Climate Change Impacts on Groundwater Recharge in a Low-Mountain Area

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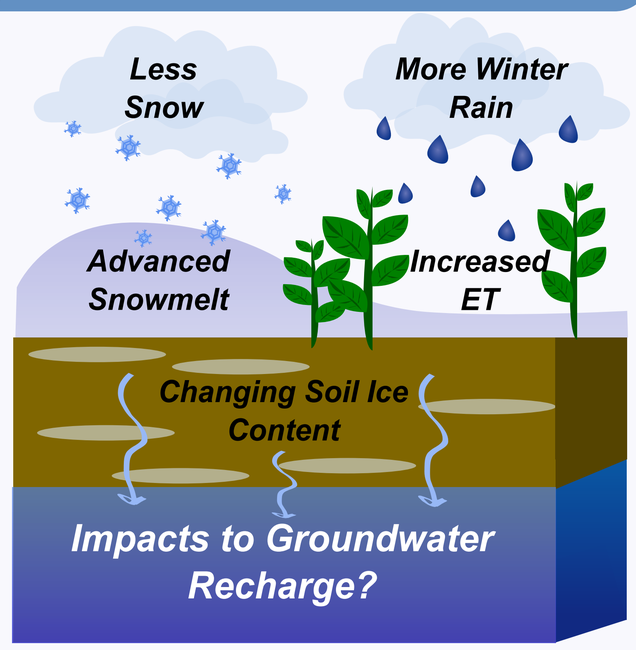
Background

In cold regions, snowmelt is a prominent source of groundwater recharge and spring streamflow[1].

However, as the climate warms, it is predicted there will be less snow falling and accumulating, and more rain[1].

Combined with other climate change impacts, the implications of a precipitation phase shift on groundwater resources are poorly understood.



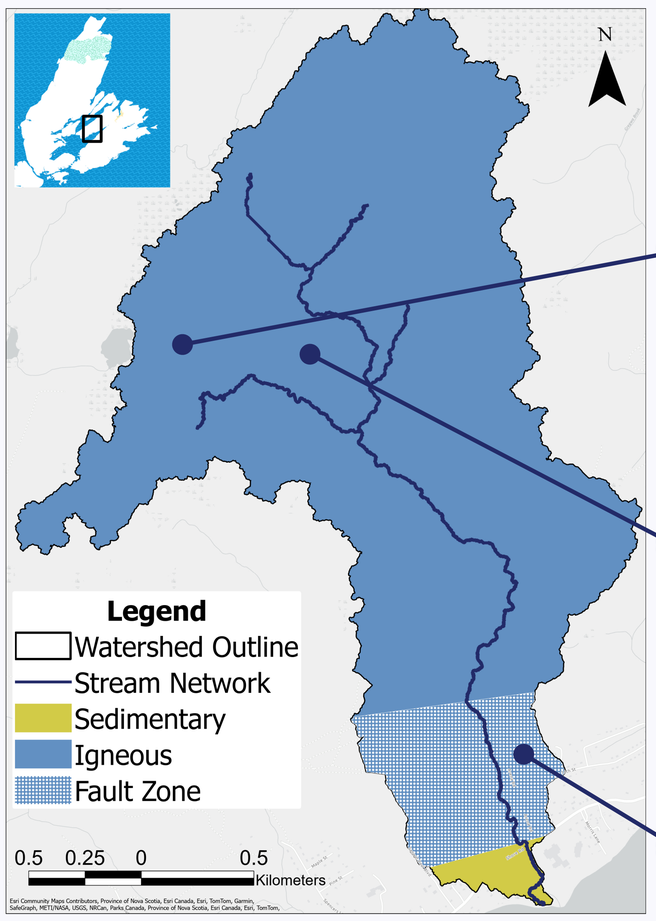
Study Objectives

(1) Determine if snowmelt is more efficient at recharging groundwater than rain across various topographic, geologic, and landcover settings

(2) Project future changes in annual and seasonal groundwater recharge and compare those to historical trends in the region.

