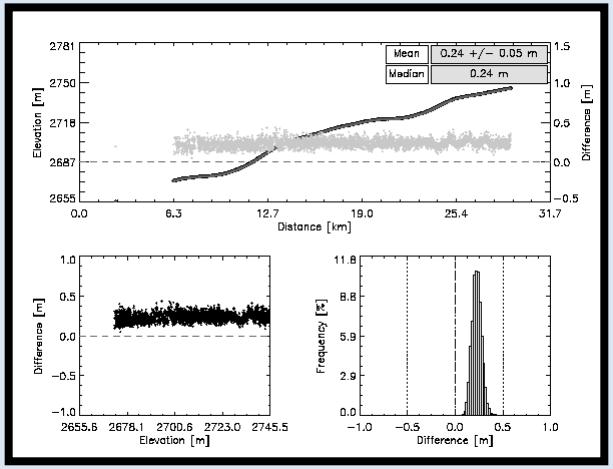


LAM (300 m)





HAM (1100 m)



Difference of unfocused ASIRAS to ALS DEM in the dry snow zone (m)			
Median	**Mean**	**Stddev**	**Mode**
0.06	0.07	0.11	LAM
0.30	0.29	0.09	HAM

Difference of SAR focused ASIRAS to ALS DEM in the dry snow zone (m)			
Median	**Mean**	**Stddev**	**Mode**
0.02	0.02	0.11	LAM
0.16	0.16	0.05	HAM

CAL Conclusions

- Runway: static offset dependent on Retracker
- Accuracy of ALS DEM is < 0.10 m
  - Static offsets of up to 0.15 m due to GPS processing
- Accuracy of ASIRAS is < 0.10 m in the dry snow zone and in the Blue ice compared to laser DEM
- Accuracy of ASIRAS is 0.1 to 2.0 m in the percolation and Ablation zone
  - Retracker dependent (TSRA suggested for all surfaces, see Helm et.al. 2006)

VAL Conclusions

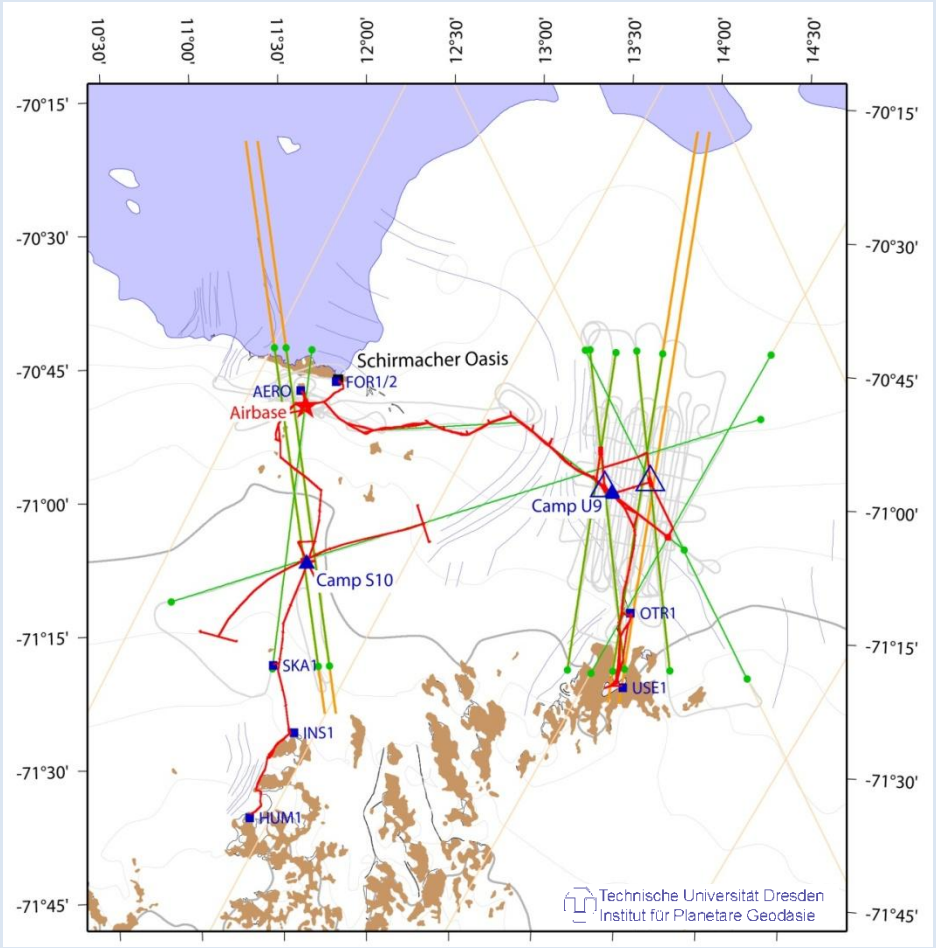
- Small Snow patches in blue ice seem to be transparent for ASIRAS
  - Shape of waveform doesn‘t change significantly
  - Systematic underestimation of airborne radar altimeter elevation due to preferential backscatter from the blue ice surface
  - Determination of snow thickness critical → ?Snow freebord?
- LRM elevations on the Antarctic plateau reliable, but with offset to SAR elevations
  - Footprint size controls the offset
  - Suggestion: run LRM and SAR Mode in combination with IceSat at Validation site (e.g. Kohnen station, DML Antarctica)
- GPS reference grids are necessary for the Cal/Val of CryoSat
- Blue ice area in combination with accumulation area are perfect validation sites for accuracy and penetration studies

