Development and Calibration of the Arctic Coastal Erosion (ACE) Model, Towards Uncertainty Quantification of Climate Change-Induced Arctic Permafrost Degradation

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Although the Arctic is warming at a rate of 4x the rest of the globe, current tools for quantifying permafrost erosion fail to explain the episodic, storm-driven erosion events occurring in the region. This talk will describe the development and calibration of a new thermo-mechanics-based ACE (Arctic Coastal Erosion) model for the simulation of permafrost erosion off the Arctic coast of Alaska, towards enabling UQ of climate change-induced Arctic permafrost degradation. The ACE model has several unique characteristics, including: (1) the ability to predict failure from any allowable deformation (block failure, thermo-denudation, thermo-abrasion); (2) the ability to predict failure modes from constitutive (rather than empirical) relationships; (3) the capability to remove elements from the underlying finite element mesh based on specified erosion criteria; and (4) the incorporation of realistic oceanic and atmospheric boundary conditions obtained from stand-alone oceanic simulations and observational data, respectively.

Following a description of the key features of ACE, I will present some results generated using this model, namely: (1) results from a sensitivity study performed using the model run in mechanics-only mode, and (2) results demonstrating that the model is capable of reproducing erosion behavior observed during a summer/fall 2018 field campaign at Drew Point, Alaska. I will also discuss perspectives towards deploying the model in forward UQ analyses.