Satellite remote sensing helps monitor lake CO2 dynamics at large scale

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Lakes play an essential role in carbon cycle. However, current bottom-up estimates of CO_2 emissions from lakes have significant uncertainties due to insufficient field data.

Satellite remote sensing approach has broad coverage and high spatiotemporal resolution, which can significantly reduce the uncertainties in CO_2 emission estimations. However, big challenges remain in developing remote sensing-based models for mapping lake CO_2 at regional or global scales.

Recently, researchers led by Prof. Duan Hongtao from the Nanjing Institute of Geography and Limnology of the Chinese Academy of Sciences have developed a dissolved CO_2 concentration (cCO_2) estimation model for meso-eutrophic lakes at regional scale, and reconstructed the spatiotemporal dynamics of dissolved CO_2 concentrations for the studied lakes from 2016–2021 using Sentinel-3 data.

Their findings were published in *Remote Sensing of Environment* on Jan. 3.

"The dissolved CO_2 in lakes is not optically active. Therefore, finding satellite-derivable variables related to CO_2 cycle processes and environmental factors in lakes is the key to realizing remote sensing estimation of lake cCO_2," said Prof. Duan.

For lakes with conditions ranging from mesotrophic to highly eutrophic in the middle and lower reaches of the Yangtze and Huai River basins (ML_YHR) in Eastern China, satellite-derived chlorophyll-a, water temperature, Secchi disk depth, and photosynthetic active radiation-related variables are good predictors for lake CO_2 concentrations.

"The stepwise quadratic polynomial model developed based on these variables showed high performance in predicting spatiotemporal dynamics of lake CO_2 concentrations for ML_YHR lakes," said Prof. Duan.

The satellite-estimated annual mean CO_2 concentrations for ML_YHR lakes revealed that about 28% of the lakes acted as weak atmospheric CO_2 sinks (14.96 ± 1.13 μmol L^{-1}) while the rest were sources (19.22 ± 2.02 μmol L^{-1}), compared with a mean concentration of CO_2 atmospheric equilibrium (16.29 μmol L^{-1}). CO_2 concentrations decreased with increasing eutrophication and decreasing lake size.

"This study advances current knowledge about CO_2 emissions from emerging meso-eutrophic lakes and shows how satellite remote sensing can expand the spatiotemporal coverage of lake CO_2," said Qi Tianci, first author of the study.

More information: Tianci Qi et al, Remote sensing of dissolved CO2 concentrations in meso-eutrophic lakes using Sentinel-3 imagery, *Remote Sensing of Environment* (2023). DOI: 10.1016/j.rse.2022.113431

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