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Linkages between Arctic and mid-Latitude weather and climate: unraveling the impact of changing sea ice and sea surface temperatures

Ralf Jaiser[1], Dörthe Handorf[1], Erik Romanowsky[1], Daniel Kreyling[1], Ingo Wohltmann[1], Tido Semmler[1], Mirseid Akperov[2], Alexander Timazhev[2], Igor Mokhov[2]

[1]Alfred Wegener Institute, Helmholtz Center for Polar and Marine Research
[2]Obukhov Institute for Atmospheric Physics

The talk gives an introduction to our current work on the topic of polar to mid-latitude linkages, In particular, it addresses the question, if Arctic sea ice decline is the main driver of observed changes in terms of Arctic-midlatitude linkages during winter. We discuss, if the increase of global sea surface temperatures plays an additional role. A set of four model sensitivity experiments with different sea ice and sea surface temperature boundary conditions is analyzed and compared to observed changes in reanalysis data. A detection of atmospheric circulation regimes is performed. Furthermore, the impacts on the large-scale circulation up into the stratosphere are investigated. The results show that the impact from sea surface temperature changes is generally stronger than the impact of sea ice concentration changes alone. However, in particular in terms of the stratospheric pathway, the combined impact of sea ice and sea surface temperature changes reproduces findings from the reanalysis best.

For early winter, the observed increase in atmospheric blocking in the region between Scandinavia and the Ural are primarily induced by the changes in sea surface temperatures. Nevertheless, the impacts on the stratospheric circulation in terms of a weakened polar vortex, are only observed if sea ice is reduced and sea surface temperatures are increased. Late winter impacts are more inconsistent in the model sensitivity study, but slightly improved when both components of forcing are changed. In this context, we further identify a discrepancy in the model to reproduce the weakening of the stratospheric polar vortex through blocking induced upward propagation of planetary waves.

Additionally, the impact on the model sensitivity study from introducing a fast interactive ozone chemistry module for the polar stratospheric vortex is discussed. In some cases, impacts from changed boundary conditions become slightly stronger and more realistic if compared to recent reanalysis data.