Detecting and quantifying groundwater discharges by combining remote sensing and geochemistry

Submarine groundwater discharge (SGD) is recognized as an important pathway between land and ocean. This unseen flow may contribute to the biogeochemical and other marine budgets, and it can even cause eutrophication and acidification of near-shore waters. These discharges typically display high spatial and temporal variability, making assessments difficult. Thus, the measurement of its magnitude and associated chemical fluxes is a challenging enterprise. The quantification of groundwater seeps is commonly based on the analysis of geochemical tracers such as radium (223Ra, 224Ra, 226Ra, 228Ra), radon (222Rn), and stable isotopes of water, or on regional hydrogeological budgets and piezometric data. While the combination of these approaches allows accurate and essential quantification at the local scale, they do not provide a comprehensive view of the seeps. Airborne thermal infrared (TIR) remote sensing can be used to detect cold or warm groundwater inputs into coastal seas because of the thermal contrast between groundwater and the surrounding coastal waters. This technique has been used in various parts of the world and is effective when used in combination with *in situ* measurements, including salinity, radon, and radium. In cold arctic and subarctic systems, however, detection using this method is more difficult. Nevertheless, it is crucial to test the performance of airborne TIR imagery in order to precisely quantify the inputs of SGD in these regions, where significant hydroclimatic changes are already underway. In this project, we will combine geochemical and remote sensing approaches to detect and quantify SGD and associated solutes (carbon, nutrients, trace metals). This work will be carried out along the St. Lawrence shores where the hydrostratigraphic contexts and hydrogeological conditions are well known. Tests will also be carried out in the Beaufort Sea (Canadian Arctic).

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