Geophysical Research Abstracts
Vol. 14, EGU2012-12091, 2012
EGU General Assembly 2012


# Sensitivity of Arctic amplification to cloud-radiation feedbacks

U. Willen and R. Bintanja

Swedish Meterological and Hydrological Institue, SMHI, Norrkoping, Sweden (Ulrika.Willen@smhi.se)

The Arctic is warming faster than the global average especially in autumn and winter and substantial reductions in summer sea-ice have been observed recently. It is also the part of the globe where climate model scenarios show the largest spread. Many recent observational data sets report significant amounts of mixed-phase clouds over the Arctic in all seasons. The frequent occurrence of Arctic mixed-phase clouds has important implications for the cloud radiative forcing at the surface, since mixed-phase clouds tend to be optically thicker than ice-only clouds. Ice crystals generally have a much larger effective radius than water droplets and therefore a much smaller optical depth for a given total water path. A number of studies have shown that models underestimate the amount of cloud water in Arctic mixed-phase clouds.

In this study we investigate how the amount of cloud liquid water in mixed-phase clouds affect the Arctic warming and sea-ice retreat in the global coupled model EC-Earth for double $CO_2$ and transient experiments. The EC-Earth model has a single prognostic variable for the mass of the cloud condensate with a temperature-based partitioning of cloud liquid and ice mass that gives small amounts of liquid compared to other models and observations. We have performed sensitivity experiments with EC-Earth using different mixed-phased cloud distributions.

The EC-Earth Arctic amplification varied between 2.7 to 4.2 times the global mean warming for the different versions. This study shows that the phase partitioning between cloud liquid and cloud ice in mixed-phase Arctic clouds could have a large impact on the model predicted climate change and can contribute to the spread in the polar amplification.