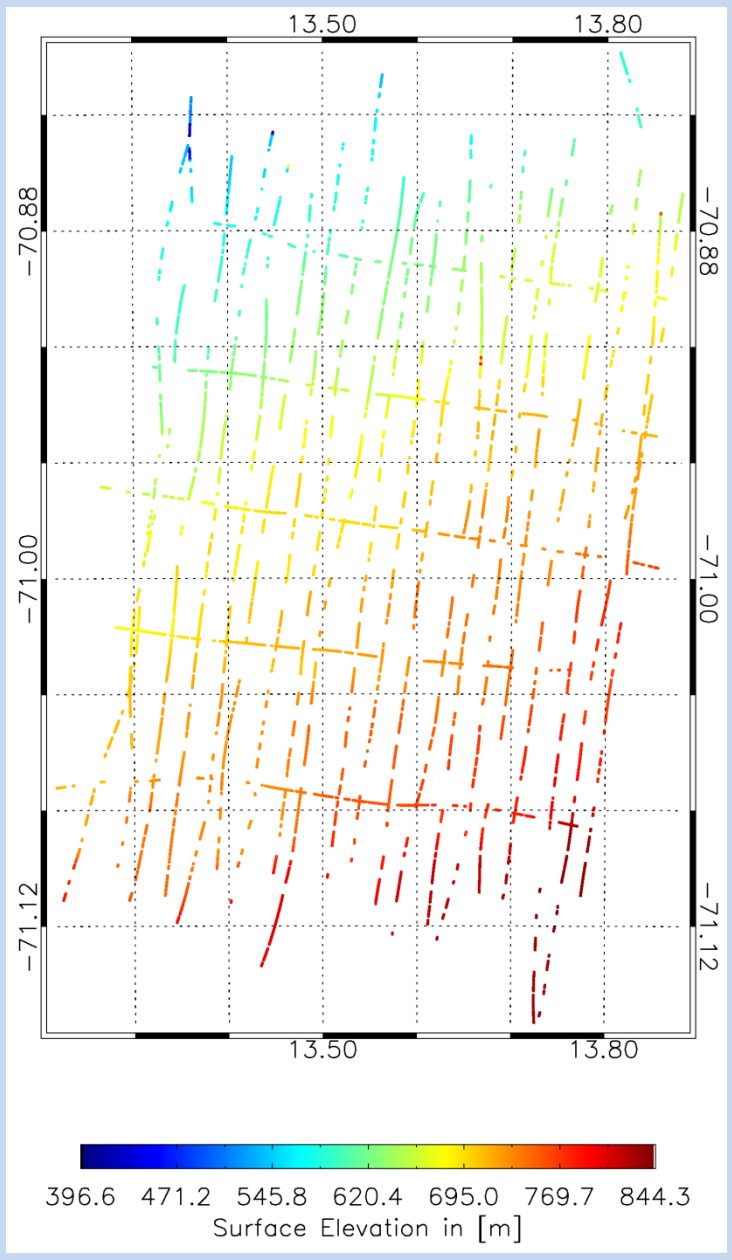
Cross point analysis of ASIRAS

Grid in Blue ice area in DML

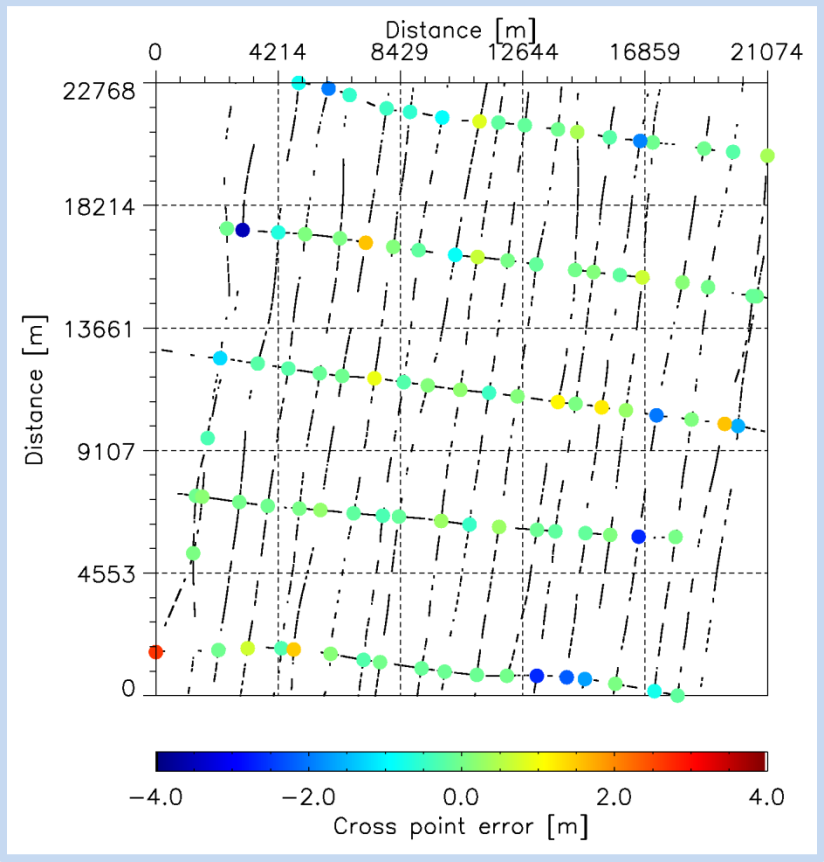
Dimensions: 20 km x 25 km

