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Simulations of Arctic clouds and their influence on the winter climate

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Simulations of Arctic clouds and radiation in coupled ocean/atmosphere climate models participating in the CMIP3 are analyzed. Satellite observations of cloudiness and radiative fluxes at the top of the atmosphere as well as at the surface are utilized for comparison. The analysis is performed as seasonal averages over the entire area north of 66.6?aN, over the open ocean and over the sea-ice separately. The analyzed model results show large variations over this region in terms of cloudiness, cloud water and ice water content. results indicate that the cloudiness seems to have a week connection to the surface. The fact that six models have the same magnitude of cloud forcing but a spread in surface mean temperature of more than 10K, indicates that non-cloud processes are important for the temperature spread. On the other hand, it is interesting that all but one model which underestimate the surface cloud forcing also underestimate the surface temperature. Further analysis of the model results show that the wintertime turbulent heat fluxes vary substantially between models and different surfaces. The simulated net longwave radiative flux at the surface is biased high over both surfaces compared to observations, but for different reasons. Over open ocean, most models overestimate the outgoing longwave flux while over sea-ice it is rather the downwelling flux that is underestimated. Based on the downwelling longwave flux over sea-ice, two categories of models are found. One group of models which shows reasonable downwelling longwave fluxes, compared with observations and ERA-Interim, is also associated with relatively high amounts of precipitable water as well as surface skin temperatures. This group also shows more uniform air mass properties over the Arctic region possibly as result of more frequent events of warm-air intrusion from lower latitudes. The second group of models underestimates the downwelling longwave radiation and is associated with relatively low surface skin temperatures as well as low amounts of precipitable water. These models also exhibit larger decrease in the moisture and temperature profiles northward in the Arctic region which might be indicative of too stagnant conditions in these models. We intend to show some preliminary results from similar analysis of the CMIP5 models if available in time for the conference. If not, we will base the presentation on results from the CMIP3 models.