

Absolute calibration of radar altimeters On lake Issykkul from GPS field campaigns



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OSTST, 2014, Konstanz, Germany

Legos (FR)
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OSU (USA)
UNC (USA)
Univ La Rochelle (FR)
GRGS (FR)
DGEO (CH)

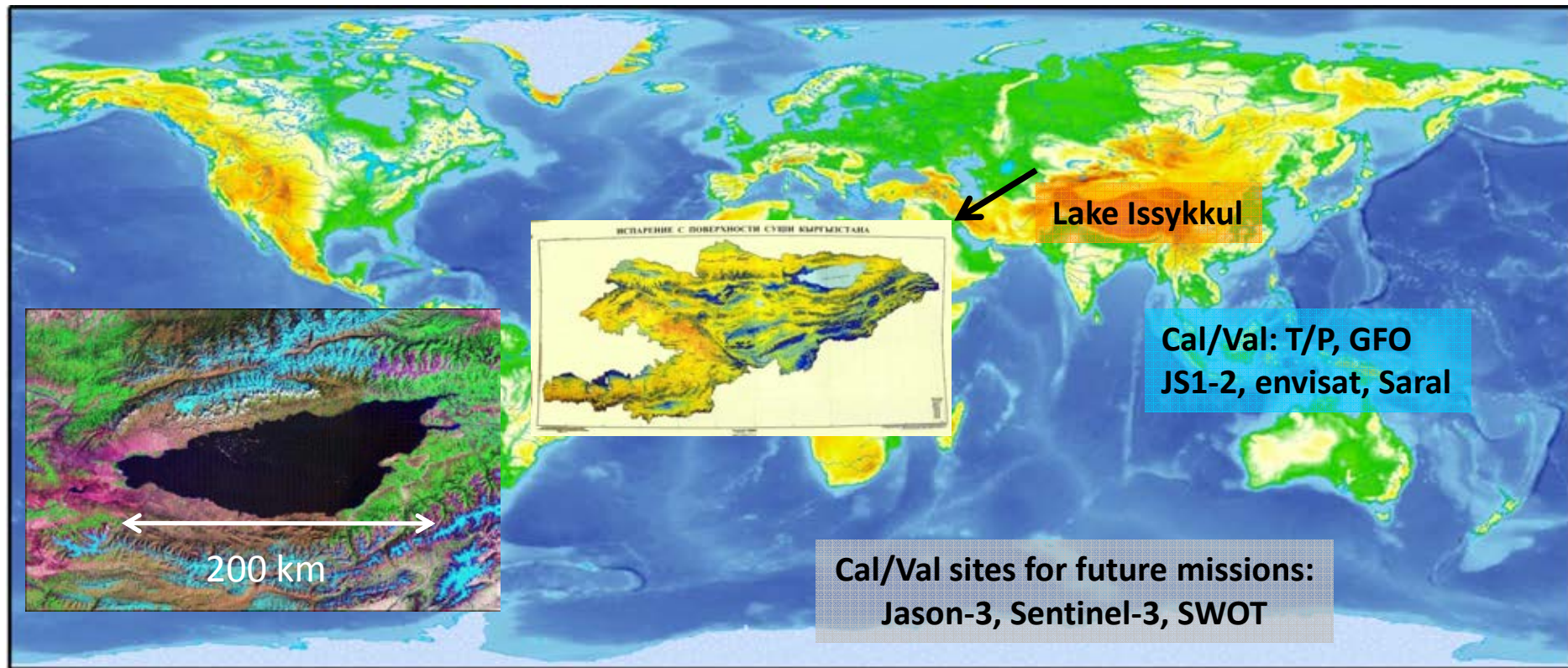
Cal / Val of radar altimetry on the Lake Issykkul

Framework project:

Initiated in 2004 by a NATO project between France and Kyrgyzstan

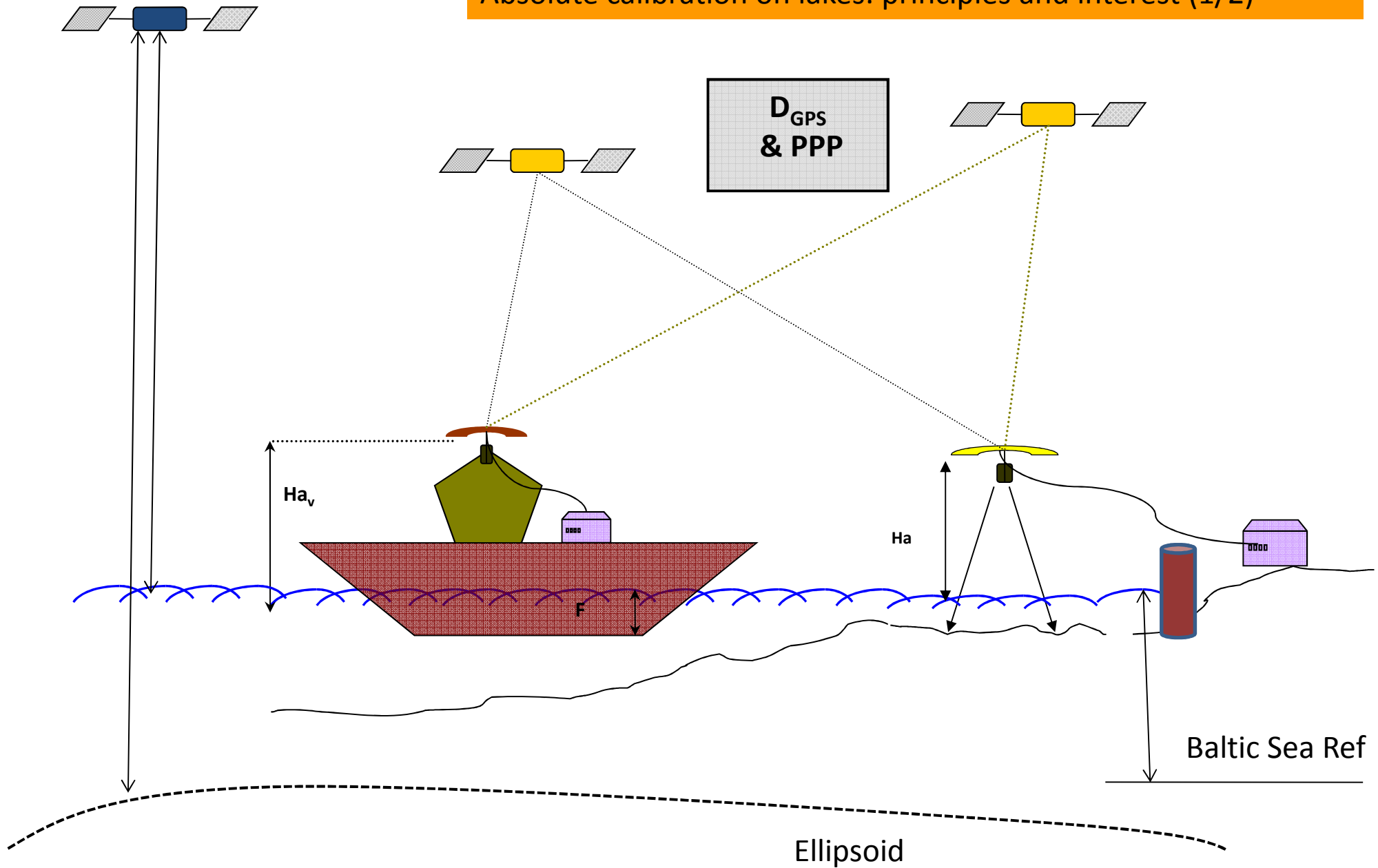
Continued in 2008 by a CNES/TOSCA project for contribution of France to C/V of altimeters: FOAM

