

# 14 years of Absolute calibration of satellite altimeters on Lake Issykkul from GPS field campaigns

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Perosanz (CNES / GET), the crew of the Multur, many others colleagues

& V. Romanovsky

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## History of collaboration between Legos and IWPH

### **-2003 for 2 years**

Collaborative Linkage Grant approved by NATO: cal/val for radar altimetry

### **-2007 for 4 years**

-CNES program for research (TOSCA) funded a full cal/val project for Jason-2 (FOAM) where Issykkul was the continental component

### **-2011 for 4 years**

-Extension of FOAM to Saral/AltiKa

### **-2015 for 4 years**

-Extension of FOAM to Sentinel-3A and Jason-3

### **-2015 for 8 years**

-Decision to include the lake Issykkul as a priority cal/val Site for SWOT

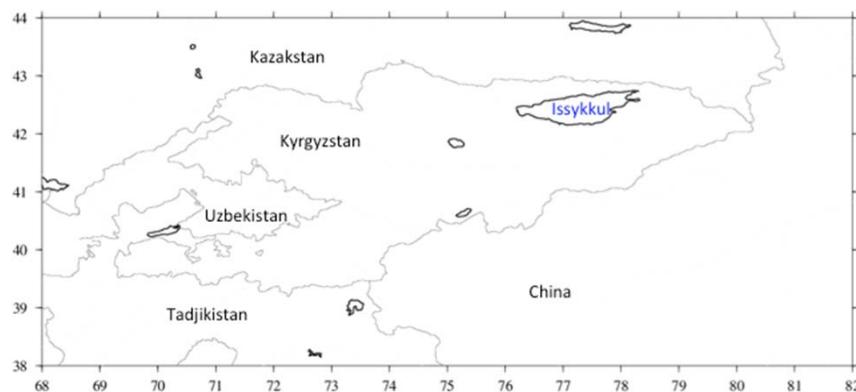


# Objectives of Cal/Val of radar altimetry over lakes

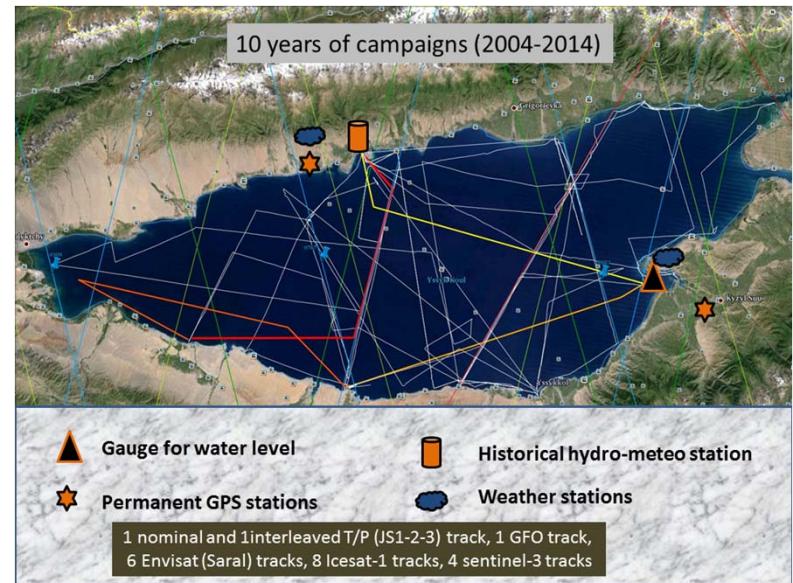
## Two complementary points of view

It allows to better quantify the performances of altimeters over lakes, their advantages and their limitations

It allows to densify the cal/val to continental sites for the calculation of altimeter biases



It allows long term survey of water height of lakes from multi satellite missions: already 25 years collected since the first satellite in 1993

