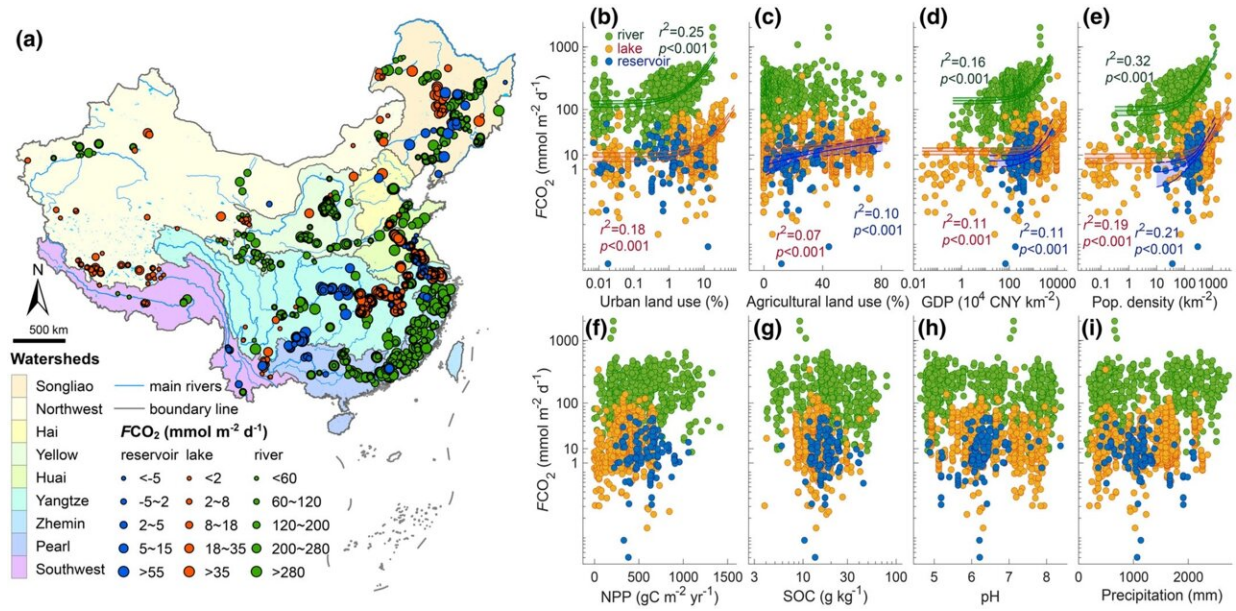
How anthropogenic disturbances drive inland water CO2 emissions

November 3 2022, by Li Yuan



Sampling locations for the measurement of CO2 efflux from reservoirs (n = 122), lakes (n = 625), and rivers (n = 658) across the nine large drainage catchments in China (a). Relationships between the efflux of CO2 and the mean catchment % urban land use (b), % agricultural land use (c), gross domestic production (GDP, d), population density (e), net primary productivity (NPP, f), topsoil organic carbon (SOC, g), topsoil pH (h), and precipitation (i) of each sampling site collected from lakes, reservoirs, and rivers. Map lines delineate study areas and do not necessarily depict accepted national boundaries. Credit: *Global Change Biology* (2022). DOI: 10.1111/gcb.16475

Carbon emissions from rivers, lakes, and reservoirs make up a large proportion of the global carbon cycle. Recent studies on carbon emission from inland waters in China have been focused on single lakes or rivers, and the underlying factors driving CO_2 emissions remain unclear.

Recently, a research group led by Prof. Zhang Yunlin from the Nanjing Institute of Geography and Limnology of the Chinese Academy of Sciences compiled meta data from literatures with measured data on efflux of CO_2 from inland waters and obtained a total of 1,405 measurements, including 658 river sites, 625 lake sites, and 122 reservoir sites sampled primarily between 2010 and 2020, and investigated the effluxes of CO_2 and drivers across inland waters in China.

This work was published in *Global Change Biology* on Oct. 10.

Based on several data sharing platforms, the researchers obtained a series of data products including land use and land cover, gross primary productivity (GPP) and net primary productivity (NPP) at spatial resolutions of 30 m and 1 km. Then, they extracted data on catchment urban and agricultural land use, gross domestic product (GDP), population density, NPP, topsoil organic carbon, topsoil pH, and precipitation.

"Through analyzing these data products, we unravel the driven mechanisms of CO_2 efflux from lakes, reservoirs and rivers in China," said Prof. Zhang.

The researchers found notably higher CO_2 efflux from rivers than from lakes and reservoirs. The effluxes of CO_2 from rivers and lakes increased significantly with the increasing catchment urban land use, and CO_2 effluxes of lakes and reservoirs increased significantly with increasing catchment agricultural land use.

The effluxes of CO_2 from lakes, reservoirs, and rivers increased with increasing catchment GDP and population density. In comparison, no significant relationships were found between the CO_2 efflux and catchment annual NPP, topsoil organic carbon concentration, pH of topsoil, or catchment precipitation.

Previous studies have found that compared to less populated regions, the increase in population density results primarily in eutrophication of inland waters caused by the discharge of agricultural, industrial, and residential effluents, as well as nonpoint sources of organic carbon. In eutrophic waters, primary production is commonly increased with high amounts of bio-labile organic matter, favoring microbial degradation and thereby strongly enhancing the CO_2 production and emission from inland waters.

These results suggest that anthropogenic disturbances in relation to urbanization and agricultural land use can influence CO_2 emissions from inland waters more than catchment productivity, which previously has been identified as the main driver for CO_2 emissions from inland waters in less populated regions.

This work demonstrated that the presence of anthropogenic disturbances in catchments, represented by urban and agricultural land use, GDP, and population density, were positively related to the emission of CO_2.

It highlighted the importance of in-situ production of CO_2 via the degradation of household effluents, nonpoint source- and algal-organic carbon in catchments draining densely populated areas compared with CO_2 being directly delivered through inflowing catchment streams.

More information: Jinling Wang et al, Urbanization in developing countries overrides catchment productivity in fueling inland water CO 2 emissions, *Global Change Biology* (2022). DOI: 10.1111/gcb.16475

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