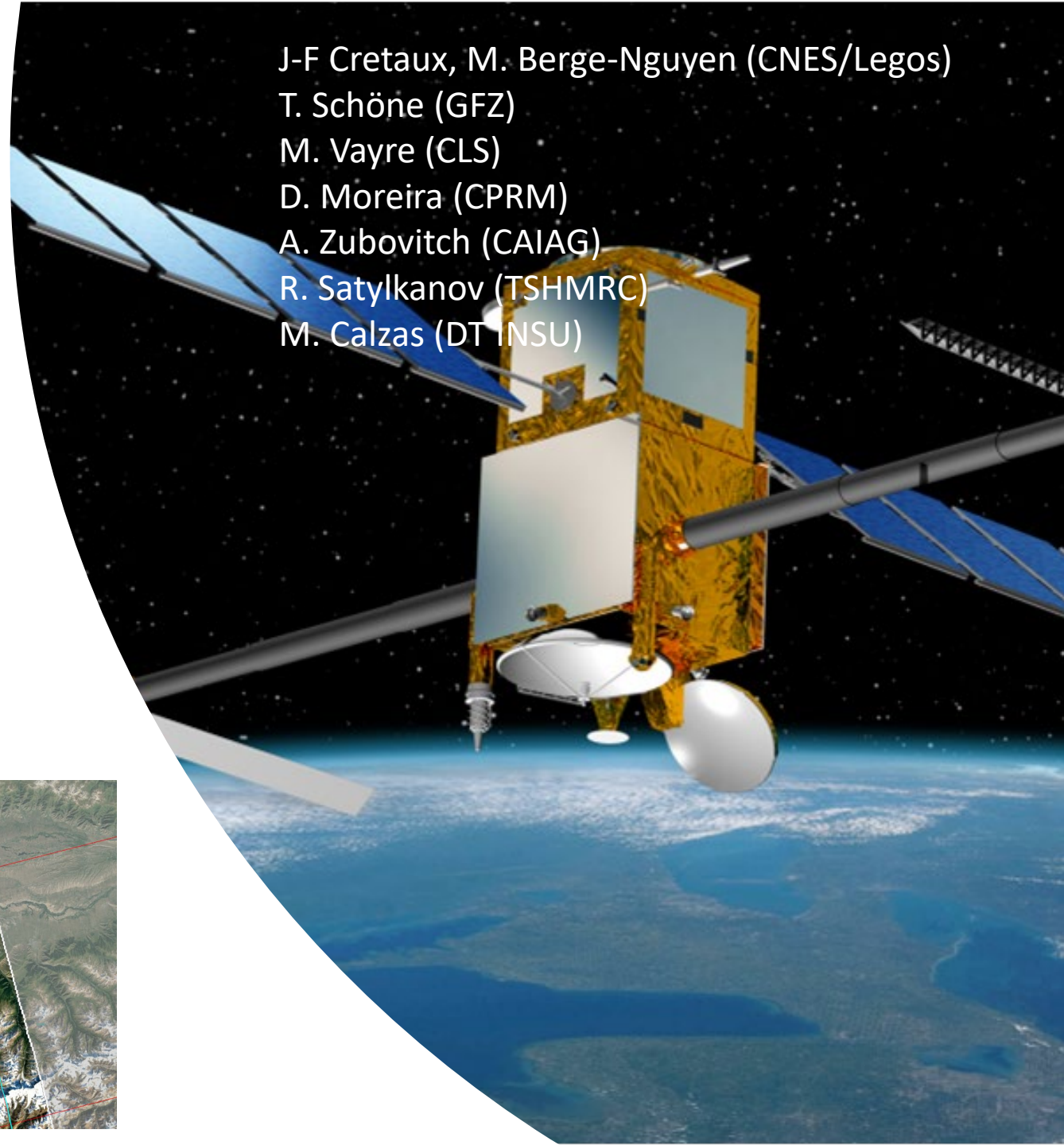


# Cal / Val of SWOT on large lakes

Lake Geneva (France/ Switzerland)



Lake Issykkul (Kyrgyzstan)



J-F Cretaux, M. Berge-Nguyen (CNES/Legos)  
T. Schöne (GFZ)  
M. Vayre (CLS)  
D. Moreira (CPRM)  
A. Zubovitch (CAIAG)  
R. Satykanov (TSHMRC)  
M. Calzas (DT INSU)

## Two approaches / objectives

Comparison to external in situ measurements (water height from fix or moving stations)

Mapping of SWOT's  $\sigma_0$ , Phase noise, and WSE and dependency on the distance to Nadir

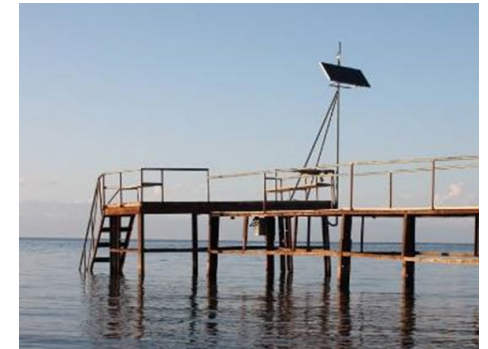


- Calibration of absolute Height (LakeAvg product)
- Assessment of random error and rolling error across the swath (PixCvec)
- Atmospheric corrections using GNSS ground network
- Validation of ocean and land processing simultaneously
- Inter-comparison of GNSS processing (PPP, DD) & different instrumentations

On lake Geneva: situ data from from BAFU data (Office de l'Environnement Suisse)

