Geophysical Research Abstracts
Vol. 12, EGU2010-1863, 2010
EGU General Assembly 2010

Integrating Permafrost into an Earth System Model: First Sensitivity Experiments

Danielle Kitover, Hans Renssen, Ronald van Balen, and Jef Vandenberghe
VU University Amsterdam, Faculty of Earth and Life Sciences, Sub-Department of Climate Change and Landscape Dynamics

Approximately one-fifth of the Northern Hemisphere's land surface is underlain by permafrost. Yet, to date, few global climate models have incorporated freeze/thaw soil processes and permafrost evolution into their simulations. This may be a significant component to omit since it has been well-established that like many parts of the Arctic system, permafrost is responding to a warming climate. As been observed at many sites around the circumpolar arctic, subarctic, and alpine locations, this includes warming soil temperatures, decreasing permafrost extent, and thickening active layer. Not only do freezing and thawing processes play a significant role in the land surface energy and moisture balance but such changes imply potential feedback effects as well. Specifically, changes in the permafrost regime can feedback to the climate system via three mechanisms: 1) as a source/sink of thermal energy through latent heat exchange, 2) as a regulator of regional hydrology, and 3) as a carbon reservoir. The best way to analyze these feedback effects, and hence the overall role of permafrost within the earth system, is to incorporate surface and subsurface freeze/thaw processes within a climate model. Therefore, as impetus to narrow this research gap, our project will be enhancing an existing earth system model of intermediate complexity called LOVECLIM by integrating a frozen soil algorithm within the land surface component. An examination of the permafrost-climate relationship will be done at both present climate and the last glacial maximum climate. We specifically focus at paleoclimate time scales that allow the simulations to capture the slow response time (relative to other earth system components) of permafrost and allow changes in permafrost and associated functions to feedback to the climate. However, before coupling to LOVECLIM, we first performed sensitivity experiments on the algorithm to determine the parameterization most fitting for the research scope. This included analyzing the effects of differing spatial and time resolutions, soil thermal conductivity, soil water content, and boundary conditions on permafrost development in a 1-D soil column.