Monitoring Water Extent And Water Level Of The Sensitive Lakes Of Intermediate Yangtze Basin Exploiting Sentinel-2 And Icesat-2 Data: Case Of The Anhui Province Lakes

Sabrine Amzil, Thomas Ledauphin, Rémi Braun, Alessandro Caretto & Hervé Yésou

ICUBE SERTIT, University of Strasbourg , Pole API, bv Sébastien Brant, BP 10413, 67412 Illkirch Graffestaden, France

Context

Lakes in the basin of the Yangtze River, play a fundamental role in regional bio-geochemical cycles and provide major services to the communities, provisioning services (drinking water, fishing...) and biodiversity keeping. However, the extreme temporal and spatial variability of these massive but extremely shallow ecosystems prevents a reliable quantification of their dynamics with respect to changes in climate and land use.

Objectives

- Monitoring water extent and water level of lakes in the middle and lower reaches of the Yangtze river. This study focuses on the case of Anhui basin lakes.
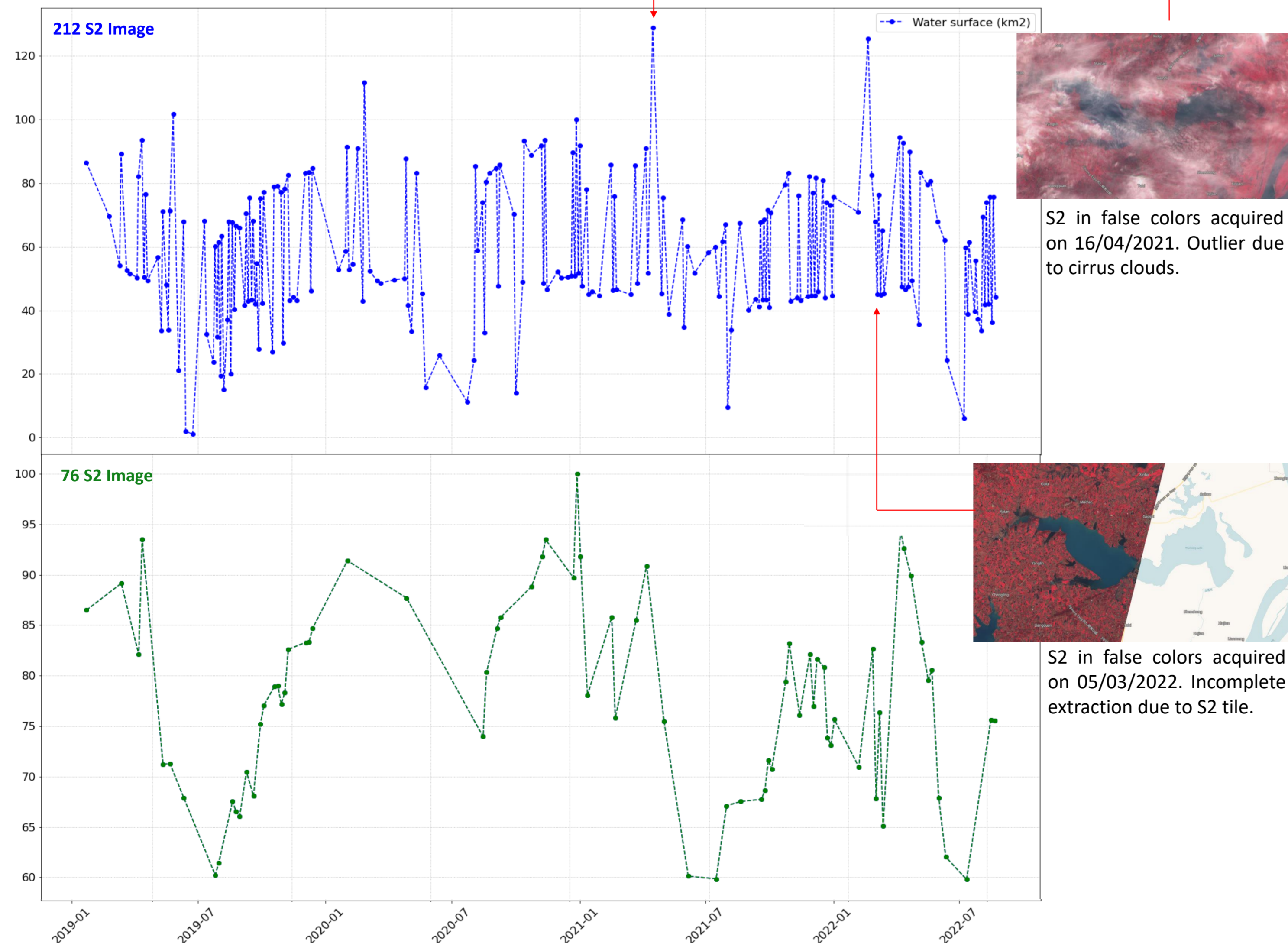- Map and explain the spatio-temporal changes in biodiversity.
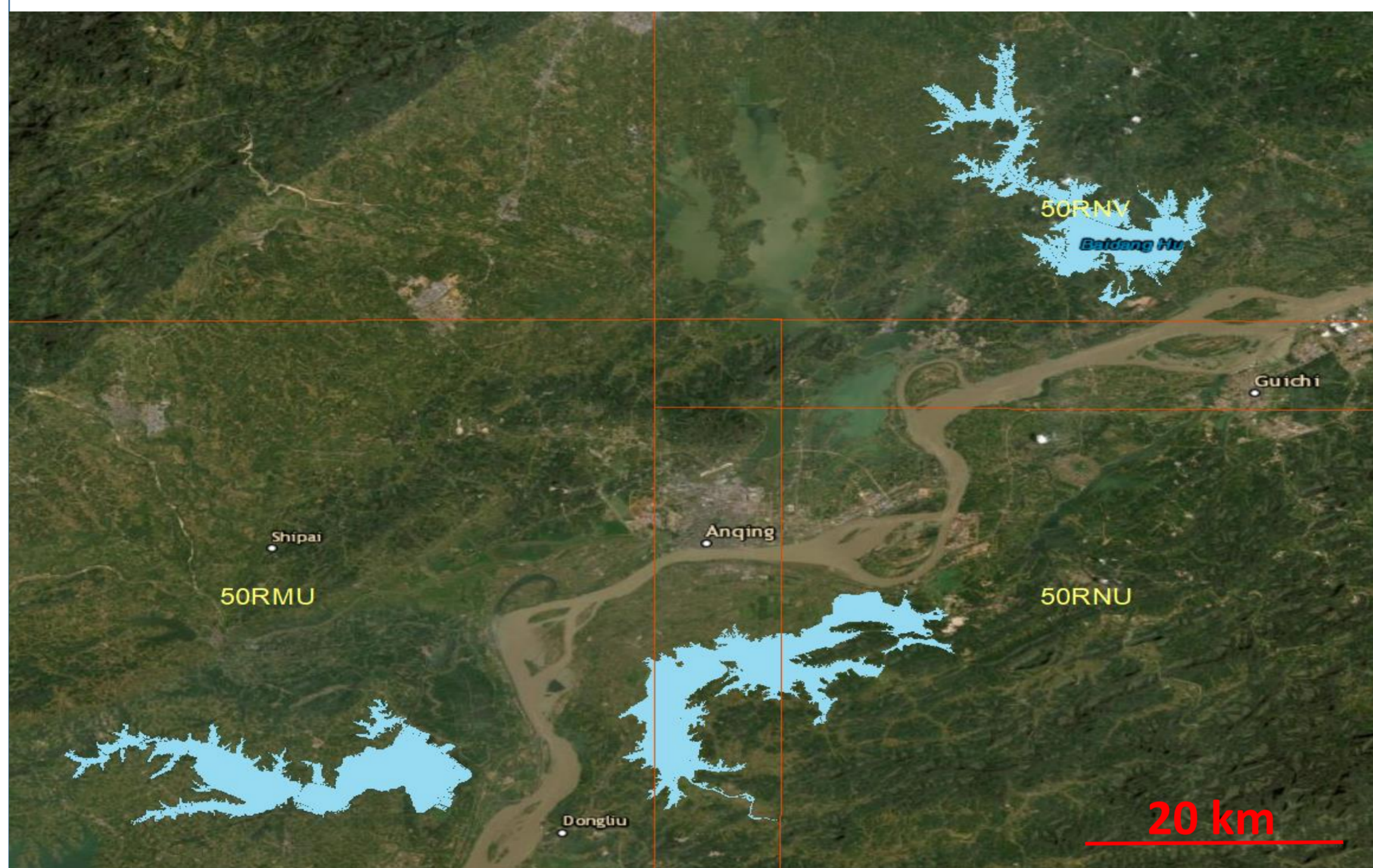
Study sites (Wuchang, Shengjin and Baiding lakes) located in Anhui province.

