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Large and small water bodies monitoring exploiting the ExtractEO processing chain: case of the Lake Fitri (Chad) and of the ponds in the Grand East Region (France)



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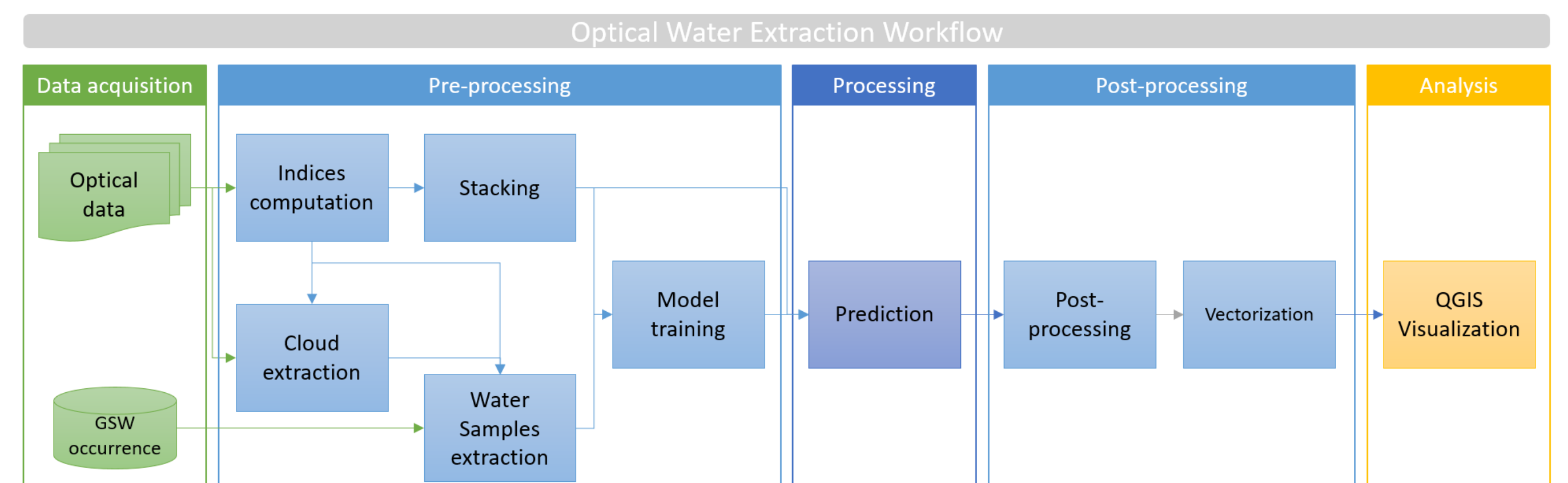
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Context :

- Importance of water bodies in the global change's context, water resources' scarcity as well as biodiversity preservation
- Earth observation: role in assessing and monitoring the water characterization's parameters (height, extent, temperature & radiance)
- ExtractEO: In house, end-to-end processing chains dedicated to water, fire, clouds recognition and extraction and focused on Sentinel1_3 time series exploitation
- Validation: exploitation of thematic databases at several scales, reference's datasets as well as VHR imagery

Single lake application: Case of Fitri Lake (Chad)

- A flat-bottomed lake, geometry not well-known with a core part and flood spreading areas.
- High intra- and inter-annual variability related to West African monsoon, + over decades trends in increasing of water surfaces.
- Sentinel-2 time series: from 01-2017 to 12-2021 (ca 300 S2 downloaded from CREODIS, Copernicus Hub and CNES PEPS)



