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Greenhouse gas dynamics across a latitudinal gradient of thermokarst lakes

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The Arctic is warming at a faster rate than the rest of the planet due to climate change. The warmer temperatures are causing, among other effects, the permafrost to thaw. When ice-rich permafrost thaws, thermokarst features form due to subsidence of the ground surface and the creation of dynamic depressions, basins, and lakes. As a result, the hydrological cycle in these latitudes is intensifying, causing an increase of nutrients and organic carbon in surface waters. Such impacts on freshwaters affect microbial community composition, and thus, these systems are good sentinels to study processes in primary ecological succession related to ecosystem processes such as productivity and greenhouse gas (GHG) emissions. This study aims to improve the current understanding of microbial processes leading to release of GHG in thermokarst lakes. To that end, we sampled a total of 12 thermokarst basins in August 2022 along a latitudinal gradient (67°N - 69°N) in the Northwestern Territories (Canada). The basins were selected so that half were in the taiga biome and half in the tundra biome. In addition, based on satellite images and in-field observations, half of the lakes sampled were in expansion and the other half were undergoing drainage. Water samples were collected for the analysis of GHGs (CH_4, CO_2, N_2O), major ions, dissolved nutrients (organic C, δ^{13}C-DOC, organic and inorganic -N) and microbial community composition (16S rRNA gene metabarcoding). We used Ar-corrected gas saturation of each GHG as a proxy of net metabolic changes. Our first results show that both expanding and shrinking lakes were strongly oversaturated in CH_4 andCO_2, slightly saturated in N_2O, and slightly undersaturated in O_2, pointing out higher respiration activity than primary production. Microbial mineralization of organic matter was used as a proxy for GHG production. We found higher concentrations of dissolved organic C in shrinking lakes compared to expanding ones. Following the latitudinal gradient (i.e. biomes), higher temperatures were found in lakes sampled in the taiga compared to those located in tundra, together with deeper permafrost table depths. In surface waters, pH values and dissolved O_2 concentrations were significantly higher in tundra lakes compared to taiga lakes, probably as a result of lateral DOM fluxes in more productive ecosystems

(i.e. boreal forests). Differences between microbial communities in both biomes are therefore expected, which we will verify once the ongoing sequencing analyses are available. Our study advances the current knowledge of GHG dynamics in thermokarst lakes and helps to predict future effects of climate change impacts in northern latitudes.