

CryoVEx08/09 Antarctica

Final presentation

Veit Helm, AWI

- Campaign overview
- Processing status
- Calibration
- Datation
- Data analysis
- Summary

- CryoSat CAL/VAL over Blue Ice in Dronning Maud Land:
 - Preliminary Cryosat ground tracks over Blue Ice
 - Validation lines of TU-Dresden
 - Repeat some profiles measured in 2007
 - First time dense grid (20 km x 25 km, spacing 1 km)
 - Runway calibration flights
 - Corner Reflector over passes

Airborne campaign overview

- Airborne activity: 21th Dec. 2008 – 9th Jan. 2009
- Base station: Novo Airfield
- Hours of Operation: ~26h (0.5 Tb data collected)
- Platform: Polar5 (Basler BT-67)
- Participants: 3 AWI, 1 FILAX
- Instrumentation: ASIRAS
Laserscanner (80 Hz, 45° swath)
INS
2 Trimble GPS receivers (1 Hz)
2 Novatel GPS receivers (20 Hz)
Laser Altimeter (LD90 – 4 Hz)

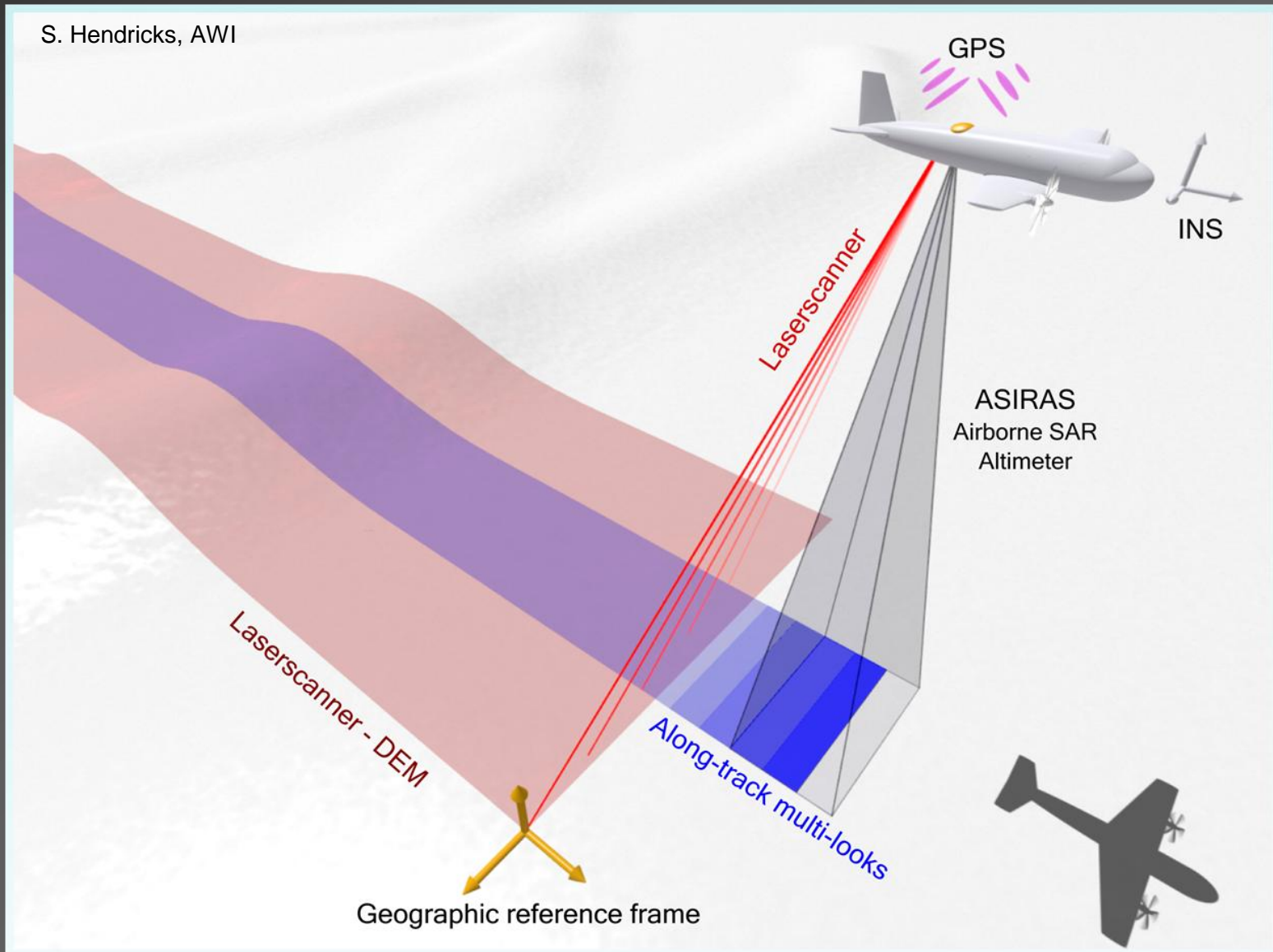
POLAR 5



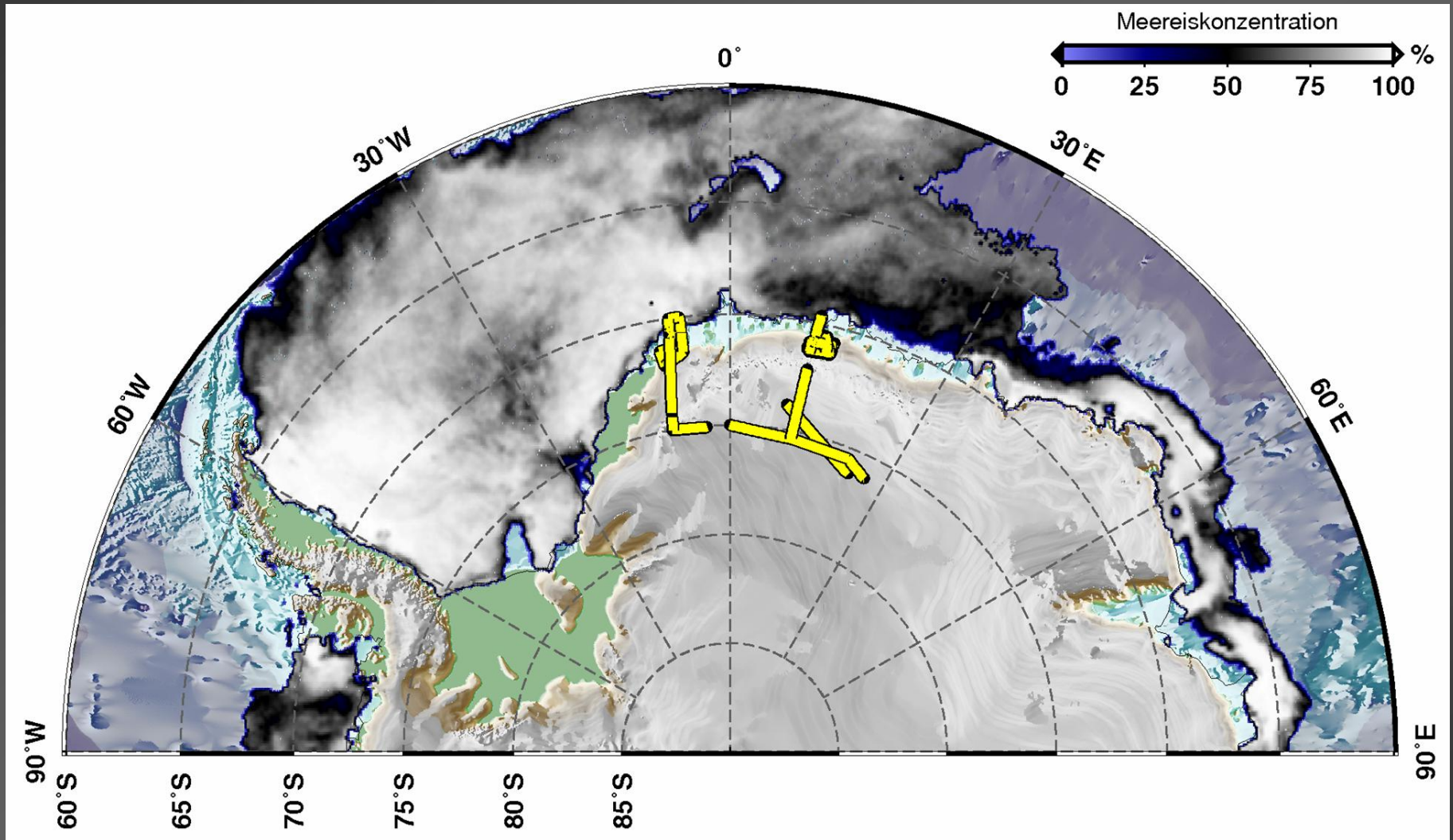
Parameter		POLAR 5
length, height, width	(m)	20,66 / 5,20 / 29,00
cabine: length, height, width	(m)	12,85 / 2,00 / 2,34
max. payload	(kg)	3900
fuel consumption	(kg/h)	500
operating distance	(km)	2900 (up to 10h)
number of passengers		18
max. flying altitude	(m)	7600
min./max. speed	(km/h)	185/400
max. take off altitude (ski)	(m)	>3850

