Winter Severity Influences Nutrient Availability and Microbial Activity in The Great Lakes

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Abstract (300 words or less):

Variation in ice cover , , is often used as an indicator for winter severity limnological studies as it creates a physical barrier between lake water and atmospheric and terrestrial inputs. Understanding how ice will drive ecological and biogeochemical processes in the Great Lakes is extremely valuable, because winter processes have interseasonal effects that impact the following seasons. Recent studies have shown that differences in the severity of winter can influence the availability of nutrients and impact the activity of microbial communities. Here, we present findings that show how both microbial activity and nutrient availability are influenced by varying degrees of winter severity. We hypothesized that more severe winters would result in reduced concentrations of DOC and reduced quality of the caron carbon, We also hypothesize that microbial activity would shift towards bacterial respiration with increasing winter severity. . Water samples from the Great Lakes and Lake St. Clair were collected during the winters of 2022, 2024, and 2025. We used the water samples to determine dissolved organic carbon (DOC) concentrations and characterized fluorescent dissolved organic matter (fDOM) using fluorescence excitation-emission matrix spectroscopy. Bacterial production was measured via incubations with tritiated leucine and thymidine. Winter severity was assessed by measuring ice quality and thickness and snow thickness at each sampling site. We found that more severe winters were associated with lower concentrations of DOC and changes in carbon availability. We also found that with more severe winters, there was a shift in microbial activity. Our findings provide insight into how interannual variation in winter severity impacts nutrient availability and microbial activity in the Great Lakes.