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The molecular composition of dissolved organic matter (DOM) and its effects on the greenhouse gas production in pristine subarctic rivers

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Controls on the degradation of dissolved organic matter (DOM) in freshwaters play a major role in the global carbon cycle. Under the changing climate, the aquatic systems are exposed to increasing terrestrial OM load due to changes in precipitation and air temperature. However, little is known about how the source and composition of this DOM influence its microbial processing in receiving waters.

In this study, we aimed to determine the composition of riverine DOM at a molecular level to gain a more comprehensive understanding on how the quality and quantity of DOM reflect its microbial degradability. Our objectives were to determine how the DOM decay patterns differ between brown-water and clearwater river and how these further regulate the potential greenhouse gas production (carbon dioxide, CO_2 and methane, CH_4) in these waters.

We collected water samples during two sampling occasions (June and October 2018) from two pristine subarctic rivers in Finnish Lapland and conducted 21-day incubation studies to follow the changes in the concentration and molecular composition of DOM, as well as the changes in the CO_2 and CH_4 concentrations. The molecular characterization of DOM was carried out using electrospray ionization (ESI) coupled to high-resolution Fourier transform ion cyclotron resonance mass spectrometry (FT-ICR MS).

Both rivers acted as a source of CO_2 and CH_4. Our preliminary results show that river water surrounded by peatlands contained a higher number of compounds such as condensed aromatic structures and lignin-like molecules, which led to slower decomposition rates compared to DOM in clearwater river. Overall, the decomposition of DOM was higher during spring flow than during fall due to recently released fresh DOM in the water.