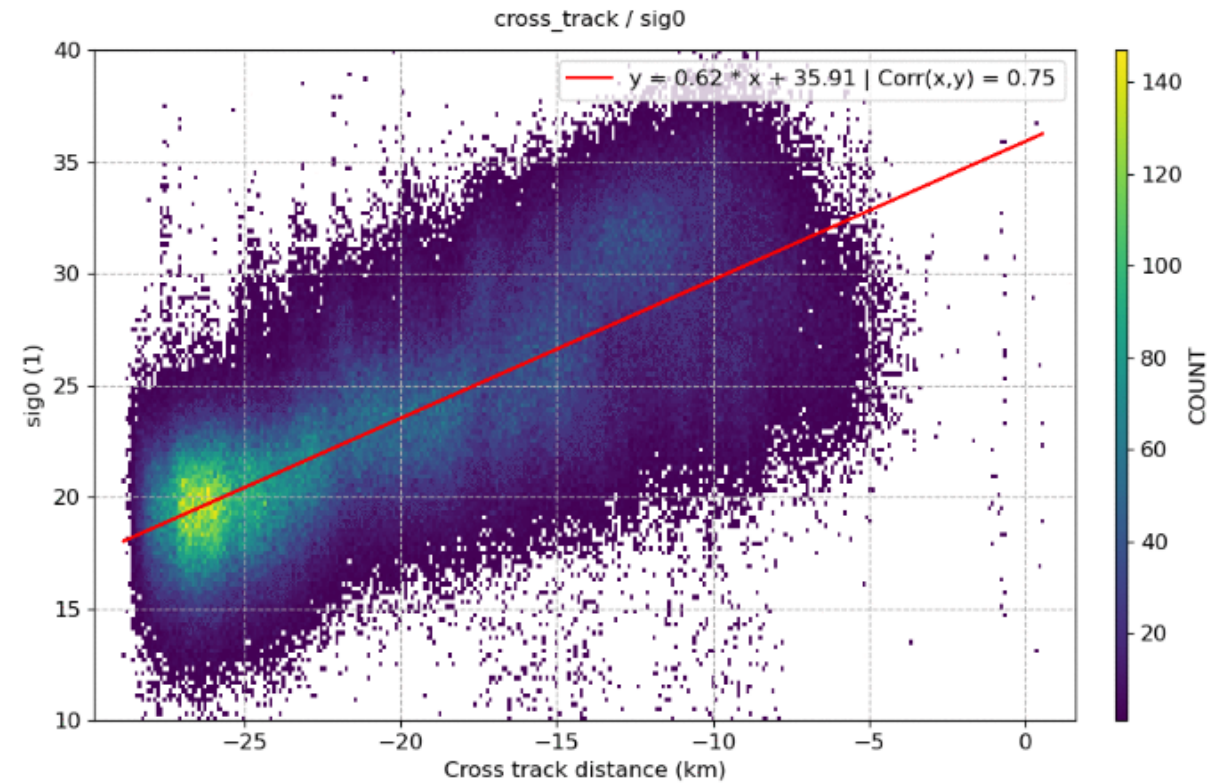
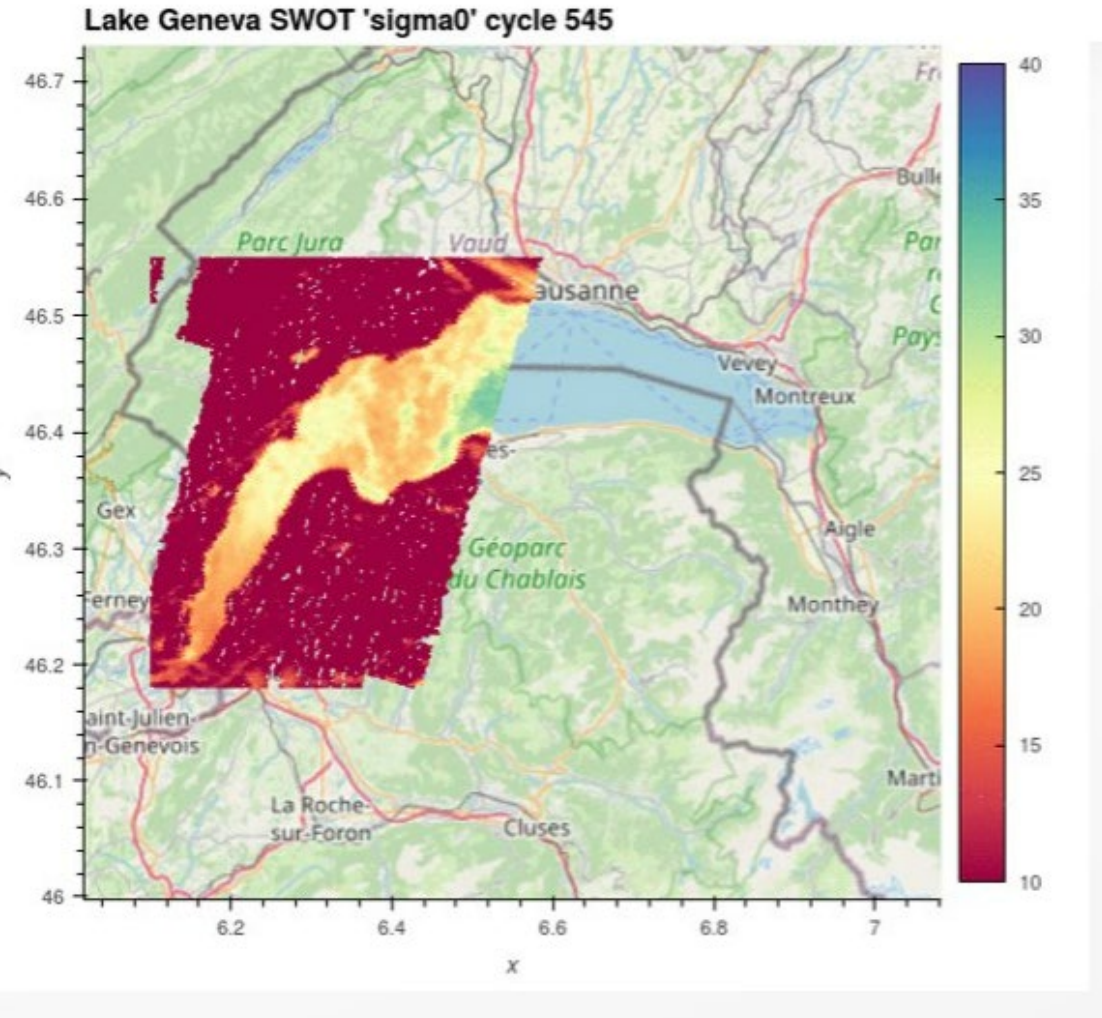
On Issykkul lake:

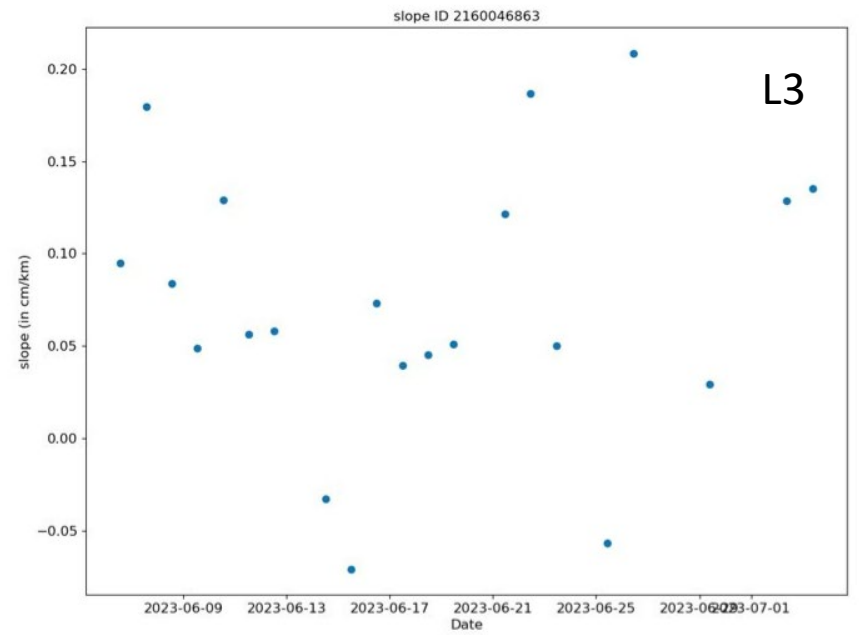
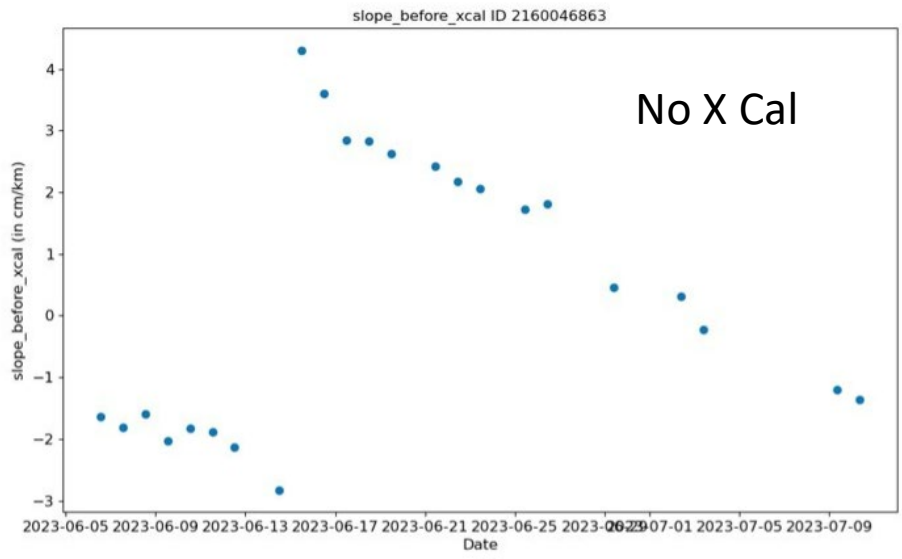
- Existing permanent network of radar, weather and GPS stations
- GPS temporary network on lakeshore below the swath
- Daily navigation across the swath with 2 boats simultaneously
- Use of Mean Lake Surface external 'truth'