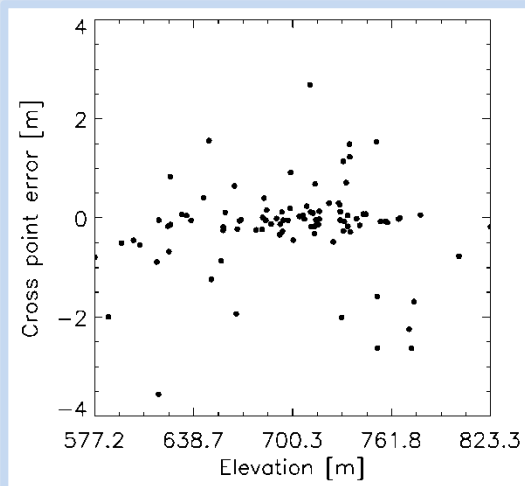
Line spacing: 1 km x 5 km

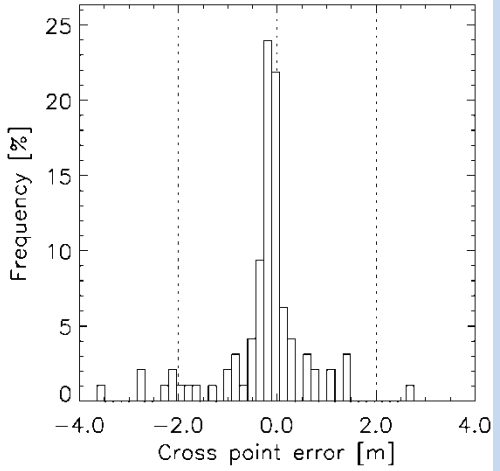




Cross point analysis of ASIRAS

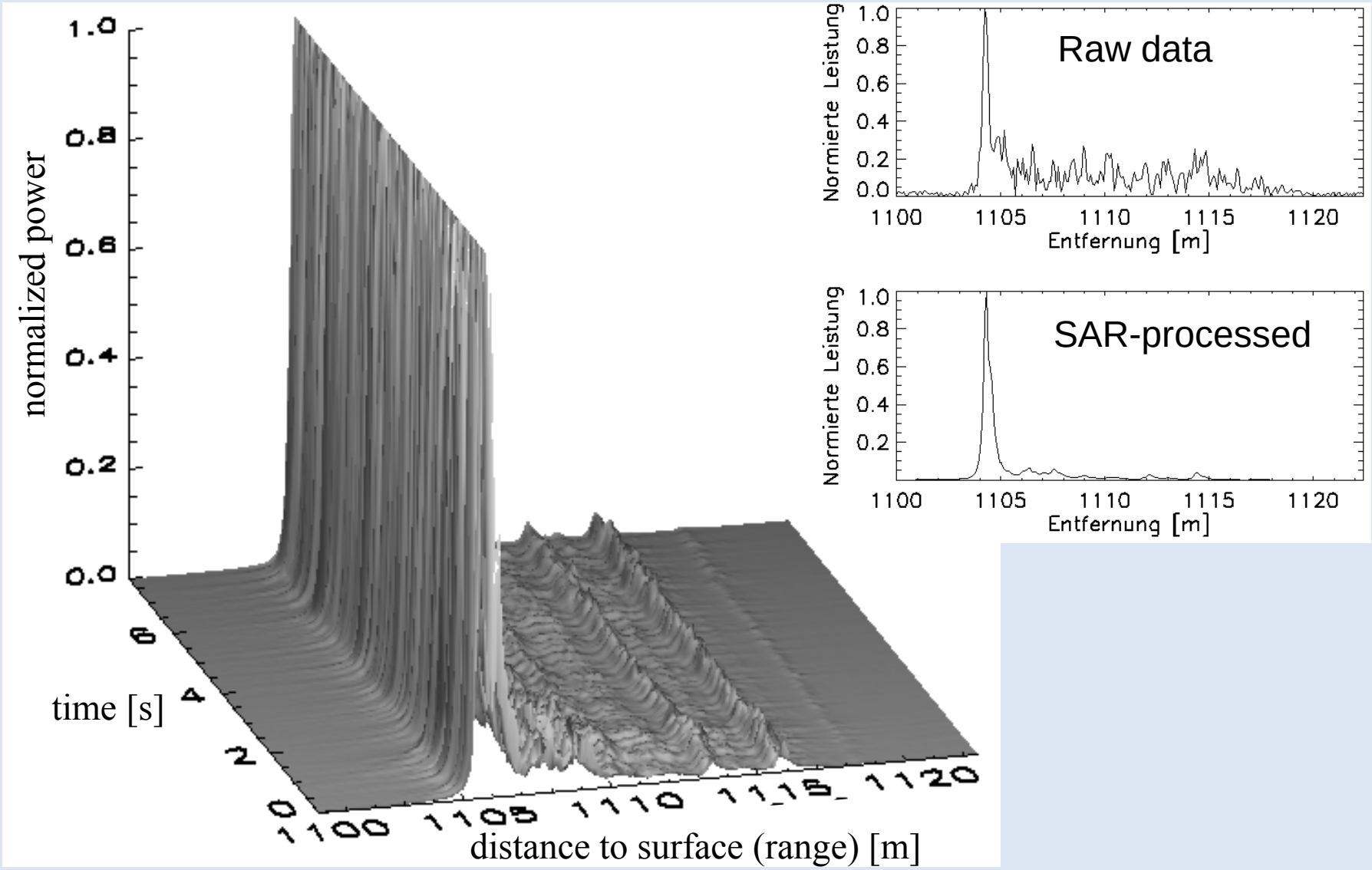