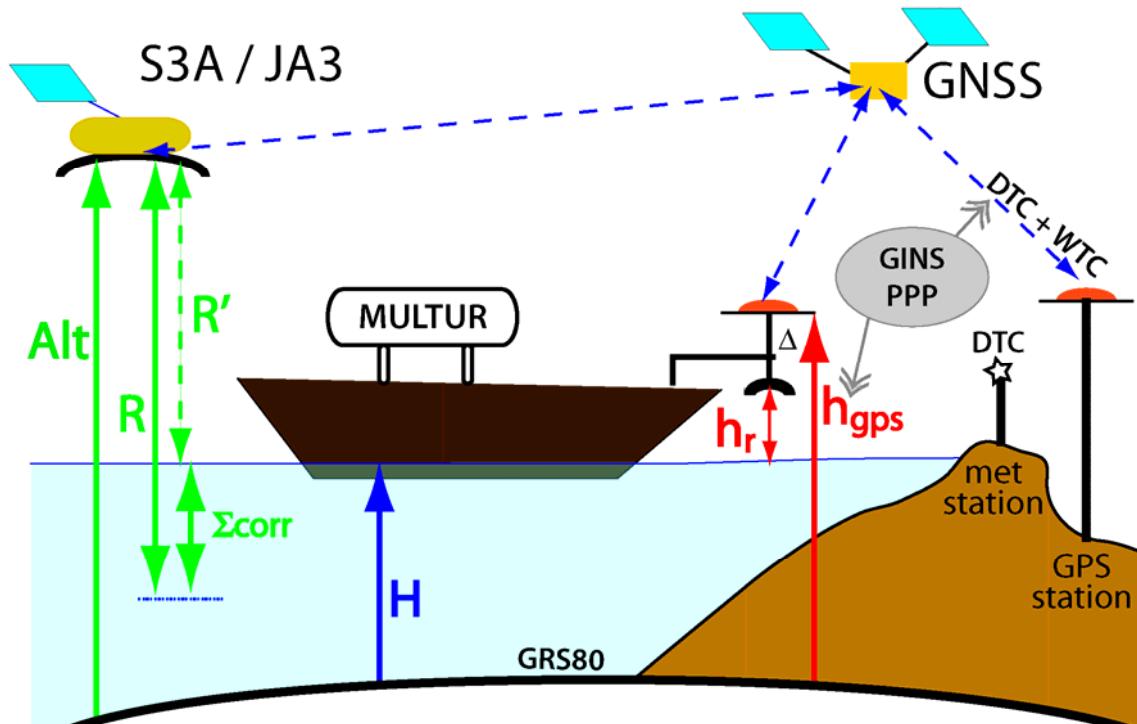


# Experimental design

Comparison of water height from GNSS system on the shore and on a vessel with water height from satellite along the track at the same time than the pass of the satellite

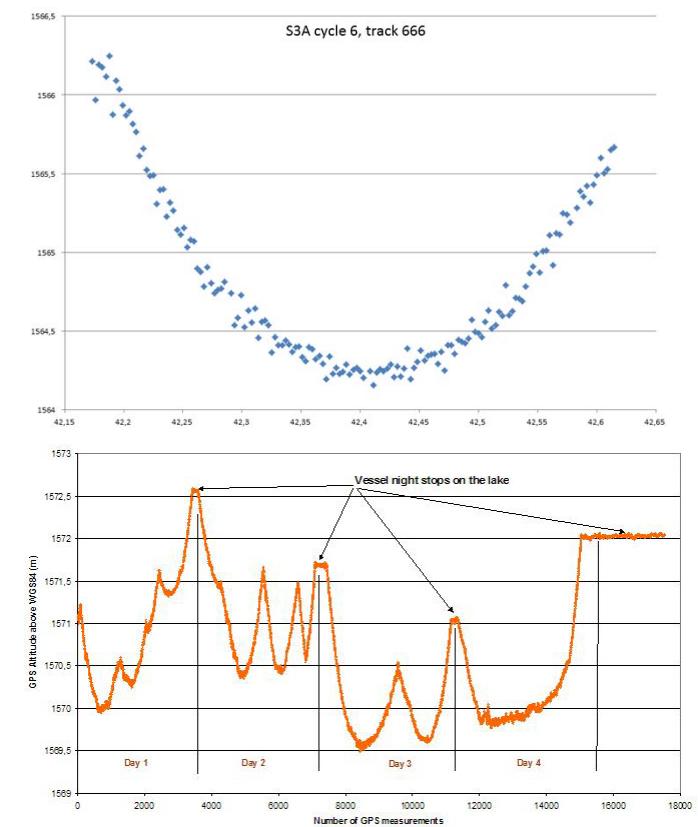
Comparison of altimetry water height time series with in situ

Absolute bias of each altimeter  
Accuracy of each altimeter



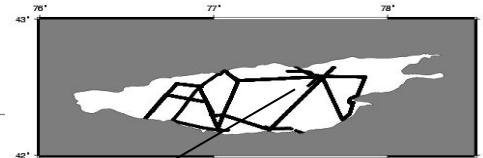
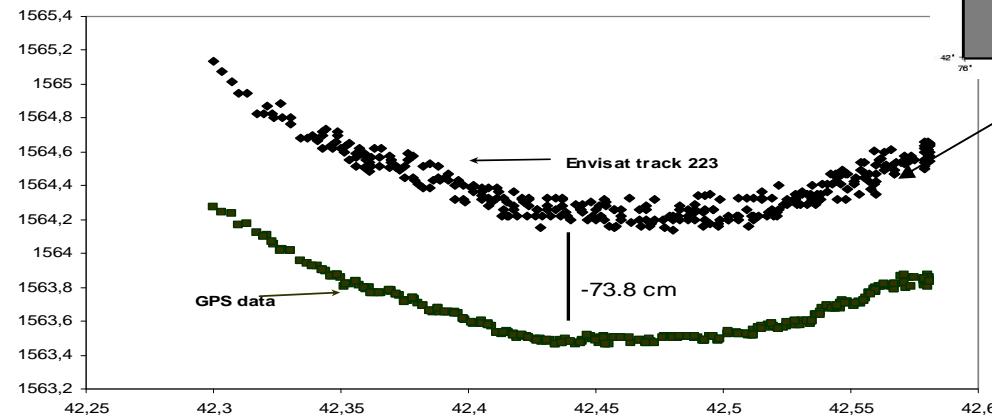
$$\text{Altimetry : } H = \text{Alt} - R' = \text{Alt} - (R - \Sigma\text{corr})$$

