

Synergy between optical imaging radiometry and radar altimetry for inland waters: an experience with Sentinel-3 on the Nasser Lake

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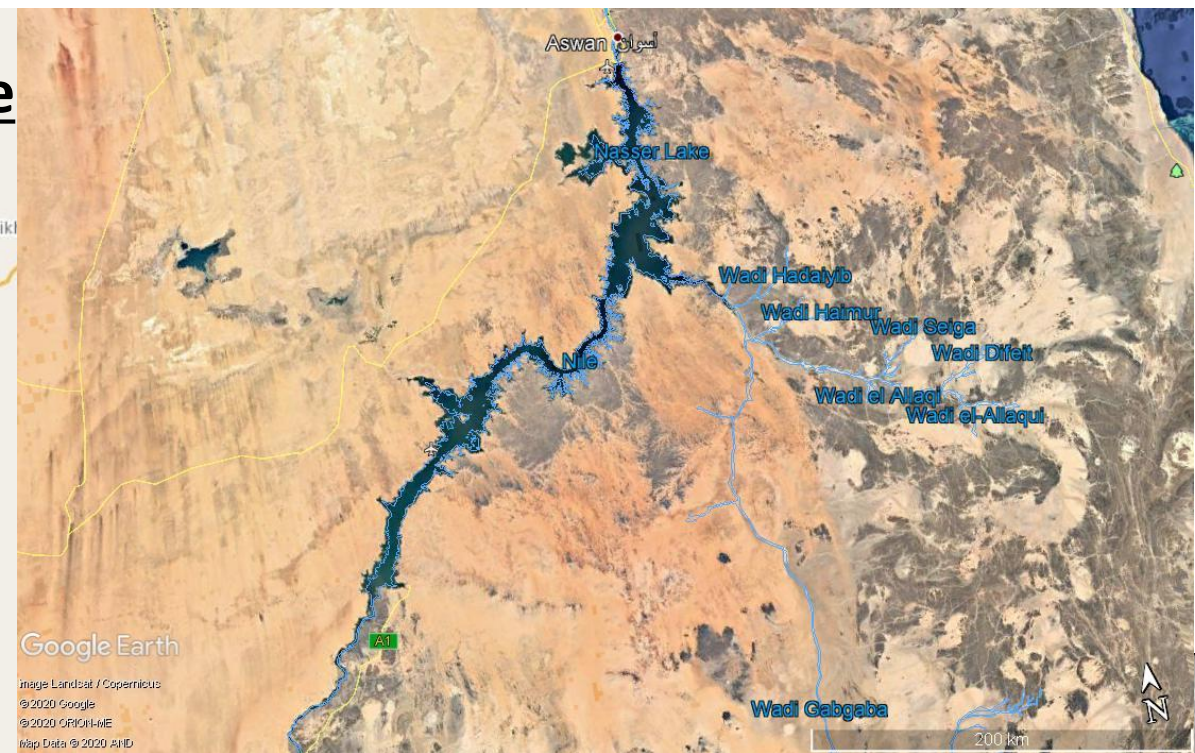
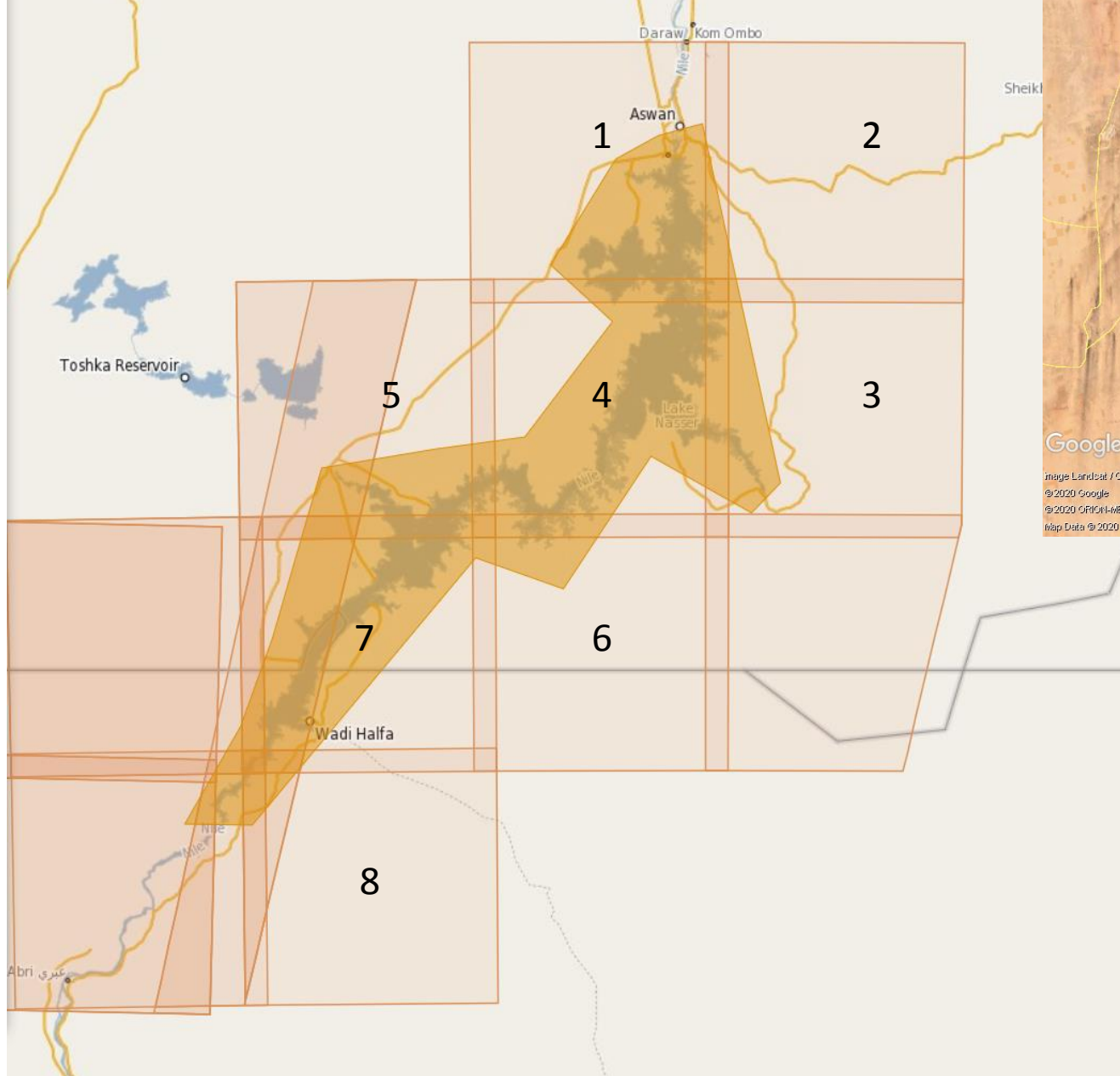
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The fundamental idea:

This is a preliminary study on the possible usage of the imaging radiometer SLSTR (Sea and Land Surface Temperature Radiometer) onboard Sentinel-3 for estimating water coverage extent in inland water contexts, in synergy with radar altimetry measurements provided by the SRAL (Synthetic aperture Radar ALtimeter) instrument. This work wants to exploit the simultaneous acquisition offered by SRAL and SLSTR instruments on the Sentinel-3A/B platform.

We introduce an alternative technique to the classical calculation of the whole water extent based on high-resolution imagery, essentially intended for the application to wide-swath short-revisit sensors. The proposed approach starts from the hypothesis that a much-reduced subset of pixels may carry enough information for assessing the status of the observed water body by estimating the water coverage percent within each single pixel. Such an assumption relies on the radiometric performance of the SLSTR instrument.

Sentinel-2 MSI tiles to cover the Nasser Lake



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SARvatore for SENTINEL3

1- DATA SELECTION 2- PROGRESSING STATUS 3- RESULTS VISUALIZATION

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For layers and overlays selection, click on the plus icon on the top-right of the map.
For more details on their usage, please refer to the instructions at the bottom of the page.

SENTINEL3 SRA L1A operations products (3A) - NTC Query

Received new 89 entries (44.149 sec)

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Showing 1 to 89 of 89 entries

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Found 89 results

Processing Parameters

The screenshot shows the Copernicus Open Access Hub interface. The main map displays the Middle East and North Africa, with a large orange polygon highlighting a region of interest. The left sidebar shows a list of Sentinel-3 SLSTR products, including their footprints, download URLs, and mission details.