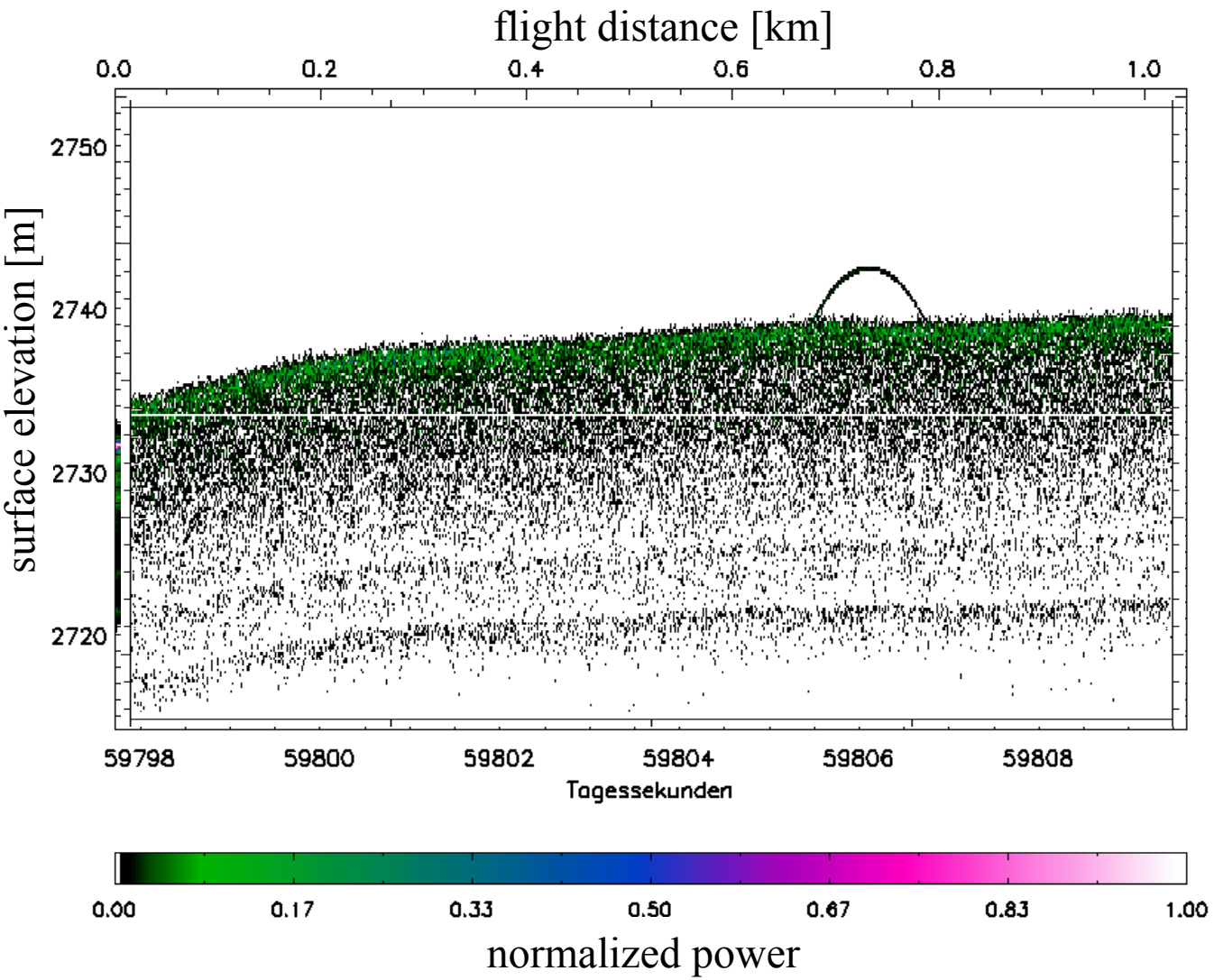


Cross Point error of ASIRAS grid		
Median	**Mean**	**Stddev**
-0.05	-0.17	0.89

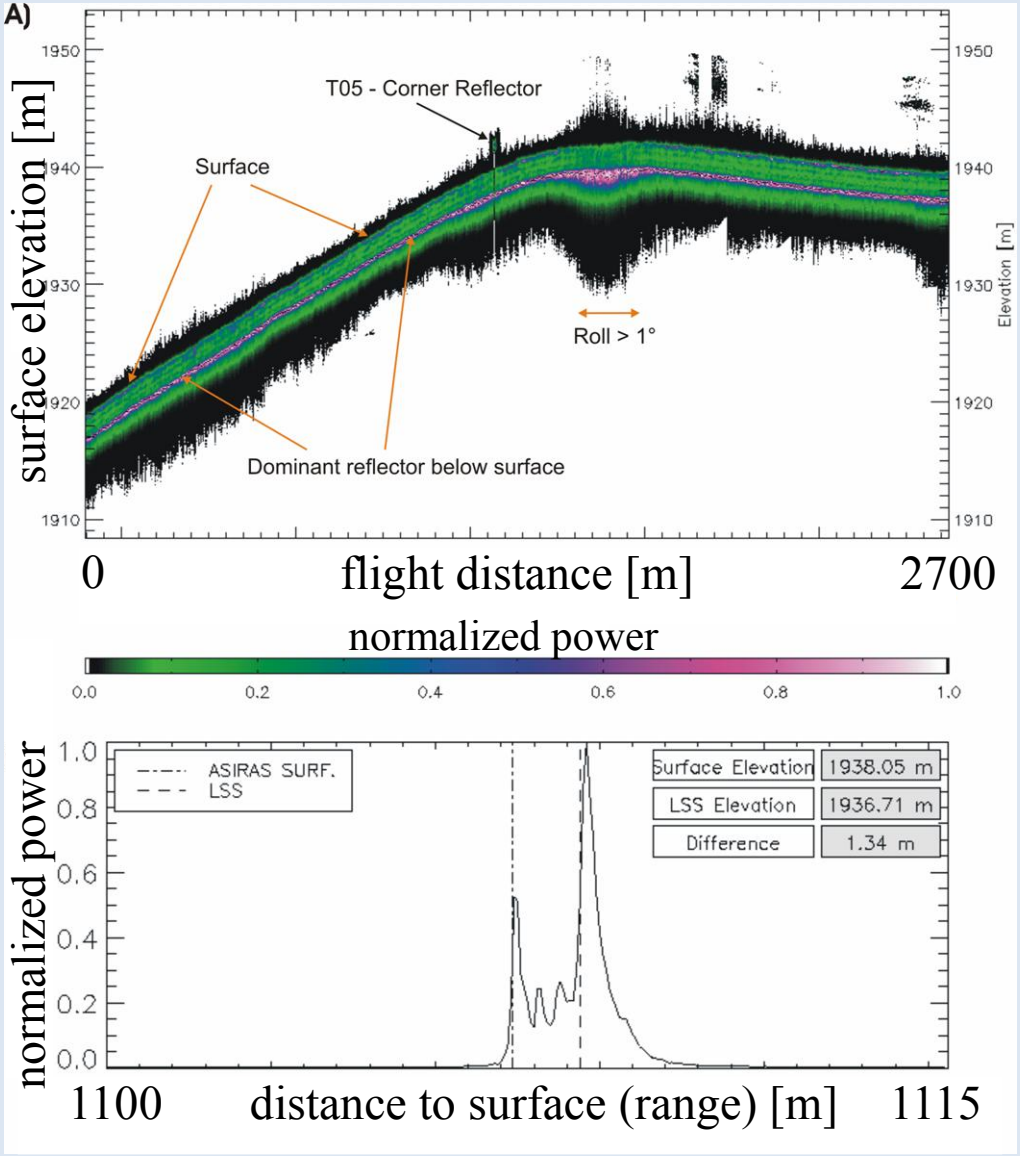
