NSERC Canadian Network for Aquatic Ecosystem Services

Theme 1, Project 1.2a: Optical Measurements for Characterizing Dissolved Organic Matter in Northern Peatland Surface Waters

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Abstract
The peatlands of the Hudson Bay Lowlands (HBL) occupy most of Ontario's Far North and contribute large quantities of freshwater and solutes, such as dissolved organic matter (DOM) and mercury, to downstream aquatic ecosystems. Despite concerns regarding the potential increases to mercury concentrations in surface waters and fish as a result of land-use changes (mining and industrial development), comprehensive water quality monitoring programs are essentially non-existent due to the high costs associated with water sampling and other logistical constraints imposed by this large wetland complex. As such, high-quality and high-resolution baseline water quality data is scant, and it is difficult to predict how these solutes will behave in response to the unprecedented climatic and land-use changes already occurring and forecasted for the HBL, which will have an impact on downstream hydrological and biogeochemical processes.
The utilization of in situ water quality sensors has not yet been implemented in northern surface waters where they may prove to be a valuable alternative strategy to monitoring changes to water quality and estimating solute fluxes. Specifically, measurements of the optical properties of DOM (i.e., absorbance and fluorescence) are straightforward and less expensive than standard water quality analyses, and can be exploited to obtain highly accurate, quantitative estimates of dissolved organic carbon (DOC), and in some cases, can be used as a proxy for total (THg) and methylmercury (MeHg).
Objectives:

- To improve our understanding of peatland hydrological connectivity by fingerprinting sources and components of surface water DOM via excitation-emission matrix (EEM) spectroscopy and instrumental analysis throughout the ice-free season.
- To assess the effectiveness of in situ spectroscopic measurements as proxies for the measurements indicated in (1) and for THg and MeHg in surface waters of the HBL.

Outcomes
In situ monitoring has the potential to make freshwater research more accessible and open the door for more extensive water quality monitoring programs in remote regions of the Far North. Initial data from the in situ loggers reveals changes in DOM quality, and other geochemical parameters (e.g., pH, specific conductivity) in response to hydrologic regime. This is indicative of the temporal variability of hydrological connectivity and of the dominant contributing sources of peatland surface waters (e.g., fen peat pore-waters, deep groundwater, smaller tributaries) over the course of the ice-free season. Such substantial datasets may prove pivotal in enhancing our understanding of how the peatlands of the HBL transport water and solutes to their aquatic environments and how this may be impacted by regional and local environmental change.