Aircraft Instrumentation

S. Hendricks, AWI



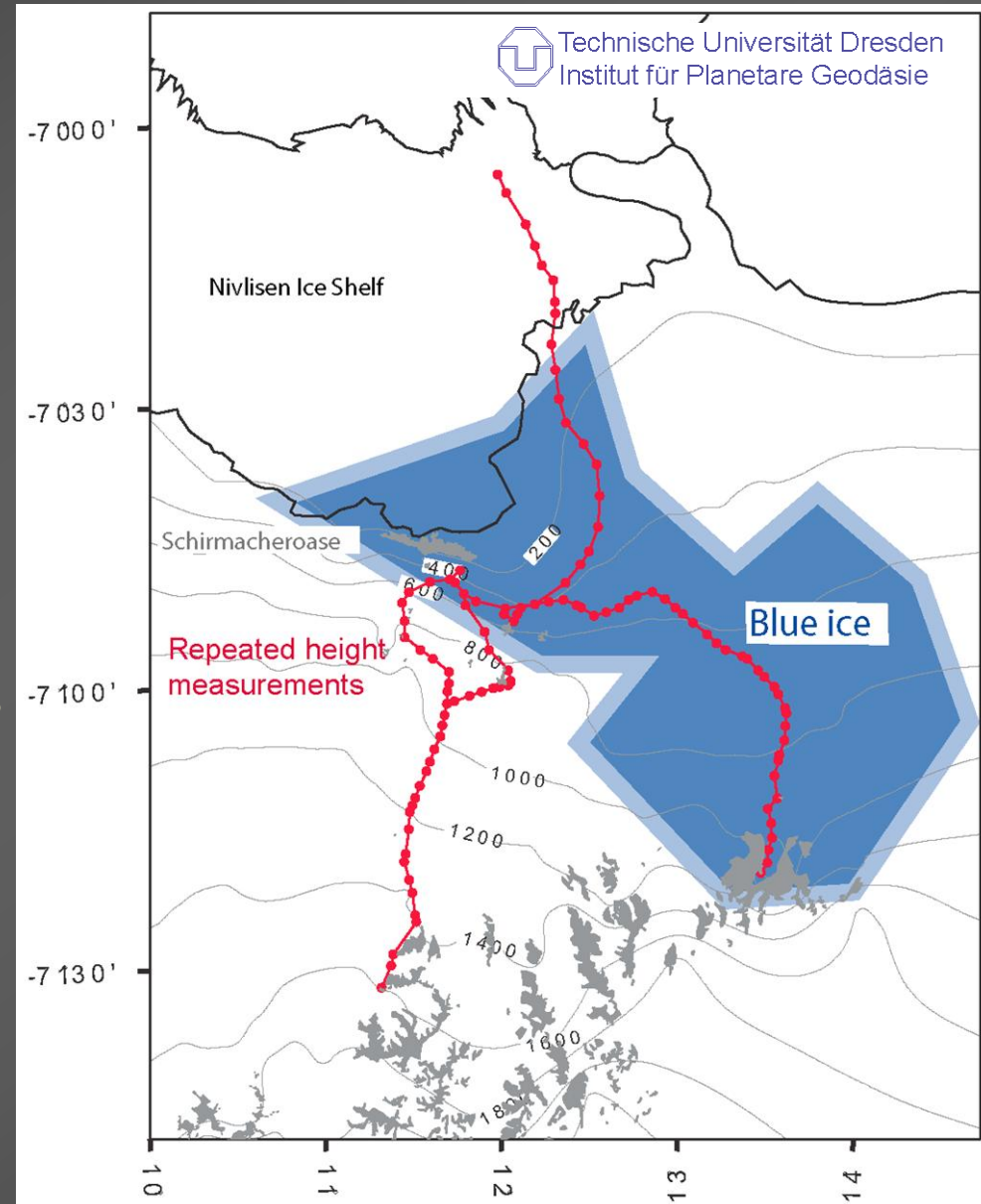
Area of Investigation



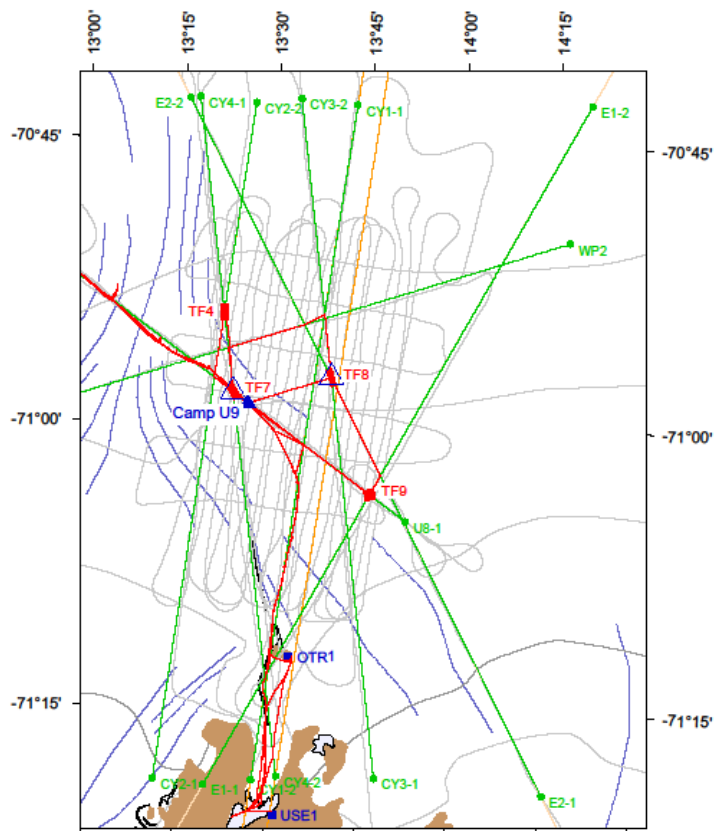
Area of Investigation

■ Airborne:

- LAMA Mode
- CryoSat2 tracks
- GPS transect
- Grid (20 km x 25 km)
- Runway calibration flights
- Corner Reflector over passes



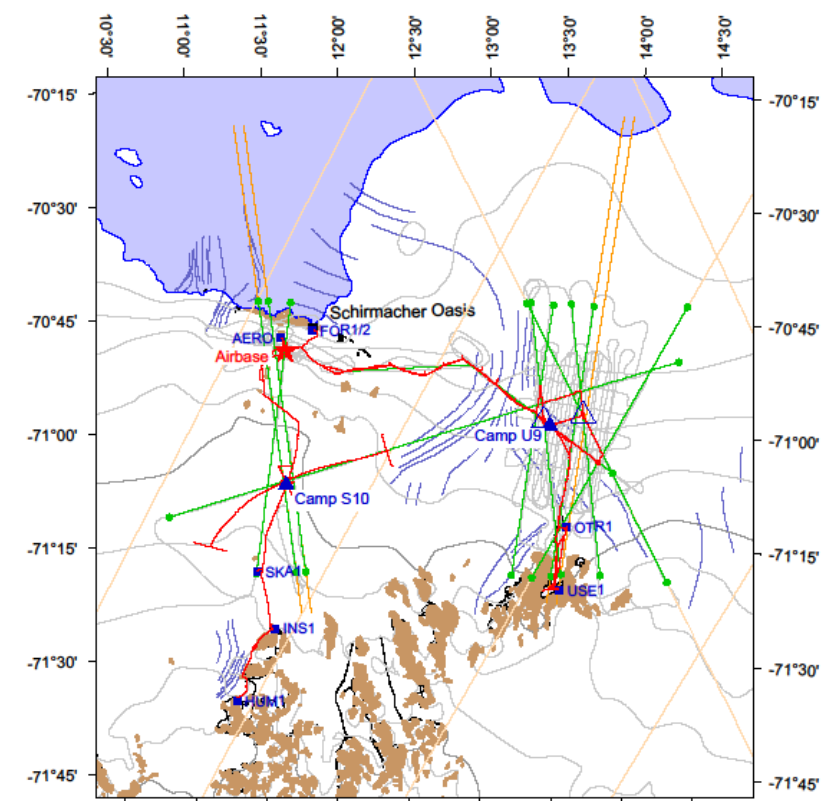
Measured profiles



CryoVEX 2008/2009: Kinematic GNSS measurements

- Pre-planned flight profile
 - Subsatellite track
 - GNSS profile
 - Flight profile 2008
 - △ Corner reflector
 - GNSS marker
- km

 0 10 20
- Scale 1:400 000
 (Basis: Antarctic Digital Database)



CryoVEX 2008/2009: Kinematic GNSS measurements

- Pre-planned flight profile
 - Subsatellite track
 - GNSS profile
 - Flight profile 2008
 - △ Corner reflector
 - GNSS marker
- km

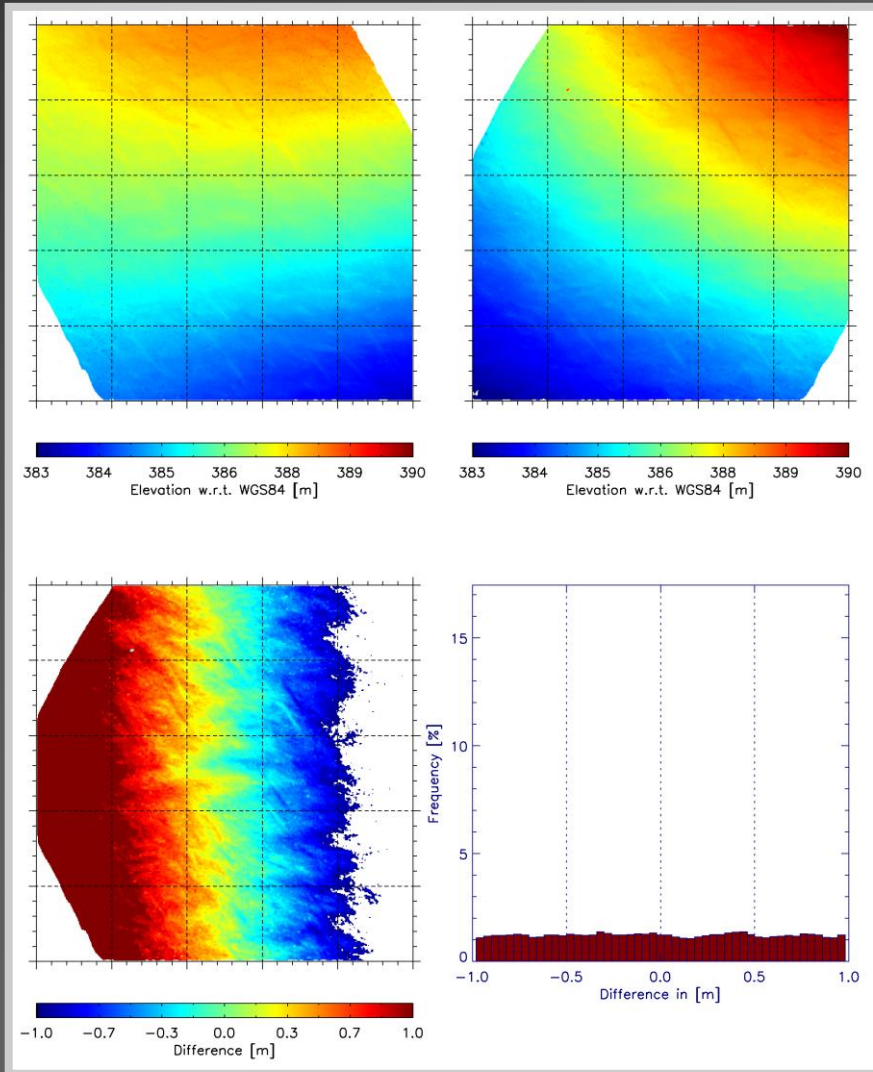
 0 50
- Scale 1:1 000 000
 (Basis: Antarctic Digital Database)

