EGU24-19799, updated on 04 Nov 2024
https://doi.org/10.5194/egusphere-egu24-19799
EGU General Assembly 2024


# Simulating Saline Permafrost and Cryopeg Evolution Using a Coupled Heat and Salt Diffusion Model

**Michael Angelopoulos**[1,2], Pier Paul Overduin[1], Frederieke Miesner[1,3], Julia Boike[1], Michael Krautblatter[2], and Sebastian Westermann[3]

[1]Alfred Wegener Institute for Polar and Marine Research Helmholtz Centre for Polar and Marine Research, Potsdam, Germany

[2]Landslides Research Group, TUM School of Engineering and Design, Technical University of Munich, Munich, Germany

[3]Department of Geosciences, University of Oslo, Oslo, Norway

Saline permafrost is primarily found in marine deposits beneath shallow shelf seas and can often extend several kilometres inland from present Arctic coastlines. On land, saline permafrost forms when previously submerged marine sediments are exposed to the atmosphere, either through a sea level regression or post-glacial rebound. Cryopegs are perennially cryotic layers or pockets within permafrost that remain unfrozen due to their high salt content. While heat and salt flow models have been applied to study subsea permafrost degradation, adapting these models to terrestrial saline permafrost remains a significant gap in model development. We utilize a version of the CryoGrid modelling suite that couples heat and salt diffusion. This enables us to simulate the formation of saline permafrost and the development of cryopegs during transitions from sub-aquatic to sub-aerial conditions. As the freezing front descends, ice forms in the sediment matrix, expulsing salts into the remaining unfrozen liquid water at sub-zero temperatures. The increased unfrozen porewater salt concentration gradient increases the rate at which salt diffuses downwards into the sediment column. Over time the thermal gradient weakens, potentially allowing a more effective salt build-up ahead of the freezing front.