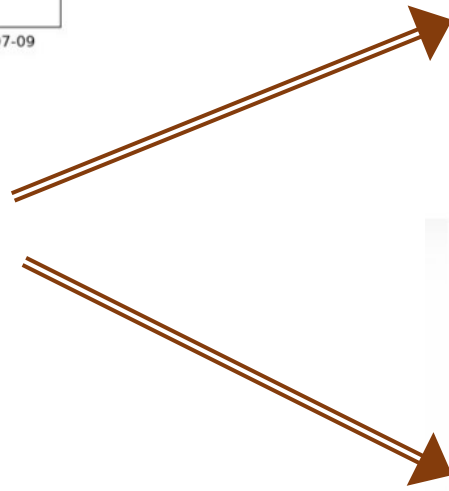
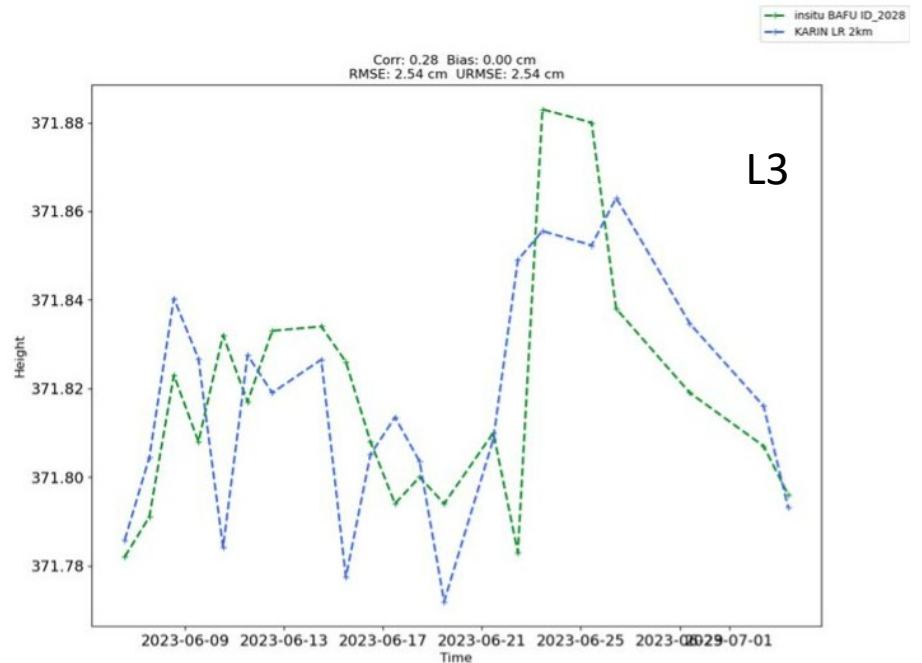
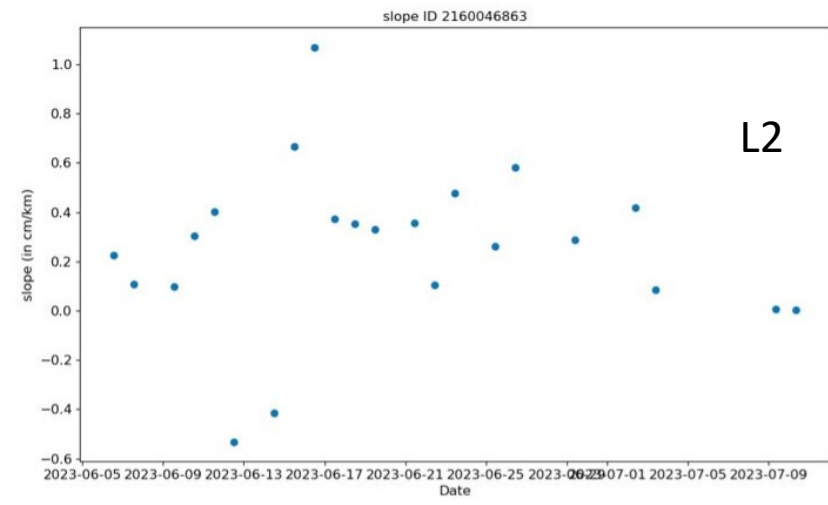
# Lake Geneva

SWOT PixC HR: sigma0 decreases w.r.t cross-track distance (a few db per 10 km)





X Cal before and after (impact on slope of wse w.r.t cross-track and on accuracy of WSE) with L2 and L3





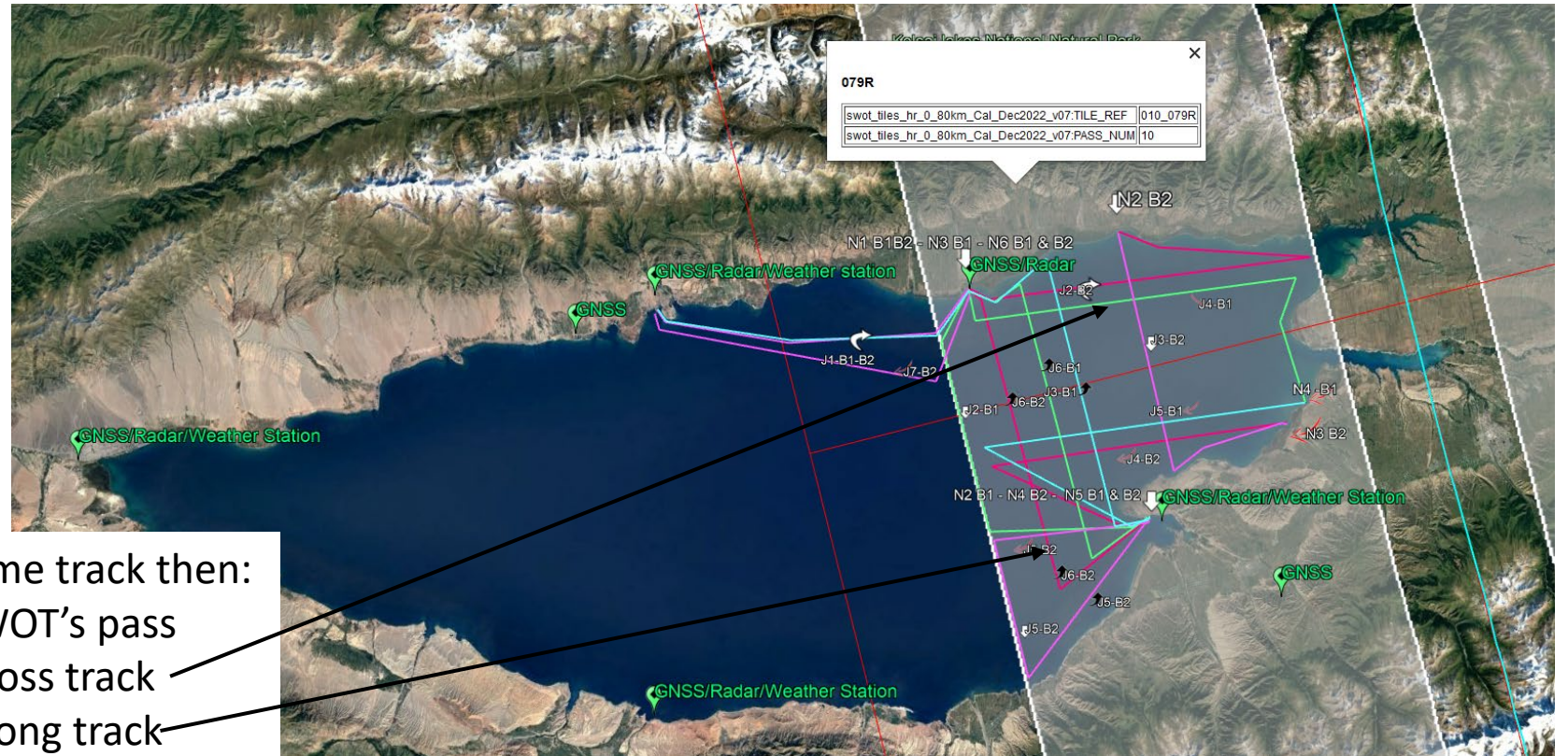
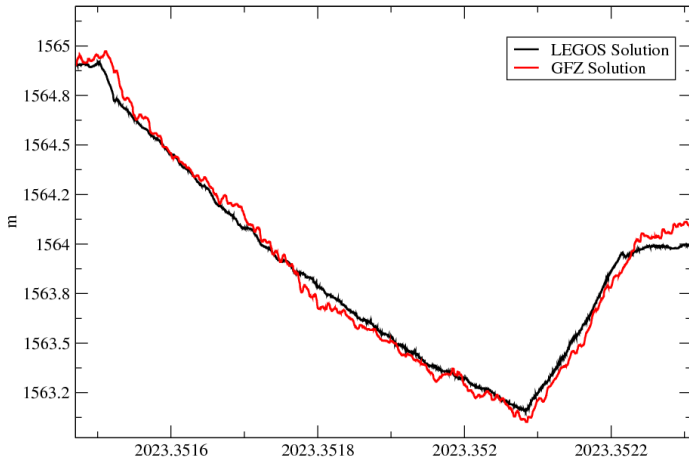
May 4 to 25, 2023 field campaign