Headed by P. Bonnefond including ocean, lakes and rivers sites



Cretaux et al., 2009, 2011, 2013

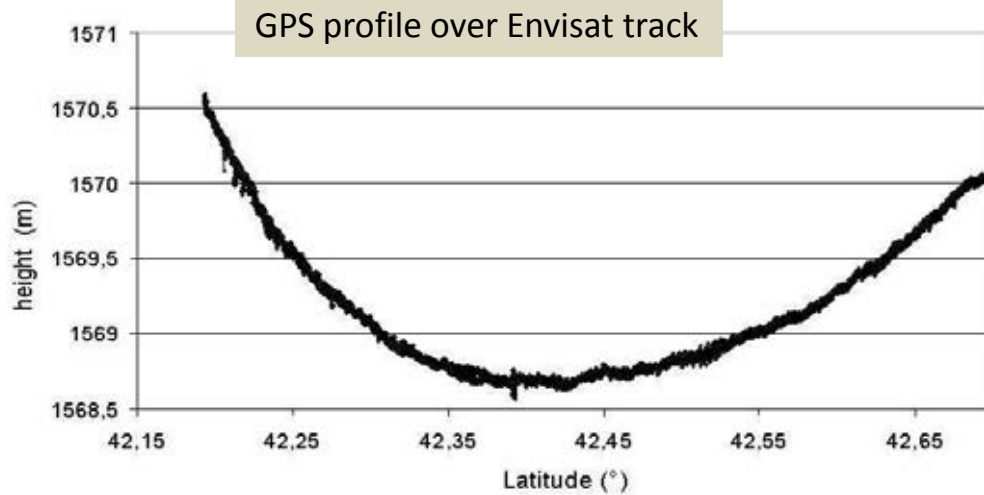
Absolute calibration on lakes: principles and interest (1/2)



Absolute calibration on lakes: principles and interest (2/2)

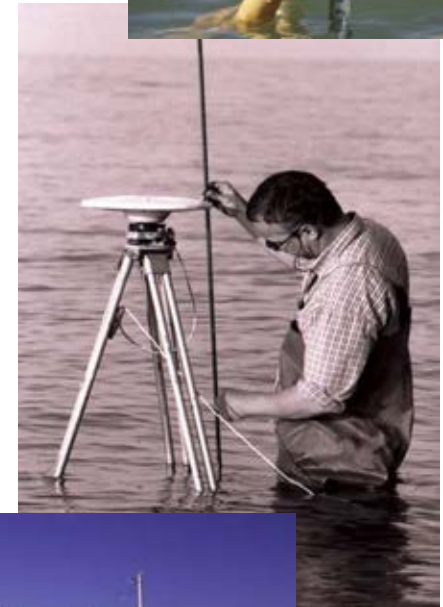
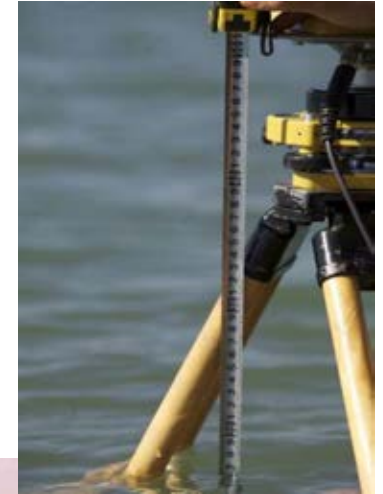
Why lake Issykkul?

- Waves, Electromagnetic Bias, tides and inverse barometer negligible
- In-Situ data available (level gauges, weather stations) and vessels (Multur, Storm, Meridian)
- Large enough for Multi satellite calibration on one site
- Assessment of performance of retracking algorithms
- densification of absolute calibration sites in continental area / oceanic sites
- Reference lake surface for height and slope validation of the future SWOT mission