Methods

- Extraction of water extent exploiting over **1100 Sentinel-2 image** (2019-2022) using **ExtractEO** and generation of water surface time series.
- **ExtractEO** is a software implementing **automated end-to-end** chains on satellite data, developed in Python by SERTIT. The pixel classification is done by training a Multi-Layer Perceptron model over each Sentinel-2 tiles. Water samples are retrieved from the Global Surface Water (GSW) Database thanks to several parameters.
- Exploiting and crossing IceSAT-2 surface water heights.

Results

➤ Water Surface

212 S2 Image

Water surface (km2)

S2 in false colors acquired on 16/04/2021. Outlier due to cirrus clouds.

76 S2 Image

S2 in false colors acquired on 05/03/2022. Incomplete extraction due to S2 tile.

Water surface time series for Wuchang lake exploiting 212 Sentinel-2 images (with 5% cloud coverage) before (blue) and after (green) removing outliers. Water and Clouds on each image were detected using ExtractEO. Low water extractions are due to the fact that the entire lake does not appear on a number of S2 images in a specific orbit.

83 S2 Image Shengjin Lake

66 S2 Image Baidang Lake
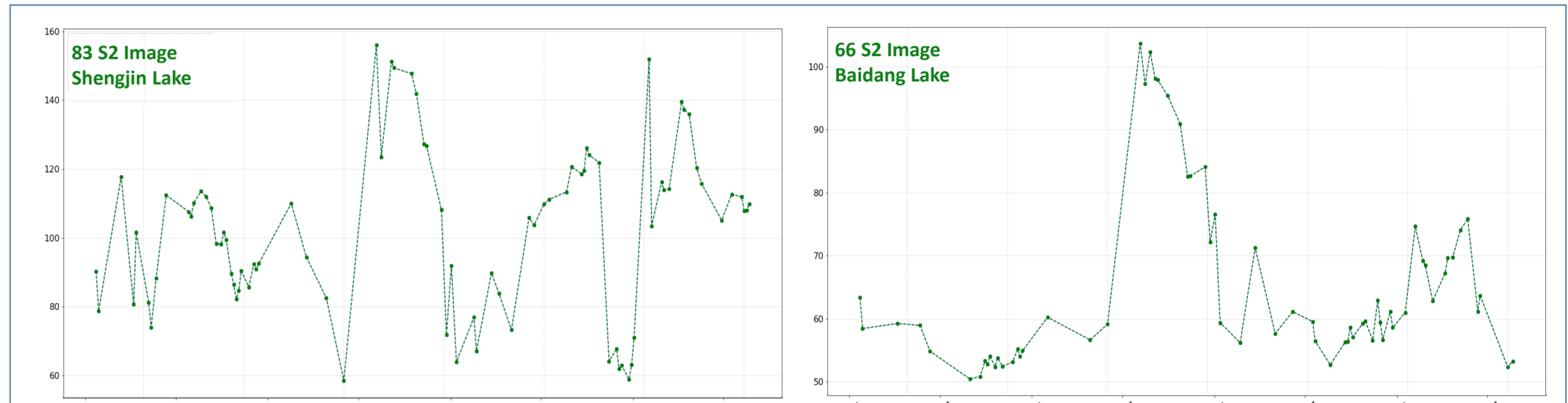
Water surface time series of Shengjin lake and Baidang lake after processing outliers.