Two ships with its own cruise plan in parallel (May 9-15)  
 One ship (May 16-22) => 21 days of lake's WSE over the swath

Ship's equipment (4 GNSS & radar)



Lake height from GNSS tool  
 May 9, 2023

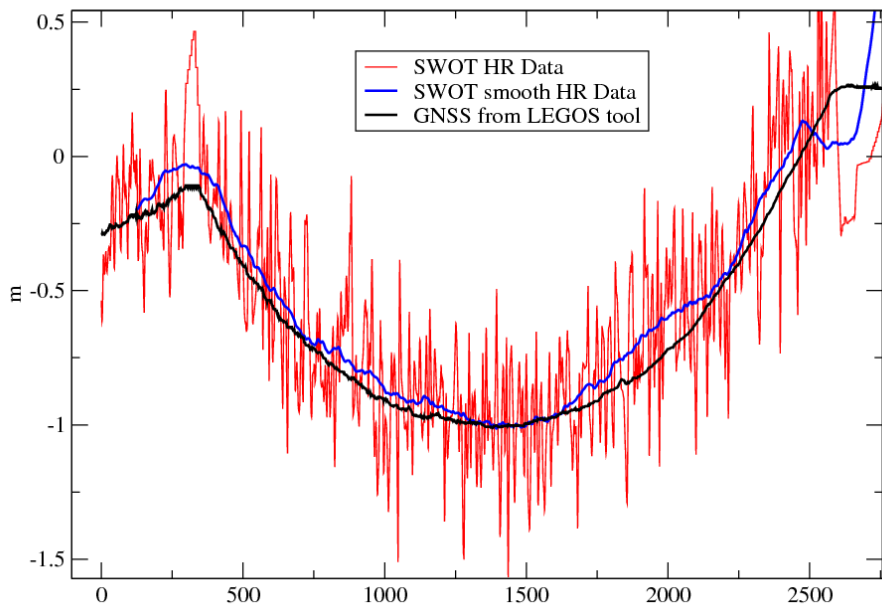


First day, both ships exactly on the same track then:  
 Each day, navigation at time of the SWOT's pass  
 Sessions with passes parallel to the cross track  
 Sessions with passes parallel to the along track