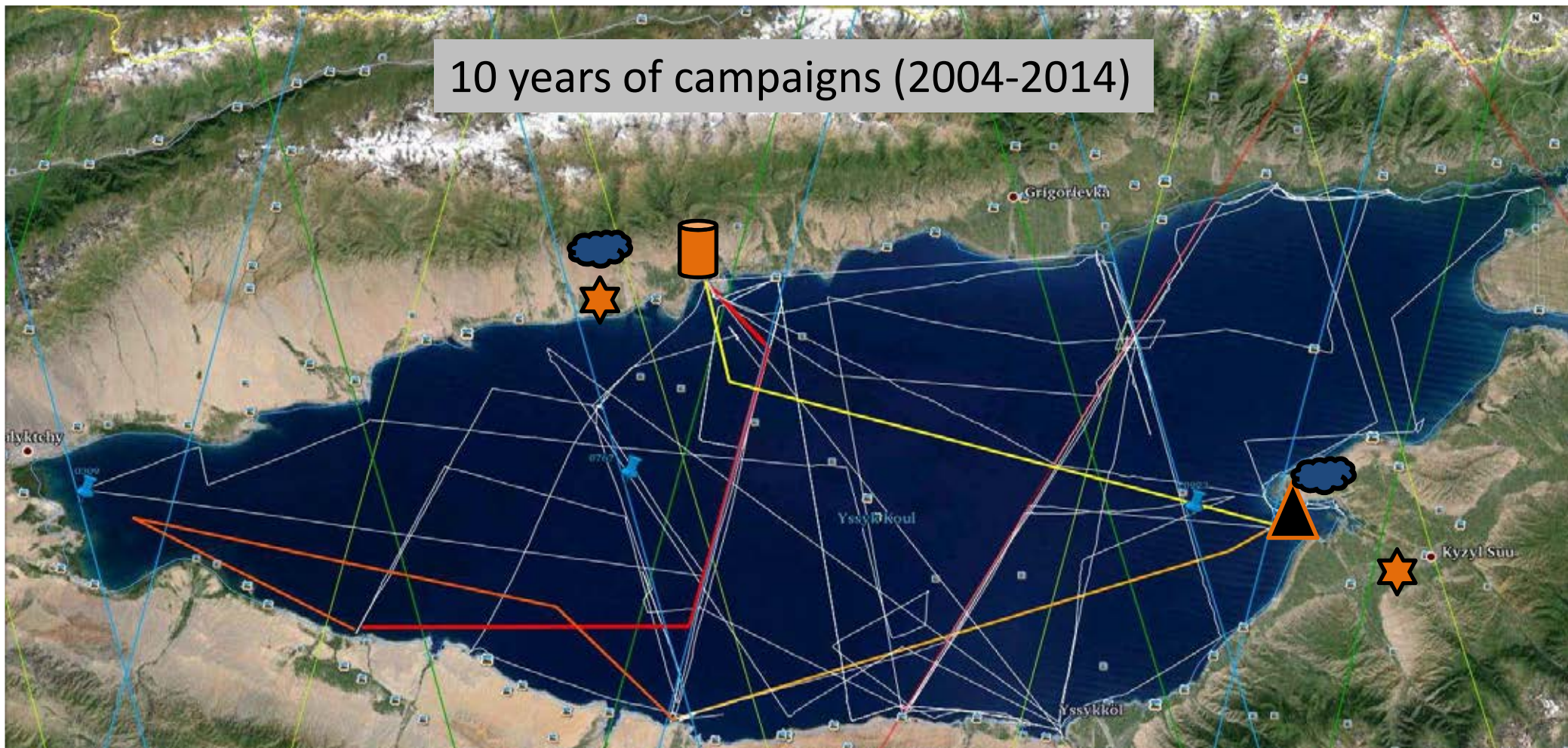


Principal sources of errors

- Wet tropospheric correction
- Antenna height errors (velocity of the vessel)
- GPS errors
- Seiches over lakes



10 years of campaigns (2004-2014)



