Carbon Fixation Trends in Eleven of the World's Largest Lakes: 2003–2018

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Science Question

How has climate change impacted phytoplankton carbon fixation in the World's eleven largest lakes which represent over 50% of the Earth's freshwater?

Analysis

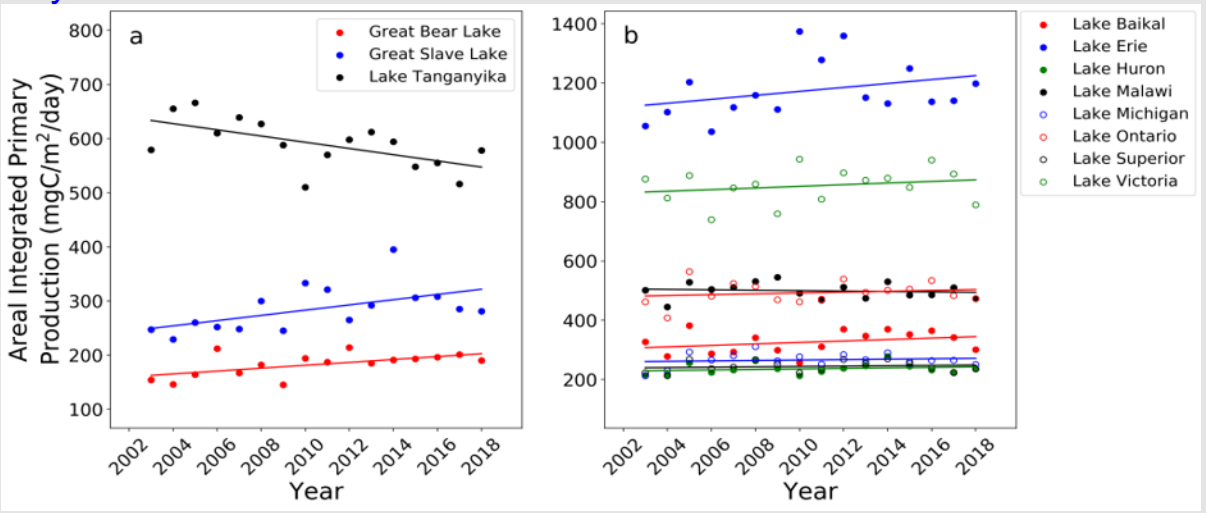
- We used 16 years of MODIS Aqua ocean color data to estimate phytoplankton biomass and light extinction for each lake as input into the Great Lakes Production Model (GLPM).
- We also developed a new relationship to estimate the GLPM large lake carbon fixation rate parameter from water surface temperature using over 300 paired values extracted from the literature.
- We estimated mean annual carbon fixation for each Lake during the ice-free periods from 2003-2018

Results

- Three of the eleven lakes experienced significant trends in annual carbon fixation for the 16 year time-series.
  - Great Bear and Great Slave Lakes carbon fixation increased
  - Lake Tanganyika carbon fixation decreased
- Changes appear to be driven by changes in climate (increasing water temperature and decreasing wind speed)

Significance

- This study is the first to compare carbon fixation in the world's largest lakes using a consistent methodology.
- The absence of climate change impacts on the other eight lakes may be due to the limited temporal observation period (16 years) as well as the offsetting interactions of other carbon fixation model input variables.
- These results are a first step in better understanding freshwater carbon fixation dynamics and their relative importance in the global carbon cycle



Annual phytoplankton carbon fixation over the 16 year study period (2003–2018). Panel (a) shows data and trends for Lake Tanganyika, Great Bear Lake, and Great Slave Lake. Panel (b) shows the data and trends for the other 8 lakes.

New Carbon Monitoring Products for Global Freshwater Lakes using Satellite Remote Sensing Time Series Data

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