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Towards Sentinel-2-based monthly water occurrence mapping with the Dynamic World data suite

Leo Helling¹, Barbara Belletti², Mathis Messenger³, Louis Rey¹, Hervé Parmentier¹, and Hervé Piégay¹

¹Environment City Society (EVS) laboratory, ENS de Lyon, Lyon, France

²Environment City Society (EVS) laboratory, Université Jean-Monnet de Saint-Etienne, Saint-Etienne, France

³EcoFloWs laboratory, National Research Institute for Agriculture, Food and Environment (INRAE), Lyon-Villeurbanne, France

Global water occurrence data derived from satellite imagery provide critical insights into surface water dynamics, informing science and management of key issues like climate change, water scarcity, and biodiversity loss. The Landsat-based Global Surface Water (GSW) dataset (Pekel et al., 2016) has notably provided an important archive of the global surface water areas and its changes over time. However, its 30-m resolution limits its applicability for smaller river systems. Since the launch of the Copernicus Sentinel-2 (S2) program, higher-resolution imagery (10 m) at recurrence times of 5 days is available, but has not yet been fully exploited. The only large-scale, temporally explicit layer of water occurrence based on S2 was provided by Yang et al. (2020) for the French Metropolitan region, but is limited by noise from clouds, terrain shadows, and seasonal snow.

The recently developed Dynamic World database (Brown et al., 2022) provides a probabilistic, pixel-scale land cover classification of S2 images updated globally in near-real time, potentially enabling computationally efficient, temporally continuous water mapping at high resolution. Here we evaluate DW's water detection capabilities and propose a workflow for large-scale, monthly surface water occurrence mapping. Our approach integrates probabilistic and physical-based water classification, topographic filtering, and cloud masking to overcome limitations of GSW and existing Sentinel-2 applications. DW's water probabilities were compared to spectral indices (NDWI, MNDWI) and combinations of these metrics were explored. We also assessed the potential for topographic data (FABDEM) and pixel-quality measures (CloudScore+) to reduce misclassification and allow the inclusion of more observations. The analysis is applied to the French Rhône-Mediterranean basin, a region chosen due to its diverse hydrological, climatic and geomorphological conditions. Verification is performed using a recently developed high-resolution annual land use product for mainland France (Manière, 2023) and results are compared to the GSW layer.

Preliminary results demonstrate that DW natively detects water in most areas well, but noise from shadow remains a challenge. Through combination with NDWI and further filtering with topographical data, significant classification improvements can be achieved. In addition, the pixel-based cloud-filtering with CloudScore+ enables the inclusion of more observations compared to

previous methods. We implemented this approach on Google Earth Engine with a simple and efficient algorithm providing monthly water occurrence observations for a whole year. This scalable workflow holds the potential to address significant limitations of prior methods and facilitate large-scale surface water mapping at high resolution. The results are especially significant in areas where in-situ hydrological monitoring is scarce.

References

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