$$\text{Validation : } H = h_{\text{gps}} - (h_r + \Delta)$$

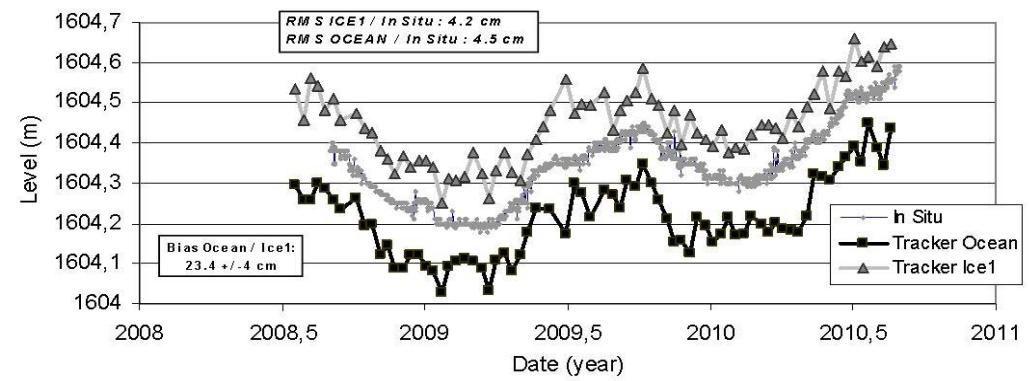
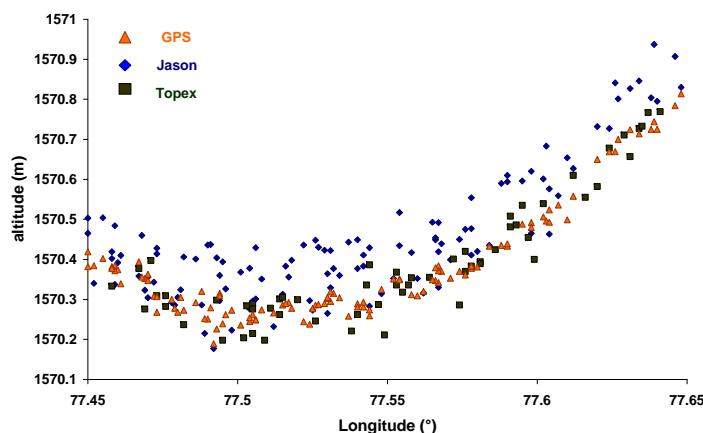


Envisat

Issykkul, bias between GPS and Envisat



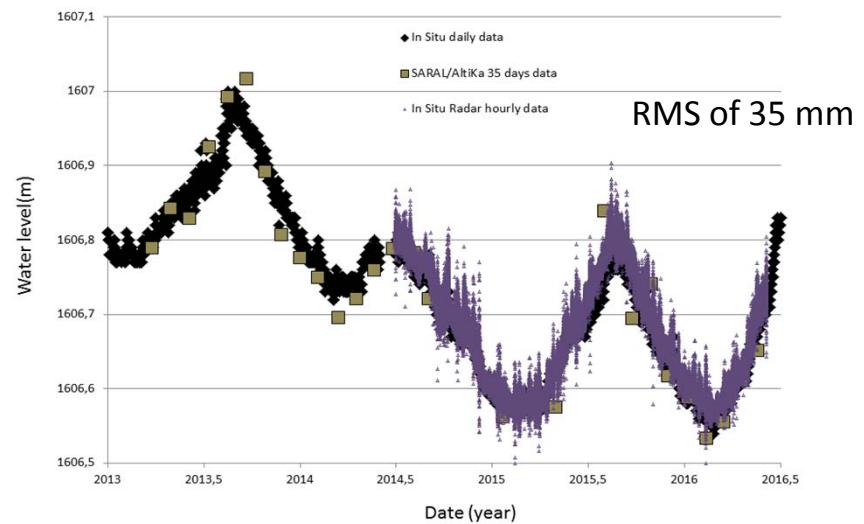
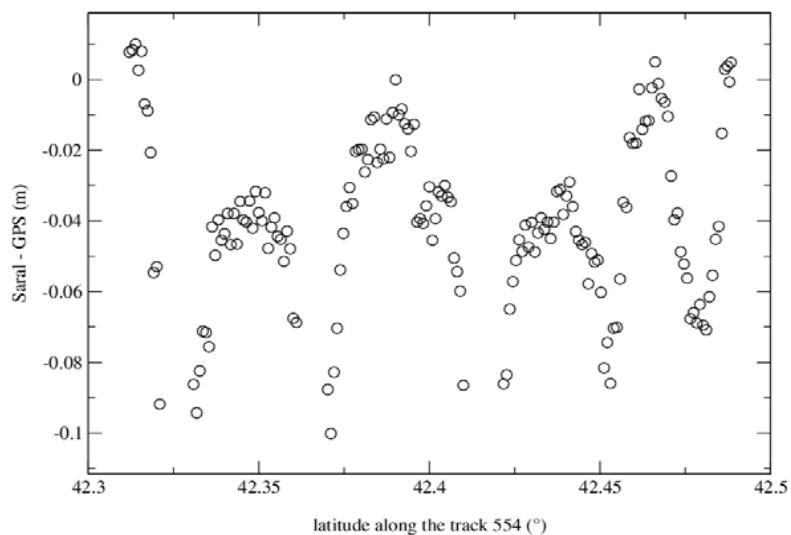
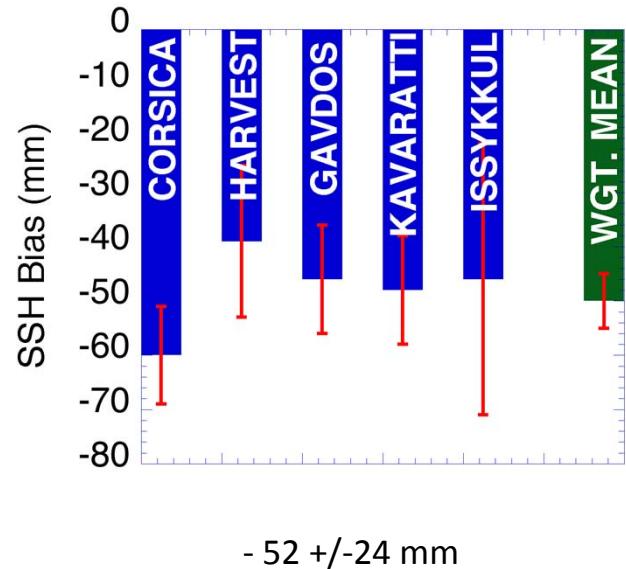
**8 Field campaigns between 2004 & 2013,  
Determination of absolute altimetric biases of  
Jason-1/2/3, T/P, Envisat, AltiKa, Sentinel-3A  
and GFO satellites**



