Groundwater Flow and Permafrost Distribution at Wolf Creek, YK





GLOBAL WATER FUTURES

SOLUTIONS TO WATER THREATS IN AN ERA OF GLOBAL CHANGE



McGill

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Mountain Catchments

- Significant sources of water
- Spring snowmelt is major event
- Permafrost in high latitude/altitude
- Very little field-based research on cryohydrogeology



Permafrost Thaw and Hydrologic Regime

Hypothesized changes:







Research Objectives

- Develop understanding of processes that control groundwater in northern mountain environments
 - SW-GW, seasonality
- Assess long-term impacts of climate change on these systems using field data and numerical modeling

Wolf Creek Research Basin

- Established in 1992
- Within Yukon River Basin
- Area = 200 km²
- 50-60% bedrock, 40-50% glacial till
- Focus on surface hydrology: runoff, snow, etc.
- North and south facing slopes (Carey and Woo 1999)
- Groundwater contributions to streamflow (Carey et al. 2013)

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Granger sub-Basin

Size = 7.6 km² Elevation = 1,310 – 2,250 m a.s.l. Average annual temperature = -3 °C Precipitation = 350 mm (40% rain)

- ▲ Mount Granger
- Granger Creek
- Granger Basin
- Outflow Point
 (60° 32' 47.8" N, 135° 11' 2.78")



Project Outline

- 1. Conduct geophysical surveys
- 2. Install monitoring wells
- 3. Develop cryohydrogeologic conceptual model
- 4. Simulate response to climate change using SUTRA

Capacitively-coupled resistivity (CCR)

- CCR Survey March 2018
- Useful in permafrost regions because of contrast in resistivity
- Geometrics TR1 Ohmmapper
- Five receivers with 10 m spacing
- 2-D model generated using RES2DINV 3.59







Summinderingoweblines Calibration GSPRg (portable levere adri2007)



Data collected from wells...

- Confirm geophysics
- Geology
- Hydrogeologic
 properties
- Temperature profiles
- Water chemistry of deep groundwater
- Monitor hydraulic head





- 2-D Model development (SUTRA-Ice, McKenzie and Voss 2013)
- Understand how permafrost and groundwater fit into subarctic hydrological cycle
- Identify processes driving change in these systems and response to climate change projections
- Incorporate additional modules simulating surface energy balance, snowpack formation/melt functions

Research Applications

- Understand significance of groundwater in headwater catchments
- Important for hydroelectricity, infrastructure, drinking water sources, recreation
- Setting up long-term groundwater monitoring network

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