NUMERICAL SIMULATIONS OF VARIABLY SATURATED FLOW WITH ENERGY AND WATER PHASE CHANGE IN NORTHERN LATITUDE PEATLANDS

Macheel, Collin A., Department of Geologic Engineering, University of Alaska, P.O. Box 755800, Fairbanks, AK 99775, collin.macheel@uaf.edu

Daanen, P. Ronald Geophysical Institute, University of Alaska Fairbanks, Fairbanks AK 99775-7320.

McGuire, A. David, Institute of Arctic Biology, University of Alaska Fairbanks, Fairbanks, AK 99775

Misra, Debasmita, Department of Geologic Engineering, University of Alaska, P.O. Box 755800, Fairbanks, AK 99775

Turetsky, Merritt, *Department of Plant Biology, Michigan State University, East Lansing, MI 48824*

Harden, Jennifer, United States Geologic Survey, Fairbanks, AK

Peatlands store an estimated quarter of the Earth's terrestrial carbon. Predominately found within northern latitudes, peatlands contribute an estimated 17-28% of global methane emissions and therefore play an important role in the global carbon cycle. The application of models attempting to accurately represent the energy and hydrologic mass transfer in peatlands have been limited by crude numerical representations and over generalizations when considering variable saturation. Unsaturated hydrology and energy transfer processes are important for regulating the oxidation and reduction of methane emission and the production of carbon dioxide. Data has been collected over a four year period at a heavily instrumented peatland located in interior Alaska. The key goal of this research has been to develop upon numerical simulation models of complex energy transfer and multiphase hydrologic processes as applied to organic variably saturated soils. The application of more complex representations of the unsaturated subsurface and energy transfer within organic soils allows for further detailed elaboration of subterranean microbiological processes associated with carbon transformations, atmospheric emission, and hydrologic transport. Finite element and volume analysis, utilizing contemporary numerical codes, account for seasonal variations of mass and energy transport. Application of a modified van Genuchten equation for variably saturated flow has been applied to account for all hydrologic and energy transport processes. The models show that the water table has a dramatic non-linear effect on heat transfer and phase change. This study will contribute to the development of coupled biogeochemical-hydrologic models that are capable of simulating the dynamics of methane, carbon dioxide, and dissolved organic carbon in northern peatlands.

Preferred mode of presentation: Either oral or poster presentation will be appropriate.