- ASIRAS processed with ESA processor version ASIRAS_04_02
- GPS and INS data processed
- ALS data calibrated and processed

Calibration of the laser scanner

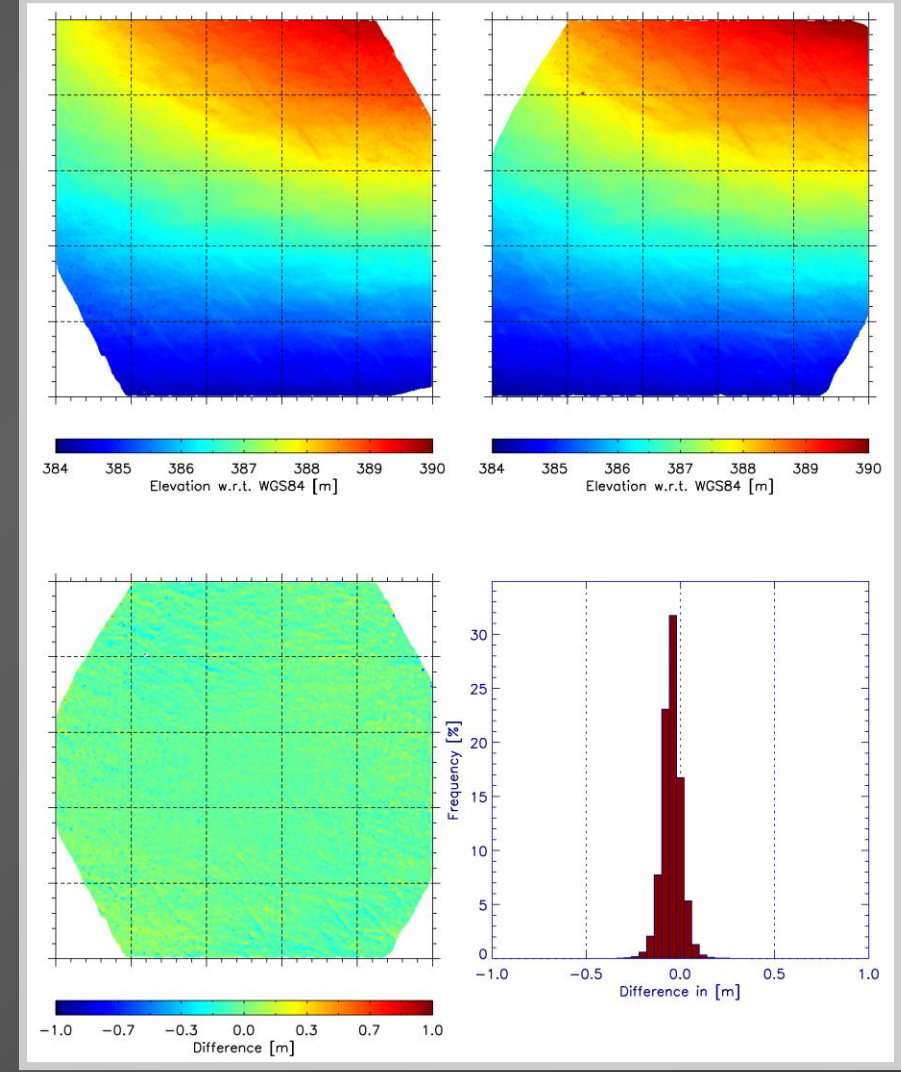
■ Uncorrected

Difference: 0.01 ± 2.76 m



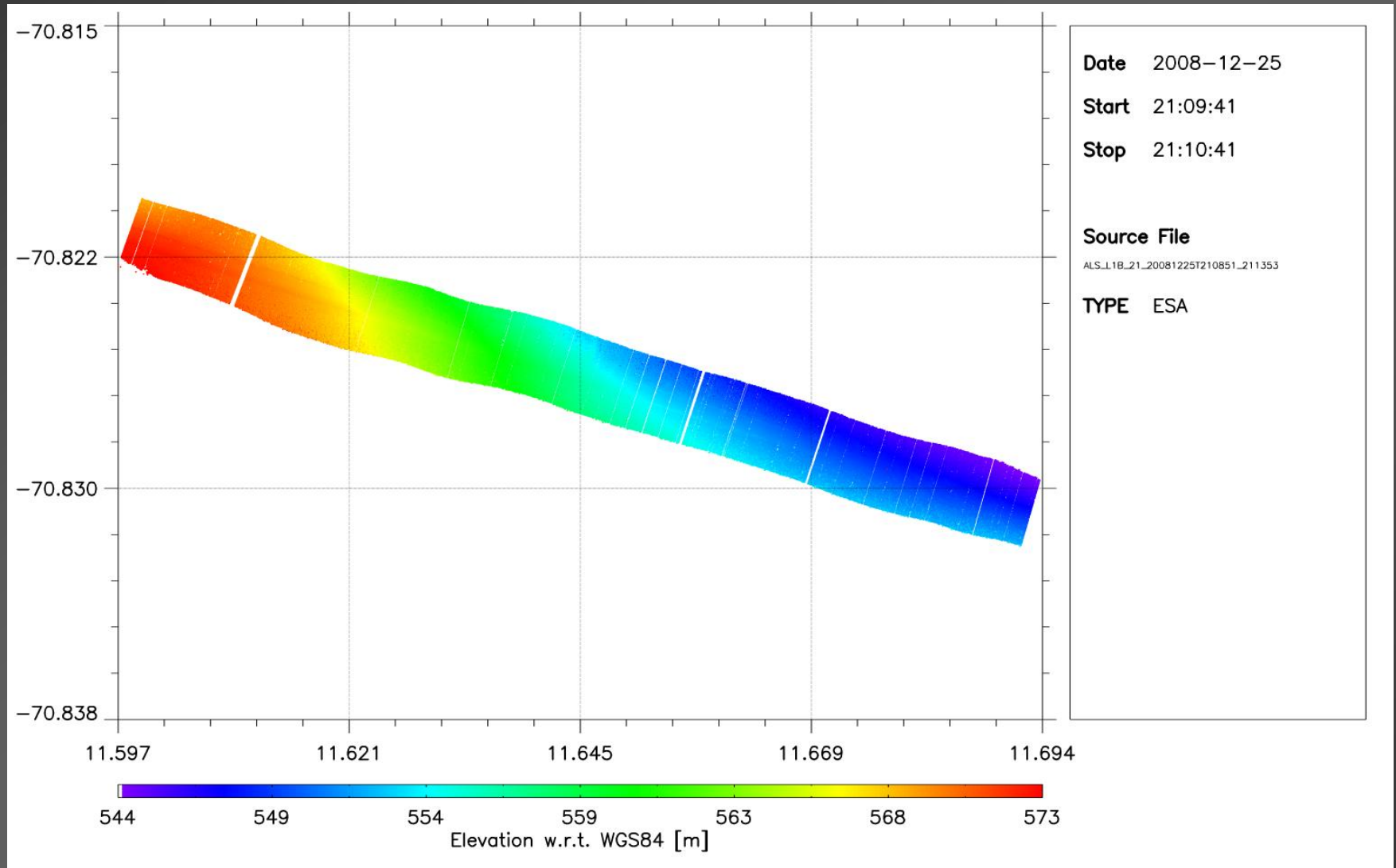
■ Squint angle corrected

Difference: 0.03 ± 0.05 m

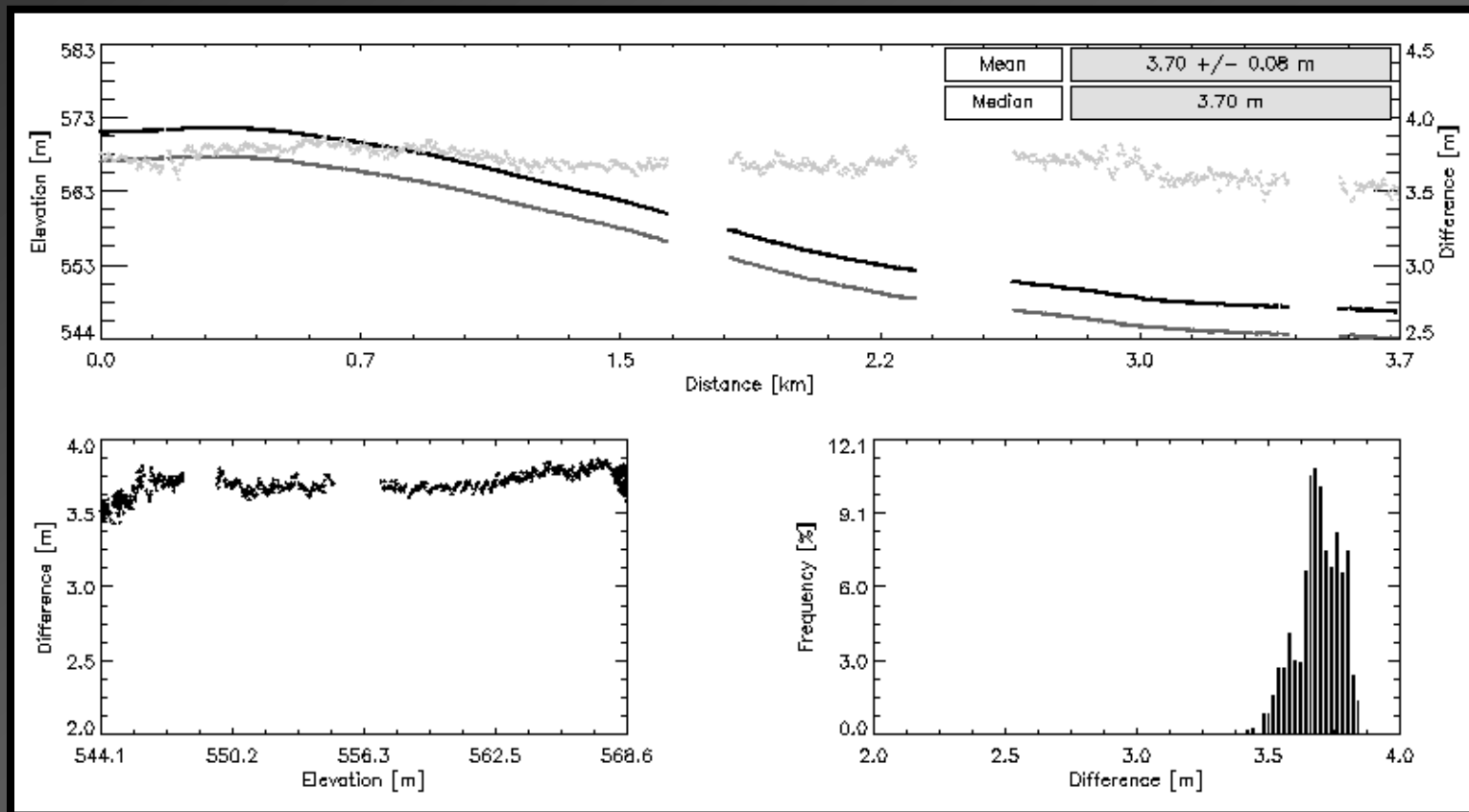


Runway calibration

ALS elevation model of runway at Novo Airbase



Runway calibration

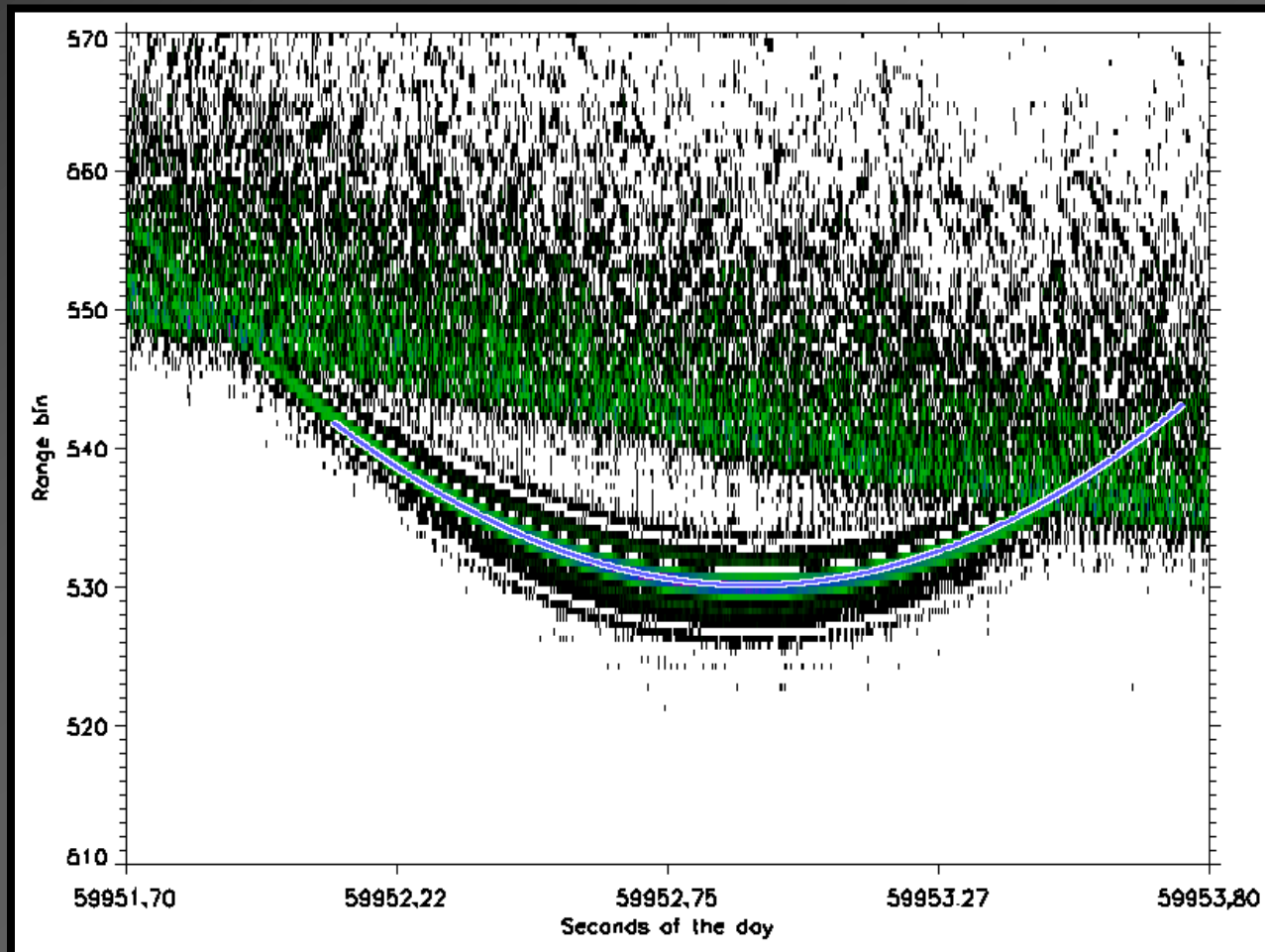