3 partners: Legos, GFZ and Kyrgyzs teams

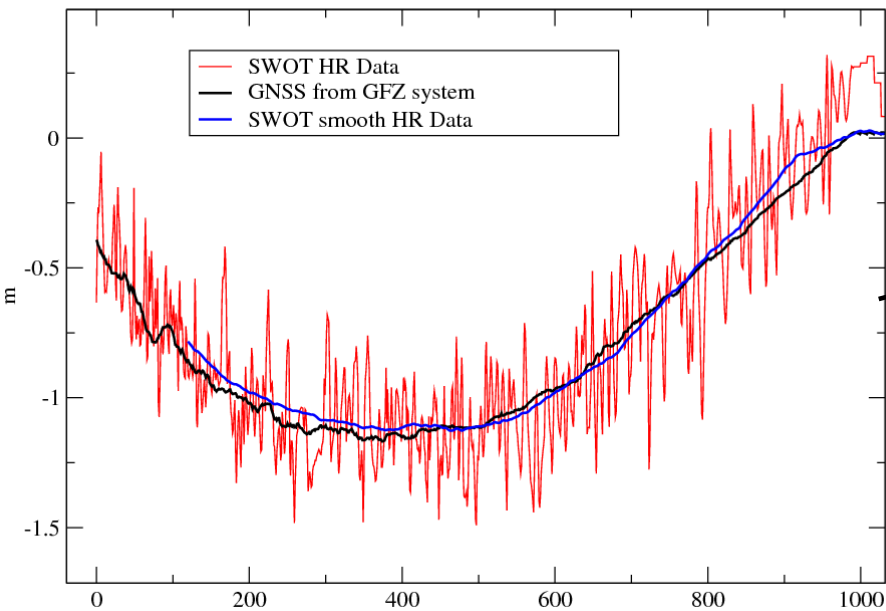
### SWOT/GNSS intercomparaison

May 14, 2023



### SWOT/GNSS intercomparaison

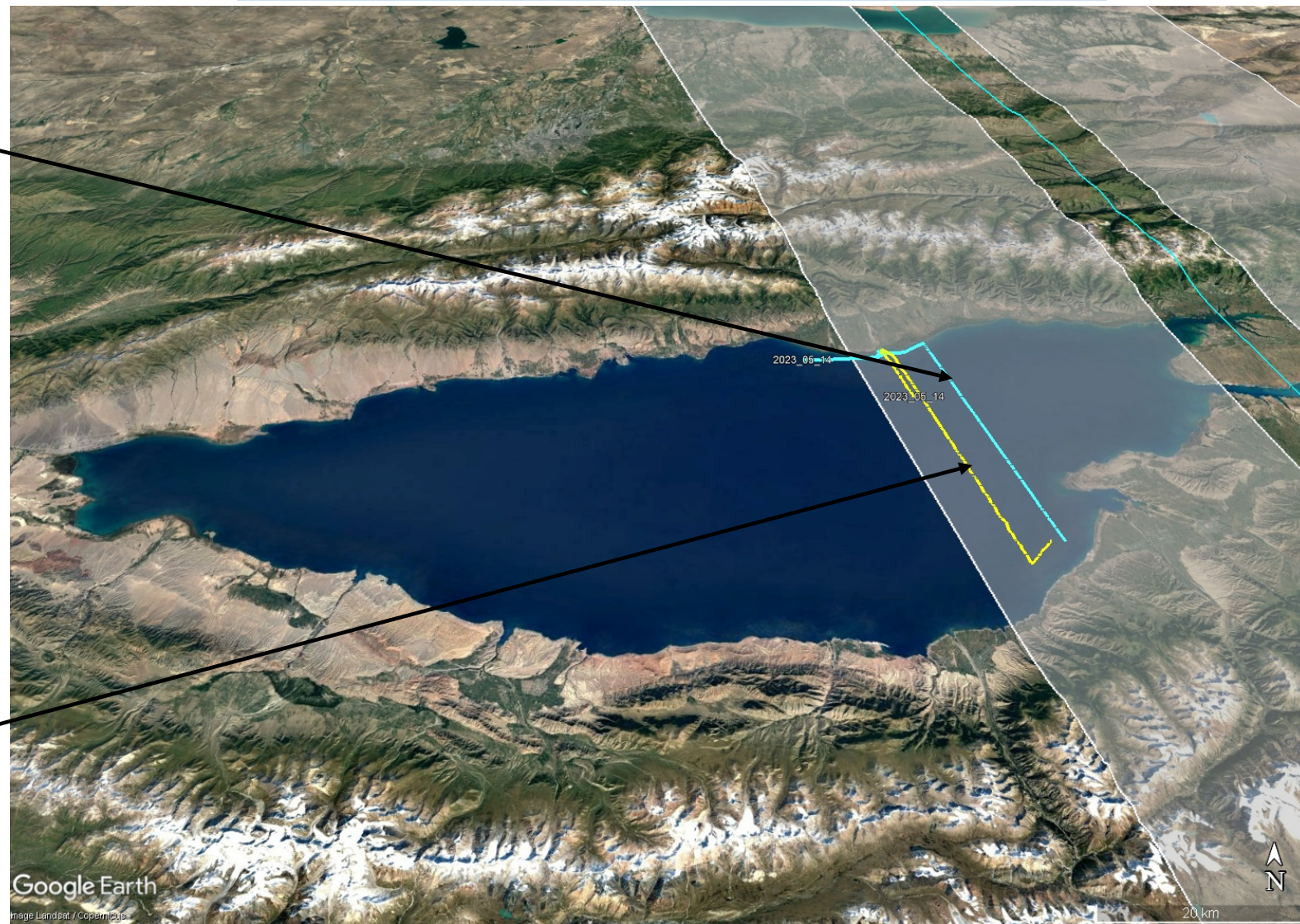
May 14, 2023



May 14: session parallel to the along track direction

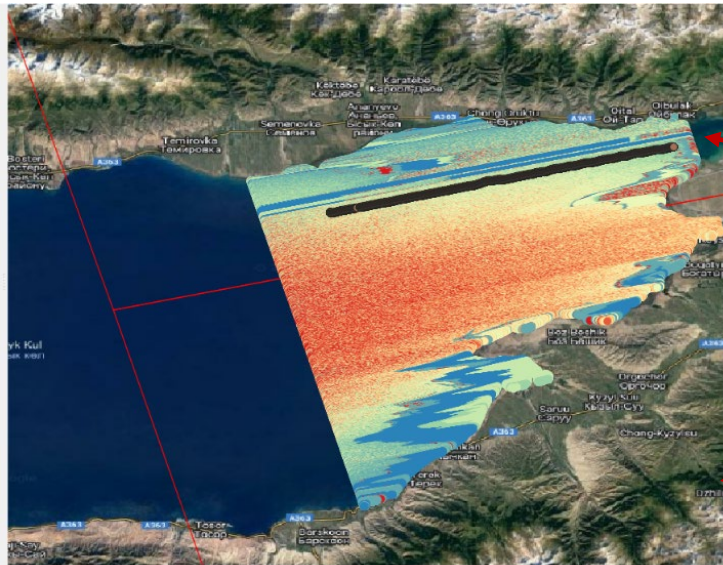
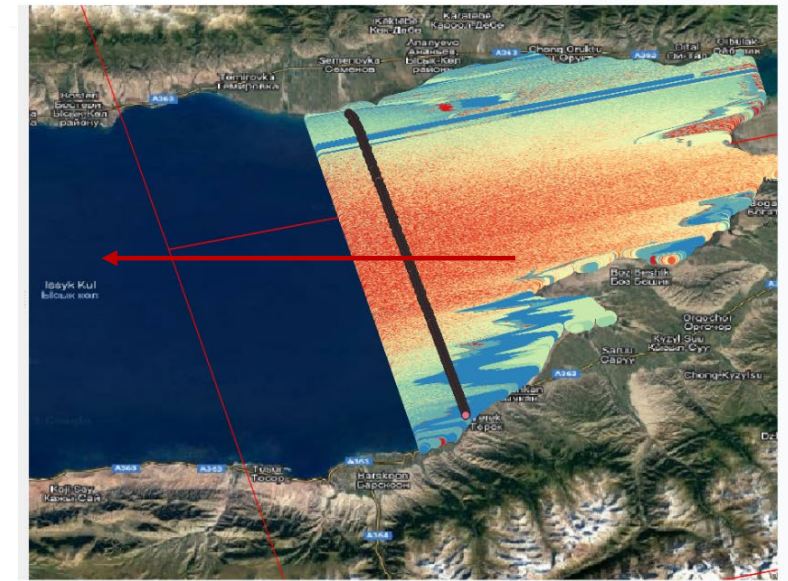
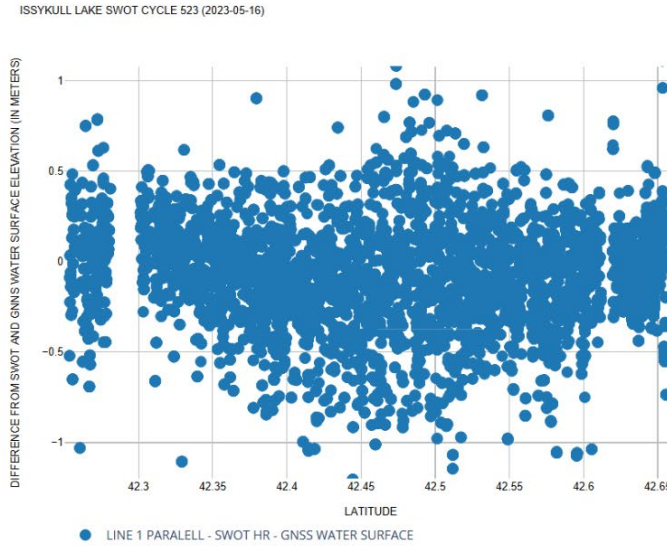
⇒ no dependency on the cross-track direction

⇒ Bias not estimated at this stage (ongoing work)

