What is the future of water security in the Canadian Prairies?

PROJECT SUMMARY

Water security is threatened by climate change and increased water demands in many areas. Increased use of groundwater resources could help in addressing this problem but the extent to which these resources could be sustainably developed is unclear. Using field work, data analysis, and numerical models we aim to understand the future of water security in the Canadian Prairies.

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PROJECT NAME: Groundwater, Climate Change and Water Security in the Canadian Prairies

Geochemistry

Students: Chandler Noyes & Nicholas Dutka

PIs: Grant Ferguson & Jennifer McIntosh

Twelve monitoring wells from the Saskatchewan Water Security Agency network with depths ranging from 20 to 80 m were sampled in June 2022 for major ions and a spectrum of groundwater age tracers. Uncorrected radiocarbon results indicate that these groundwaters in intertill and buried valley aquifers have apparent ages ranging from 3,800 years to >38,500 years, the limit of radiocarbon dating. The low $\delta^{18}O$ values indicate that these waters were recharged under colder conditions during the Pleistocene or earliest Holocene. If these waters are pumped, it is unclear whether they will be replenished under current conditions.

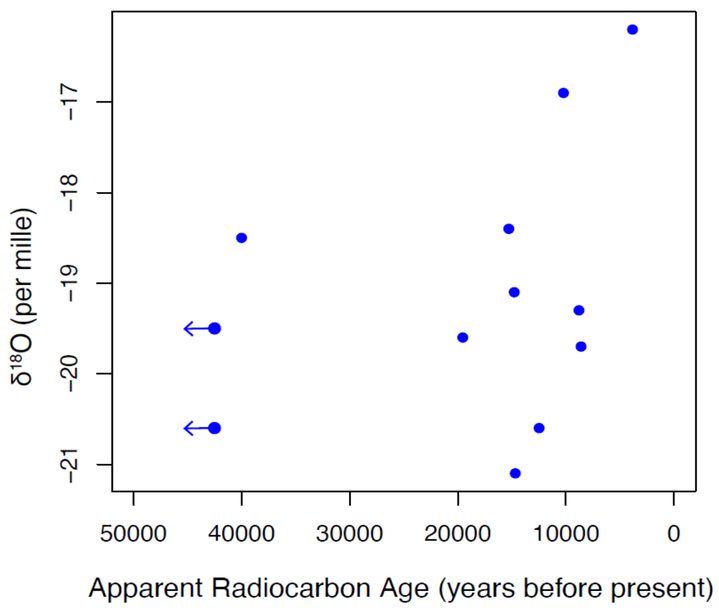

Fig 1: Initial groundwater tracer results

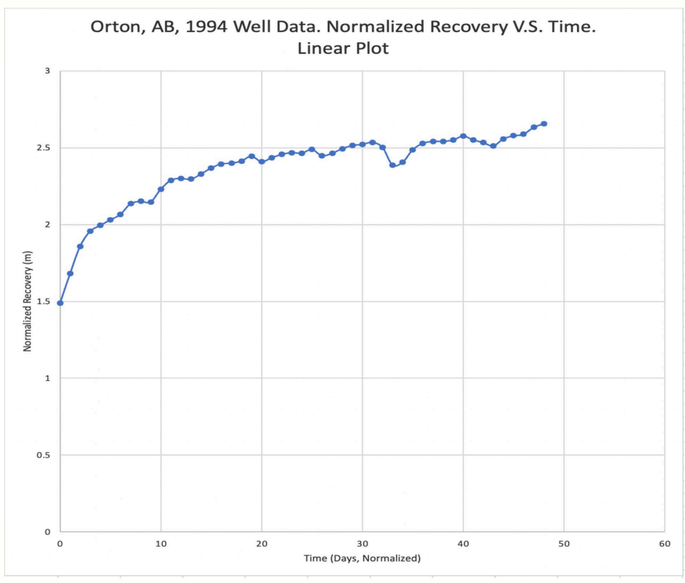

Fig 2: Example graphical boundary analysis

Graphical Analysis

Student: Mélanie Brunet

PI: Randy Stotler

Well data from agriculturally heavy areas in the Canadian Prairies are to be graphically analyzed to determine their boundary conditions. The boundary conditions of the aquifers will be identified and compared to the conditions found at other points in the system. This will allow for a qualitative assessment of the aquifers' extent and connections. We will develop a map of the general areas of recharge in the Canadian Prairies and areas of vulnerability. Vulnerability will be assessed qualitatively (using DRASTIC) rather than quantitatively, given that the well data used does not contain the data needed for such an analysis, such as pumping rate.

Numerical Model

Student: Hilary Wilson

PI: Andrea Brookfield

We will evaluate the sensitivity of the existing groundwater resources to climate change, land-use and groundwater usage with the integrated hydrologic model, HydroGeoSphere. A model is built to represent a typical alluvial aquifer in the Canadian Prairies, the Dalmeny aquifer in Saskatchewan, and simulates both groundwater and surface water. It is calibrated to generalized, steady-state conditions that reflect current water use and climate. Future climate and water use scenarios will be simulated to improve our understanding of the future of groundwater resources in the Canadian Prairies.

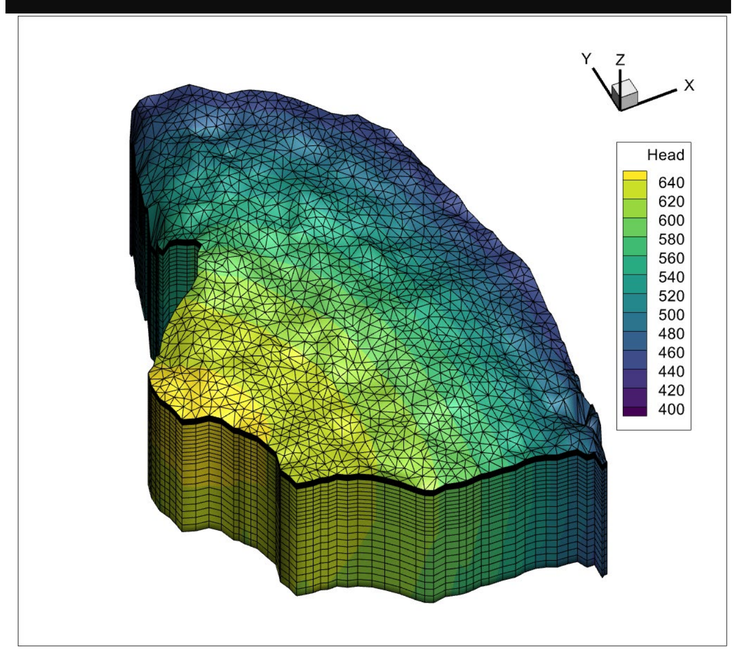

Fig 3: Preliminary HydroGeoSphere results

Preliminary results indicate groundwater is vulnerable to depletion and potential contamination

- Existing groundwater in deeper aquifers do not appear to be rapidly replenished with recent recharge
- Shallower aquifers, including alluvial aquifers, appear susceptible to changes in the surface and near-surface environment, including changes to climate and land use
- Work is ongoing to further confirm these initial findings and interpretations