Request Done: (footprint:"Intersects(POLYGON((30.706353103950512

Display 1 to 25 of 46 products.
Order By: Ingestion Date **0 products selected**

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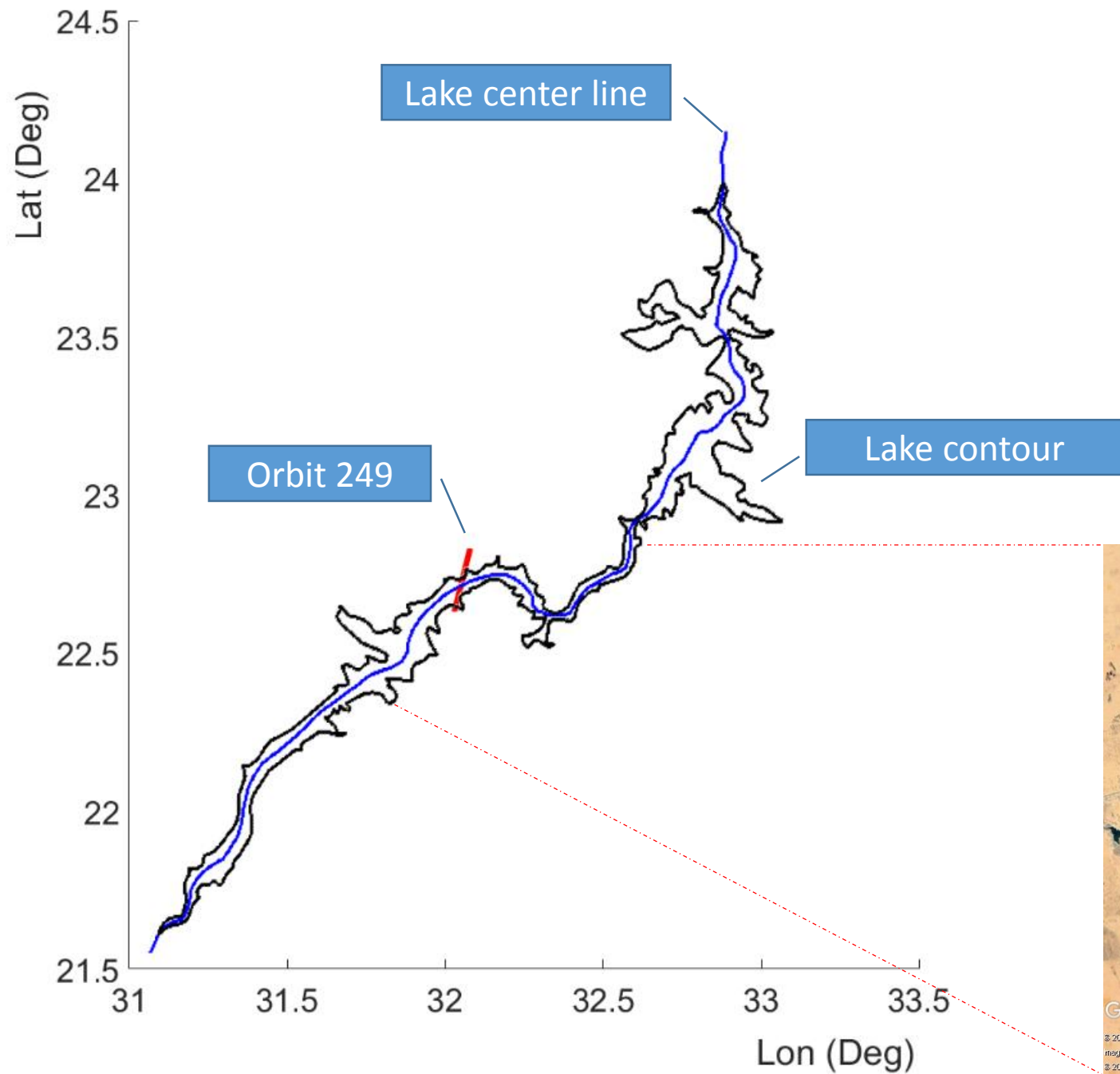
