

EGU2020-7133

<https://doi.org/10.5194/egusphere-egu2020-7133>

EGU General Assembly 2020

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SentiLake - Sentinel-2 satellite data-based service for monitoring of Latvian lakes

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Lakes and water reservoirs are important ecosystems providing such services as drinking water, recreation, support for biodiversity as well as regulation of carbon cycling and climate. There are about 117 million lakes worldwide and a high need for regular monitoring of their water quality. European Union Water Framework Directive (WFD) stipulates that member states shall establish a programme for monitoring the ecological status of all water bodies larger than 50 ha, in order to ensure future quality and quantity of inland waters. But only a fraction of lakes is included in in-situ monitoring networks due to limited resources. In Latvia, there are 2256 lakes larger than 1 ha covering 1.5% of Latvian territory, and approximately 300 lakes are larger than 50 ha, but only 180 are included in Inland water monitoring program, in addition, most of them are monitored once in three to six years. Besides, local municipalities are responsible for the management of lakes, and they are also interested in the assessment of ecological status and regular monitoring of these valuable assets.

Satellite data is a feasible way to monitor lakes over a large region with reasonable frequency and support the WFD status assessment process. There are several satellite-based sensors (eg. MERIS, MODIS, OLCI) available specially designed for monitoring of water quality parameters, however, they are limited only to use for large water bodies due to a coarse spatial resolution (250...1000 m/pix). Sentinel-2 MSI is a space-borne instrument providing 10...20 m/pix multispectral data on a regular basis (every 5 days at the equator and 2..3 days in Latvia), thus making it attractive for monitoring of inland water bodies, especially the small ones (<1 km²).

Development of Sentinel-2 satellite data-based service (SentiLake) for monitoring of Latvian lakes is being implemented within the ESA PECS for Latvia program. The pilot territory covers two regions in Latvia and includes more than 100 lakes larger than 50 ha. Automated workflow for selecting and processing of available Sentinel-2 data scenes for extracting of water quality parameters (chlorophyll-a and TSM concentrations) for each target water body has been developed. Latvia is a northern country with a frequently cloudy sky, therefore, optical remote sensing is challenging in or region. However, our results show that 1...4 low cloud cover Sentinel-2 data acquisitions per month could be expected due to high revisit frequency of Sentinel-2 satellites. Combination of C2X and C2RCC processors was chosen for the assessment of chl-a concentration showing the satisfactory performance - $R^2 = 0,82$ and $RMSE = 21,2 \mu\text{g/l}$. Chl-a assessment result is further converted and presented as a lake quality class. It is expected that

SentiLake will provide supplementary data to limited in situ data for filling gaps and retrospective studies, as well as a visual tool for communication with the target audience.