➤ Water Level
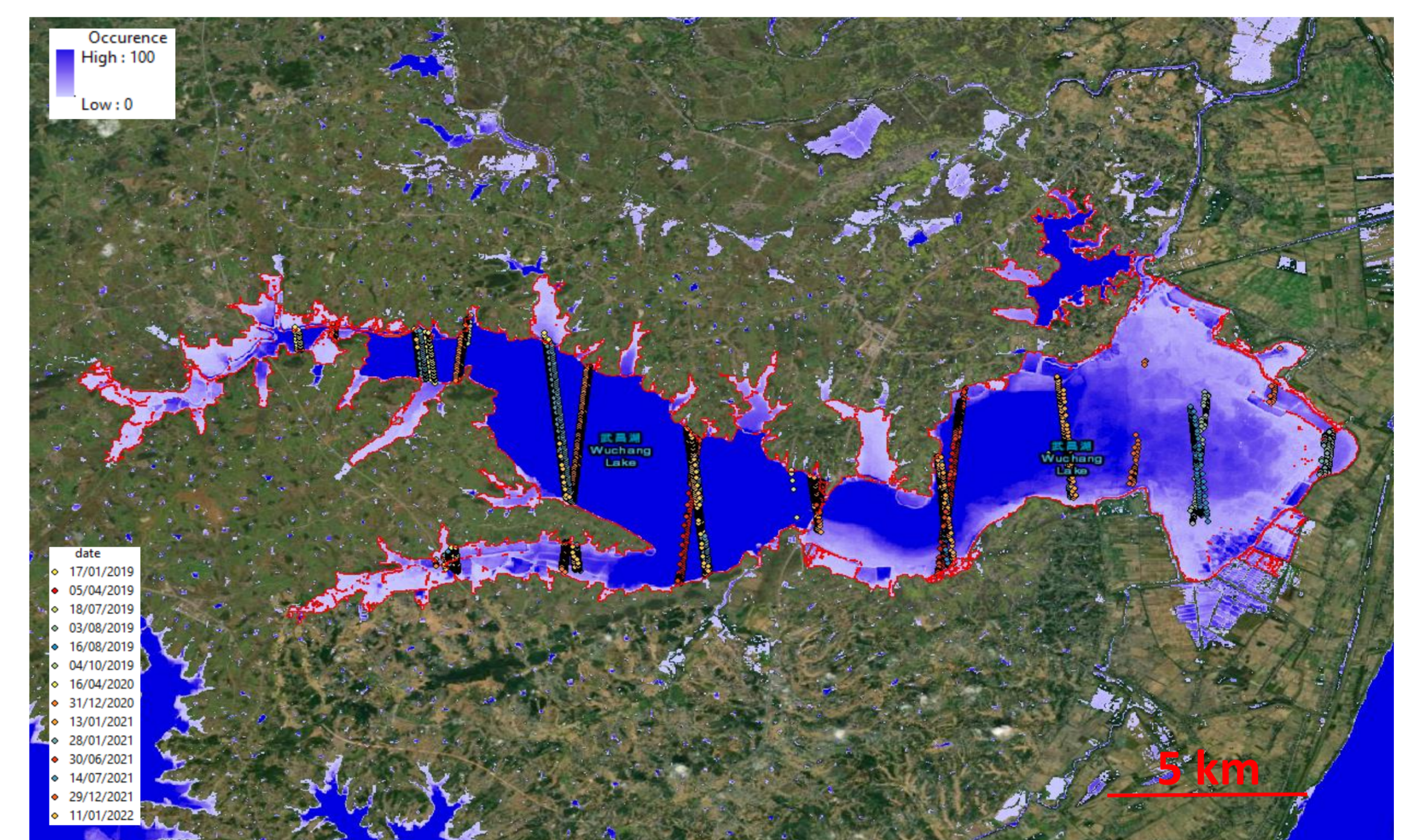
Crossing along-track water surface heights with GSW 2020 maximal water extent and occurance (14 dates available in 2019-2022) for Wuchang lake.

Height \ Lake	Wuchang	Shengjin	Baidang
Available Dates	14	23	14
Min (m)	8.50	8.04	5.77
Max (m)	12.96	15.55	12.34
Mean (m)	10.62	9.99	9.38

Statistics of IceSAT-2 water surface heights available over the period 2019-2022. All elevations are reported as orthometric heights above the WGS84 ellipsoid. Water level time series will be presented in next work.

Discussion

- Different water bodies and wetlands dynamics.
- Accurate detection but some incomplete Sentinel-2 water extractions and presence of outliers due to cirrus clouds (not detected during the processing).
- Automatic process to identify and remove outliers.
- IceSAT-2 altimetry is complementary to Sentinel-2 data.

Conclusion

- Possibility to follow water extent and level over short or longer periods.
- Complexity of sensitive ecosystems such as the Anhui lakes.
- IceSAT-2 altimetry has a centimetric accuracy but not representative of the entire lake surface height.
- Use of cloud masks in water extraction process is being improved for future work.
- Set up a reference database for further SWOT products validation.

Acknowledgements

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