Profile	Time start	Time stop	Tshift [s]	Mean [m]	Median [m]	Stdv [m]	Remark
A081225_21	76181	76264	0.0	3.31	3.32	0.11	TSRA
A081225_21	76181	76264	0.0	3.57	3.58	0.11	OCOG
A081225_22	76635	76705	0.0	3.44	3.44	0.08	TSRA
A081225_22	76635	76705	0.0	3.70	3.70	0.08	OCOG

Methods to determine the datation error

1. Corner reflector analysis
2. Comparison with ALS elevation model

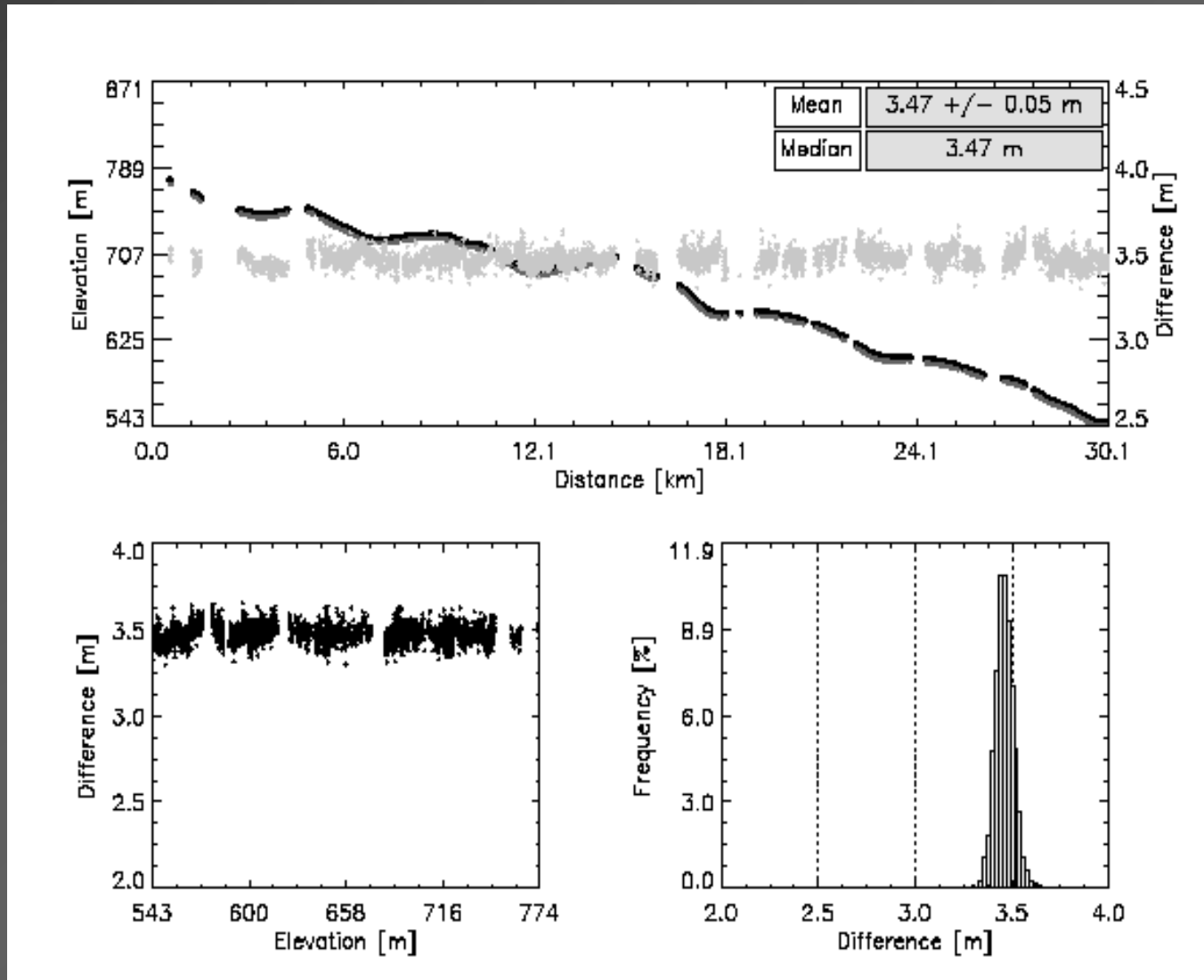
Best fit of simulated hyperbola to raw data



CR	Profile	Closest approach [m]	Time [Seconds of day]	Time shift [s]
08CY4U8	A081225_07	1.36	59952.81	0.00