Gauge for water level



Historical hydro-meteo station



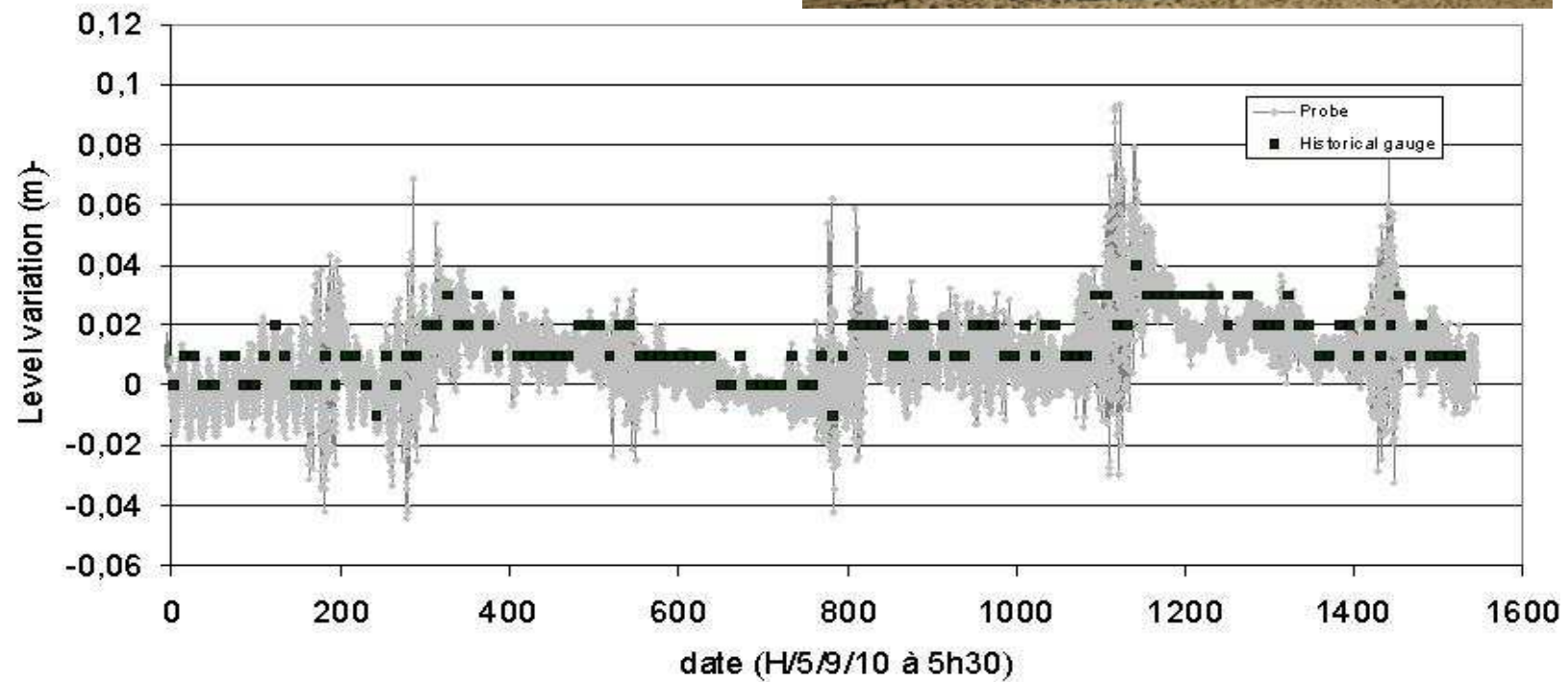
Permanent GPS stations



Weather stations

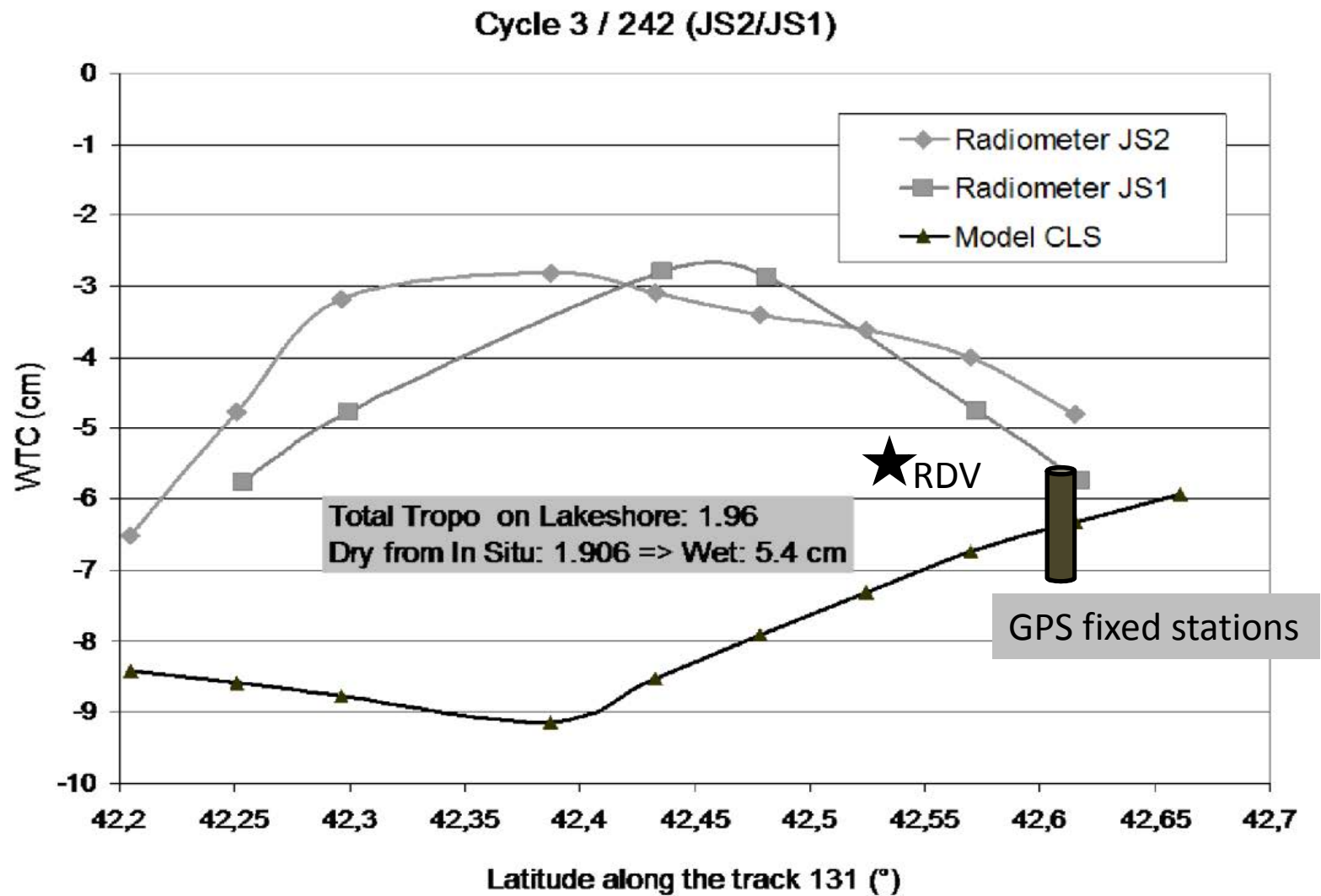
1 nominal and 1 interleaved T/P (JS1-2-3) track, 1 GFO track,
6 Envisat (Sara) tracks, 8 Icesat-1 tracks, 4 sentinel-3 tracks

Error reductions by successive improvements on the ground procedures (1/3)



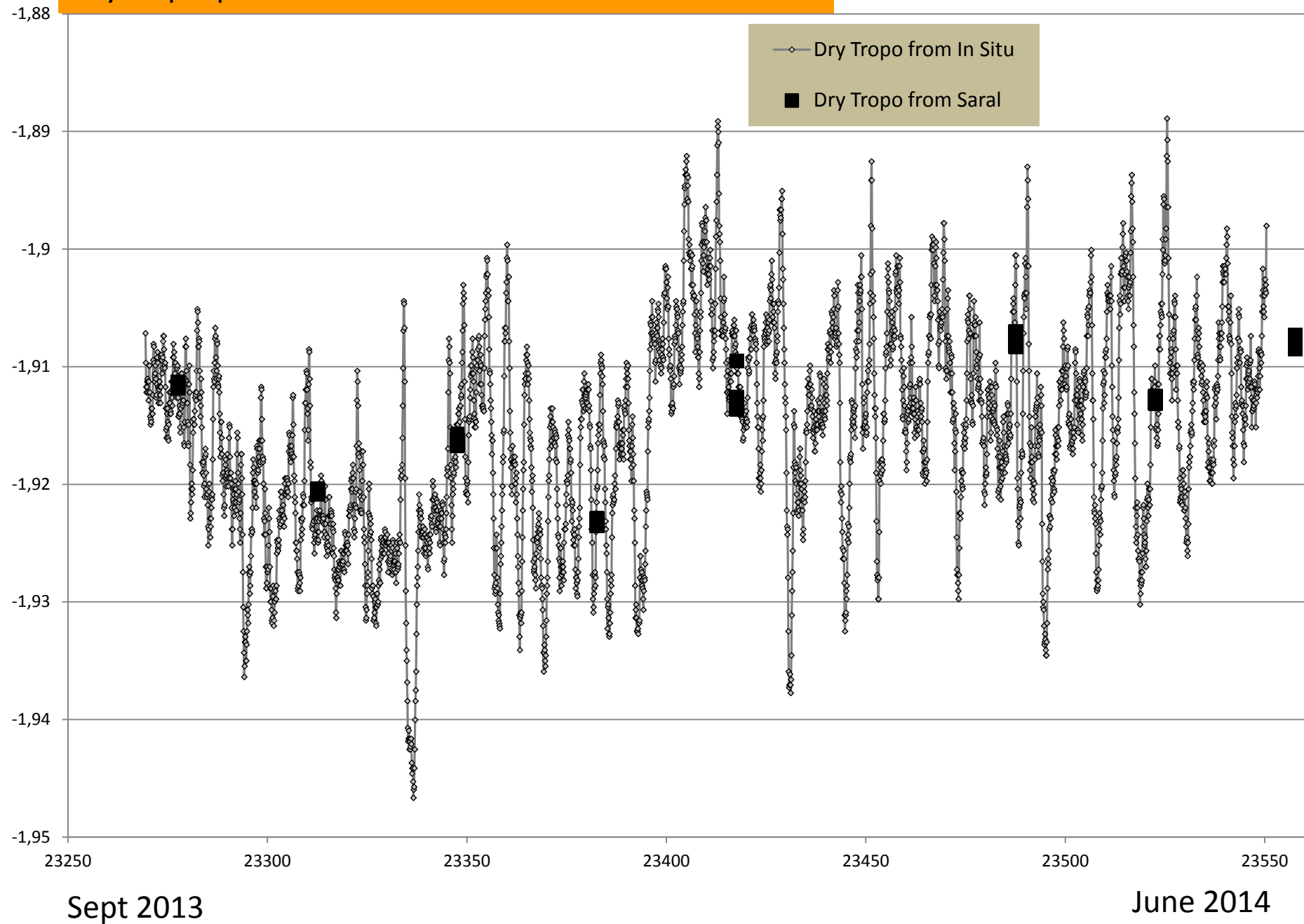
After 2009, GPS measurements are collected along the track at the time of the pass of the satellite