For long term water height monitoring on lakes, relative  
biases between missions are essential to be known

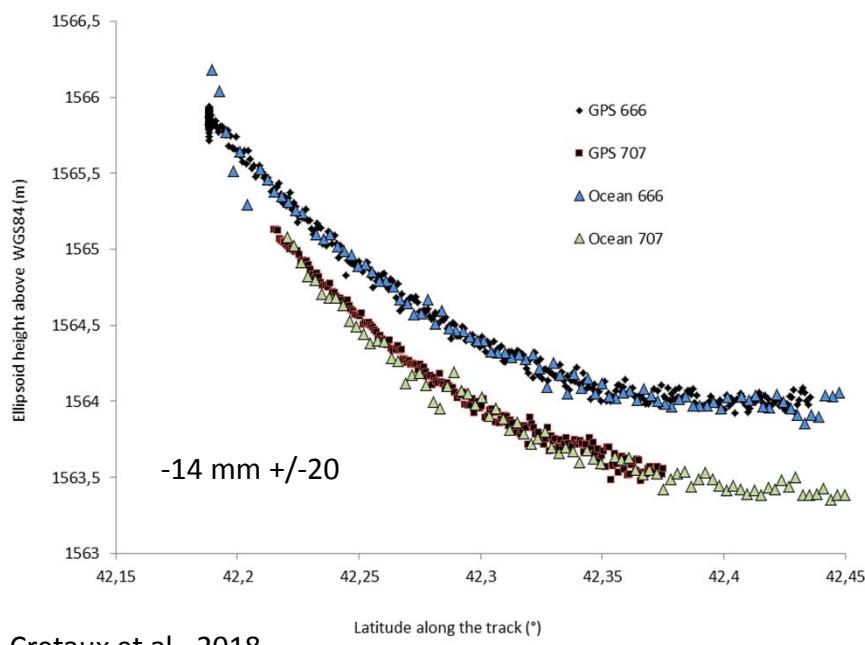
Cretaux et al., 2009, 2011, 2013

## Cal/Val on Saral / AltiKa (field campaign in 2014)

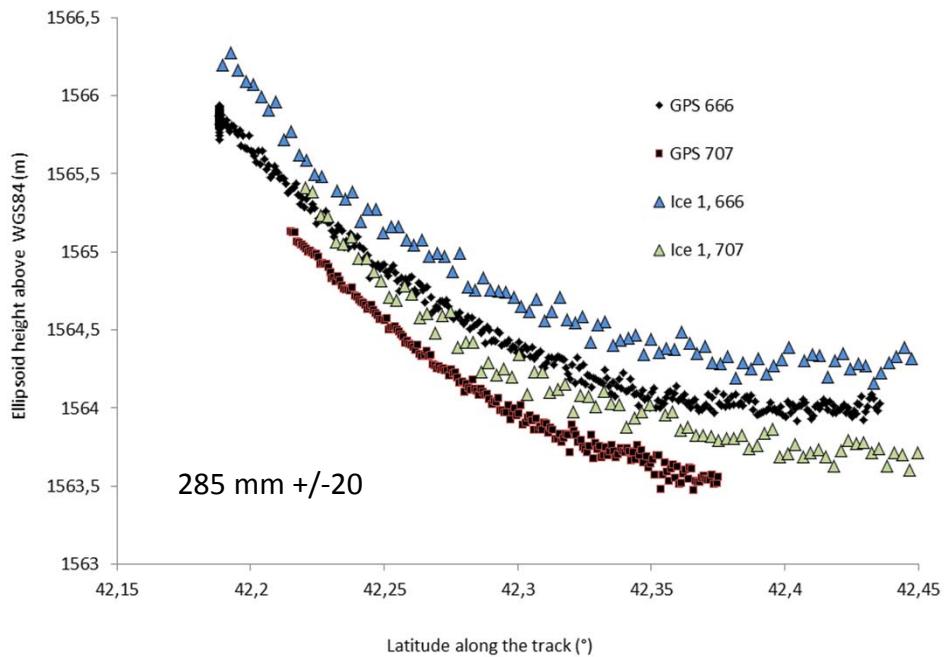
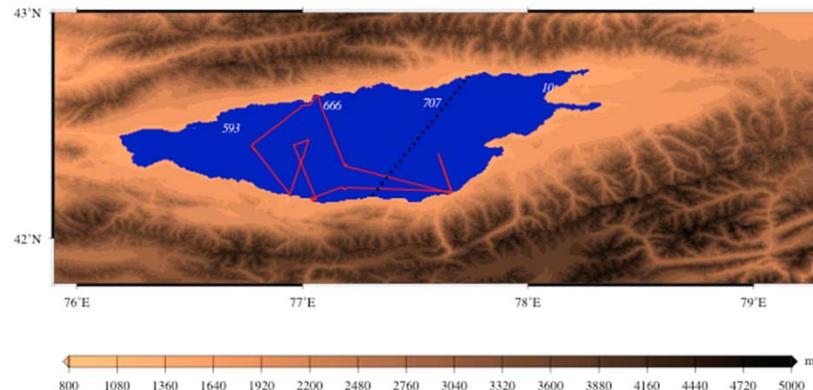


Bonnefond et al., 2018

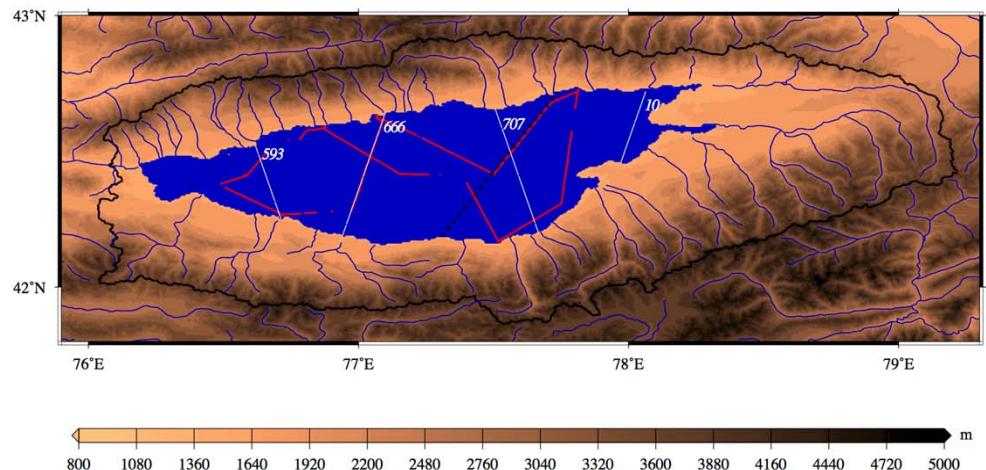
## Campaigns of 2016-2017: Sentinel-3A absolute bias