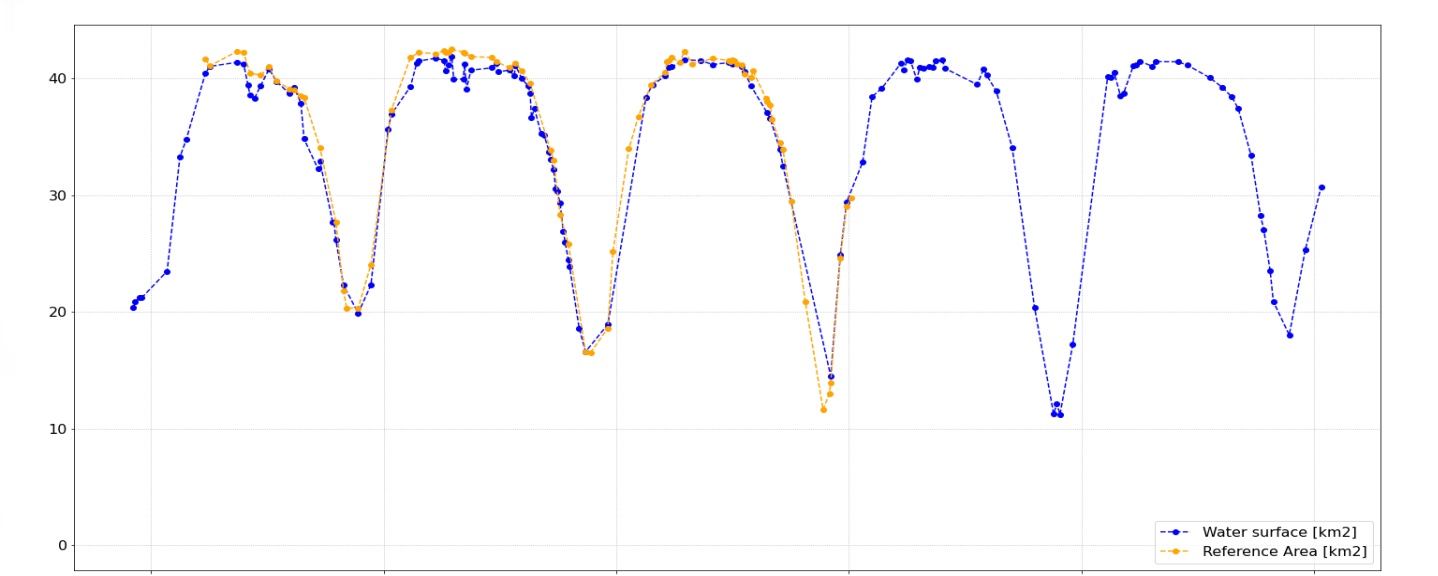
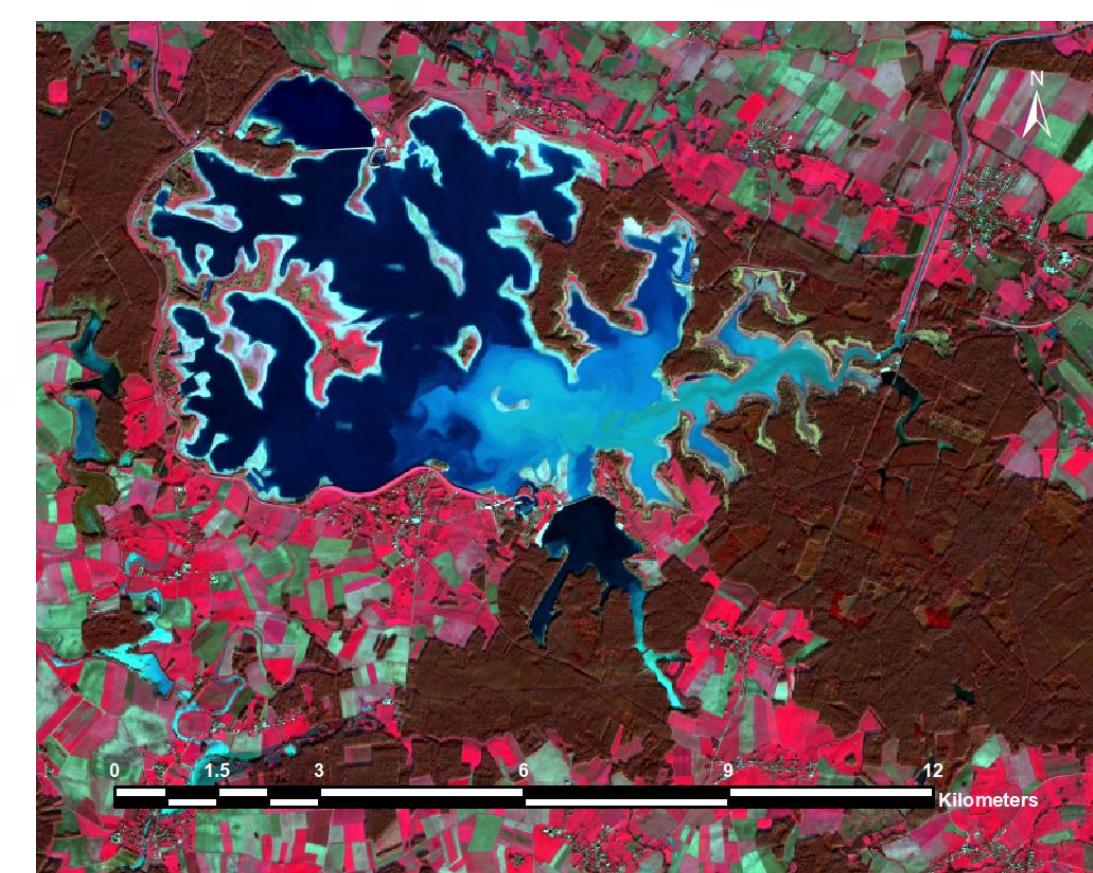
ExtractEO structure based on multilayers perceptron algo with a fine and rigorous selection of training samples based on GSW

