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# Response of Wind-Driven Antarctic Sea-Ice Transport to External Anthropogenic Forcings

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We study mechanisms controlling the long-term changes of Southern Ocean sea-ice cover. In particular, we focus on the response of the atmospheric circulation and the Antarctic sea ice to stratospheric ozone depletion and greenhouse-gas increase that have been controversially discussed. Changes of the circulation strongly influence the sea ice of the southern hemisphere because it is rather mobile. This is related to the absence of lateral boundaries and strong near-surface winds. Accordingly, knowledge of the affects of the external factors on the atmospheric circulation and thus on the ice movement is crucial to understand the evolution of the sea ice around the Antarctic continent. In terms of future changes of the southern polar climate, Antarctic sea ice might be a key element for the amplitude of anthropogenic warming, the stability of ice shelves, or the Southern Ocean circulation, for example.

In order to better understand the implications of circulation changes, we particularly focus on the role of the wind-driven sea-ice transport using model studies and satellite observations. We use these two complementary data sources since observational records are rather short and, hence, only allow a limited statistical analysis of long-term trends, on the one hand. Climate models, on the other hand, are still not able to reproduce the trends and variability of Antarctic sea ice accurately. Performing coupled global climate model experiments, we evaluate the response of the sea ice, its transport, and the atmospheric circulation to potential scenarios of stratospheric ozone depletion and recovery, and greenhouse-gas increase in the period 1850 to 2100.

Our results show a strong regional relation between the trends of the northward ice transport and the sea-ice cover which is retrieved from the satellite data. This stresses the importance of the dynamical forcing for the Southern Ocean sea ice. Consequently, we have analyzed the simulated wind field in order to explain the observed transport patterns. The fully coupled model is not able to reproduce the observed sea-ice cover and the trends accurately. However, the model simulations still allow us to identify the impact of the external forcings on the near-surface wind field and the sea-ice transport. Moreover, we point out problems that arise in the dynamical forcing of the Antarctic sea ice in our model and assess possible future changes of the ice cover.