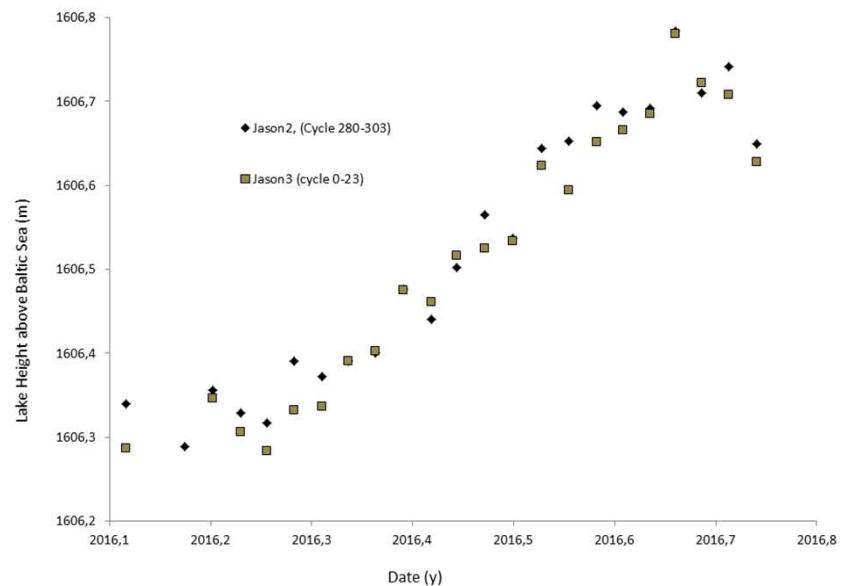
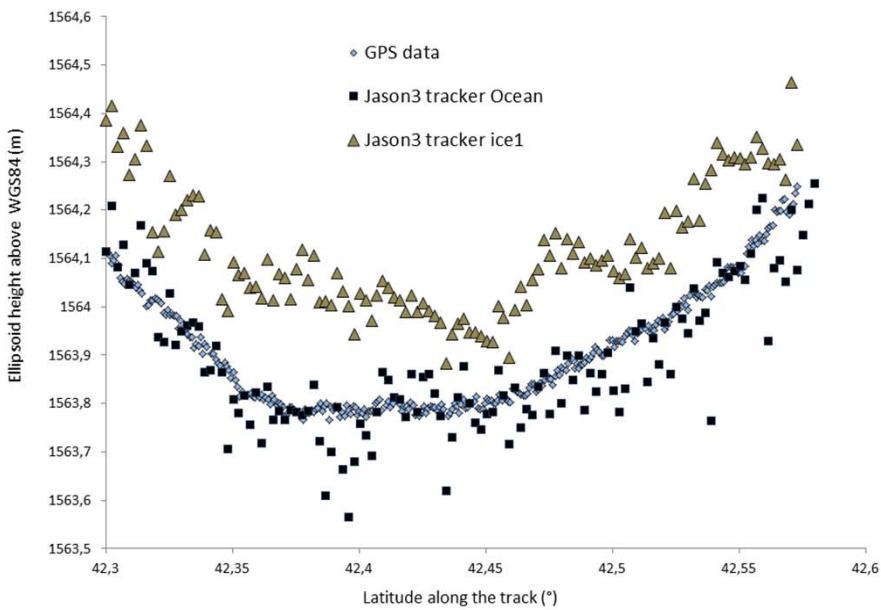
Cretaux et al., 2018



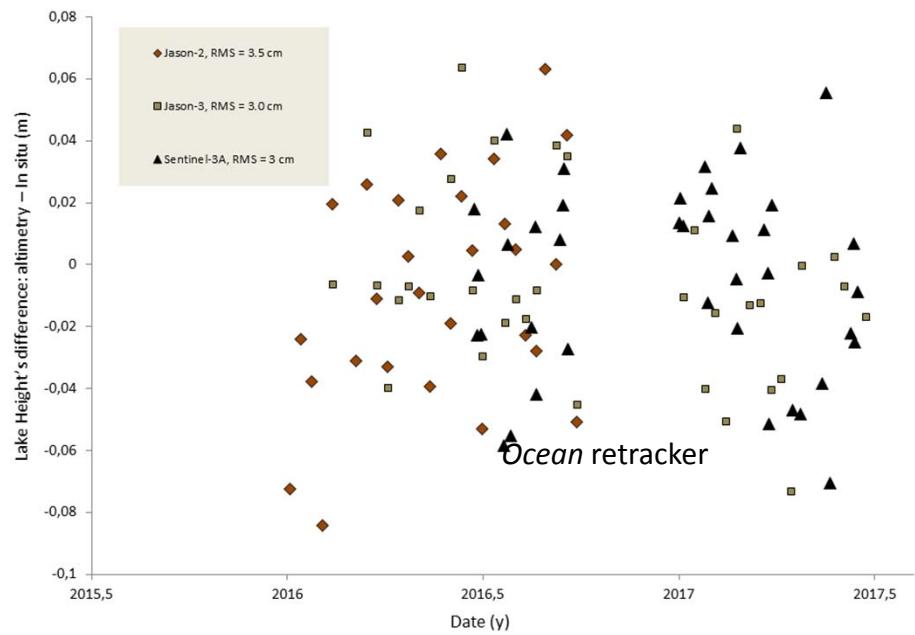