Datation - ALS

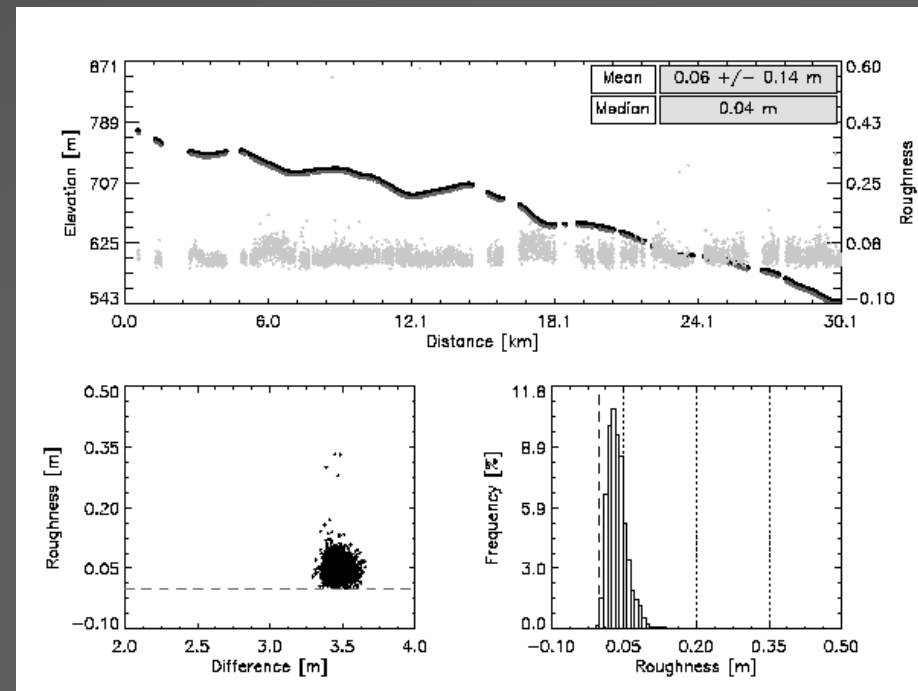
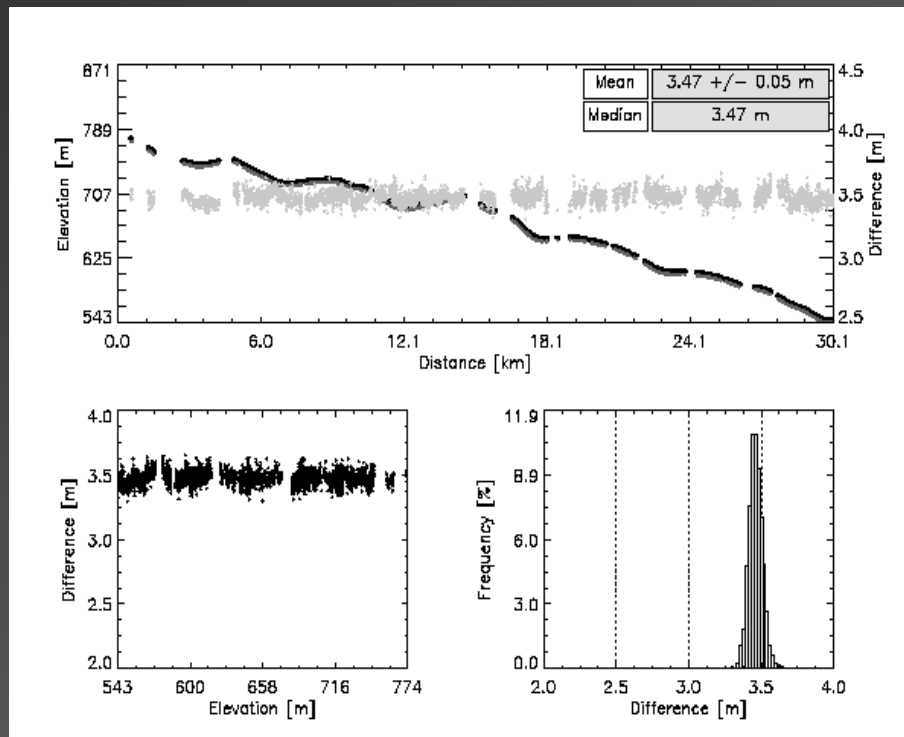
Comparison of ASIRAS and ALS elevation without time shift correction



Calibration Summary

- AWI processed L1B product as requested by ESA
(Processor version ASIRAS_04_02)
- Runway calibrations show not the same offset
- Offset is depending on retracker algorithm
- ASIRAS L1B data contains **no** datation errors
- Quality in general good but:
ALS shows data loss, due to hardware problems

Comparison of ASIRAS with ALS DEM



Difference of ASIRAS to ALS DEM (m)

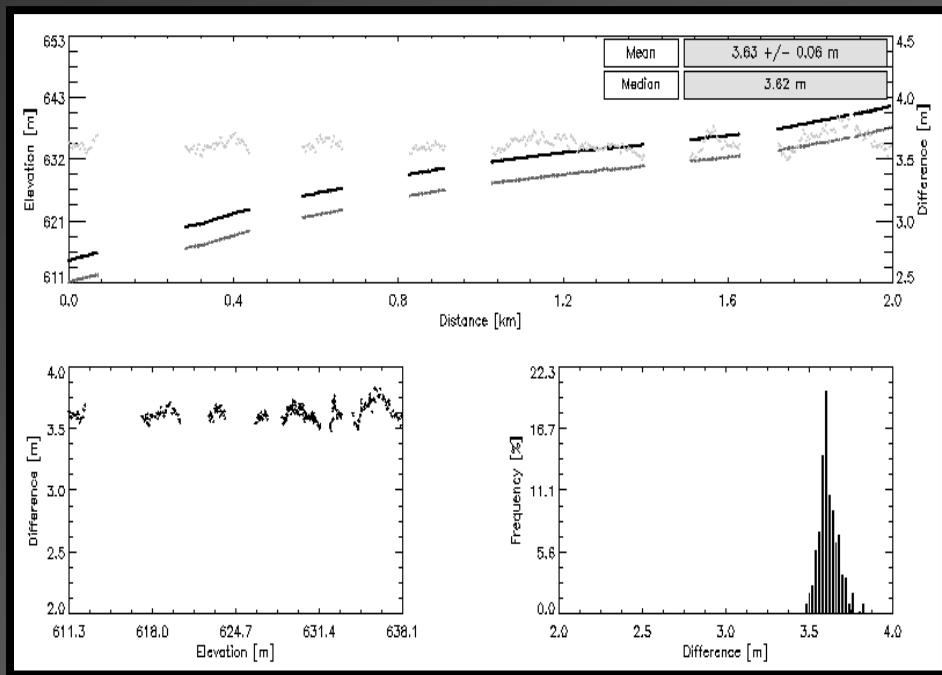
Median	Mean	Stddv
3.47	3.47	0.05

ASIRAS Footprint Roughness (m)