Regional application: Case of Grand Est Region lakes (France)

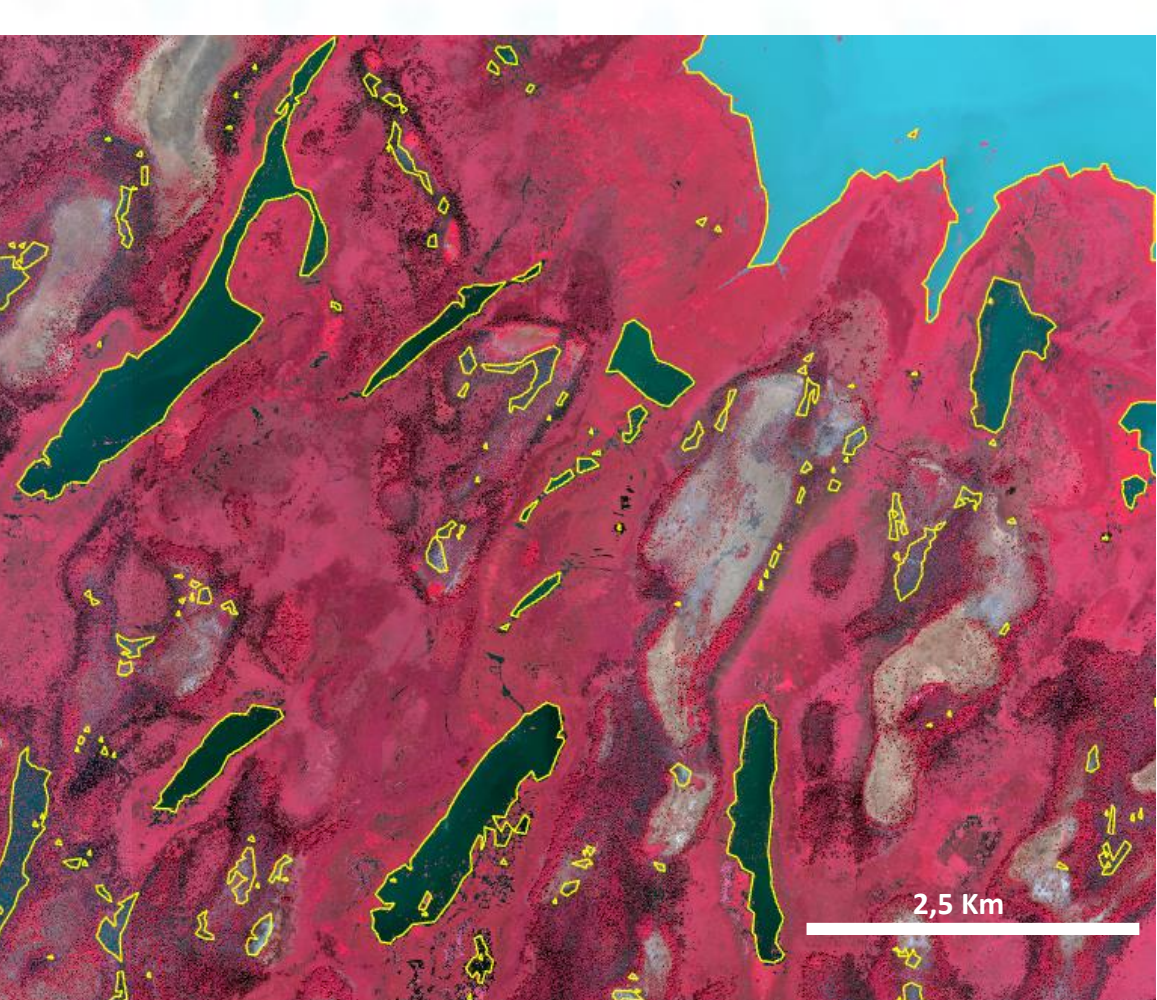
- Rare information available on lakes, ponds and small reservoirs inter and intra annual behaviors
- More than 280 lakes to be monitored, from 10 to 45 000 ha.
- All images up to 95% of clouds coverage taken into account (16 tiles, 500-700 images by tile downloaded from AWS & CREODIAS)

Water bodies extraction assessment based on a reference ALCD tiles reaching high scores: high score particularly for images acquired in fall and winter