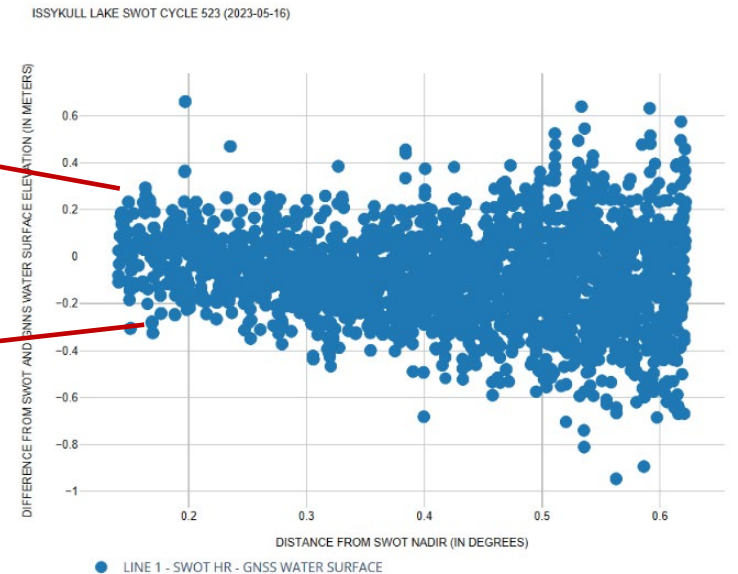


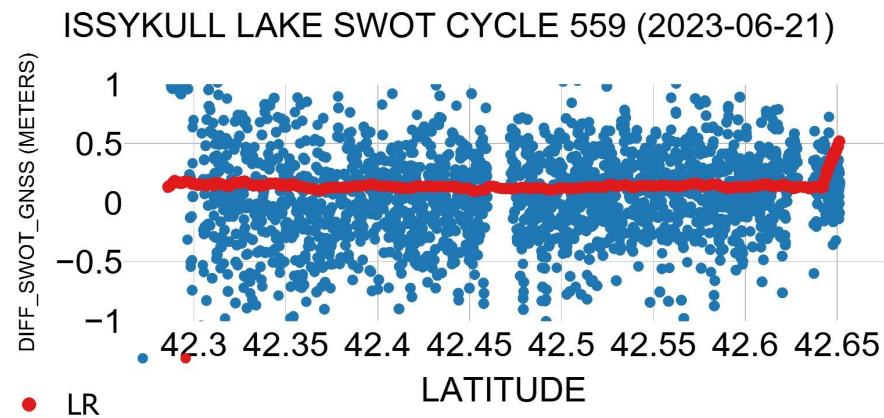
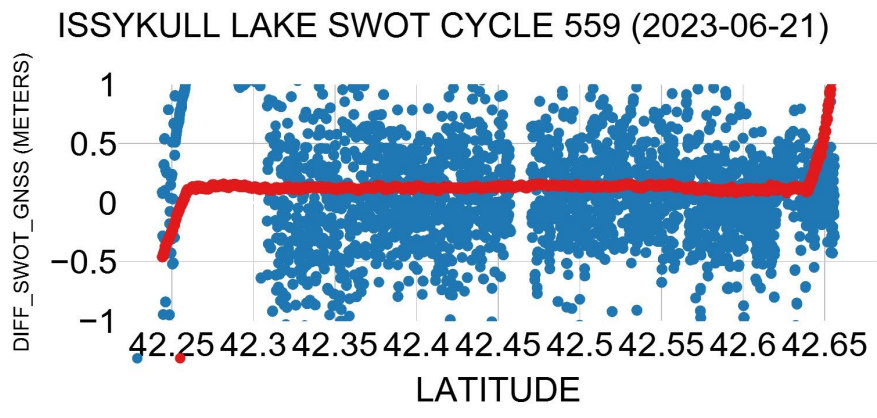
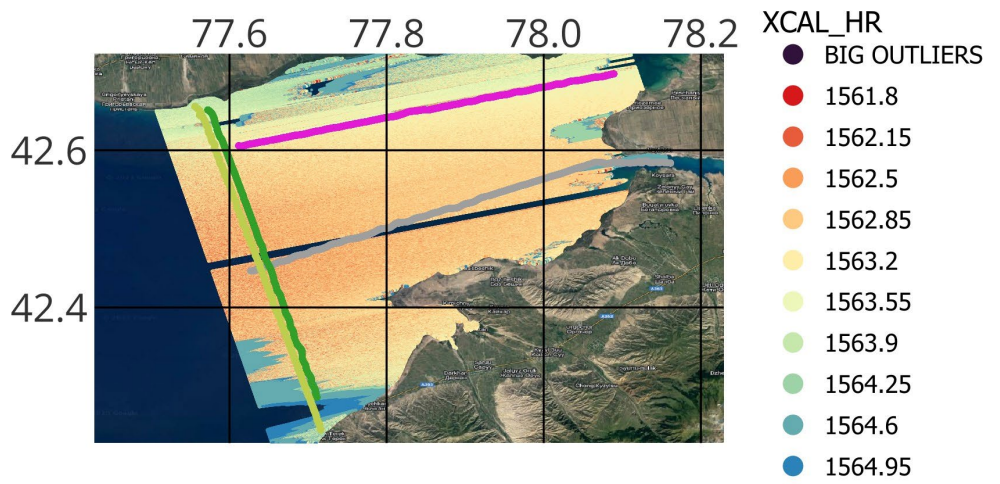
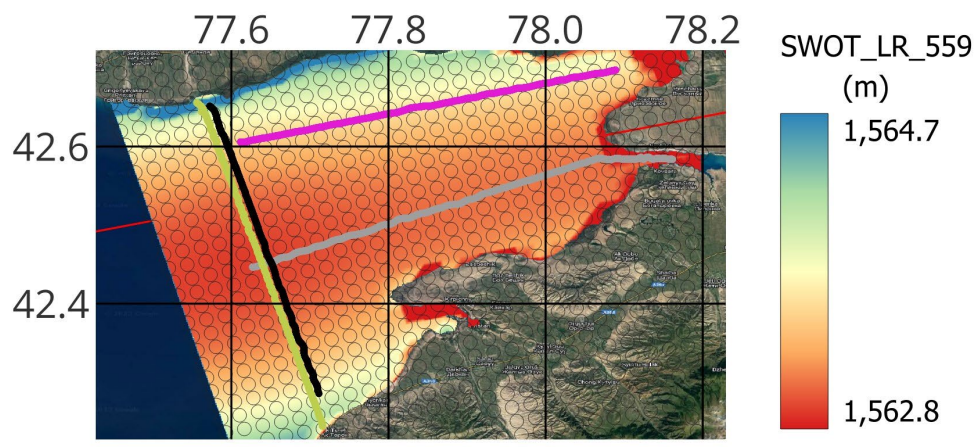
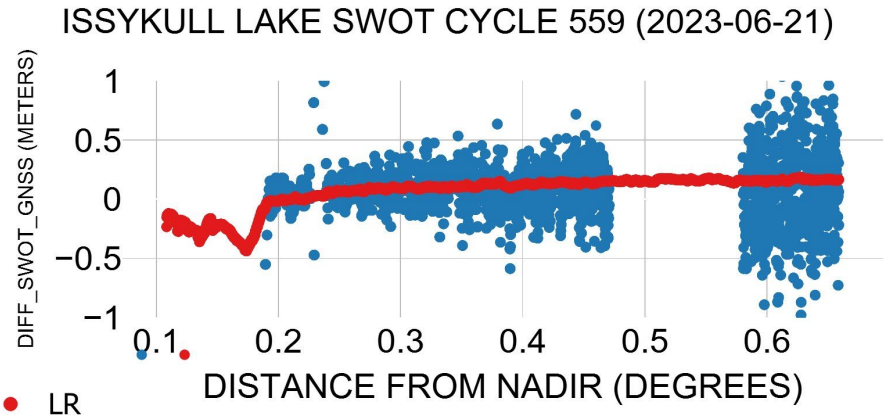
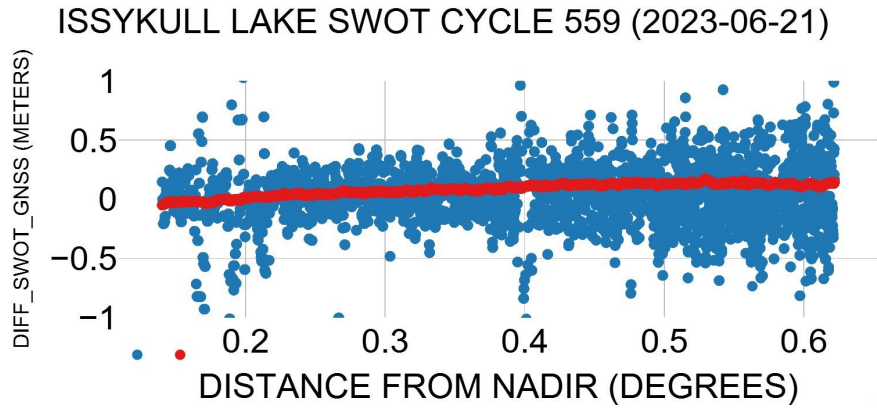
$$H_{obs} = H_{real} + \varepsilon + \alpha(t) * d$$

Noise and errors are stable along the track  
 Patterns of errors on the lake surface from HR data



