



Impact of permafrost relevant processes on hydrological change

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Permafrost or perennially frozen ground is an important part of the terrestrial cryosphere; roughly one quarter of Earth's land surface is underlain by permafrost. As it is a thermal phenomenon, its characteristics are highly dependent on climatic factors. The impact of the currently observed warming, which is projected to persist during the coming decades due to anthropogenic CO₂ input, certainly has effects for the vast permafrost areas of the high northern latitudes. The quantification of these effects, however, is scientifically still an open question. This is partly due to the complexity of the system, where several feedbacks are interacting between land and atmosphere, sometimes counterbalancing each other. Moreover, until recently, many global circulation models (GCMs) and Earth system models (ESMs) lacked the sufficient representation of permafrost physics in their land surface schemes.

Within the European Union FP7 project PAGE21, the land surface scheme JSBACH of the Max-Planck-Institute for Meteorology ESM (MPI-ESM) has been equipped with the representation of relevant physical processes for permafrost studies. These processes include the effects of freezing and thawing of soil water for both energy and water cycles, thermal properties depending on soil water and ice contents, and soil moisture movement being influenced by the presence of soil ice. In the present study, it will be analysed how these permafrost relevant processes impact projected hydrological changes over northern hemisphere high latitude land areas. For this analysis, the atmosphere-land part of MPI-ESM, ECHAM6-JSBACH, is driven by prescribed SST and sea ice in an AMIP2-type setup with and without the newly implemented permafrost processes. Observed SST and sea ice for 1979-1999 are used to consider induced changes in the simulated hydrological cycle. In addition, simulated SST and sea ice are taken from a MPI-ESM simulation conducted for CMIP5 following the RCP8.5 scenario. The corresponding simulations with ECHAM6-JSBACH are used to assess differences in projected hydrological changes induced by the permafrost relevant processes.