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Global lake warming trends derived from satellite and in situ observations

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Several recent studies have reported that global and regional climate change has significant impacts on lake temperatures worldwide. However, the underlying mechanisms of the observed lake warming and the spatial patterns in trends at the global scale are currently not well understood. The Global Lake Temperature Collaboration (GLTC) was recently established as an international network of limnologists, hydroclimatologists, and experts on satellite remote sensing, with the goal of analyzing lake temperature time series acquired from both satellite and in situ datasets, deriving potential trends, and investigating possible physical drivers of the observed temperature changes.

Here we report some of the first results to come out of the GTLC, which currently consists of 57 scientists from 15 different countries. Using nighttime thermal infrared data from the Advanced Very High Resolution Radiometer (AVHRR) instruments and the series of Along-Track Scanning Radiometers (ATSR), trends in lake temperature for over hundred of the world's largest lakes by surface area were computed for the last three decades and mapped at the global scale. The results indicate that the vast majority of studied lakes has been warming, on average by 0.45 °C per decade. The spatial patterns in trends mostly agree with those of global air temperature in that the higher latitudes generally exhibit more rapid rates of warming than the lower latitudes, although some discrepancies exist at the level of individual lakes.

In addition, in situ data of lake temperature were compiled from various research groups representing 74 globally distributed monitoring programs and the time series were analyzed with respect to potential trends. While the lake temperature trends generally follow those of surface air temperature both in magnitude as well as in spatial patterns, some lakes demonstrate substantially more rapid warming rates than the ambient air. Rapid warming is particularly conspicuous in some lakes with large surface area. Potential physical drivers include interactions with solar radiation, air temperature, and lake morphology.