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Intercomparison of Arctic regional climate models: Modeling clouds and radiation for SHEBA in May 1998

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To improve simulations of the Arctic climate and to quantify climate model errors, four regional climate models (ARCSYM, COAMPS, HIRHAM, and RCA) have simulated the annual Surface Heat Budget of the Arctic Ocean (SHEBA) under the Arctic Regional Climate Model Intercomparison Project (ARCMIP). The same lateral boundary and ocean surface boundary conditions, i.e., ice concentration and surface temperature, drive all the models. This study evaluated modeled surface heat fluxes and cloud fields during May 1998, a month that included the onset of the surface ice melt. In general, observations agreed with simulated surface pressure and near surface air properties. Simulation errors due to surface fluxes and cloud effects biased the net simulated surface heat flux, which in turn affected the timing of the simulated ice melt. Modeled cloud geometry and precipitation suggest that the RCA model produced the most accurate cloud scheme, followed by the HIRHAM model. Evaluation of a relationship between cloud water paths and radiation showed that a radiative transfer scheme in ARCSYM was closely matched with the observation when liquid clouds were dominant. Clouds and radiation are of course closely linked, and an additional comparison of the radiative transfer codes for ARCSYM and COAMPS was performed for clear-sky conditions, thereby excluding cloud effects. Overall, the schemes for radiative transfer in ARCSYM and for cloud microphysics in RCA potentially have some advantages for modeling of the springtime Arctic.