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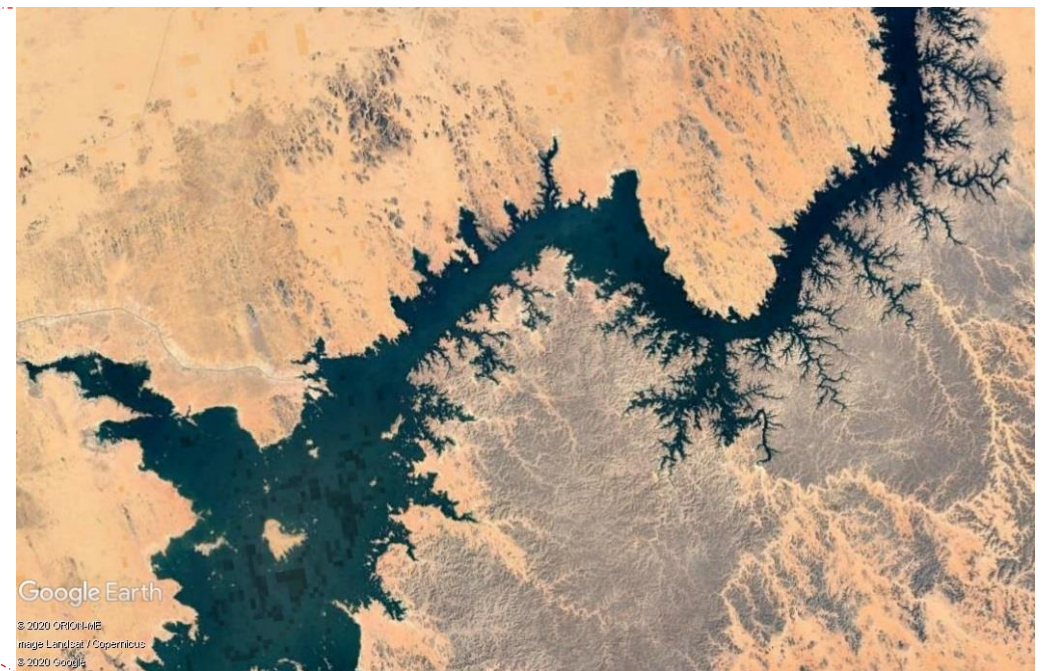
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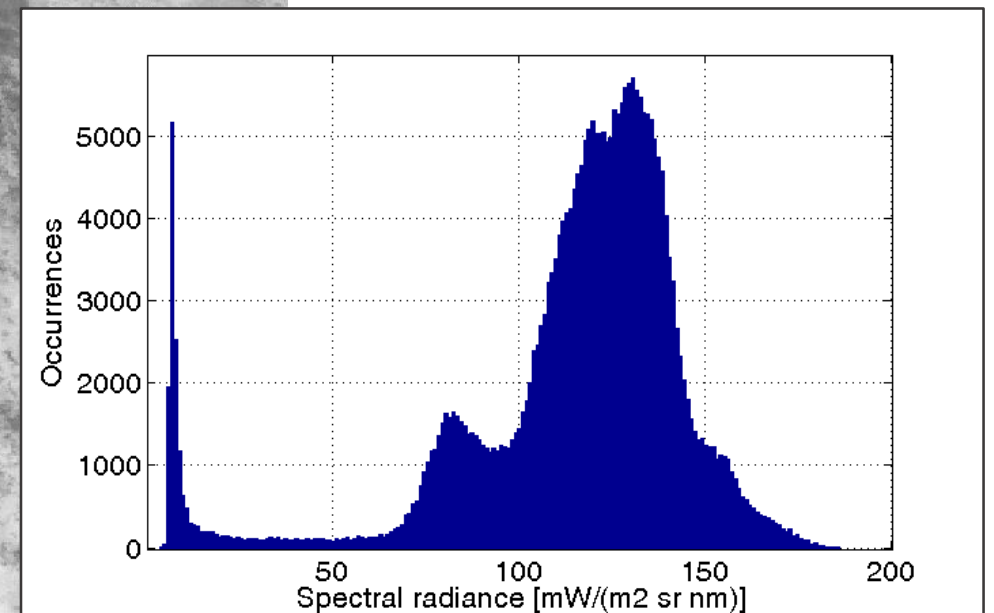
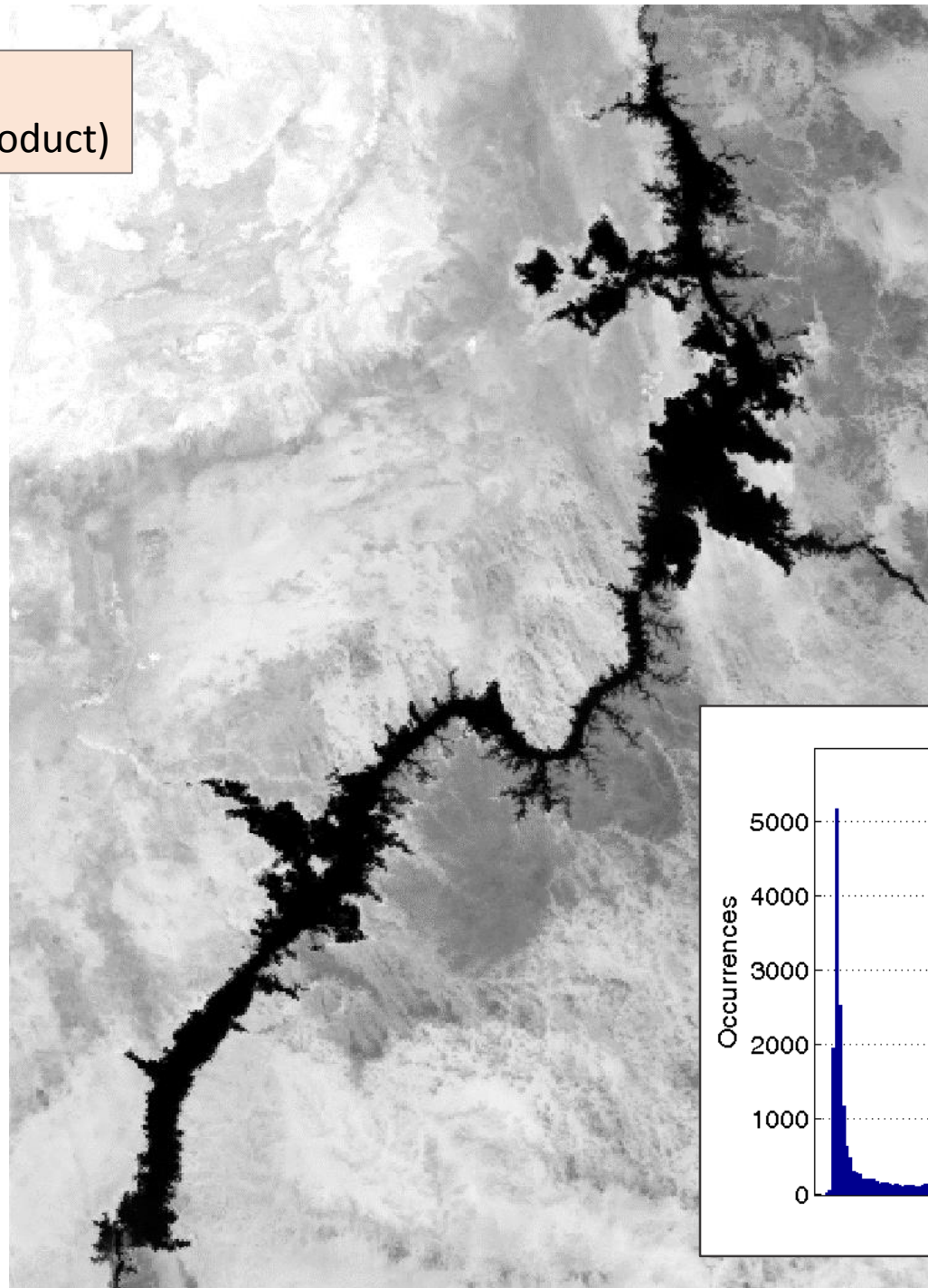
Lat Lon: 12.59, 17.67