SAR processed ASIRAS echo



Internal layering in Greenlands dry snow zone



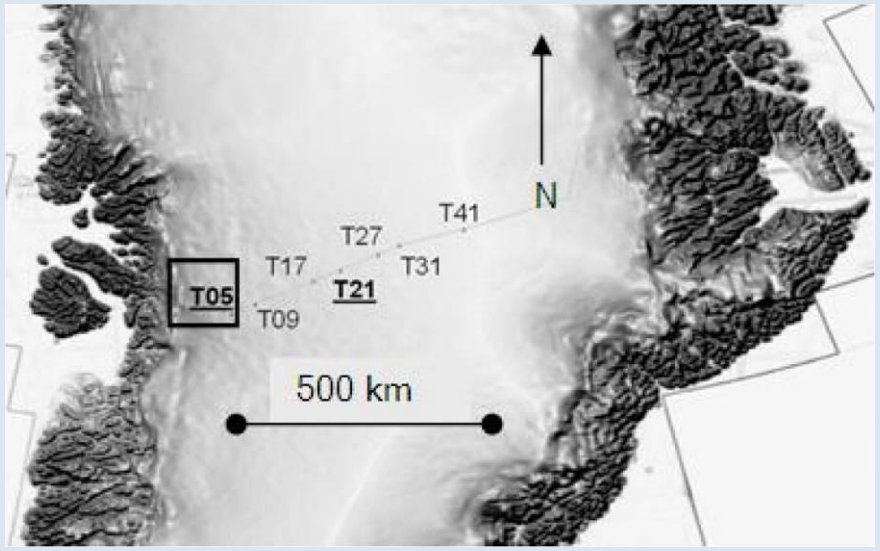
Determination of winter accumulation



Helm (2007)

Next to the surface a second very strong reflector is visible

This corresponds to the previous summer horizon (Parry, 2006)



differenz yields the winter accumulation
(Density obtained from snow pit)