EGU2020-1150
https://doi.org/10.5194/egusphere-egu2020-1150
EGU General Assembly 2020

Primary production in a kettle lake (Canada) was not driven by effective moisture over the last ~900 years

Rebecca Doyle[1], Zijun Liu[2], Jacob Walker[2], Ryan Hladyniuk[2], Katrina Moser[1], and Fred Longstaffe[2]
[1]The University of Western Ontario, Geography, Canada, rdoyle25@uwo.ca
[2]The University of Western Ontario, Earth Sciences, Canada

Globally, lakes and reservoirs are vital sources of fresh water. In temperate zones like the Great Lakes region, Canada, it is not known if climate warming will increase or decrease effective moisture, or affect water availability. The links between effective moisture and primary production are also unclear. To test for possible linkages, we have reconstructed the ~900-year history of effective moisture and primary production in a small, kettle lake (Barry Lake, Ontario, Canada). To reconstruct the history of effective moisture at Barry Lake, we measured the carbon ($\delta^{13}C$) and oxygen ($\delta^{18}O$) isotope ratios of marl and shelly fauna in two ~900-year sediment core records, tightly constrained by radiocarbon and lead-210 dates. To reconstruct primary production, we analyzed the carbon ($\delta^{13}C_{TOC}$) and nitrogen ($\delta^{15}N_{TN}$) isotope ratios, total organic carbon to total nitrogen (TOC:TN) ratios and chlorophyll-*a* concentrations of the sediments. Analyses of n-alkane relative abundances further refined our understanding of the history of primary production in Barry Lake and confirmed the predominately autochthonous origin of the sediment organic matter.

Relative to present conditions, we determined that effective moisture was lower during the Medieval Warm Period (MWP: AD 1000- 1300) and higher during the Little Ice Age (LIA: AD 1450-1650). Despite these differences, primary production remained unchanged until AD ~1917. After AD ~1917, primary production accelerated, reaching levels unprecedented across the entire record. A 4 ‰ increase in $\delta^{15}N_{TN}$ is coincident with this rise in primary production. This change may be related to the introduction of organic fertilizer from nearby agricultural fields. A rise in the relative abundance of nC_{17} at AD ~1917 suggests that the proliferation of algae was responsible for the increase in primary production. Our findings suggest that primary production was insensitive to climate change on the scale of the LIA and MWP, but highly sensitive to nutrient loading. The fact that modern indicators of effective moisture are within the natural range of variation observed over the last ~900 years suggests that modern climate warming has not altered the hydrologic regime of Barry Lake beyond baseline conditions. Comparisons of our hydroclimatic record with similar records from the region confirm this finding. In short, our research demonstrates that, in small lakes like Barry Lake, primary production is primarily driven by nutrient loading rather than changes in effective moisture related to moderate oscillations in hydroclimate.