Study Site

The community of Eskasoni, Nova Scotia relies on groundwater pumped from the fault aquifer in the Christmas Brook watershed as one of their drinking water resources.



Monitoring Locations

1 Wetland Plateau

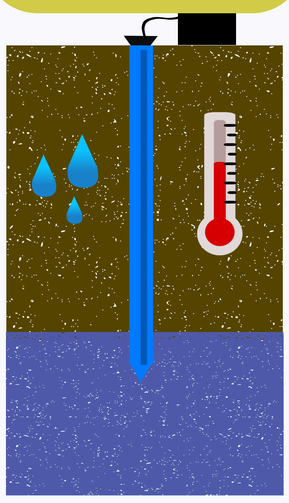
2 Forested Upland

3 Forested Lowland

Photo Credit: Fred Baechler

Methods

Soil Moisture & Temperature Sensors

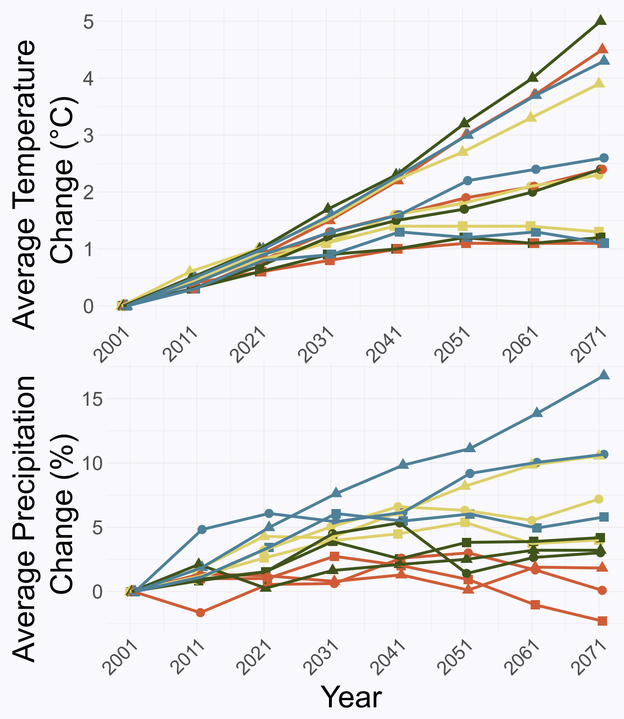


Groundwater Monitoring Wells

Snow Depth Sensors

Simultaneous Heat & Water Model (SHAW)

Climate Change Projections



- Increasing temperature across all seasons.
- Increasing wintertime precipitation.
- Suggests more winter rain & less snow.

Snow Depth & Snowmelt

Soil Ice & Moisture Content, & Temperature

Vertical Water Fluxes

Results & Discussion

Decrease in Snow Depth

Earlier Meltout Timing

Higher Frequency of Snow-free Days

Wintertime recharge from snowmelt will decline, and the dominant recharge mechanism may shift to rainfall infiltration.

Will rainfall recharge compensate for snowmelt losses?

Conclusions

Climate change projections of increasing winter temperature and precipitation and the simulations of decreased snow depth suggest wintertime rainfall may become the dominant recharge mechanism in the Christmas Brook watershed.

However, the exact impact of this precipitation phase shift on groundwater recharge remains unknown.

Study Next Steps:
(1) Calibrate soil moisture and temperature in the SHAW model
(2) Simulate ice content and water flux to determine and compare the efficiency of rainfall and snowmelt recharge

Study results will be used to inform source water protection planning by the community of Eskasoni.

Acknowledgments

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References

1. Jasechko, S., Birks, S. J., Gleeson, T., Wada, Y., Fawcett, P. J., Sharp, Z. D., McDonnell, J. J., & Welker, J. M. (2014).The pronounced seasonality of global groundwater recharge. *Water Resources Research, 50*(11), 8845–8867. Scopus. https://doi.org/10.1002/2014WR015809