Median	Mean	Stddv
0.04	0.06	0.14

Accuracy of ASIRAS and ALS

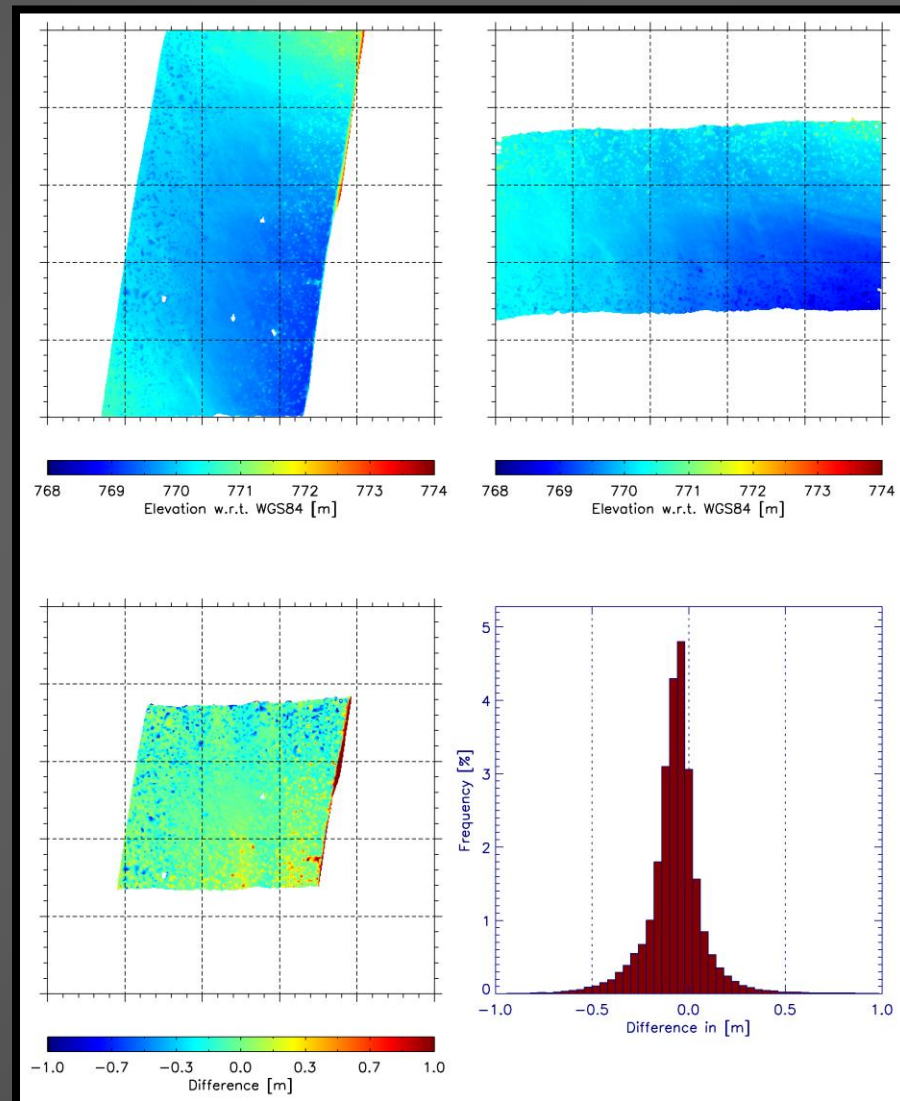
Comparison of ASIRAS and ALS



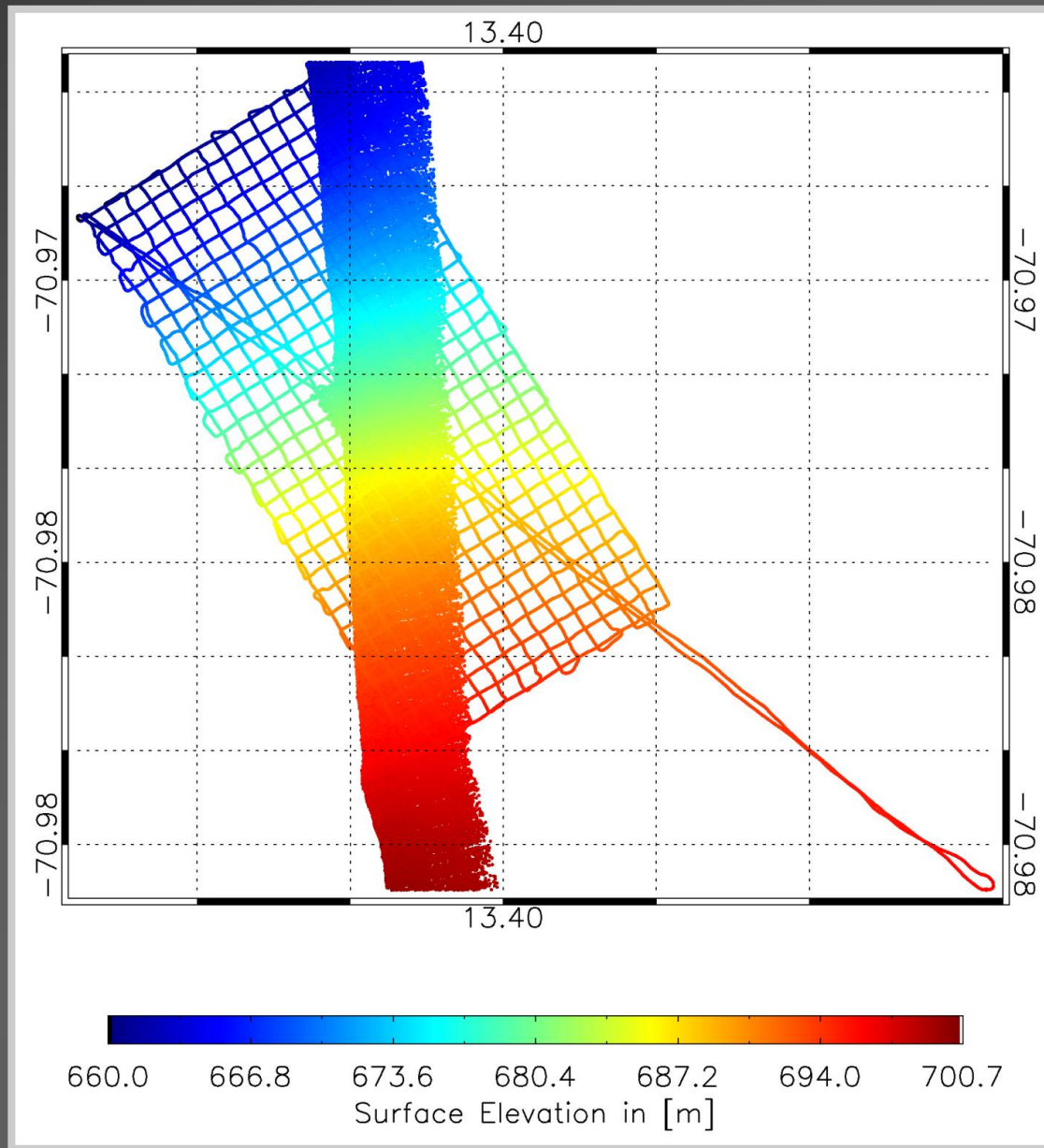
Accuracy of ALS: +/- 0.20 m

Accuracy of ASIRAS: +/- 0.10 m

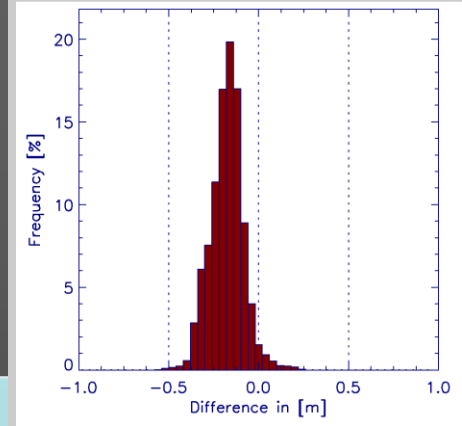
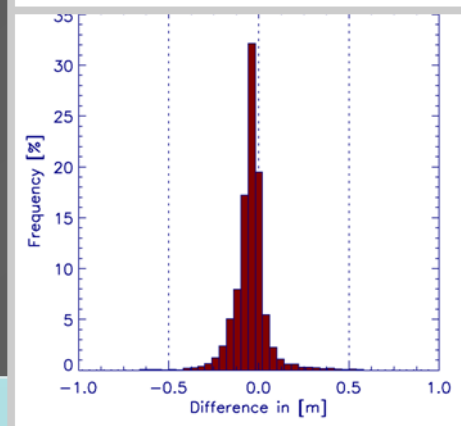
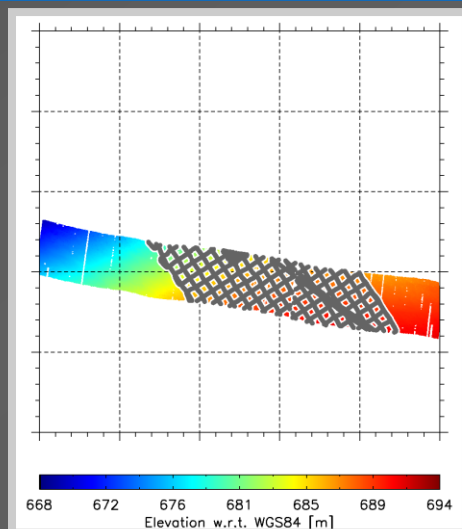
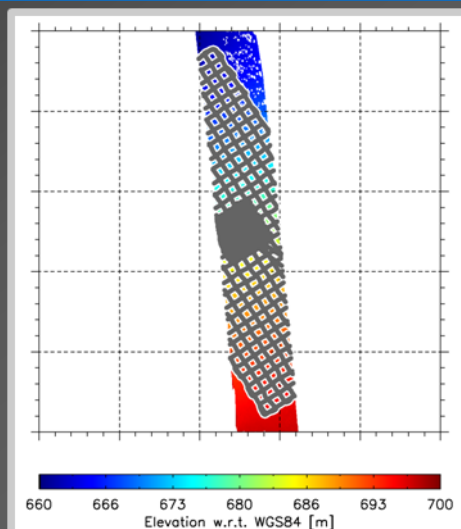
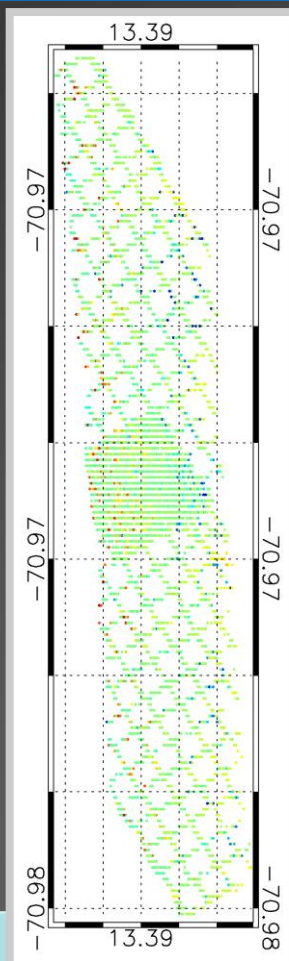
Comparison of two crossed ALS-DEMs



Comparison of ALS 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 – GPS Difference (m)

-0.06

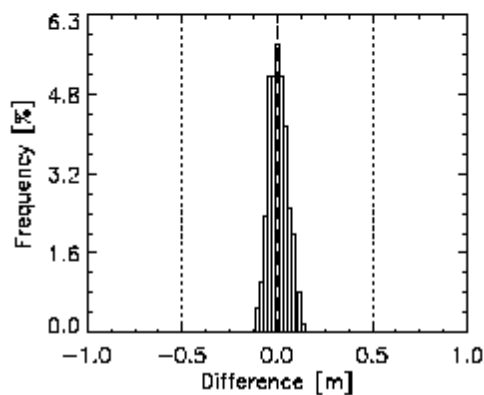
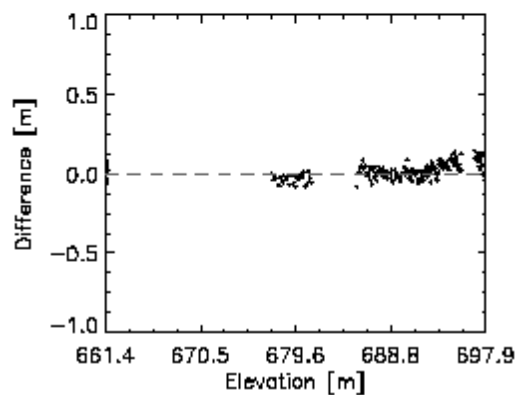
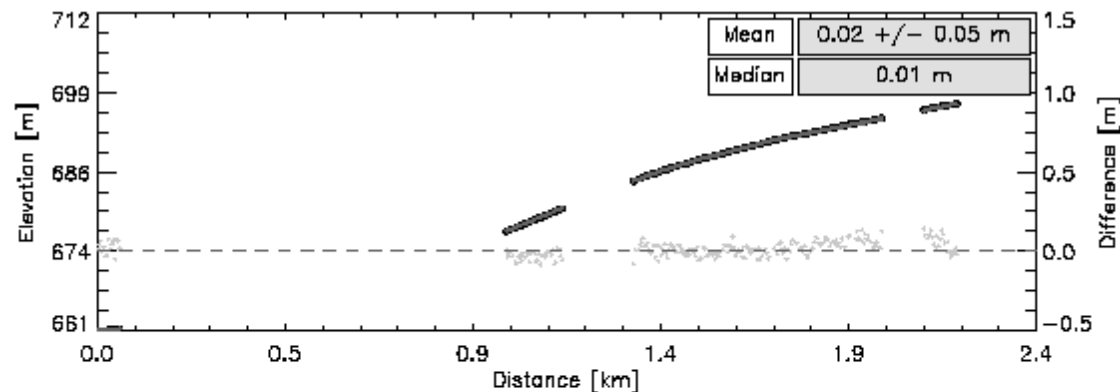
-0.20

Stddev DEM – GPS Difference (m)