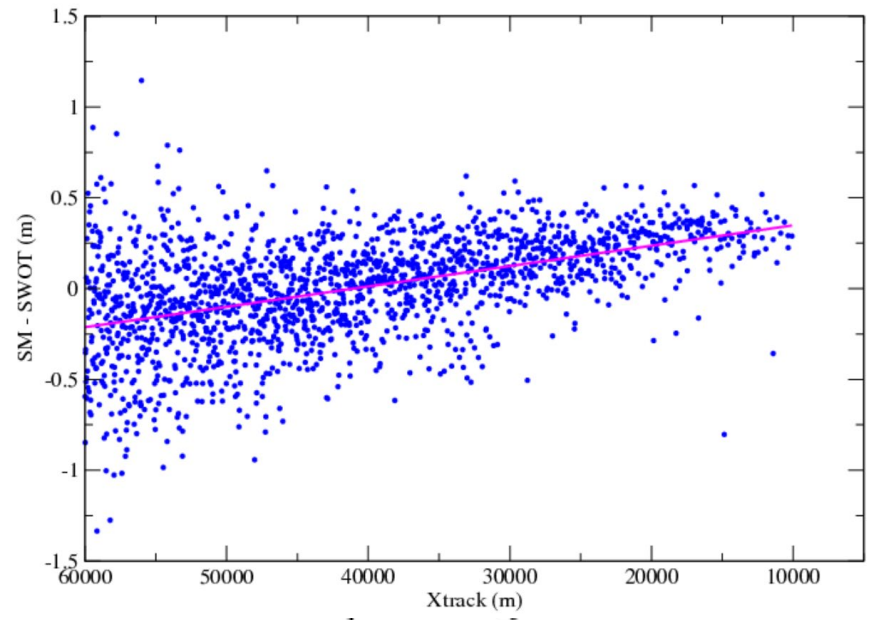
Dependency and errors increase with the distance to Nadir



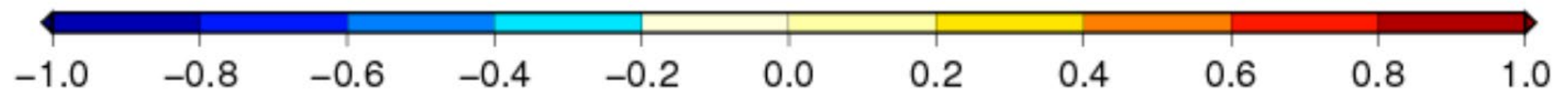
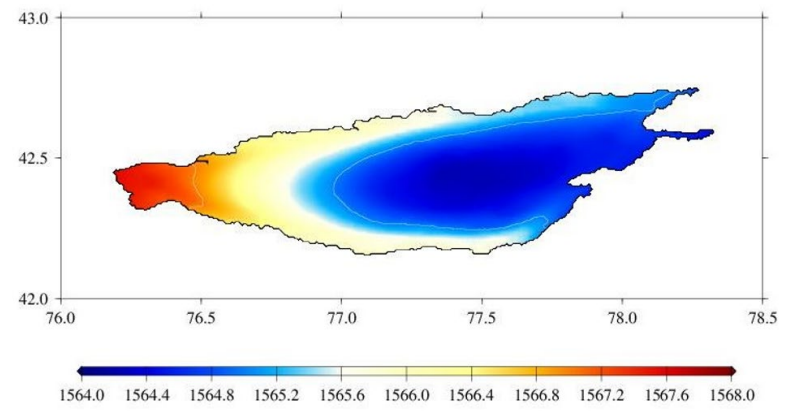
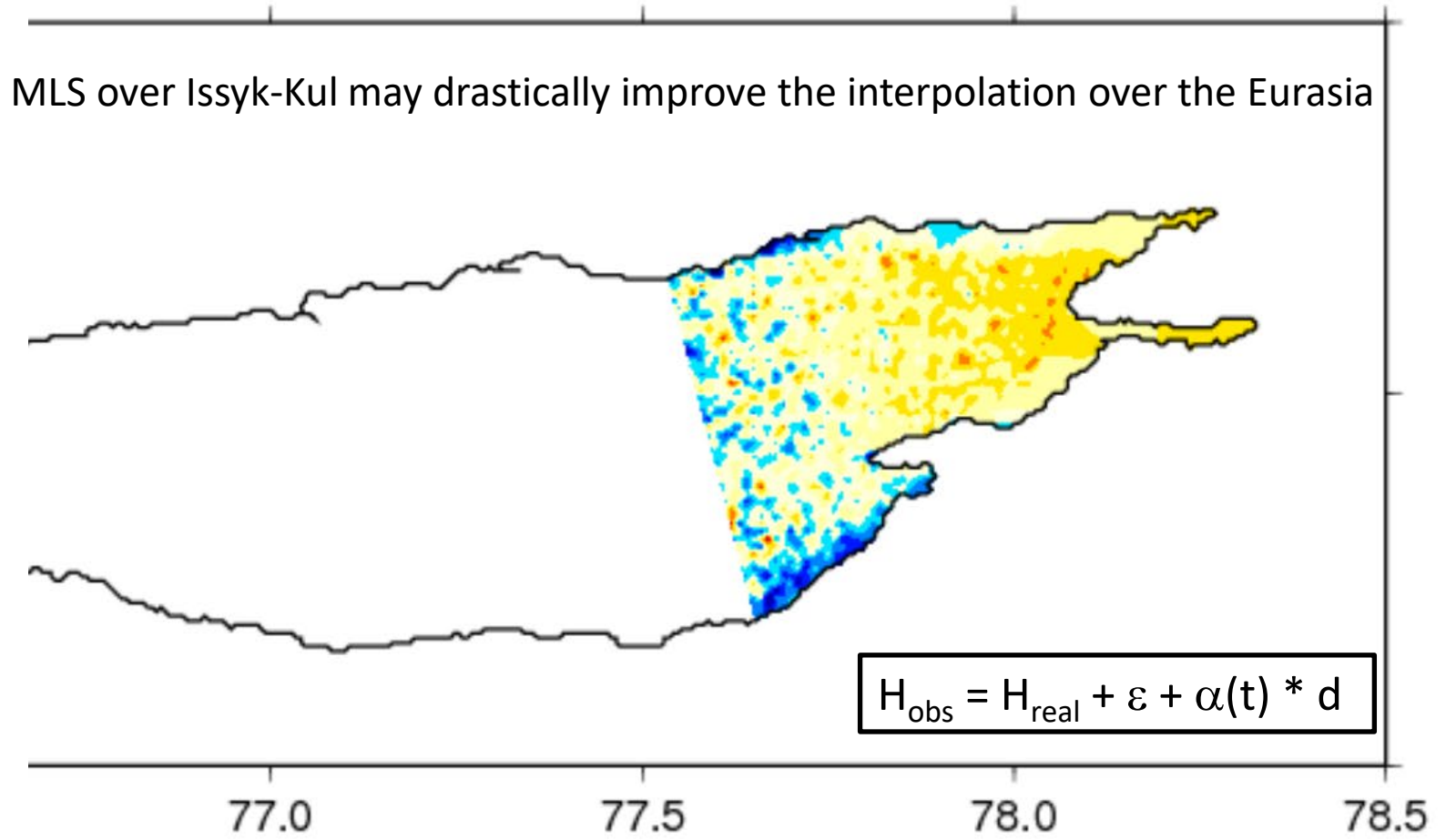


