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

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Abstract (300 words or less):

Variation in winter severity, such as ice cover, can create physical barriers between lake water and atmospheric and terrestrial inputs. Understanding how ice and other winter factors will drive ecological and biogeochemical processes in the Great Lakes is extremely valuable. Recent studies and The Great Lakes Winter Grab have shown that differences in the severity of winter can influence the availability of nutrients and impact the activity of microbial communities. We present our findings aimed at better understanding how microbial activity and nutrient availability is influenced by varying degrees of winter severity. We hypothesized that more severe winters would result in less available carbon and a shift in microbial activity. 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 examine Dissolved Organic Carbon (DOC) and 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 resulted in 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 further insight into how interannual variation in winter severity impacts nutrient availability and microbial activity in the Great Lakes.