0.09

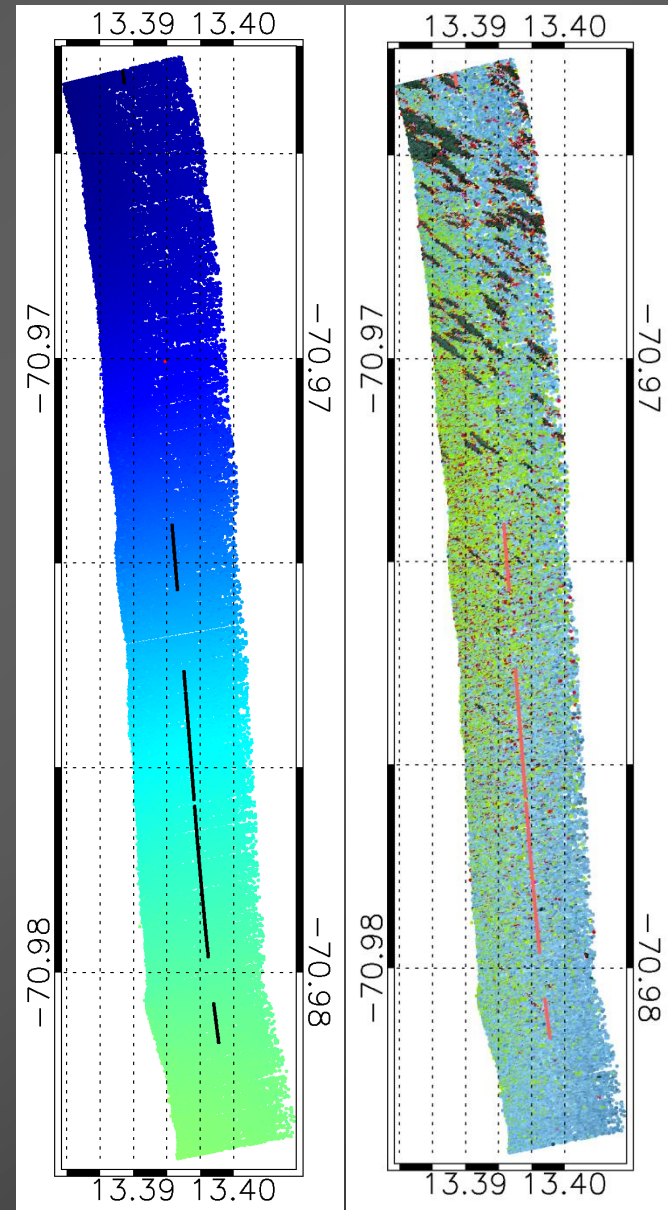
0.09

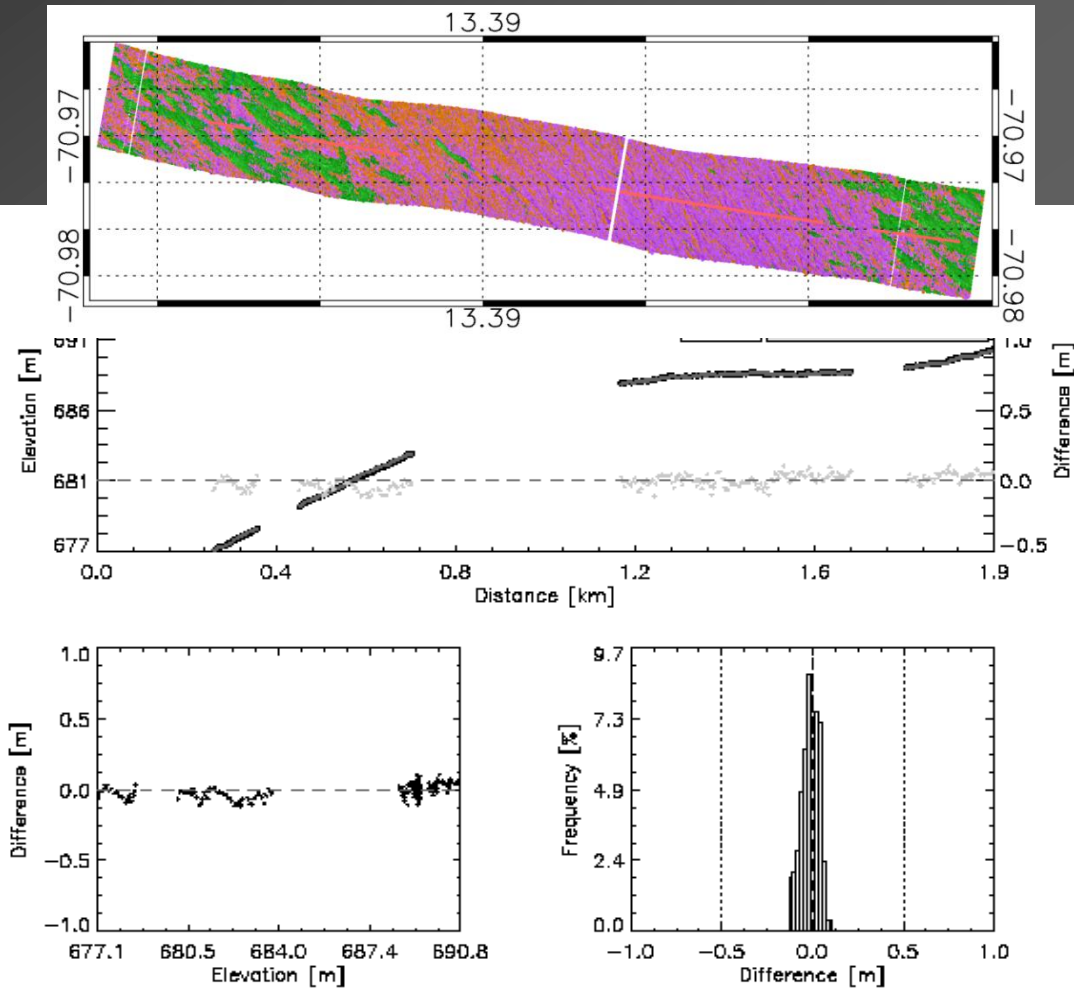
Comparison of ASIRAS with laser DEM



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

0.00

Mean

0.00

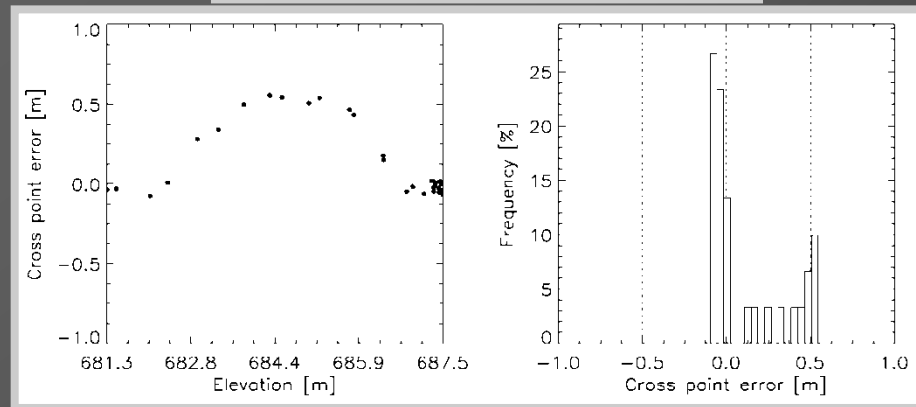
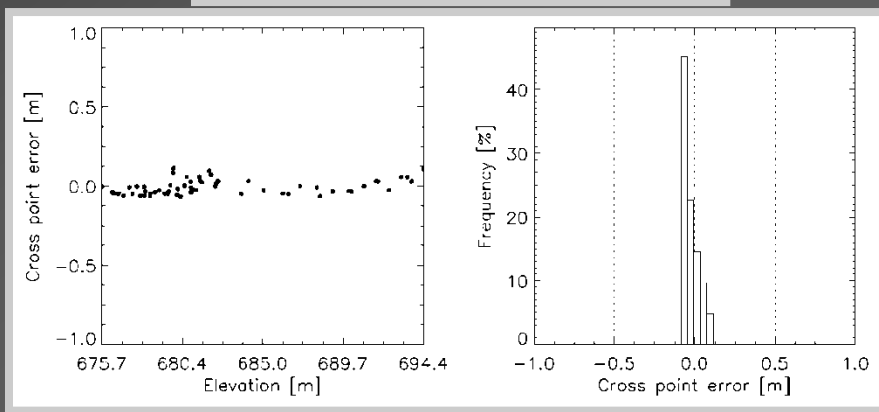
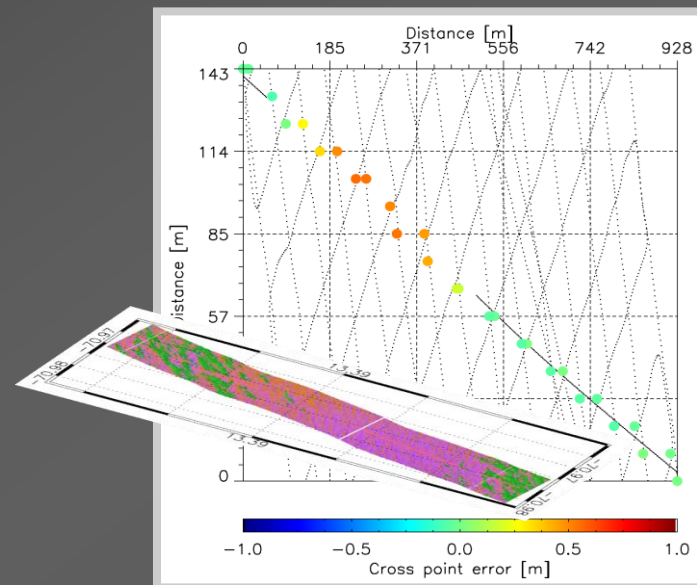
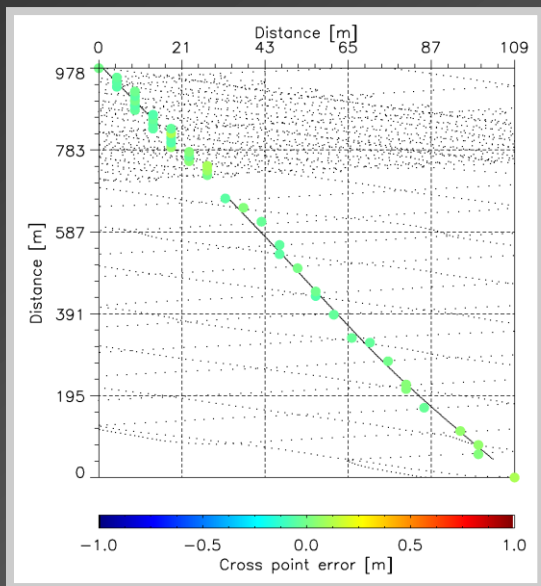
Stddev

