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Tropo- and stratospheric teleconnection response to Arctic sea-ice and continental snow-cover changes

Dörthe Handorf (1), Ralf Jaiser (1), Klaus Dethloff (1), Annette Rinke (1), and Judah Cohen (2)

(1) Alfred Wegener Institute Helmholtz Centre for Polar and Marine research, Research Department Potsdam, Germany (doerthe.handorf@awi.de), (2) Atmospheric and Environmental research, Inc., Lexington, Massachusetts 02421, USA

Extreme winters in Northern Hemisphere mid-latitudes in recent years have been related to declining Arctic sea ice in late summer and continental snow-cover changes in autumn. These sea-ice and snow-cover changes can trigger changes of the planetary waves in the coupled troposphere-stratosphere system and subsequent changes of atmospheric teleconnection patterns in the following winter.

By performing statistical and dynamical analyses of ERA-Interim reanalysis data and model simulations with the state-of-the-art atmospheric general circulation model ECHAM6 we study the mechanisms between Arctic sea-ice and Northern hemisphere land snow-cover changes in autumn and atmospheric teleconnections in the following winter. The observed negative phase of the Arctic Oscillation in response to sea-ice cover changes is too weakly reproduced by the model. The planetary wave train structures over the Pacific and North America region are well simulated. The model deficits in simulating the negative Arctic Oscillation response are related to deficits in the simulated changes in planetary wave propagation characteristics. The changes in the upward propagating planetary-scale waves are of opposite sign in the mid-latitude troposphere over the Atlantic Ocean sector and in the whole troposphere and stratosphere over the Pacific Ocean sector. Our results support strongly the need for improved model performance with respect to seasonal to inter-annual climate predictions.