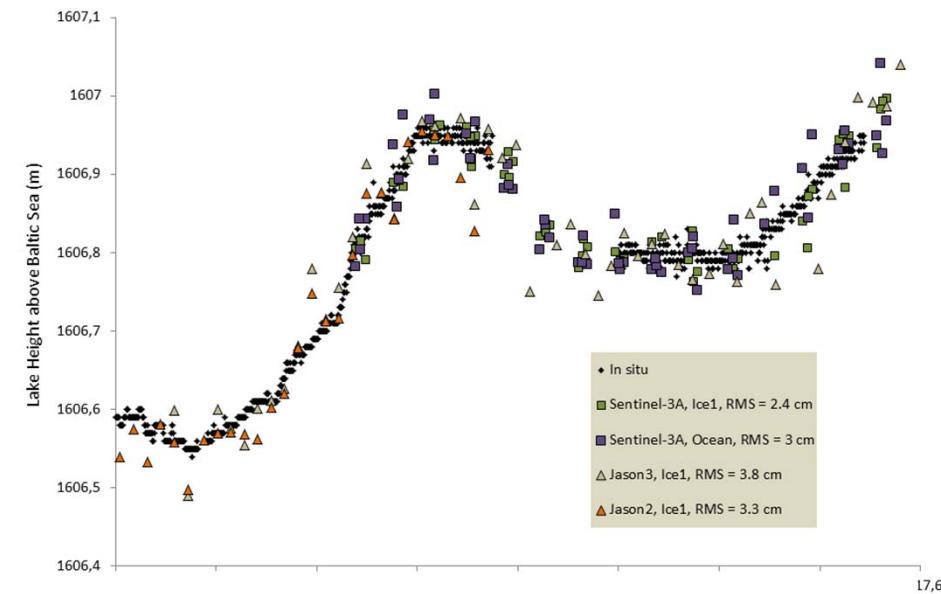
## Campaigns of 2016-2017: Jason-3 absolute and relative biases



