Goldschmidt 2024 Abstract
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Deciphering river baseflow age distribution through environmental and artificial tracing experiments in a partially ice-covered river (Quebec, Canada).

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Groundwater is the predominant contributor to surface waters in most wet and temperate climates [1], such as in Québec, Canada. These inflows form a baseflow that support surface ecosystems as well as human needs (e.g. drinking water source) throughout the year, and especially during low flow periods. In this context, assessments of surface water vulnerability to anthropic forcing (e.g. global climate change and urbanisation) must consider this groundwater contribution. Theoundwater residence time within the aquifer is roughly inversely proportional to its vulnerability to surface activities, as it controls the resource response to pollution events and is related to its renewal rate [2]. For baseflow dominated rivers, the knowledge of the groundwater transit time distribution is relevant to study the rivers vulnerability at the catchment scale [3].

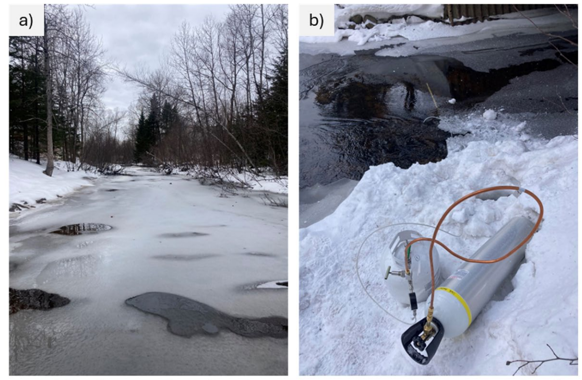
We studied this problematic in the Nelson River, one of the main contributors of a surface drinking water uptake supplying 300 000 people in Québec City. Cold winter temperatures in the area allow rivers' surface to freeze and snow storage as snowpack, leading to the lowest flow and making this period the best to study groundwater contribution to streams. We used a multi-tracing experiment that aimed to constrain the transit time distribution of groundwater inflows into the partially ice-covered river. In addition to water quality parameters (major ions and dissolved silica), in 6 locations (see map), namely SF_6, chlorofluorocarbons, ^{85}Kr, ^3H and noble gases. Then, a dual continuous injection of SF_6 and He gases was performed in the river to determine air-water exchange coefficients. Concentrations of He were monitored *in situ* using a miniRUEDI [4], while discrete SF_6 samples were analysed at Geotop lab using GC-ECD. This unique dataset is then used to model and deconvolute groundwater inflows and their transit time distribution, at the catchment and sub-catchment scales. This promising methodology could be replicated to most baseflow dominated Canadian rivers.

[1] Beck et al. (2013), Water Resources Research, 49, 7843-7863.

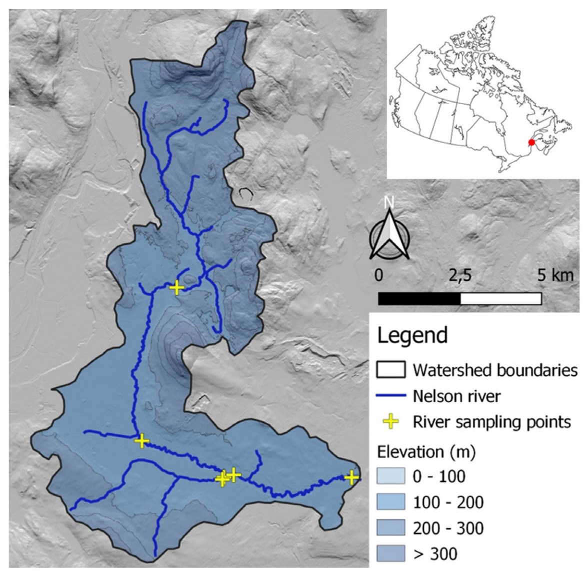
[2] McGuire & McDonnell (2006), Journal of Hydrology, 330, 543-563.

[3] Solomon et al. (2015), Water Resources Research, 51, 8883-8899.

[4] Brennwald et al. (2016), Environ. Sci. Technol., 50, 13455-13463.



(a) Field conditions in the Nelson River (February 2024) and (b) *in situ* sampling for radiokrypton using a passive membrane (*Musy et al., 2021*).



Location in Canada and map of the studied watershed with river sampling points indicated in yellow.