Error reductions by successive improvements on the ground procedures (2/3)



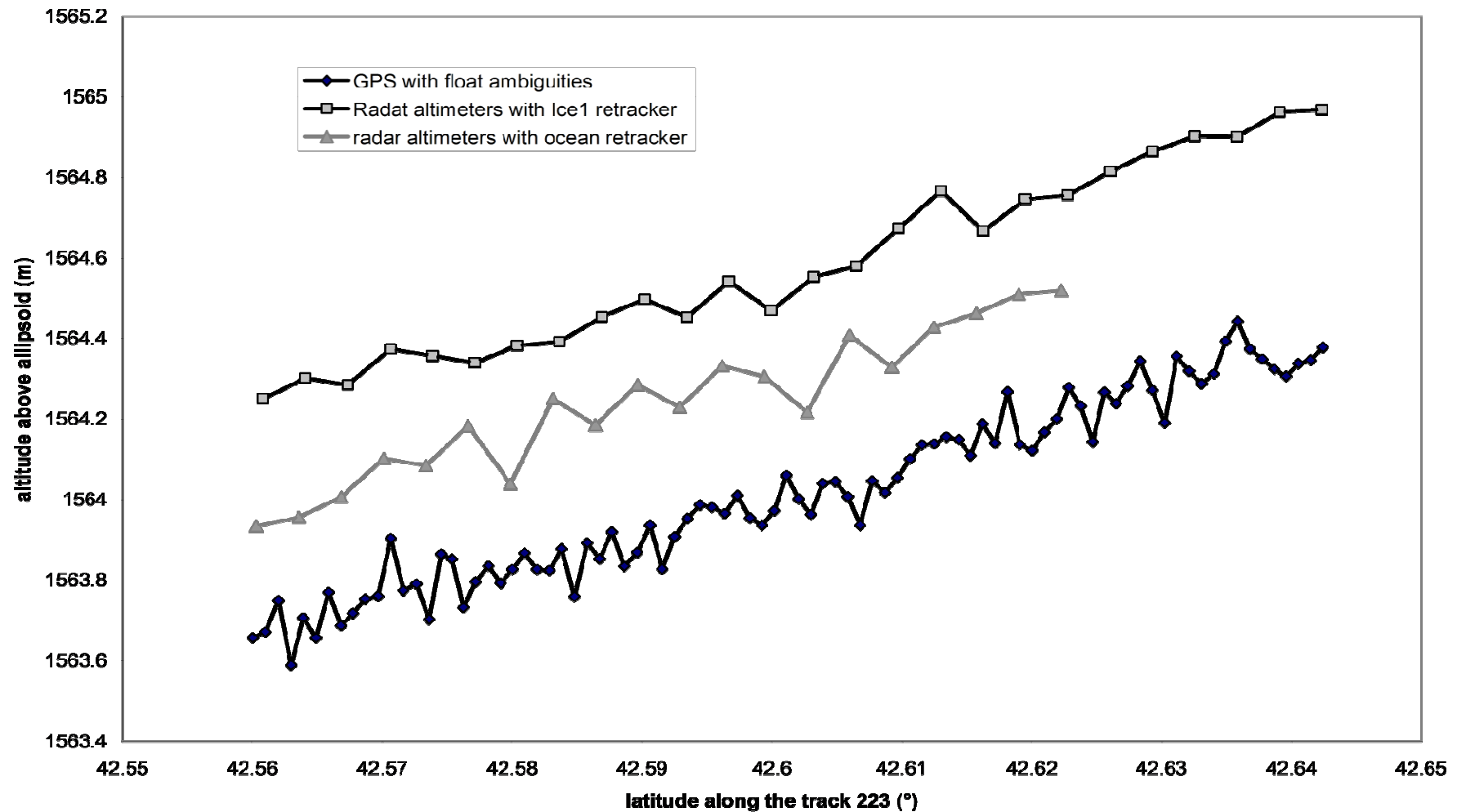
Averaged differences of 2-3 cm for 4 campaigns. GPS derived WTC is chosen after 2009