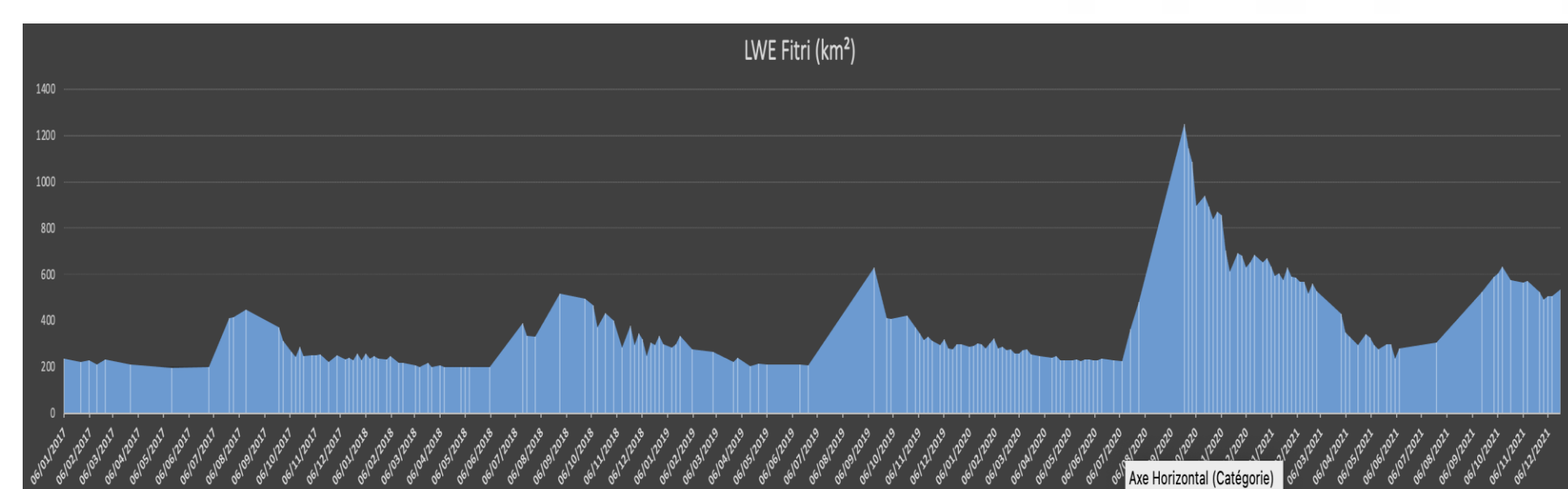
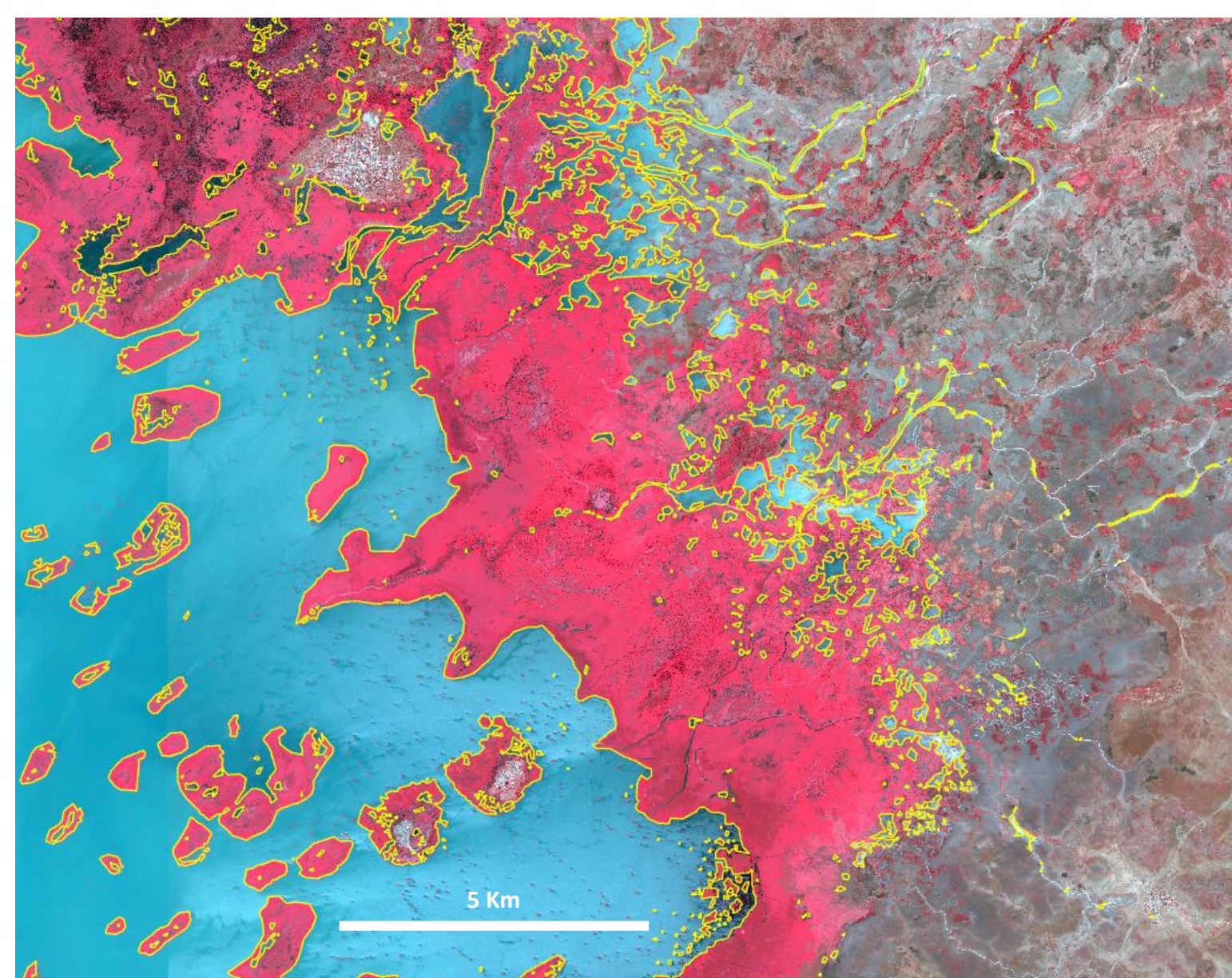
| Date | Product | EEO | | | |
|------------|---------|----------|-----------|--------|-------|
| | | F1 score | Precision | Recall | MCC |
| 2019.07.17 | LZA | 0.922 | 0.978 | 0.872 | 0.923 |
| 2019.12.04 | LZA | 0.941 | 0.929 | 0.953 | 0.941 |
| 2019.12.29 | LZA | 0.906 | 0.930 | 0.883 | 0.905 |



