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# Impact of decreasing sea ice cover and warming Arctic surface temperature on the energy budget and on the large-scale circulation

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In recent years record low Arctic sea ice extents have been observed repeatedly. This can have important impacts on the Arctic energy budget as well as on the large-scale atmospheric circulation. Impacts of both a reduced and a removed Arctic sea ice cover are investigated with the atmospheric general circulation model EC-EARTH-IFS. Therefore sensitivity experiments driven by original and modified ERA-40 sea surface temperatures and sea ice concentrations have been performed at T255L62 resolution, corresponding to 79 km horizontal resolution. In winter, over the Arctic the reduced or removed sea ice leads to strongly increased upward heat and longwave radiation fluxes and precipitation while in the surrounding areas reduced upward turbulent heat fluxes and precipitation are simulated. In summer, the most pronounced change is the stronger absorption of shortwave radiation in the Arctic which is enhanced by optically thinner clouds. Averaged over the year and over the area north of 70° N, the negative energy imbalance at the top of the atmosphere decreases by about 10 W/m2 in both sensitivity experiments. The energy transport across 70° N is reduced. Over the central Arctic in winter a baroclinic response can be seen with sea level pressure decrease and 500 hPa geopotential increase. The circulation cells are weakened due to the reduction in poleward heat transport in the sensitivity experiments, especially the polar cell, implying a weaker jet stream. Results of these idealized sensitivity studies are different compared to climate predictions with coupled atmosphere-ocean-sea ice models which consider many more feedback mechanisms. The upper tropospheric warming in the tropics in those coupled climate simulations leads to a stronger westerly flow in the mid-latitudes. Furthermore Arctic cloud cover generally increases. The uncertainty in simulated Arctic cloud cover can have important implications on the future development of Arctic sea ice and therefore also the large-scale circulation.