Estimation of surface water extent and dynamics from passive microwave satellite observations, for climate purposes

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Requested background: Strong background in physics. Good knowledge in statistics. Proficiency in at least one programming language.

Continental surface waters encompass a wide variety of environments, from tropical wetlands rich in biodiversity, to boreal peatlands very sensitive to climate change. These water areas play a key role for the management of water and natural resources and for climate change, although they cover only ~8% of land surfaces. They are the main natural source of atmospheric methane emissions, a powerful greenhouse gas that contributes to the global warming.

Despite their importance, the extent of these water areas and their dynamics still suffer from very large uncertainties, and satellite observations provide the only way to map these surface waters globally and over long time periods.

A method has been developed to estimate global continental surface water extent and their dynamics, from the merging of different types of satellite measurements (passive microwaves, active microwaves, visible and near infrared data). This makes it possible to benefit from the synergy between the multiple satellite observations, and to extract surface water extent regardless of the environments and even under dense vegetation canopy. GIEMS-2 (Global Inundation Extent from Multiple Satellites-2) provides monthly estimates of surface water extent, at 25 km spatial resolution, across the globe, from 1992 to the present day (Prigent et al., 2018). The time series have already been evaluated, by comparison with other surface water datasets or with other hydrological variables such as water levels in rivers.

The current GIEMS spatial and temporal resolutions are not suitable for some applications at regional or local scales. A new dataset is being generated, with higher spatial and temporal resolutions (0.125° and 10 days). The objective of this study will be to analyze the temporal and spatial variability of the new results and to evaluate them. This will include comparison with the original GIEMS version, and comparisons with other estimates, from inventories or from satellite data, both at global and basin scales. Special efforts will concentrate on the evaluation of the coastal wetlands, where low spatial resolution observations are contaminated by ocean surface contribution in the signal. This work will also use high resolution land cover datasets from visible and near-infrared observations, to help understand the limitation of the new GIEMS dataset and quantify its uncertainties.

This study will involve:

- Developing the tools to analyze multiple satellite data at different spatial and temporal scales.
- Analyses of the spatially-aggregated wetland estimates (for instance, per basin) and how they correlate with other relevant datasets, such as precipitation or soil humidity.

- Temporal analysis to establish the stability of the wetland data record with time and their suitability for climate studies.

Reference:
Prigent, C., Jimenez, C., and P. Bousquet (2019). Satellite-derived global surface water extent and dynamics over the last 25 years (GIEMS-2), JGR, doi.org/10.1029/2019JD030711, 2019.