EMS Annual Meeting Abstracts
Vol. 14, EMS2017-196, 2017

Large ensembles of uncoupled and coupled model experiments on the influence of Arctic sea ice decline on mid-latitude weather and climate

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We have conducted a series of idealized atmosphere-only and coupled model experiments on time scales from weather to climate and with different methods to address the question how the large scale circulation of the Northern mid-latitudes is affected by the shrinking Arctic sea ice. A recurring response feature to declined Arctic sea ice is the slowdown and southward shift of the jet stream with less cyclone activity north of it leading to around 0.5 K colder conditions over some limited regions of North America and North Siberia in winter. This happens despite the tendency of less intense cold advection due to the warmer Arctic in cases of anomalous northerly flow. It should be noted that for robust responses large ensemble simulations are needed due to low signal-to-noise ratio. In this respect it has been proven helpful to perform simulations in a Numerical Weather Prediction setting as the short simulation time enables us to easily run ensembles of several hundreds of realizations. Furthermore, in such a setting the initial response to a suddenly changed Arctic sea ice cover can be studied giving us hints how anomalies in the atmosphere develop. Coupled simulations hint at no discernable influence of shrinking Arctic sea ice on the ocean on time scales of a year while on decadal to centennial time scales the ocean starts to react with possible feedbacks to the atmosphere.