Der's Lake, 45 000 ha: 5 years of LWE plus a comparison with a tailored reference

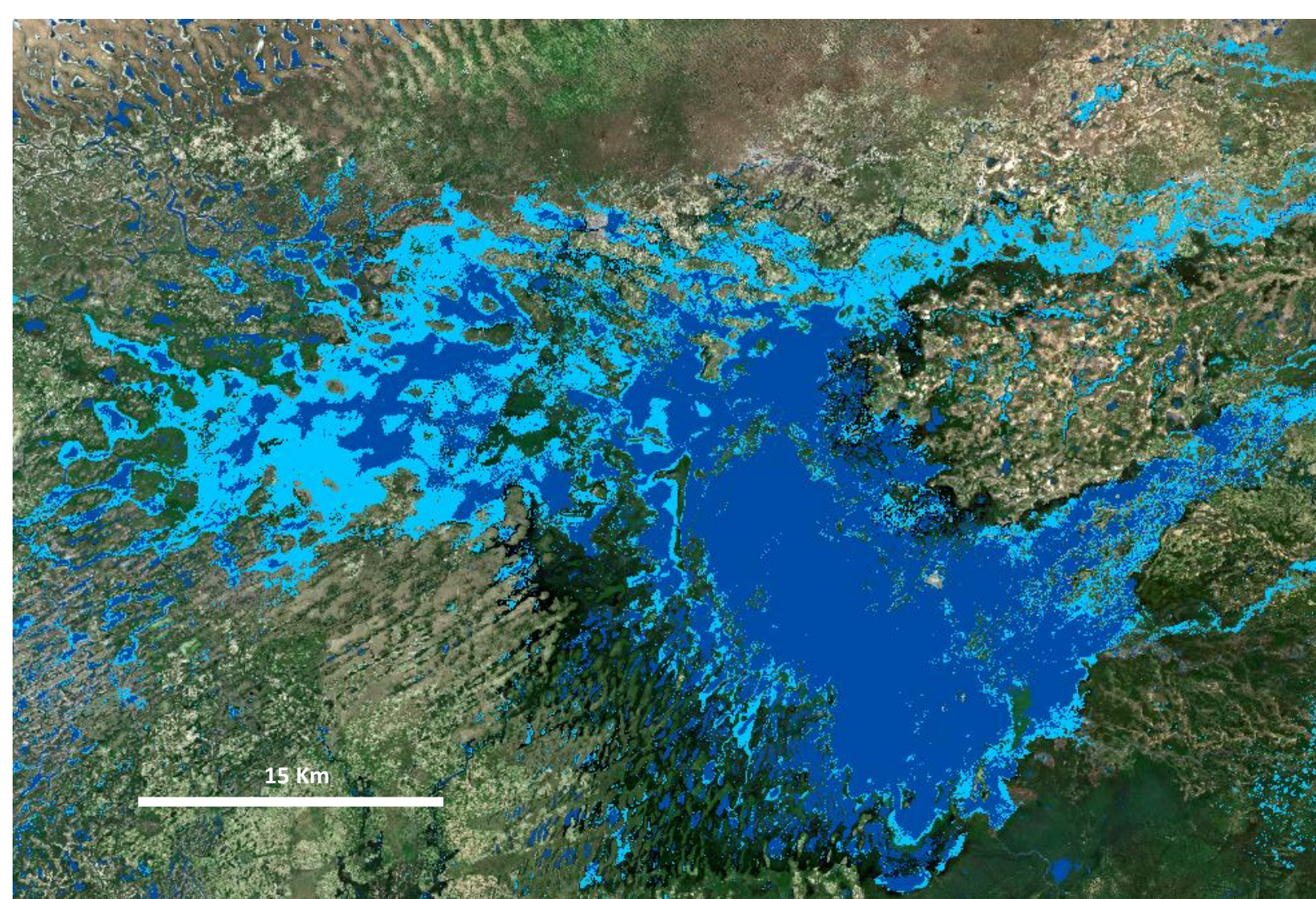


Synchronous Pleiades (70 cm) with S2 10m LWE : the 2021-11-11



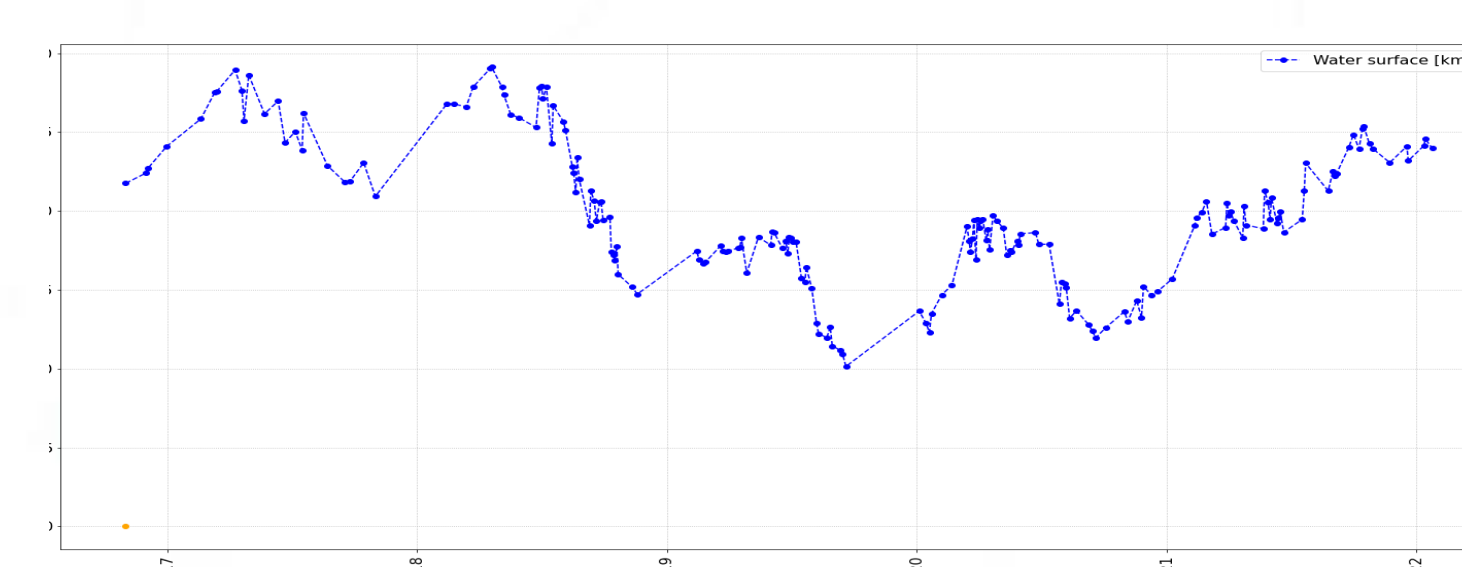
Dynamic of the LWE of Fitri Lake with the 2020 flood peak (1492 km²) and remaining high water extent in beginning 2021

Comparison of the Water max extent based from the S2 exploitation (light blue) compared with the 1984-2000 GSW (dark blue) highlighting the spreading areas as well as the importance the Northern channel in lake infilling process during major flood events