Dry tropospheric c orrection error's assessment

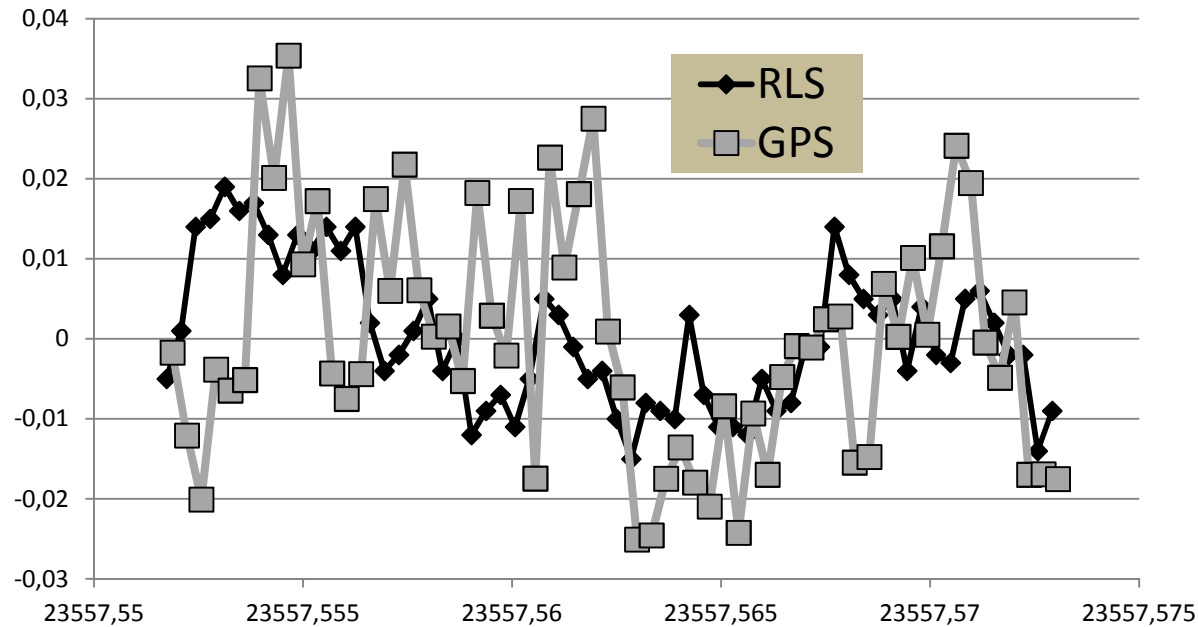


Altimeter bias of Envisat Satellite from two field campaigns in 2009

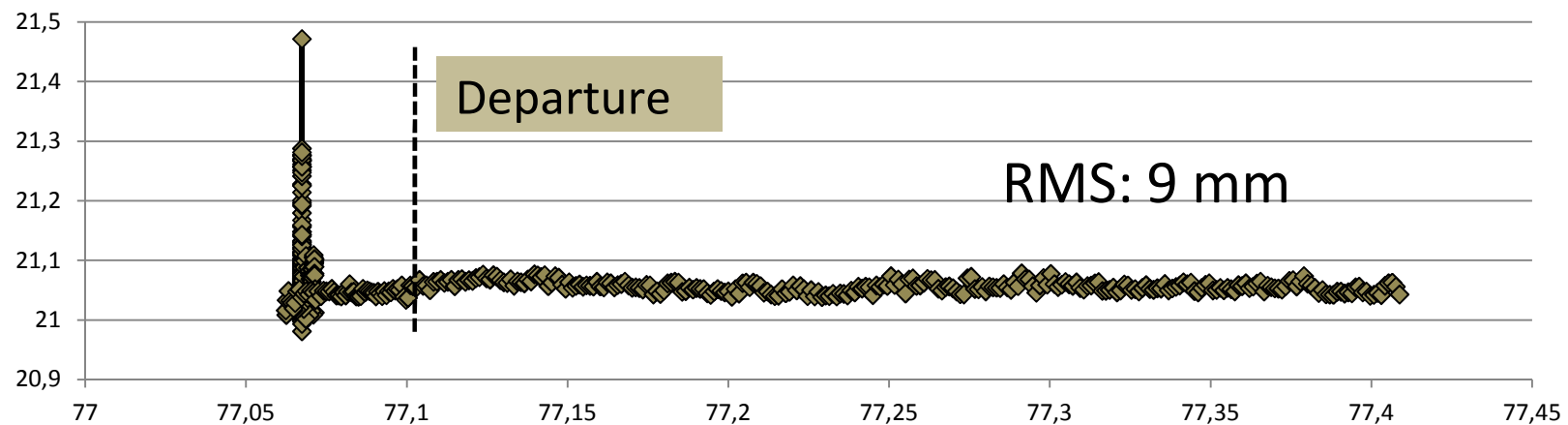
The absolute bias is comprised between 62.1 and 63.4, using the *Ice-1* retracking algorithm, and between 46.9 and 51.2 cm with the *ocean* retracking algorithm with a standard deviation of 3.7 cm



Error reductions by successive improvements on the ground procedures (3/3)

