Special Session:

Physical Modeling for Cryosphere Applications

Organisers

Michael Gardner; University of California, Davis (mhgardner@ucdavis.edu)

Michael Gardner is an assistant professor in the Department of Civil and Environmental Engineering at the University of California, Davis. He has led geotechnical centrifuge testing on thawing rates and thaw-dependent behavior of frozen soils at the Center for Geotechnical Modelling at UC Davis. Further, he has expertise in geological engineering, rock mechanics, natural hazards engineering, and the application of numerical and stochastic methods to shallow earth processes and engineering analysis.

Ryley Beddoe; Royal Military College of Canada (ryley.beddoe@rmc.ca)

Ryley Beddoe is an Associate Professor at the Royal Military College in Canada, with a research program focused on understanding the overarching impact on geotechnical design driven by climate change in Canada's Arctic. Her research uses both physical modelling techniques as well as numerical model simulations to investigate the influence of climate on infrastructure, roads, and railways.

Jason DeJong; University of California, Davis (jdejong@ucdavis.edu)

Jason DeJong, PhD, is a professor at in the Department of Civil and Environmental Engineering at the University of California, Davis. He is the director of the Center for Geotechnical Modelling at UC Davis. He has expertise in physical modeling, site characterization, equipment design, earthquake engineering, and soil behavior. He is also routinely involved in reviewing the design of large infrastructure projects.

Session Description

The cryosphere is composed of areas that experience temperatures below 0℃ for at least part of the year, and includes permafrost, seasonally frozen ground, ice sheets, ice shelves, glaciers, among others. Seasonal fluctuations may induce substantial change to material properties and associated behavior of natural materials that can have severe impacts on engineering performance. Paired with anthropogenic-driven causes of climate change and associated increases in temperature variability, it is likely that geotechnical engineering challenges associated with these regions will increase in their prevalence and severity. The scale at which these phenomena occur often limits the applicability of laboratory testing to only describing element-level response which precludes a more wholistic description of the system evolution. Here, scaling in a hypergravity setting can enable system-level experiments which tie model predictions to field-scale observations of temperature-dependent system evolution.

The aim of this session is to bring together researchers from a broad array of topics associated with cryosphere applications to highlight both recent research advances and necessary developments for successful centrifuge testing that will inform climate impacts on cryosphere applications. The scope of this session is purposefully broad in that many of the physical modeling systems and capabilities required to conduct successful experimentation of temperature-dependent response of systems below and near-freezing will be similar, and having a broad range of applications presented will facilitate cross-disciplinary discussion. For example, temperature control required for assessing the influence of freeze-thaw cycling in the active layer above permafrost is similar to those necessary to investigate temperature and pressure dependent evolution of glacial firn. Through this session we specifically aim to create a community of researchers working toward developing cryosphere testing capabilities in a hypergravity setting, facilitating collaboration development and capability sharing.