Recovery dynamics of surface water/groundwater interactions following an intense flooding event at a 2-lake bank filtration site

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The implementation of pumping wells within the bank of a lake or a river can artificialy modify the intensity and direction of surface-groundwater interactions. As surface water travels throught the bank towards the pumping wells, it enters a biogeochemical reactor where contaminants and pollutants can be attenuated, removed or released given the occurrence of physical processes and redox-sensitive biogeochemical reactions. In addition to pumping rates, drought or flooding events are likely to act as driving forces on groundwater flow and impose non-steady state conditions for physical and biogeochemical dynamics.

Rapid snowmelt, combined with consecutive rain episodes, triggered a major flooding event in southern Quebec in April of 2017. This event affected the direction and velocity of groundwater flow at a well field located between two lakes, one receiving input from snowmelt from a large watershed (Lake A) and one with no surface inlet (Lake B). Although baseline water levels were re-established in early June, geochemistry and isotopic data ($\delta^{18}O$-δD) reveal a complex spatio-temporal pattern where snowmelt water i) rapidly infiltrates from Lake A and modifies groundwater chemistry and physico-chemical conditions inside the banks, ii) locally passes through the bank causing major discharge into Lake B and iii) remains stored for months within the banks before being pumped or discharged back to the lakes. This study illustrates the need to consider transience when studying groundwater/surface water exchanges, since both surface and subsurface components present spatio-temporal distribution variability. The case study also helps to explain the driving forces affecting water quality at the pumping wells and anticipate the propagation of contaminants. This knowledge is of interest since the wells installed in the bank provide drinking water for up to 18 000 people.