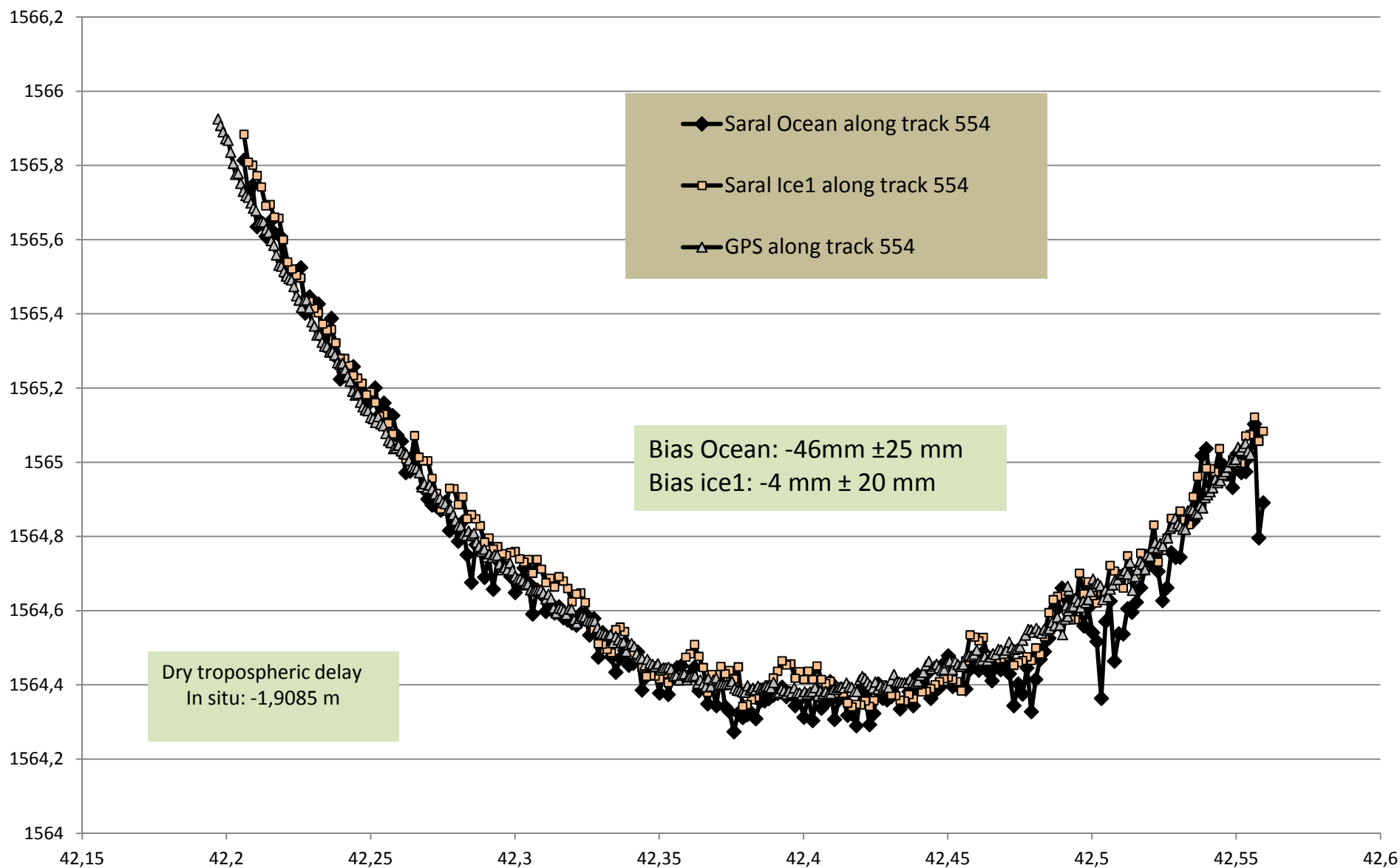


Distance (m) between GPS antenna onboard the vessel

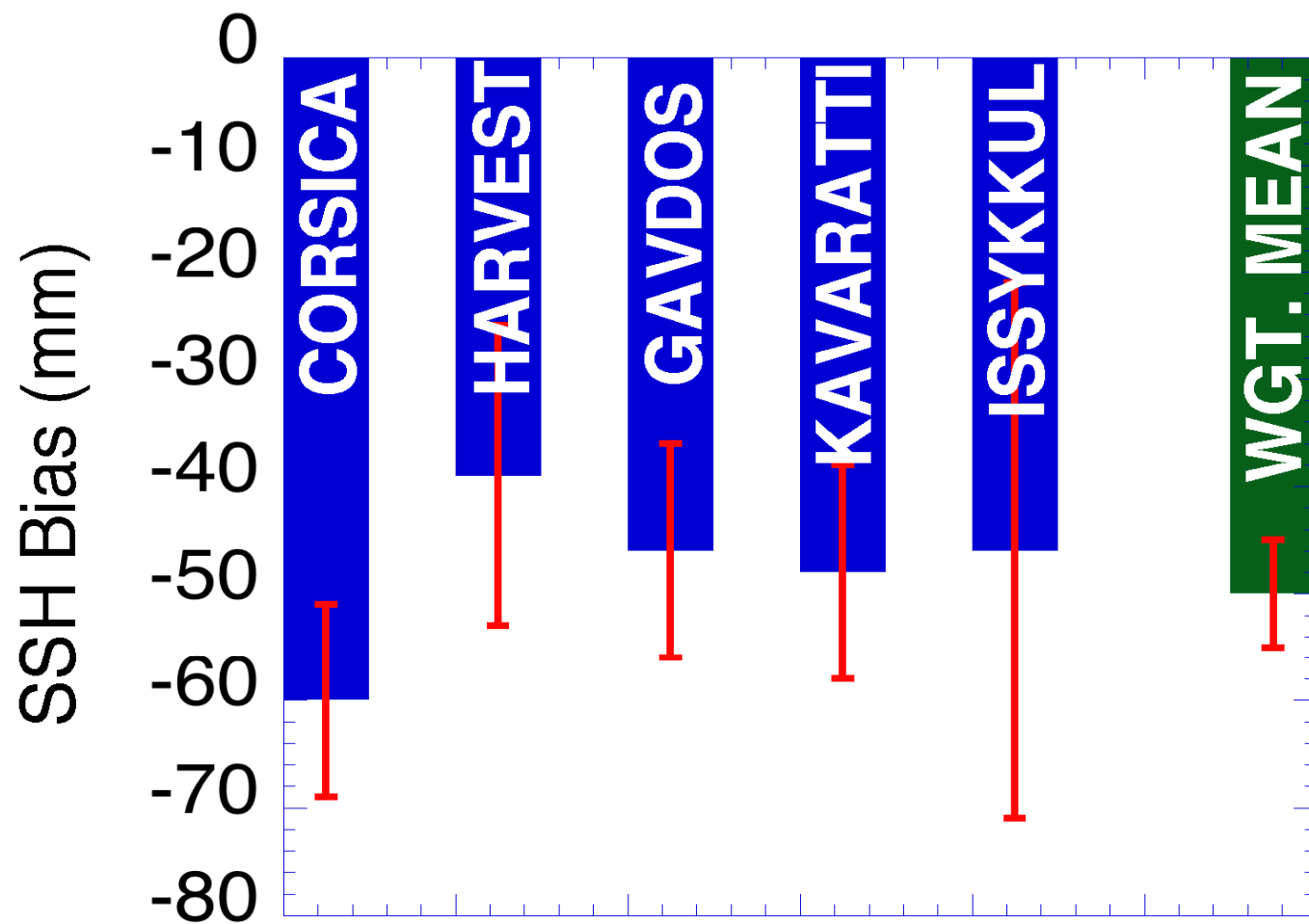


New procedure for height antenna measurements applied over the last campaign in June 2014

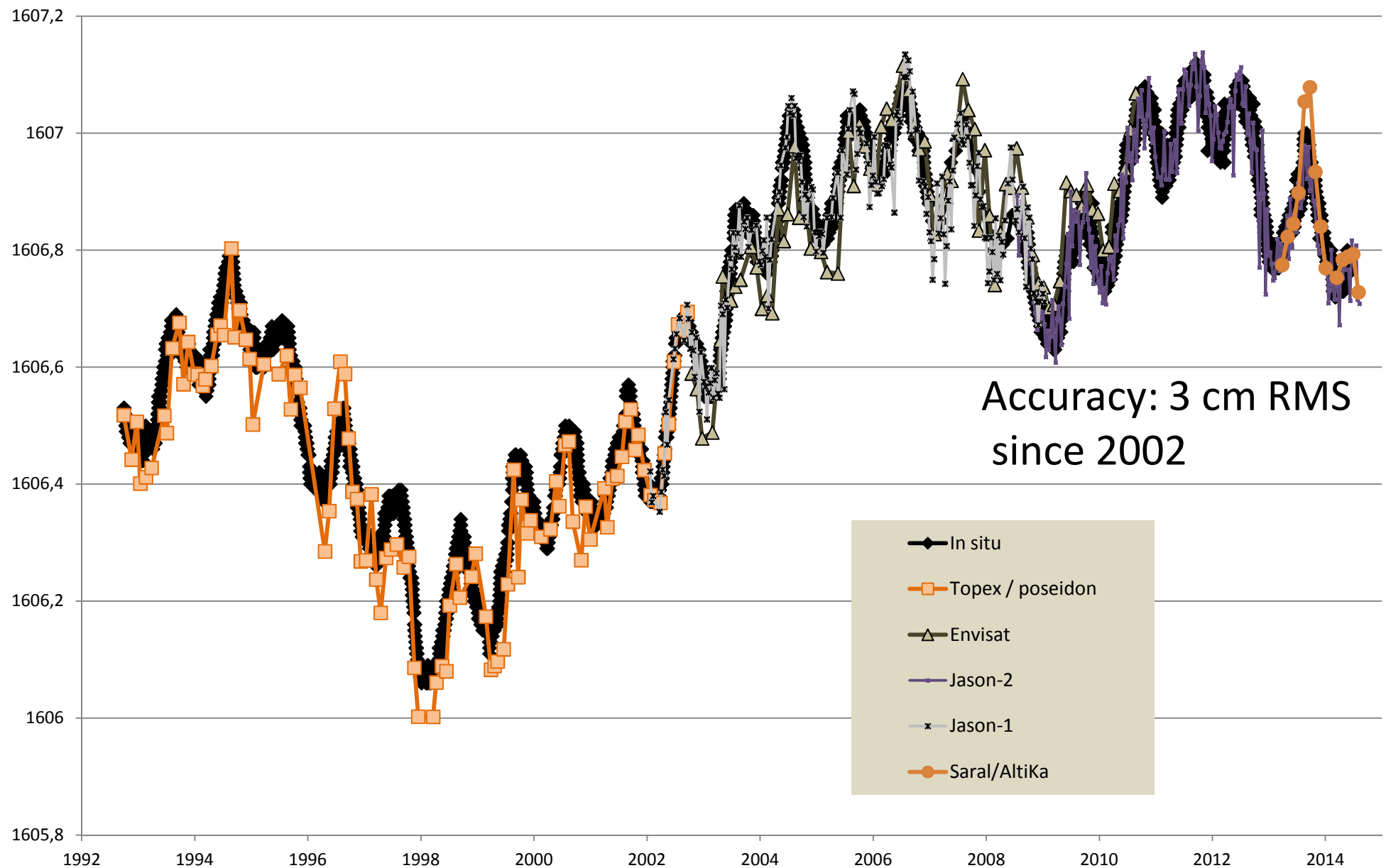
Altimeter bias of AltiKa from the field work in June / July 2014



