Flow system dynamics, south-central Ontario

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ABSTRACT

Flow system dynamics can be elucidated by numerous techniques including numerical groundwater flow modelling and observations from long-term monitoring data sets. While many regional groundwater flow models (steady-state and transient) have been constructed within the study area, there currently exists a paucity of long-term field observations with which to calibrate and test the numerical models. The transient nature of field responses/characteristics can be applied to assist with the quantification of difficult problems, for example groundwater recharge rates in heterogeneous terrain or the natural tracer input function and evolution to and within regional groundwater flow systems. The latter also relates to the degree of hydraulic interaction between shallow and deep parts of a regional flow system and the integrity of intervening aquitard units.

The data from a long term monitoring program, comprising various groundwater monitoring nests located within different hydrogeological settings in south-central Ontario, is continually being analysed and evaluated as an additional tool in assisting with flow system understanding. Since 1994, the program has consisted of semi-regular water quality sampling, as well as monthly and continuous (hourly) water level and temperature recording. Given the observed variation in temperature and $\delta^{18}O$, preliminary interpretation suggests that a seasonal recharge component may be preserved within the shallow groundwater regime. This seems to indicate that perhaps the shallow flow system is much more active than previously assumed, and if correct, has implications for current recharge estimation methods particularly in areas of till which are characterized by heterogeneity and secondary permeability features. For example, it is often assumed that mixing within the shallow subsurface largely removes the variation in isotopic signatures that occurs within the precipitation input and therefore that shallow groundwaters reflect the average annual composition of local precipitation. The current data set hints that this may not always be the case. Another interesting observation is that deeper groundwater temperature measurements at some locations show a gradual rise of approximately 0.05 ^{o}C/year, perhaps reflecting long-term climatic and/or groundwater recharge response.

This paper will focus on discussion of field observations within various hydrogeological settings, the insights gained and the implications they may have on the problems of recharge estimation in heterogenous deposits (i.e. till) and the relationship between precipitation and groundwater in south-central Ontario.