0.05

Roughness

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

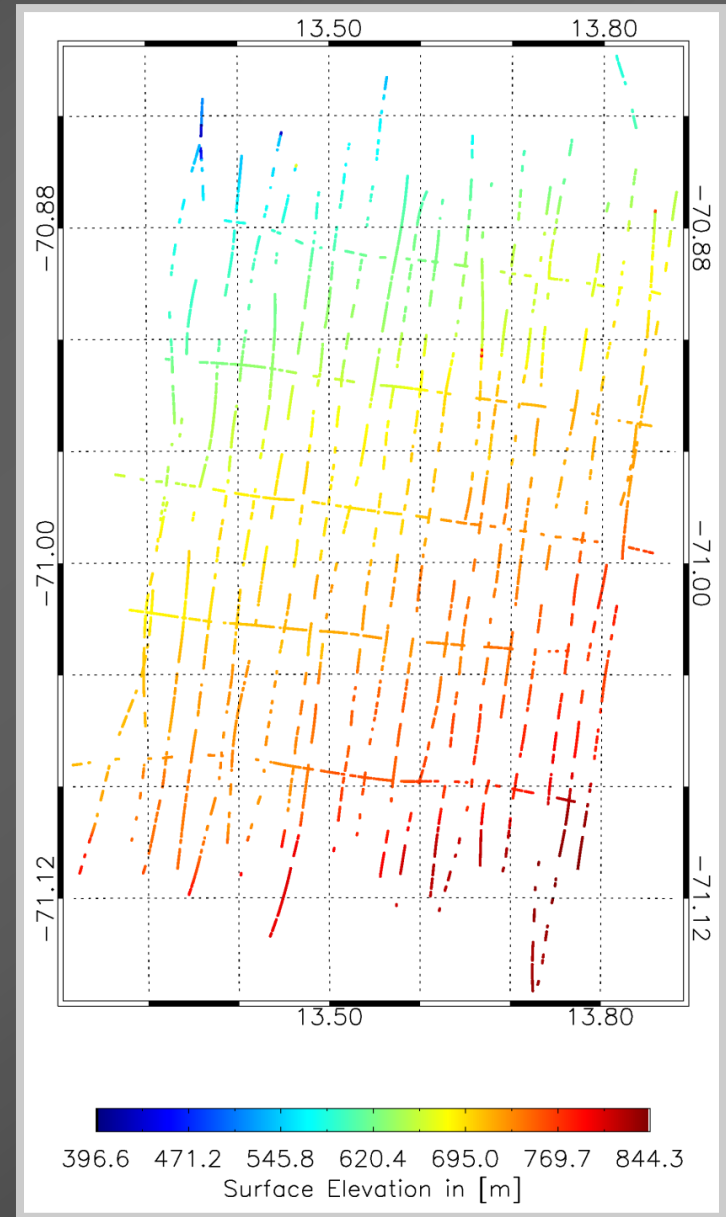
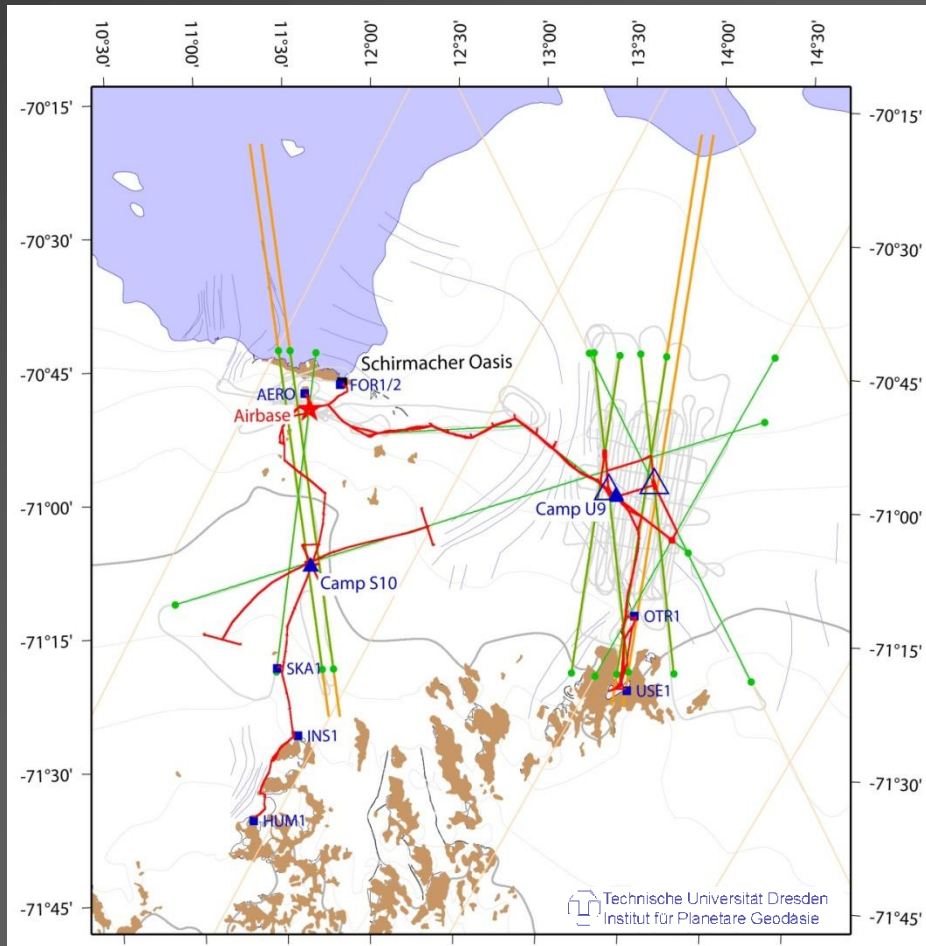
CP error of ASIRAS to GPS (m) – snow patches

Median	Mean	Stddev
-0.00	0.13	0.23

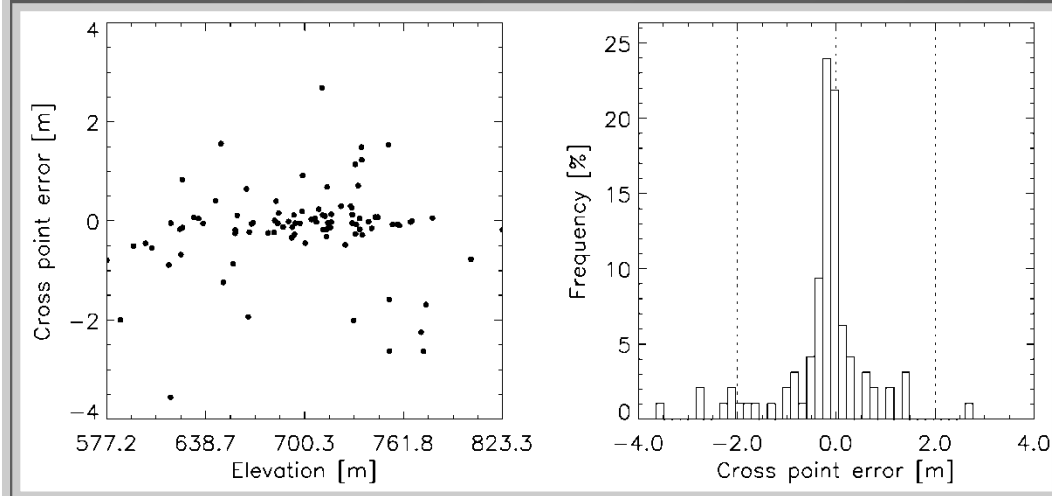
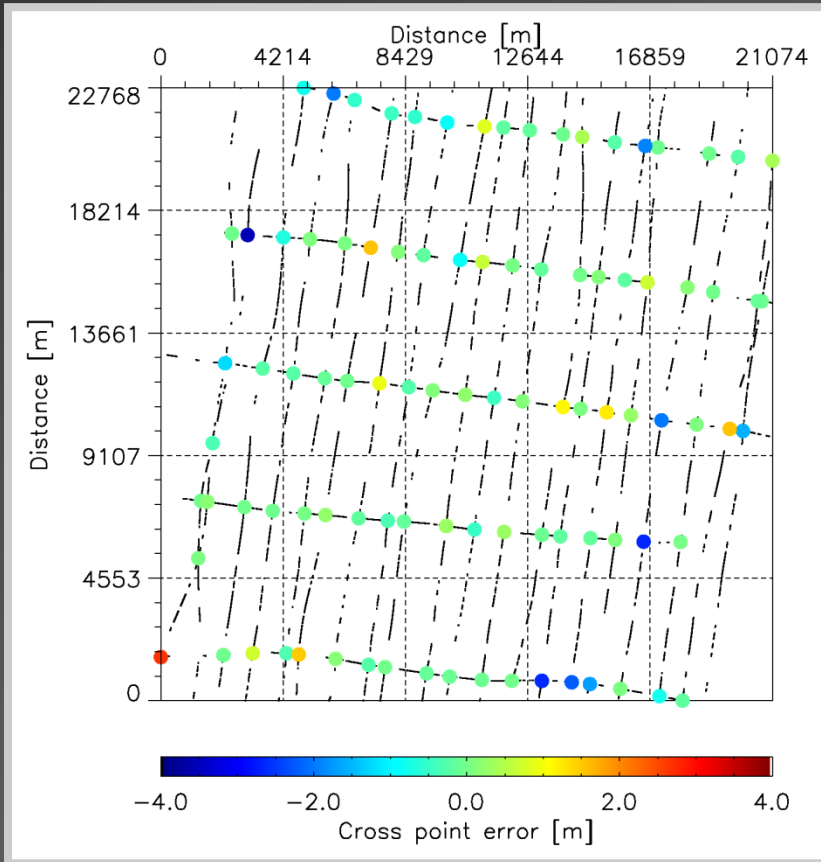
Cross point analysis of ASIRAS Grid

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

-0.05

Mean

-0.17

Stddev

0.89

Conclusions

- Campaign was successful and acquired data set is a good basis for coming CAL/VAL activities in this area
- Accuracy of ASIRAS is better than 10 cm over Blue Ice
- Small Snow patches in blue ice seem to be transparent for ASIRAS
 - Systematic underestimation of airborne radar altimeter elevation due to preferential sampling of blue ice
 - Further activity necessary to get more info about the Radar penetration
- GPS reference grids are necessary for the validation of CryoSat
- Blue ice areas might be of interest as validation sites for other Satellite missions