Water body outline and
satellite track crossing the
water body



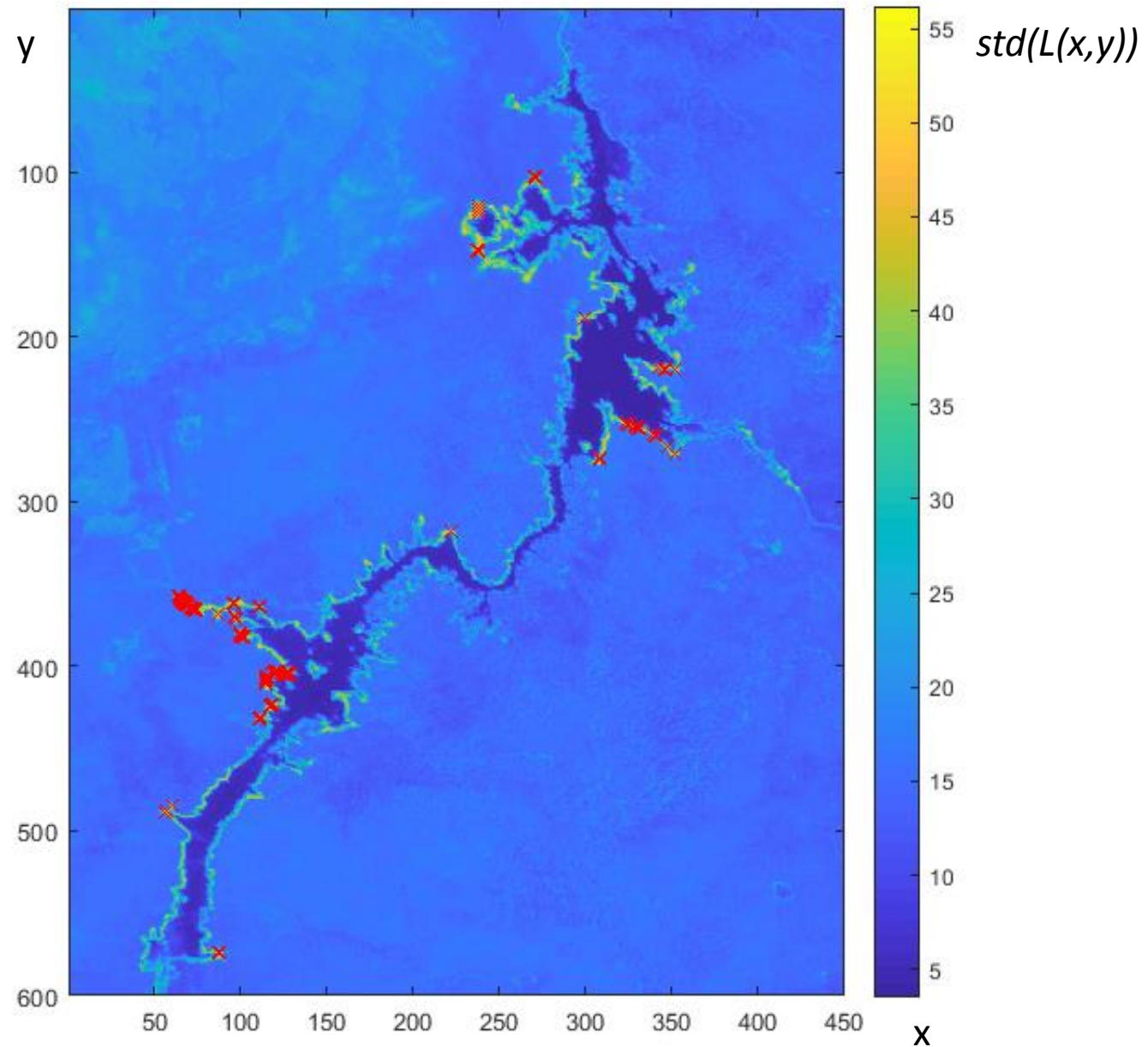
Nasser Lake (Egypt)
SLSTR S3an-radiance (L1 product)



