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Ulyssys Water Quality Viewer: a satellite-based global near real time water quality visualization

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Sampling-based water quality monitoring networks are inherently spatially sparse. In locations or times where no in-situ water quality data are available, satellite imagery is an essential source of information. Satellite remote sensing can provide high spatial or temporal resolution imagery and has provided a breakthrough for oceanography, but so far, applications for coastal and inland water were limited by data resolution. Recently established satellite systems provide significant advances: Sentinel-2 delivers imagery with 20 m resolution, suitable for viewing even small rivers and ponds. Sentinel-3 delivers daily imagery with 300 m pixel size, which for lakes and coastal seas allows tracking water quality processes at the speed they happen. Information on suspended sediment and chlorophyll concentrations in water can be derived from optical images using simple calculations. The accuracy of these operations will vary across locations and can only be assessed through calibration and validation with in situ data. In absence of such data for all lakes globally, UWQV is based on a small set of algorithms that have been verified on several optically complex water systems to have a close to linear correlation with chlorophyll or suspended sediment concentration. Suspended sediment visualization is based on radiances observed in the 620 or 700 nm spectral bands, while chlorophyll visualization uses fluorescence-based indicators: Fluorescence Line Height, Reflectance Line Height and Maximum Chlorophyll Index. Since remote sensing based chlorophyll retrieval in sediment-laden waters with low transparency is hardly possible, for such cases chlorophyll concentrations are not visualized. The viewer runs as a Custom Script in the Sentinel-Hub EO Browser, which is a global, near real-time satellite data viewing and algorithm testing framework. The Javascript code is open source and enables users to easily tune visualization parameters and select different algorithms for cloud and water masking and chlorophyll and suspended sediment visualization.
Wherever in-situ water quality measurements are available, UWQV contributes significant added value by complementing water sample or instrument-based data, providing a map view or even a timelapse of maps; by providing an early warning system for water quality deterioration; by supporting optimization of sampling times and locations based on spatially and temporally explicit information, and enabling cross-validating water quality information from different sources to reduce uncertainty or identify implausible measurements. Additionally, data-driven spatially explicit models can be verified and tuned based on similarity of their output to situations observed on satellite imagery.
UWQV is has all the advantages and drawbacks of a global solution: it will never be more accurate than a locally tuned water quality remote sensing algorithm; however, we hope that it will

encourage water quality authorities and stakeholders to initiate the development of locally optimized satellite-based monitoring. By providing easy to read visualizations in a framework accessible to the general public, UWQV can democratize water quality information and raise public awareness of water quality processes and problems.

The first version of the algorithm is available in the Sentinel-Hub Custom Script Repository under the following link: https://github.com/sentinel-hub/custom-scripts/tree/master/sentinel-2/ulyssys_water_quality_viewer

An interactive test example of the visualization can be accessed here: tinyurl.com/UWQV-example