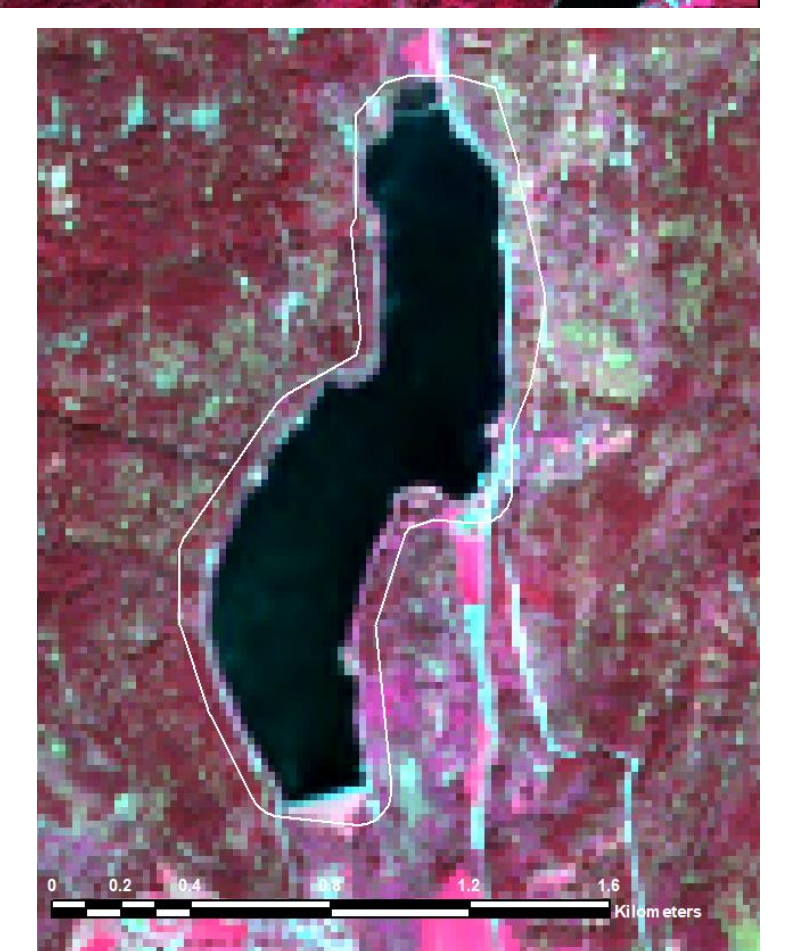
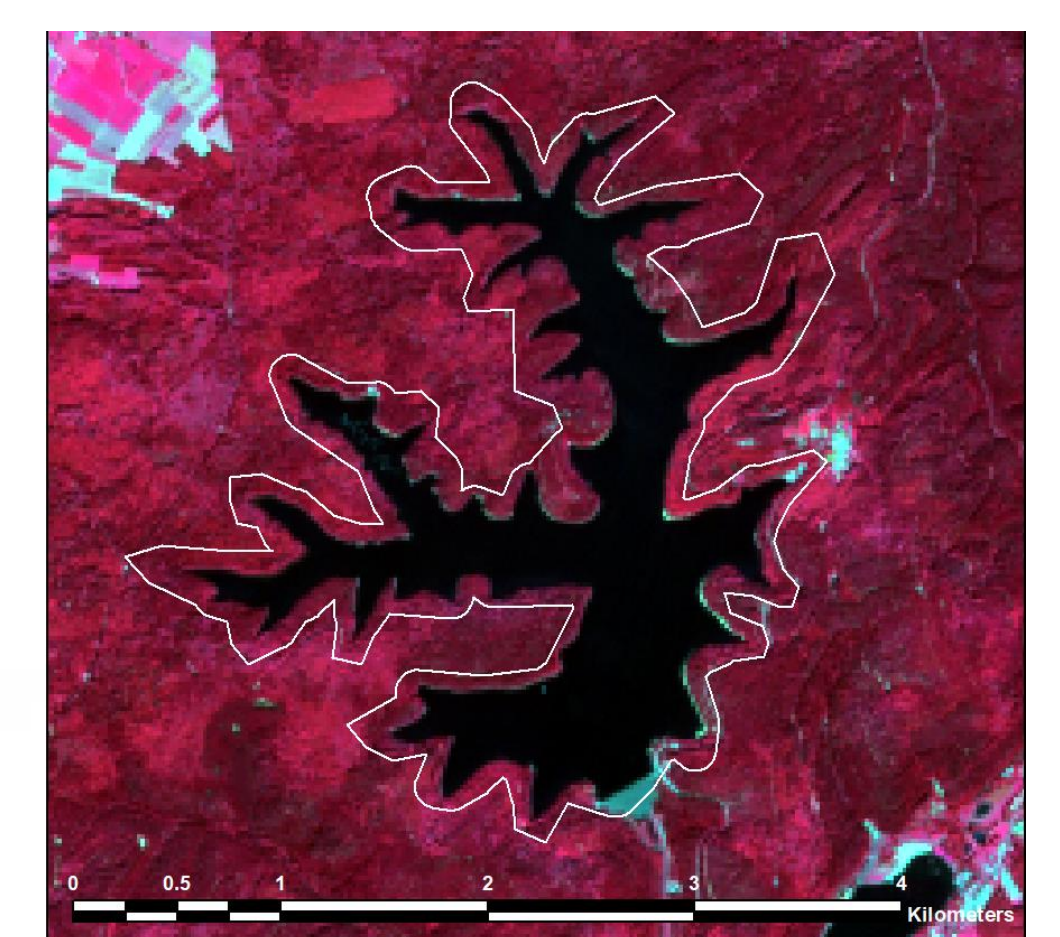
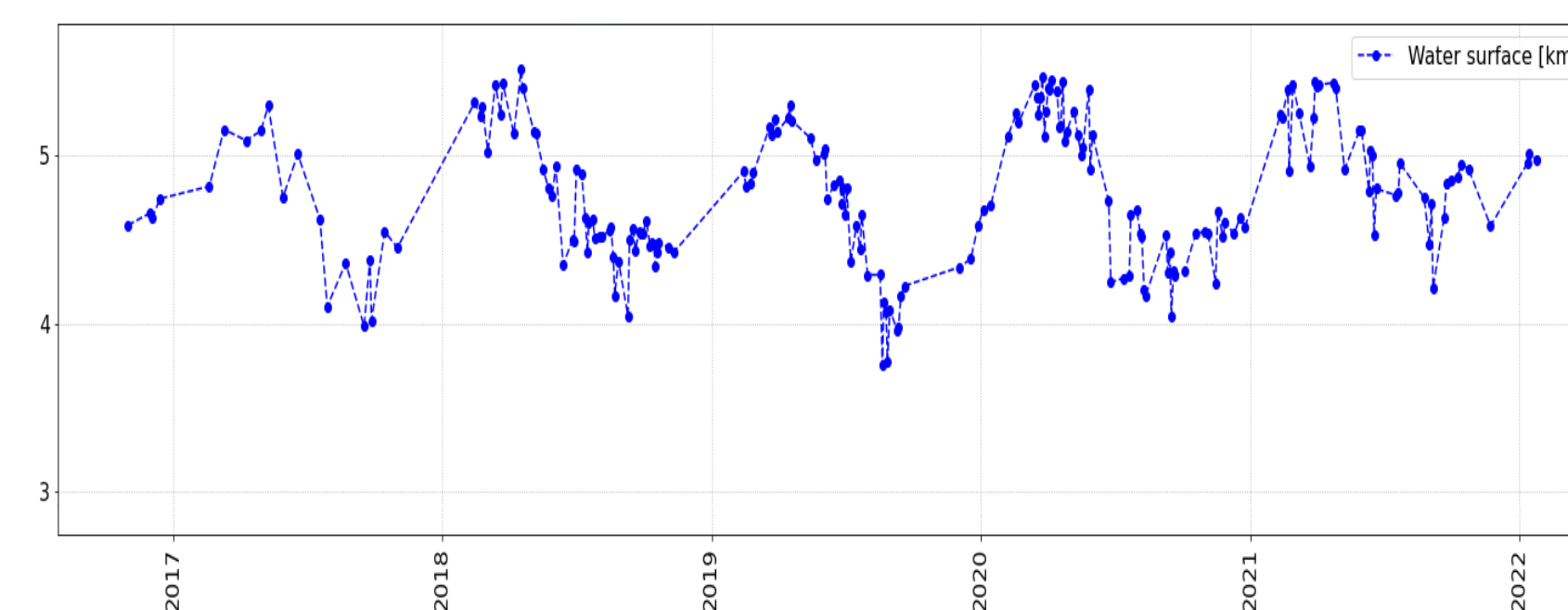


- S2 LWE : very rich information for the Fitri study and management
- An excellent indicator of climate trends in this remote and poorly studied region, but also of resource stresses due to population growth

References
 X. Yang, Q. Qi, H. Yésou, Th. Ledauphin, M. Koehl, P. Grussenmeyer, 2020: Monthly estimation of the surface water extent in metropolitan France at a 10-m resolution using Sentinel-2 data. Rem Sens Env., 244, S.Peña-Luque, S. Ferrant, M.. Cordeiro, Th. Ledauphin, J. Maxant, and JM. Martinez, 2021, Sentinel-1&2 Multitemporal Water Surface Detection Accuracies, Evaluated at Regional and Reservoirs Level, Remote Sens. 2021, 13, 3279



Pierre Percée reservoir (up), 300 ha and Kruth reservoir (bottom), 80 ha: 5 years of S2 LWE



Conclusion-perspectives

- ExtractEO : Operational and accurate tools for LWE extraction and monitoring both for large water bodies and small ones
- Next steps: Generation of reference time series of water surfaces for
 - SWOT Surface water validation during CalVal Phase
 - CCI Lakes Phase II