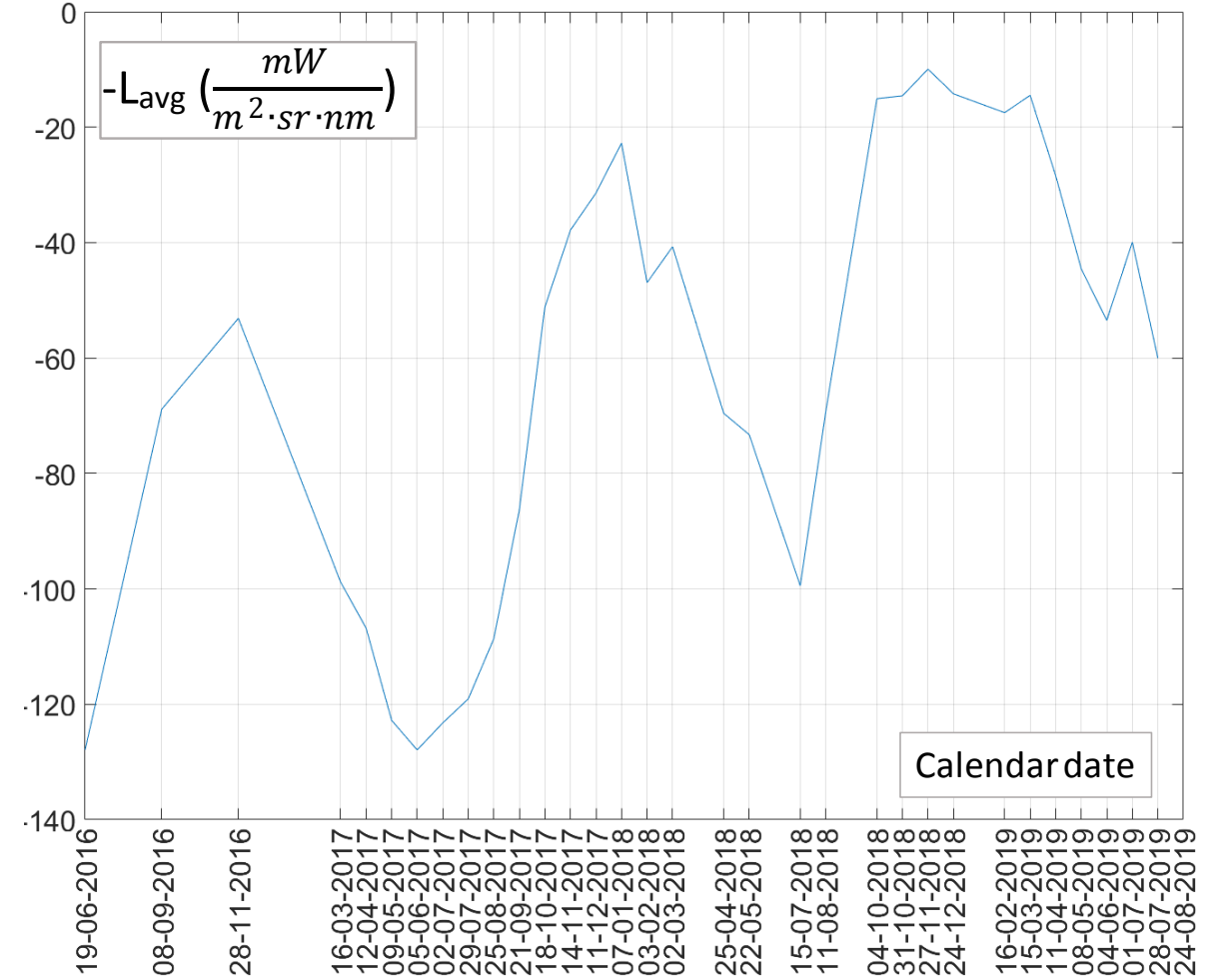
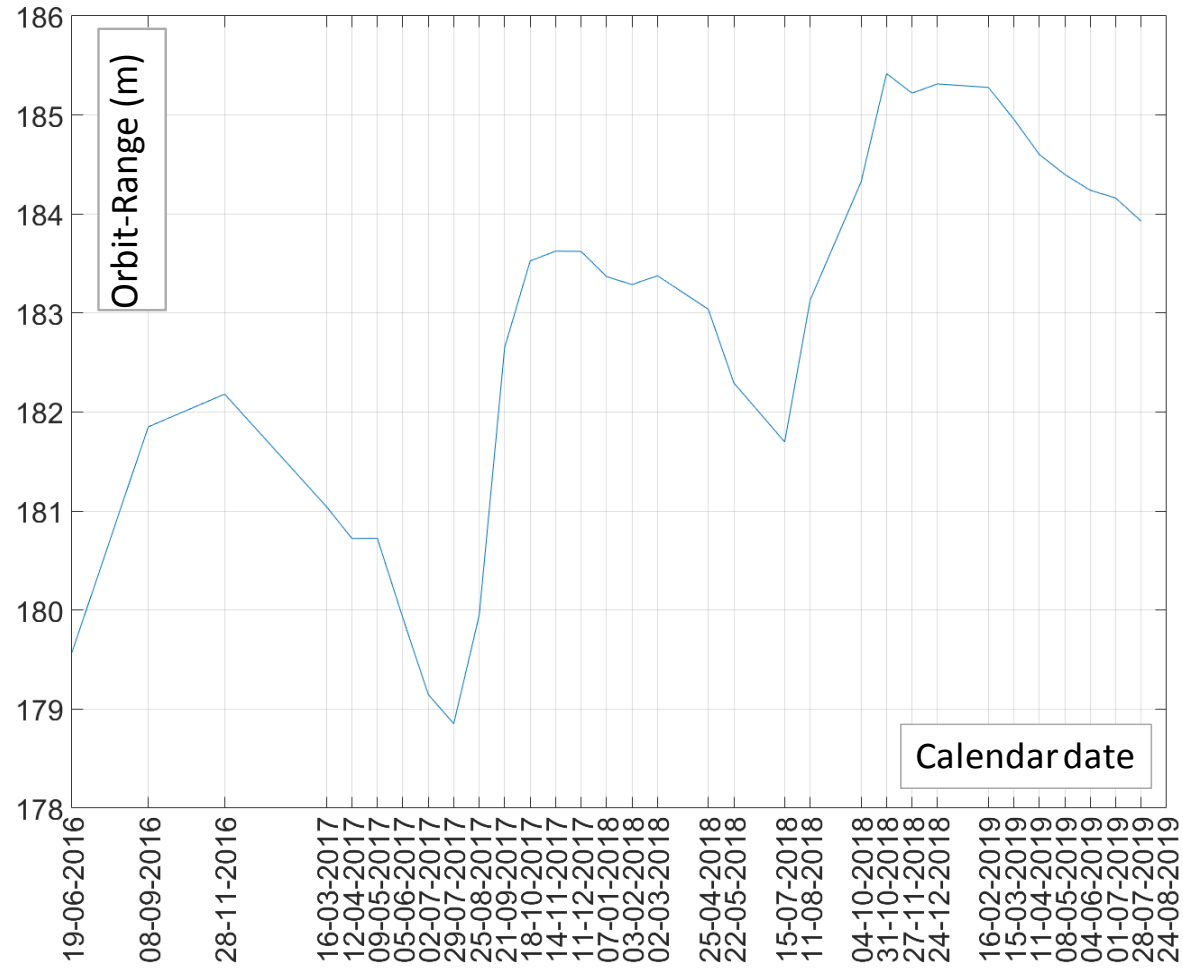
Processing steps

- In our approach, co-located spatial subsets of 450x600 pixels have been extracted from each SLSTR scene
- A variability map is obtained by calculating the point-wise standard deviation of the measured radiance for each pixel in the whole timeseries
- The first N pixels exhibiting the highest variability of the collected radiance are selected
- A timeseries related to water storage variations is built, based on the optical radiometric measurements
- Cross-validation is performed with radar altimetry and an in situ gauge, essentially in terms of co-variance

