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Evaluating climate controls on P, Si, and Fe biogeochemical cycling in lakes and rivers draining a dynamic, post-glaciated landscape

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The Northeast is experiencing the fastest warming in the contiguous United States, projected to reach an average +2ºC increase in temperature by 2035[1]. In response, trends towards milder and shorter winters are reducing snowfall and subsequent snowmelt, which constitutes a significant portion of total annual precipitation[2]. Decrease in snowmelt is accompanied by a projected increase in rainfall intensity and flooding. Such shifts in climate are predicted to heavily influence hydro-biogeochemical cycling in the region. Dynamic landscapes such as those characterizing the Finger Lakes region in Central New York, hosting a unique network of gorges carved into Devonian shales and glacial till deposits from prior glaciation, should be particularly susceptible to a rapidly warming climate. Recent work analyzing hydrogen (d^2H) and oxygen ($d^{18}O$) stable isotope compositions of the Finger Lakes compared to historical records has shown a systematic shift towards higher values (+7 ‰ and +2 ‰, respectively) over the past 30 years that appears to be climate driven. These preliminary findings are further supported by an increase in the alkalinity of local streams over a 20-year period, consistent with long-term trends observed regionally[3]. This talk will focus on evaluating climate controls for highly coupled biogeochemical cycles of phosphorous (P), silicon (Si), and iron (Fe) in lakes and streams draining a dynamic, "patchwork"[4] Critical Zone. To evaluate the timing and behavior of biogeochemical responses, seasonal sampling of all 11 Finger Lakes along with their inlets and outlets was complemented by high frequency (daily) monitoring of two representative analogues for gorges feeding into the lakes, Fall and Cascadilla Creek; and characterization of shales and glacial tills through a series of batch experiments. This study highlights the role of storm events in a changing climate on Si, P, and Fe export efficiency and increased nutrient loading in lakes due to enhanced channel erosion of clay-rich glacial till and colloidal transport.

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