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Dynamical links between the Arctic and the global climate system and influences on atmospheric low-frequency variability

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Improved snow and sea-ice albedo parameterizations have been developed, which lead to a better agreement of the simulated albedo with the Advanced Very High Resolution Radiometer polar pathfinder as well as with the Surface Heat Budget of the Arctic Ocean data. The improved sea-ice and snow albedo formulation have been implemented in the regional climate model HIRHAM. The new scheme gives a higher and more realistic albedo in winter and early spring, leading to improved Arctic surface air temperatures compared to a climatological data set. Series of ten-year integrations (1990-1999) with atmosphere only and coupled regional climate models were conducted to understand the atmosphere-ice-ocean feedbacks on the variability of the atmospheric circulation.

By means of simulations with the global coupled AOGCM ECHO-G it is shown that changes in the polar energy sink region can exert a strong influence on the mid- and high-latitude climate by modulating the strength of the mid-latitude westerlies and storm tracks.

It is found, that a more realistic sea-ice and snow albedo treatment changes the ice-

albedo feedback and the radiative exchange between the atmosphere and the ocean-sea-ice system. The planetary wave energy fluxes in the middle troposphere of mid-latitudes between 30 and 50 ˚N are redistributed, which induces perturbations in the zonal and meridional planetary wave trains from the tropics over the mid-latitudes into the Arctic. It is shown, that the improved parameterization of Arctic sea-ice and snow albedo can trigger changes in the Arctic and North Atlantic Oscillation (AO/NAO) pattern with strong implications for the European climate. The 500 year long AOGCM simulations show the non-stationarity of the AO/NAO pattern.