Altimeter bias of AltiKa from different Cal / Val sites

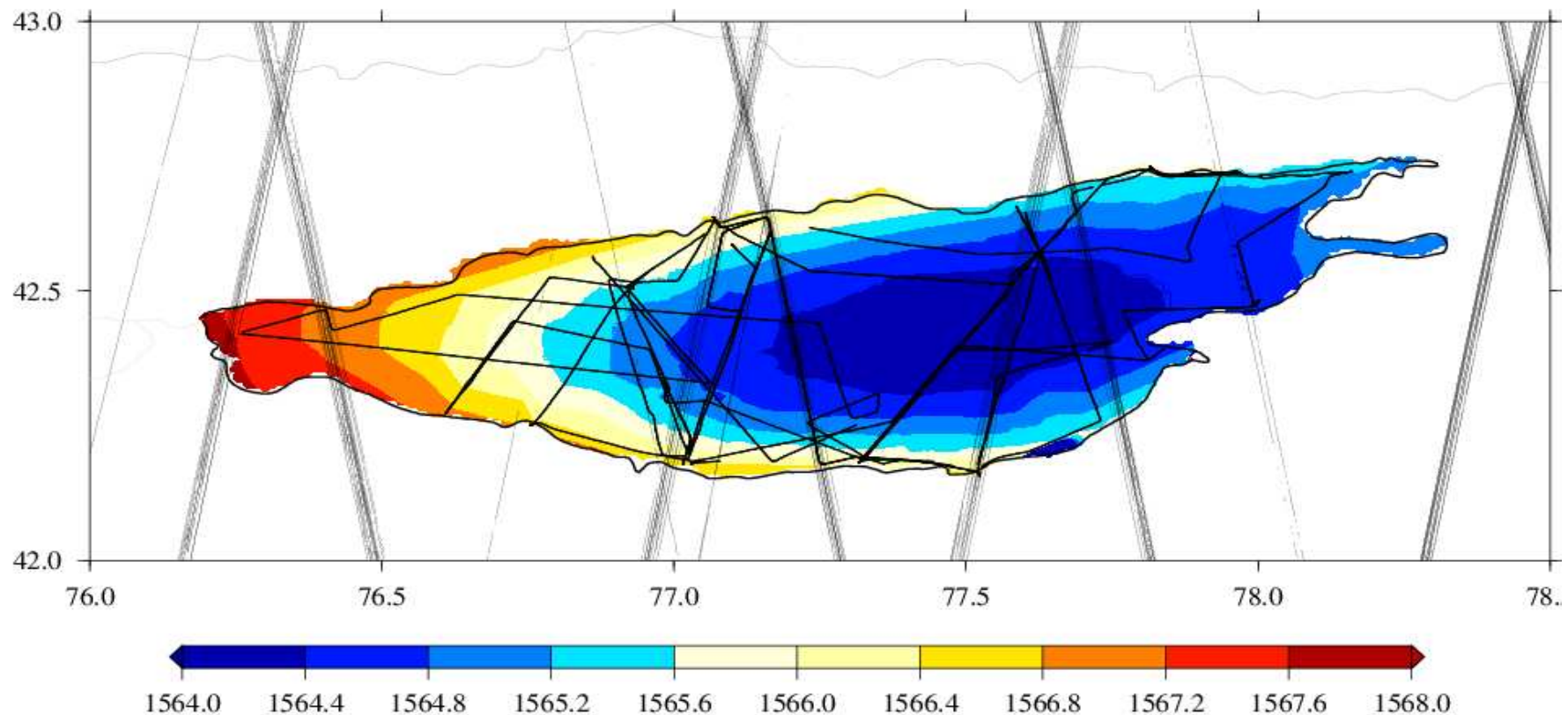


Comparison Altimetry / In Situ



Mean lake surface from GPS campaigns (2004-2010) & Icesat data (2003-2009)

- Internal consistency of the GPS measurements: 2 cm RMS at the cross over points after the removal of the hydrological signal
- Icesat mean vertical profiles calculated over 8 tracks with 2 cm RMS w.r.t GPS profiles at the cross over points



To be continued with campaigns in 2012, 2013, and 2014
Cal/Val of SWOT mission for height and slope

Conclusions and perspectives

Absolute calibration of altimeters:

- ✓ From first experiment in 2004 until the last campaign in June 2014, the Lake Issykkul became an altimetry C/V site for multi-mission purposes
- ✓ Many solutions have been carried out to mitigate the various sources of errors (Wet tropo remains the main problem)
- ✓ Absolute bias of past missions in agreement with ocean C/V sites including Saral

Use of satellite altimetry for lakes:

- ✓ Different sources of errors have been identified over each mission (atmospheric corrections, retracking algorithms)
- ✓ Long term multi-satellite lake monitoring at 3 cm accuracy is reachable

Future works

- ✓ C/V of Sentinel-3 and Jason-3
- ✓ Calculation of a mean lake surface using all existing data in the framework of SWOT C/V