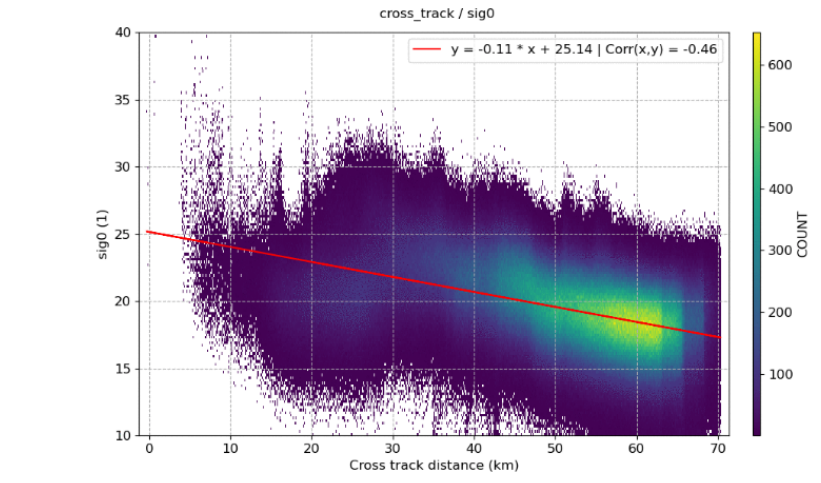
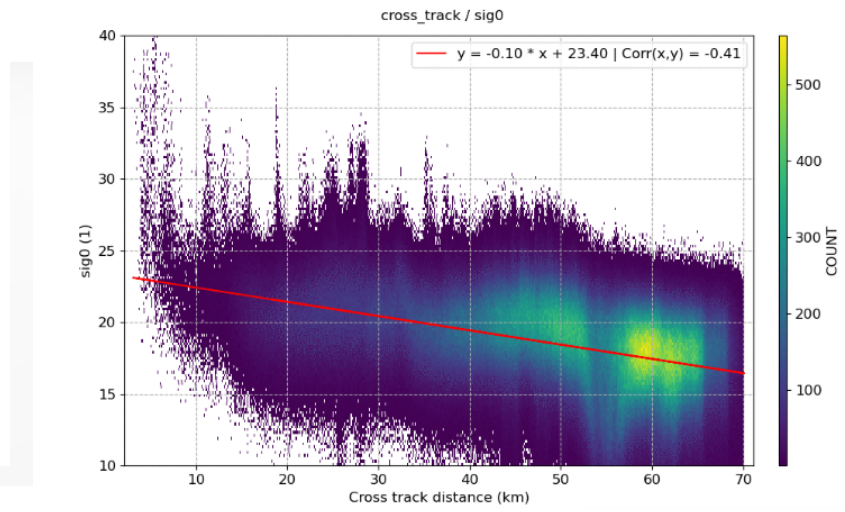
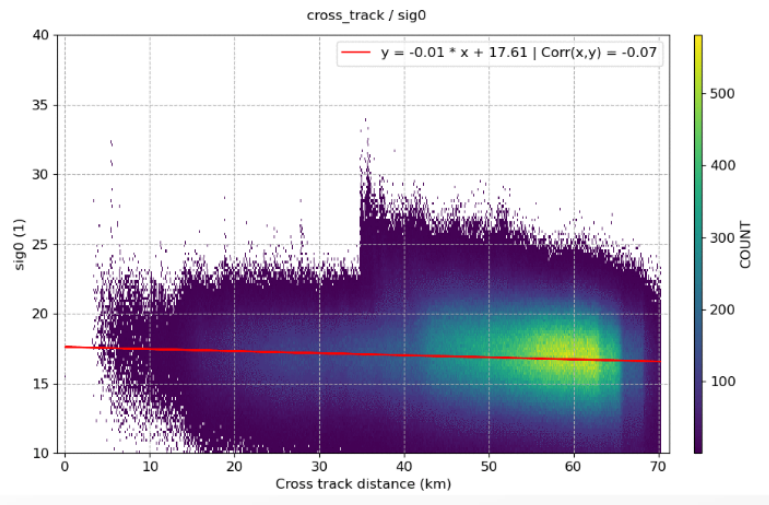


# Adjustement of X Cal over the lake Issyk-kul



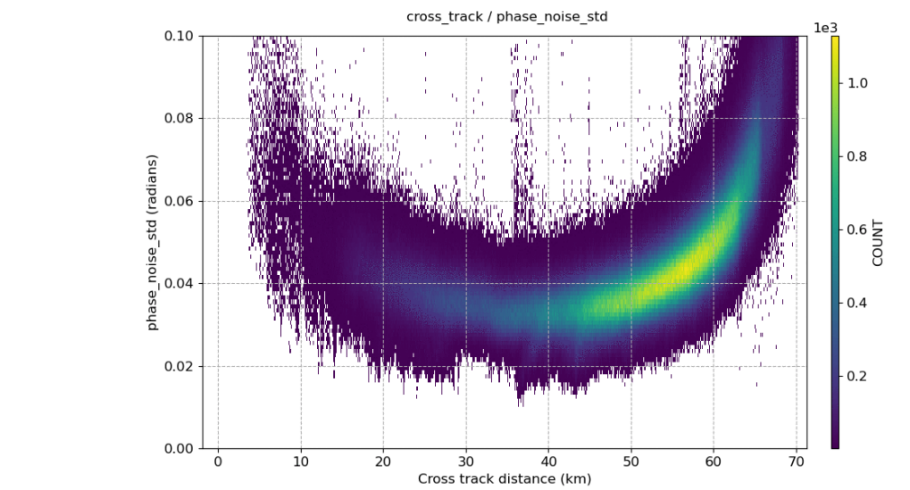
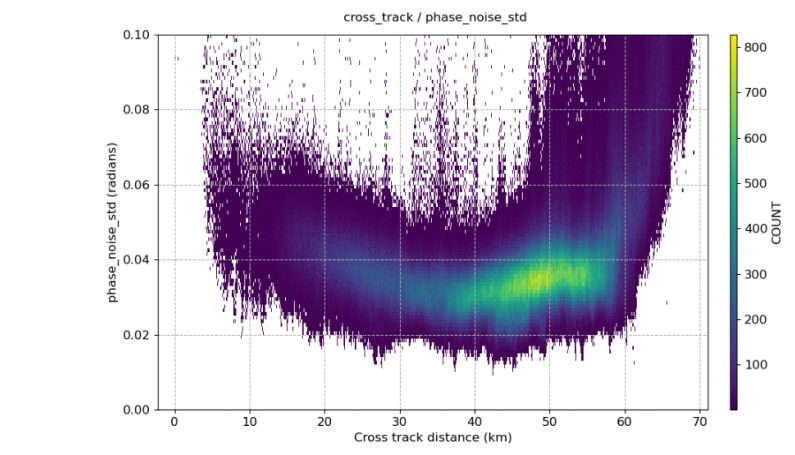
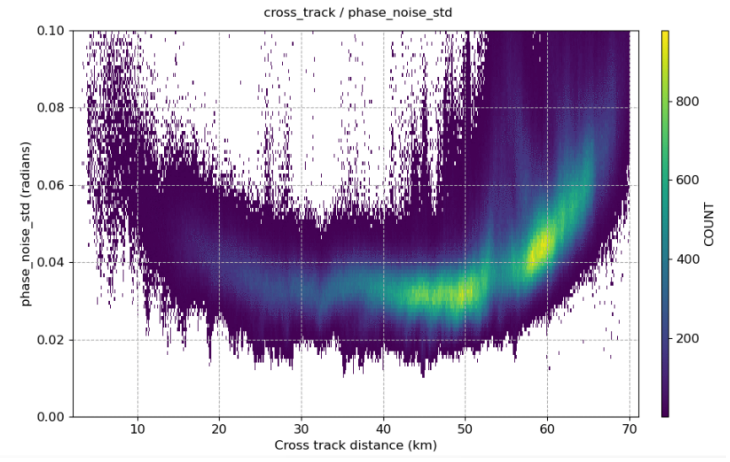
MLS over Issyk-Kul may drastically improve the interpolation over the Eurasia





SWOT PixC HR: sigma0 decrease w.r.t cross track distance (a few db per 10 km)

SWOT PixC HR: Phase noise std w.r.t cross track distance presents the expected shape



## Conclusion and future work

### Many work remains to be done

#### 1) From the 2023 field campaign data

Analyse time series of WSE over Issykkul and compare to in situ

Intercomparison of HR and LR w.r.t GNSS data collected

Validation of onboard processing and analysis of EM bias

Estimation of in situ wet tropo correction around the lake Issykkul

#### 2) Determine and monitor seiche effect from in situ measurements at both sides of the lake and merge with Mean Lake Surface to product new X Cal values pass per pass

#### 3) During the nominal science orbit

Organise new Cal / Val international campaigns in 2024 and 2025

Routine validation of SWOT WSE using operationnal in situ gauges

WSE at Karabulun from radar