Variability map with the highest 100 points marked



The altimetry-based and the radiance-based timeseries

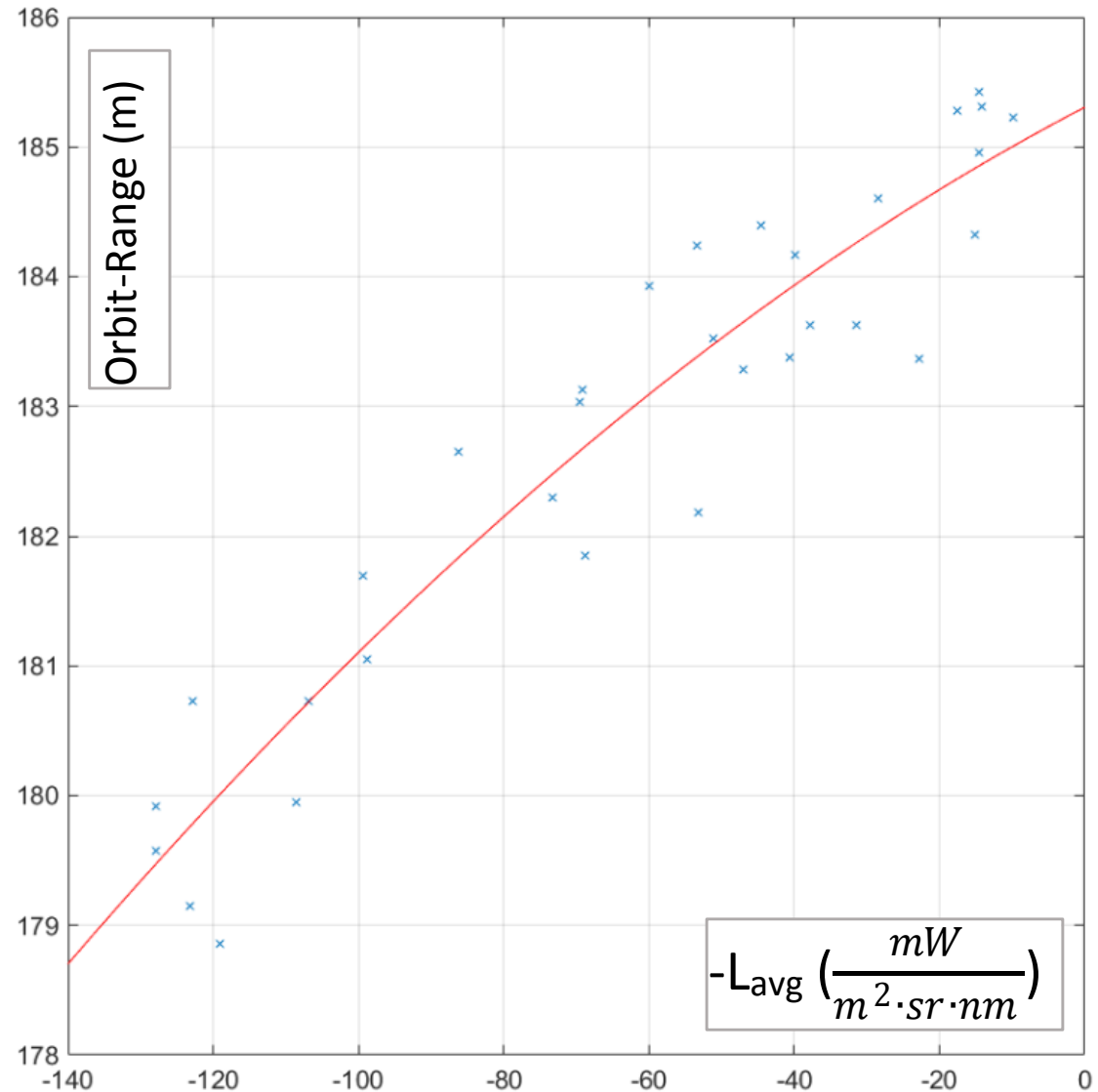


Analysing the simultaneous radiometric and altimetry measurements...

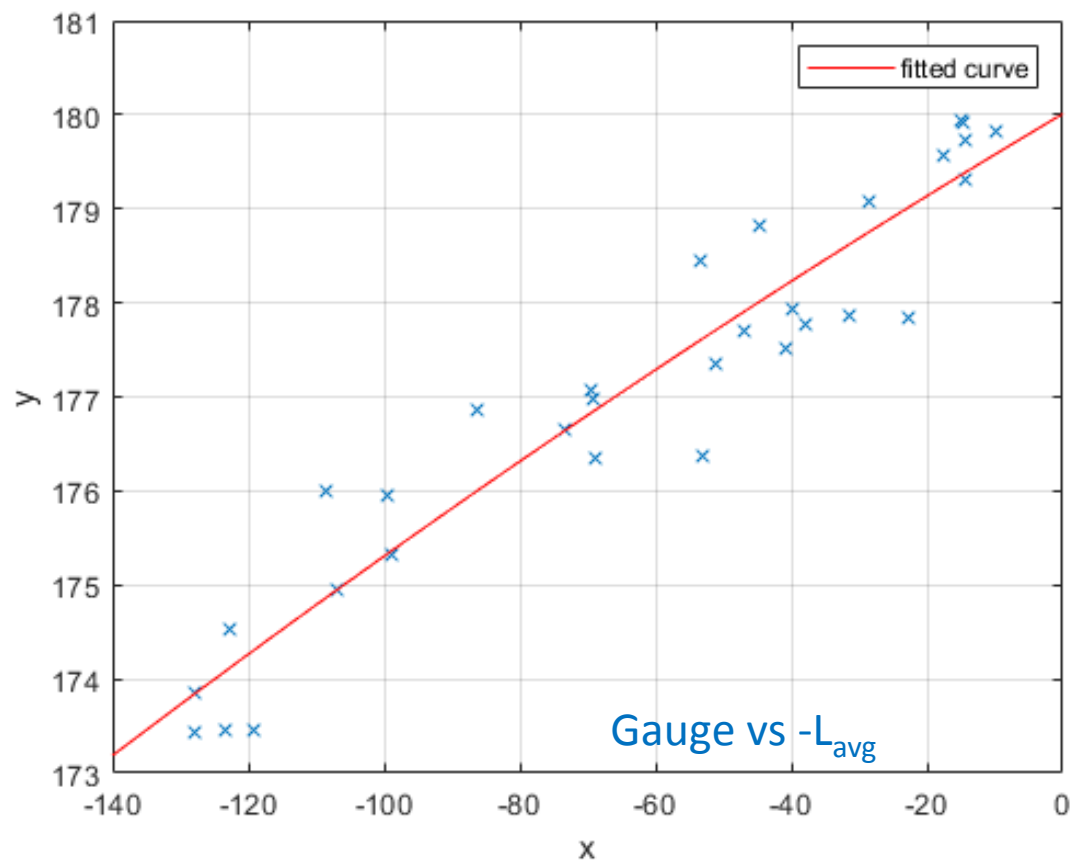
We can assume the natural system as a conceptually simple single-input single-output time invariant system characterised by a non-linear transfer function, which depends on the topography of the observed site.

