Geophysical Research Abstracts,
Vol. 11, EGU2009-5491, 2009
EGU General Assembly 2009


# 1500-2100 A.D. forcing impacts on the water balance in polar regions

F. Lehner (1,2), C. C. Raible (1,2), T. F. Stocker (1,2), D. Hofer (1,2)

(1) Climate and Environmental Physics, Physics Institute, University of Bern, Switzerland, (2) Oeschger Centre of Excellence for Climate Research, University of Bern, Switzerland

Despite the scientifically consistent picture of climate change, a comprehensive understanding of the hydrological cycle, which is of fundamental importance for the climate system, is still missing – especially in polar regions (White et al., 2007). Within this cycle, river freshwater discharge into the ocean is a crucial element for ocean currents. Peterson et al. (2002) observed an increase of Arctic river runoff throughout the 20th century, while Wu et al. (2005) projected this trend to continue in the first half of the 21th century. Furthermore, the freshwater transport to high latitudes increases stronger on the Northern Hemisphere than on the Southern Hemisphere indicating a possible change in the distribution of major water masses (Stocker and Raible, 2005).
To assess changes of the hydrological cycle in polar regions we use a series of simulations with the Community Climate System Model version 3 (CCSM3) from NCAR. Starting from different initial conditions an ensemble of four transient simulations from 1500 to 2100 (with natural forcing and the SRES scenario A2 from 2000 to 2100) is generated. Comparisons of trends and rates of river runoff, precipitation, sea ice and other variables show that the model data is in reasonably good agreement with observational data. We found that the simulated freshwater flux to the ocean north of 60° N varies with $\pm$10% around a mean of about 5'100 ton/m2 yr for the period of 1500-1900, showing a weak signal of the natural forcing. From 1900-2100 this flux rises by over 60% to about 8'400 ton/m2 yr related to CO2 increase. River runoff contributes with about 60% to this freshwater flux increase. The trend is stongest in the winter season (DJF), where the freshwater flux in the Arctic area increases by nearly 240%. The trend in freshwater flux south of 60° S (mainly related to precipitation changes) is less pronounced compared with the Northern Hemisphere, which confirms the hypothesis of Stocker and Raible (2005). To further understand these changes the atmospheric moisture transport to polar regions will be investigated, as well as its contribution to the decrease of the AMOC, found in the ensemble simulations for the 21th century.

References:
White et al. (2007): The arctic freshwater system: Changes and impacts. J. Geophys. Res., 112, G04S54
Peterson et al. (2002): Increasing river discharge to the Arctic Ocean. Science, 298, 2171-217
Wu et al. (2005): Human influence on increasing Arctic river discharges. Geophys. Res. Lett., 32, L02703
Stocker and Raible (2005): Water cycle shifts gear. Nature, 434, 830-833