GLOBAL REAL TIME ONLINE WATER QUALITY MAPPING

Satellite-based water quality mapping is now available from everywhere, to everyone!

The challenge

Understanding hydrodynamic and ecological processes in lakes and coastal seas is essential for ensuring clean drinking and bathing water and sustainable fisheries. Satellite imagery has been used by scientists for decades to visualise the most important properties of water: chlorophyll content, which tells us about the amount of algae and nutrients in the water and suspended sediment, which informs about the transparency. However, these data have only so far been available at selected locations and to remote sensing experts, but not to authorities or NGOs interested in water quality protection and management. Citizens interested in the quality or status of lakes and rivers had no direct access to up-to-date maps, limiting their awareness of and engagement with water quality processes.

The space based solution

A recently released massive data processing platform, Google Earth Engine, allows on-demand access and server-side processing on the full archive of Sentinel 2 and 3 satellites, which is regularly updated as new images are collected. We have implemented a set of widely used simple algorithms for mapping chlorophyll, suspended sediment, and temperature on these datasets and other satellite sources (Landsat, MODIS). The resulting images are shown over an easy to use Google Maps interface. Sentinel-2 provides high resolution imagery at lower repetition rates whilst Sentinel-3 imagery delivers lower spatial resolution but higher accuracy maps up to every second day. Whilst these images are not calibrated against local water samples, the algorithms themselves are robust and therefore the patterns and processes observed in the imagery can be used for monitoring.

Benefits to Citizens

Information on water quality used to be the privilege of water authorities, whilst spatially explicit maps were hardly ever produced for the public or even for the managers themselves. Globallakewatch.org democratises water quality data by delivering regularly updated maps free of charge to any user globally. This means that any internet user concerned about the status of a certain lake or coastal sea can directly access a time series of information with a spatial and temporal resolution they can understand. Interested citizens can thus provide early warnings: water quality maps can be used to identify pollution sources, inform authorities and hold polluters responsible. In the case of bodies of water in conflict zones or remote areas, globallakewatch.org may well be the only source of up-to-date information on water quality. The high detail and frequent acquisition of the images allows understanding of processes such as algae blooms or sediment resuspension, and will raise awareness of the importance of water quality amongst the public. Specifically on Lake Balaton, Hungary, images and maps generated by globallakewatch.org have already been widely shared in online news and social media. Additionally, water quality of many small lakes that are not regularly monitored by authorities can now be followed by the local angling communities. By boosting
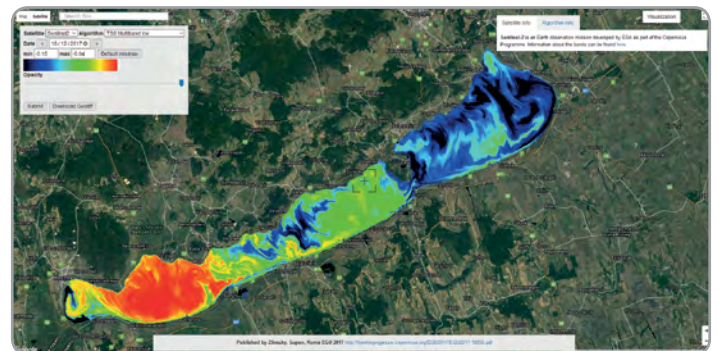
Sentinel-2 based suspended sediment map of Lake Balaton, showing dramatic differences in water transparency.
Credit: Contains modified Copernicus Sentinel data [2017]

Thematic Area	Region of Application	Sentinel mission used	Copernicus Service used	Usage Maturity Level
CLIMATE, WATER AND ENERGY	CENTRAL TRANS-DANUBIA, WESTERN TRANSDANUBIA SOUTHERN TRANS-DANUBIA	S2 S3	–	3

the availability of satellite water quality data, globallakewatch.org will foster the development of locally calibrated, high accuracy water quality monitoring from satellite imagery in many regions worldwide.

Outlook to the future

The next steps currently being tested are time series graphs and data export functions that support user-generated local calibration based on water sample data. By enabling non-specialists such as schools or NGO's to perform their own calibration, the number of lakes with regular water quality monitoring worldwide is expected to grow rapidly. The improving revisit times resulting from new satellite launches will further increase the potential of globallakewatch.org for education, monitoring and management.

RGB image of ice breaking up on Lake Balaton, obtained via globallakewatch.org. This image has been very popular in Hungarian social media.
Credit: Contains modified Copernicus Sentinel data [2017]

> **"Satellite imagery has been essential for understanding the limitations of our water quality models."**
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> *Márk Honti, General Directorate of Water Management, Hungary*

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