

## Numerical Simulation of Partially Frozen Soils to Understand Aufeis Formation in Polar Regions.

Many hydrologic features in the polar regions will be impacted by increasing temperatures because of climate change. One of these such features is Aufeis (also known as Icings) which are large sheets of ice that form in river channels that can stay frozen well into summer. These features can be over 10 km<sup>2</sup> in surface area and provide flow to rivers during the summer when other water resources are reduced (Pavelsky et al. 2017). The aim of this research is to better understand the processes that cause Aufeis to form, particularly the movement of groundwater below and near Aufeis fields. Specifically, we use SUTRA-ICE to analyze these groundwater conditions. Because these conditions include areas of permafrost and seasonally frozen soils, water is restricted and conveyed in complex patterns that can vary over time. Furthermore, the movement of subsurface water transports heat which then influences which areas are frozen or unfrozen. Terry et al. 2020 has come up with a conceptual model of these groundwater conditions using field data gathered from the Kuparuk Aufeis Field on the North Slope of Alaska. In this study we replicate this conceptual model using numerical simulations. So far, we have developed a 2-D model which shows a process by which subsurface water is forced to the surface by regions of frozen soils and regions of higher hydrologic conductivity during winter months. This water forced to the surface would then freeze contributing to Aufeis formation. Moving forward we will perform sensitivity analyses on this model with different soil hydraulic conductivities and different surface temperature forcings. By understanding the formation processes of Aufeis we will be able to predict how these hydrologic features might change because of rising temperatures and the potential impact to river ecosystems.

**Bio:** Alexi Lainis is a master's student in the Hydrology, Water Resources & Environmental Fluid Mechanics program at CU Boulder. His advisor is Professor Roseanna Neupauer. Alexi's research focuses on the groundwater modeling of partially frozen soils to understand Aufeis formation. His other research interests include glaciology, snow hydrology and reservoir sedimentation. Previously he received his BS in Civil Engineering at CU Boulder in 2019.