Absolute bias with *Ocean* 28 mm +/-40  
Offset with *Ice1* 206 mm +/-30



## Accuracy of sentinel-3A and Jason-3



## Absolute bias Summary

### Ocean retracker

Jason-3 : **28 mm +/-40**

Sentinel-3A : **-14 mm +/-20**

Saral : **-52 mm +/-24**

### Ice-1 retracker

Jason-3 : **206 mm +/-30**

Sentinel-3A : **285 mm +/-20**

Saral : **34 mm +/-20**

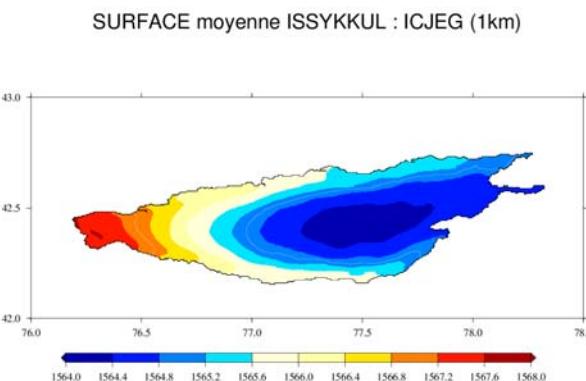
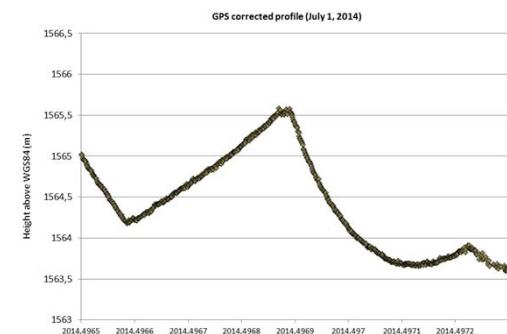
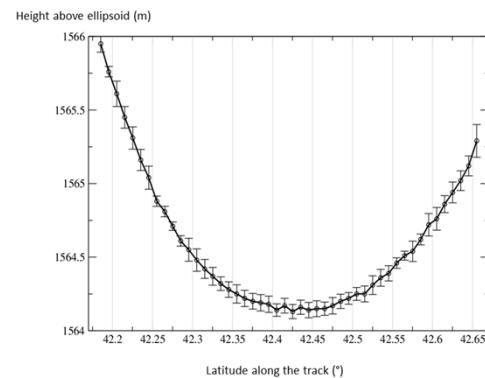
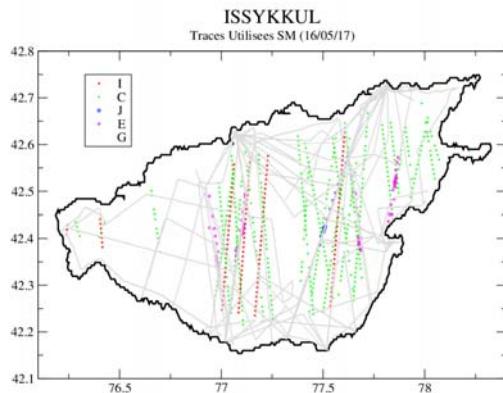
(Bonnefond et al., 2018, Cretaux et al., 2018)