In the scatterplot aside, a 2nd-order polynomial fitting is plotted in red.

R^2 is 0.89

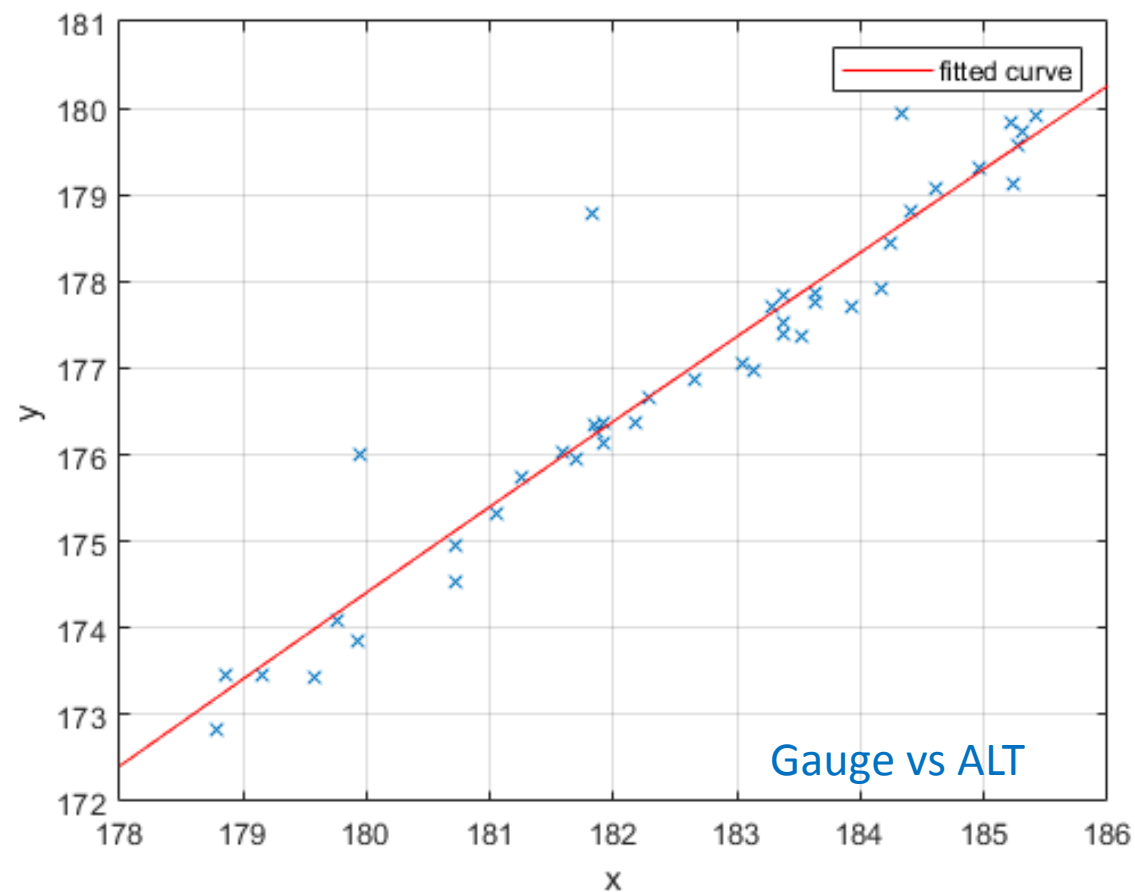


$$R^2=0.91$$



Latest results with
in situ gauge measurements

$$R^2=0.91$$

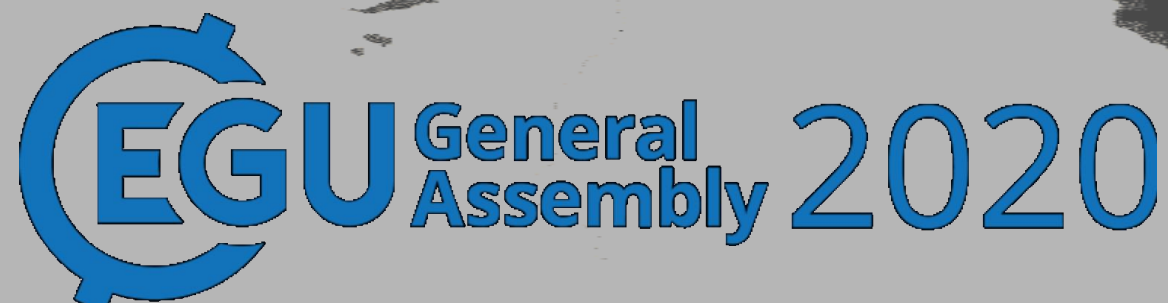


Conclusions

We have experimented a technique based on radiometric measurements on a reduced set of pixels for quantifying a hydrological parameter.

This approach has multiple advantages:

- the possibility to monitor targets not crossed by the satellite altimeters' tracks
- the availability of a complementary and independent measurement in addition to altimetry
- a much narrower time sampling than satellite altimetry , if using the full S3A/B constellation (1 day), thanks to the conical scanning concept of SLSTR
- the possibility to make cross-validation with radar altimetry by simultaneous measurements



EGU General Assembly 2020

Thank you!



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