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Near real-time qualitative monitoring of lake water chlorophyll globally using GoogleEarth Engine

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Monitoring ocean chlorophyll and suspended sediment has been made possible using optical satellite imaging, and has contributed immensely to our understanding of the Earth and its climate. However, lake water quality monitoring has limitations due to the optical complexity of shallow, sediment- and organic matter-laden waters. Meanwhile, timely and detailed information on basic lake water quality parameters would be essential for sustainable management of inland waters. Satellite-based remote sensing can deliver area-covering, high resolution maps of basic lake water quality parameters, but scientific application of these datasets for lake monitoring has been hindered by limitations to calibration and accuracy evaluation, and therefore access to such data has been the privilege of scientific users. Nevertheless, since for many inland waters satellite imaging is the only source of monitoring data, we believe it is urgent to make map products of chlorophyll and suspended sediment concentrations available to a wide range of users. Even if absolute accuracy can not be validated, patterns, processes and qualitative information delivered by such datasets in near-real time can act as an early warning system, raise awareness to water quality processes and serve education, in addition to complementing local monitoring activities. By making these datasets openly available on the internet through an easy to use framework, dialogue between stakeholders, management and governance authorities can be facilitated.
We use GoogleEarthEngine to access and process archive and current satellite data. GoogleEarth Engine is a development and visualization framework that provides access to satellite datasets and processing capacity for analysis at the Petabyte scale. Based on earlier investigations, we chose the fluorescence line height index to represent water chlorophyll concentration. This index relies on the chlorophyll fluorescence peak at 680 nm, and has been tested for open ocean but also inland lake situations for MODIS and MERIS satellite sensor data. In addition to being relatively robust and less sensitive to atmospheric influence, this algorithm is also very simple, being based on the height of the 680 nm peak above the linear interpolation of the two neighbouring bands. However, not all satellite datasets suitable for FLH are catalogued for GoogleEarth Engine. In the current testing phase, Landsat 7, Landsat 8 (30 m resolution), and Sentinel 2 (20 m) are being tested. Landsat 7 has suitable band configuration, but has a strip error due to a sensor problem. Landsat 8 and Sentinel 2 lack a single spectral optimal for FLH. Sentinel 3 would be an optimal data source and has shown good performace during small-scale initial tests, but is not distributed globally for GoogleEarth Engine. In addition to FLH data from these satellites, our system delivers cloud and ice masking, qualitative suspended sediment data (based on the band closest to 600 nm) and true colour images, all within an easy-to-use Google Maps background. This allows on-demand understanding and interpretation of water quality patterns and processes in near real time. While the system is still under development, we believe it could significantly contribute to lake water quality management and monitoring worldwide.