Geophysical Research Abstracts
Vol. 13, EGU2011-1586, 2011
EGU General Assembly 2011

Bayesian climate projection for the northern subpolar land based on ensemble of global climate models forced by SRES A1B scenario

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Contemporary global climate models (GCMs) still markedly disagree on magnitude of climate changes, in particular, in middle to subpolar latitudes over Eurasia and North America. In this work, a GCM–ensemble based climate projection is performed for the pan–Arctic in the 21st century. We consider an atmospheric output of the SRES A1B simulations with ten CMIP3 global climate models. To assess the change of soil state in the pan–Arctic regions, off–line simulations are performed with a model for thermal and hydrological processes in soil developed at the A.M.Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences (IAP RAS). The IAP RAS soil model is forced by output of above–mentioned simulations with global climate models. Ensemble mean and ensemble standard deviation for any variable are calculated by using Bayesian averaging which allows to enhance a contribution of more realistic models and diminish that of less realistic models. The Bayesian weights for each model are calculated based on their performance for the present–day surface air temperature (SAT) and permafrost distributions, and for SAT trend during the 20th century. It is obtained that the models basically agree on statistically significant warming in the northernmost regions of Eurasia and North America with typical values from $3\ K$ to $6\ K$ for annual mean and from $4\ K$ to $12\ K$ for winter. This warming is very robust within the ensemble because respective Bayesian intermodel standard deviations are typically below $0.5\ K$ in the pan–Arctic regions. Ensemble mean soil moisture content depletes in subpolar latitudes and increases in middle latitudes of these continents. However, Bayesian intermodel standard deviation is comparable in magnitude to change in ensemble mean soil water content. As a result, changes in soil moisture content during the whole 21st century for this ensemble are interpreted as statistically non–robust. The models agree on drastic permafrost degradation during the 21st century. The area underlain by near–surface permafrost decreases from the contemporary value $16 \pm 3\ mln\ km^2$ to $8 \pm 3\ mln\ km^2$. The latter results in development of risk for geocryological subsidence. This risk is largest in the southern and western parts of Siberia, in Tibet and in the band stretched from Alaska to the Labrador Peninsula.