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Effects of heatwaves on lake composition derived from satellite observations

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As a consequence of the ever-increasing global temperature, not only the air, and surface, but also lakes are warming up. This is expressed by steadily increasing base temperatures, but also in increases in the frequency and intensity of lake heatwaves. Land-based organisms may adapt to a changing climate by migrating to more suitable habitats, but this is usually not an option for lake-dwellers. Because many livelihoods depend on the ecosystem services of lakes, understanding the effects of heatwaves on lake composition form an important input for the assessment of climate change impacts and design of adaptation strategies.

Using satellite data of lake temperature and water quality observations, we here investigate the effects of heatwaves on lake composition by studying the relationship between heatwaves and water quality variables of temperature, chlorophyll-a , colored dissolved organic matter, and suspended particulate matter . The latter can be used to infer effects of heat stress on health and populations of phyto- and zooplankton communities and higher aquatic organisms. Satellite-based data sets provided by the Climate Change Initiative of the European Space Agency, CCI-Lakes (https://climate.esa.int/en/projects/lakes/) are used in conjunction with the 2SeaColor model to determine depth-dependent attenuation coefficients and water quality variables.These data are complemented with and compared to data from Copernicus Global Land Services (https://land.copernicus.eu/global/products/).

The co-occurrence of heatwaves and changes in lake composition is investigated using statistical tools, and the causality is examined by comparison with biophysical models. The results from this study are discussed in light of previously published projected changes in heatwave frequency and intensity.