

Poster #5

Recent Advances in Fine-Scale Integrated Modeling of Permafrost Systems

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The Advanced Terrestrial Simulator (ATS) is a tool developed primarily for and by NGEE-Arctic to develop fine-scale, process rich models of eco-thermal-hydrological models of permafrost evolution in a variety of landscapes. Critical to this effort is the recognition that model structure and model coupling is not certain – different problems require different physical components, and accurate and efficient solution of those problems may require different coupling strategies. Here we highlight how ATS enables coupling through the Arcos multiphysics framework using two examples of ongoing work critical for NGEE-Arctic. First we show how ATS has been coupled to Amanzi's transport processes, and then to reactions for biogeochemical simulations through the Alquimia interface. This combined capability, which enables the use of PFLOTRAN and other biogeochemical codes, is becoming the go-to NGEE-Arctic fine-scale modeling capability as it allows biogeochemistry experts familiar with developing nutrient cycles in PFLOTRAN to couple their work with ATS's thermal hydrology. Simulations are constrained through data with a study of the Barrow tracer experiment. Next we demonstrate how ATS and Arcos allow experimentation with coupling strategies through ongoing development of ice-wedge thaw subsidence and frost heave simulations. In this example, it is shown how identical processes are coupled in multiple ways to test the importance of tightly coupling deformation with thermal hydrology.