AGCM SIMULATIONS OF ATMOSPHERIC RESPONSES TO ARCTIC WARMING: IMPACTS OF LOW-CLOUD PARAMETERIZATION

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Decreasing Arctic sea-ice cover has been observed in recent years. Recent observed changes in the arctic and mid-latitude circulation are often perceived as response to the Arctic warming. However, the magnitude of the sea-ice forced change compared to natural atmospheric internal variability still remains unclear. In this study, two versions of an atmospheric general circulation model (AGCM) are used to simulate the response of atmospheric circulation to the Arctic sea ice and SST anomalies of 2000'. The revised version differs from the original one only in the treatment of low-cloud: generation of low cloud is suppressed in cold condition following the work of Vavrus and Waliser (2008). A series of 120-member ensemble simulations were conducted using the two versions of the AGCM by prescribing climatological (1981–2010) and recent decade (2001–2010)'s seasonal cycle of SST and sea ice over the Arctic.

Results show that the arctic atmosphere is characterized by its large internal variability. Observed arctic warming may have affected recent cold winter over mid-latitude continents, but our results suggest that its quantitative role is minor. It is also shown that simulation of atmospheric responses to arctic warming is sensitive to details of the parameterization of low cloud. The revised version simulates a negative phase of the AO when forced with the recent SST and sea ice anomalies, while the control version simulates a positive phase of the AO. The long-wave radiative feedback of low-cloud is much stronger in the revised version due to a lower mean low-cloud fraction. This difference seems to cause the contrasting atmospheric response to arctic warming.