Geophysical Research Abstracts
Vol. 13, EGU2011-10885, 2011
EGU General Assembly 2011

Simulations of Siberian climate using REMO with changed soil parameterizations: Influence of permafrost-relevant processes

Tanja Blome (1) and Stefan Hagemann (2)

(1) Max-Planck-Institute for Meteorology, Land in the Earth System, Hamburg, Germany (tanja.blome@zmaw.de), (2) Max-Planck-Institute for Meteorology, Land in the Earth System, Hamburg, Germany (stefan.hagemann@zmaw.de)

Permafrost or perennially frozen ground occurs beneath roughly one quarter of the earth's land surface. It is a globally relevant carbon reservoir, and has an impact on the regional climate and hydrology.
The regions where lowland permafrost is abundant are situated in the high latitudes, one of the 'hot spots' of climate change. Therefore rising of ground temperatures and widespread thawing of near-surface permafrost is very probable, and is partially already observed.
This will lead to altered heat fluxes between surface and atmosphere, changed hydrological dynamics, and can enable decomposition of long stored, formerly deep-frozen organic material. The latter implies the danger of intensifying global warming through adding significantly more greenhouse gas to the atmosphere.
Climate models can be a tool to study these feedback effects quantitatively. For this purpose, the processes that are relevant in high latitudes need to be included in the models' soil schemes.

For modelling the biogeochemistry of the land surface, soil temperature and moisture are decisive quantities.
The global and regional climate models of the Max-Planck-Institute for Meteorology, ECHAM and REMO, were, like many others, developed using approaches which were optimized for mid latitudes. In arctic and sub-arctic regions, freezing and melting of soil moisture can no longer be neglected, since it dampens temperature change through latent heat effects. Moreover, properties like heat conductivity and capacity are influenced strongly by soil's water and ice contents.
Both effects are important for the correct simulation of soil temperature.
In order to simulate soil wetness properly, it is also important to consider the impact of frozen ground on hydraulic conductivity.

We will show results from experiments with the regional climate model REMO with the respective changes. These comprise the extension of freezing and melting of soil water on a layered soil structure, the dependency of the soil's thermal properties on water and ice content, and the influence of the thermal state of the ground on hydraulic conductivity.
Simulations have been conducted for a domain covering Siberia, with a spatial resolution of 0.5 degree, and driven with ERA40-data.
Results from the new model version will be compared with results with unchanged soil scheme, as well as against observations. Focus of the validation will be on ground temperatures and on the fluxes of heat and moisture between land surface and atmosphere. In addition, the influence of the new scheme on simulated river runoff will be investigated.