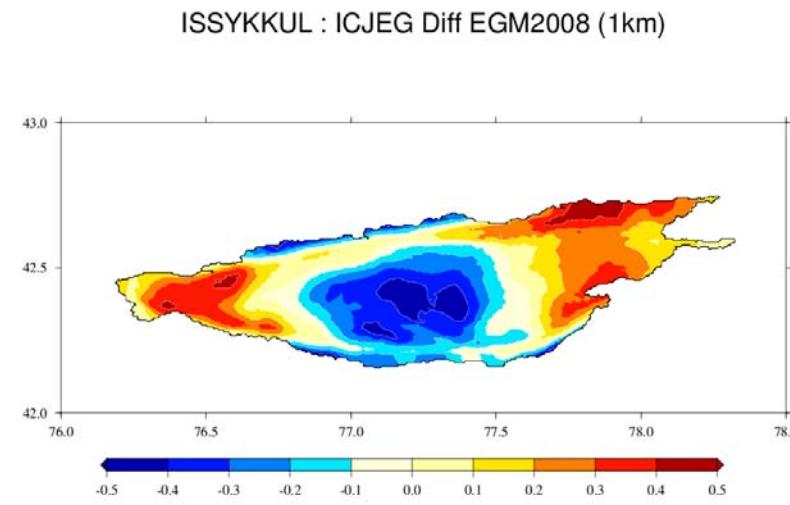
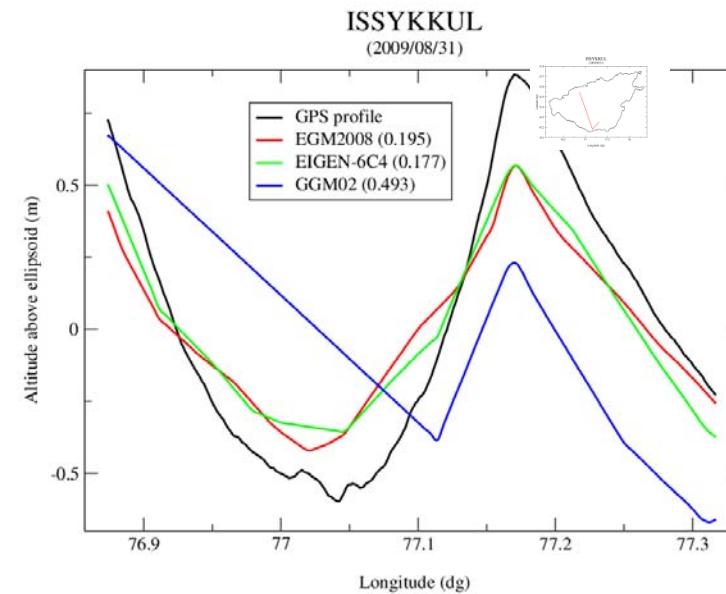
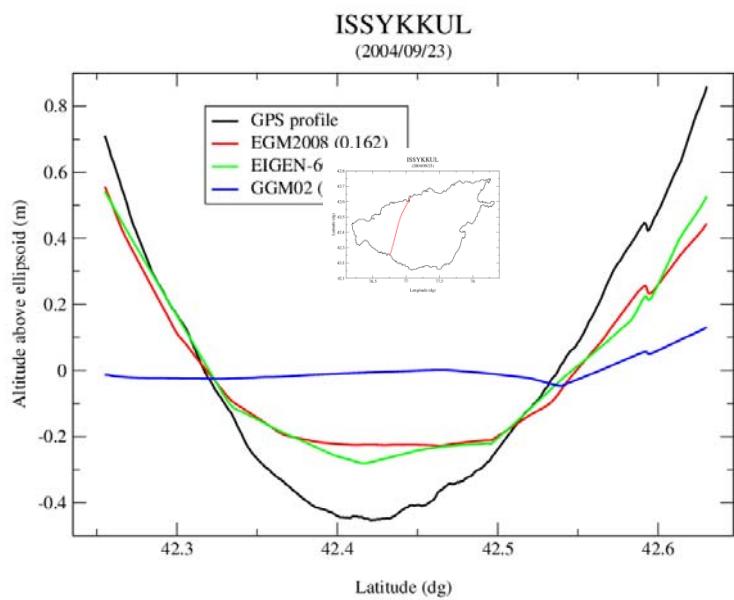
# Geoid undulation from satellite altimetry and GPS levelling

From Combination of all campaigns we may calculate mean lake surface of Issyk-Kul which will serve as

external data to assess geoid model accuracy  
calibration of future mission (SWOT: 3D mapping of water surface)



# Geoid undulation: comparison with models



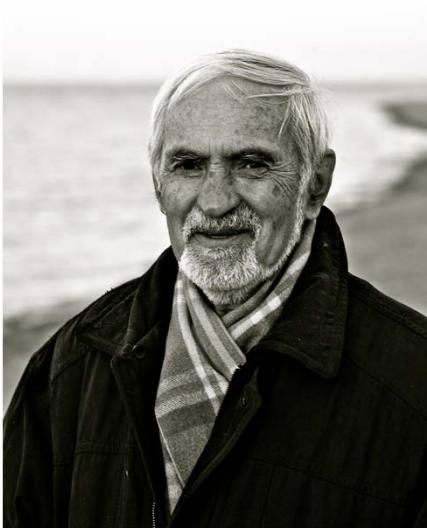
# Conclusions & perspectives

## Last 15 years: cooperation with IWPH

- 15 field work for calibration of 8 altimeters
- Installation of 2 permanent GPS receivers
- Installation of a permanent lake gauge 5 scientific publications



Ready for C/V of current and future missions (S3B, Jason-CS, Icesat-2, SWOT.....)



# Thank you for your attention

