EGU2020-17763
https://doi.org/10.5194/egusphere-egu2020-17763
EGU General Assembly 2020

Regime behaviour in the Atlantic-Eurasian Arctic related to sea ice and sea surface temperature changes

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Climate change in the Arctic is embedded in the global climate system leading to phenomenon like Arctic Amplification and linkages to the mid-latitudes. A major forcing emerges from changed surface conditions like declining sea ice cover (SIC) and rising sea surface temperatures (SST). We performed time-slice model experiments with the global atmosphere-only model ECHAM6 and changed SIC and SST to either high or low states, respectively. These experiments are compared to reanalysis data and analysed aiming at a separation between the influences of SIC and SST, while focusing on linkages between the Arctic and mid-latitudes in winter.

We identify five significant regimes in the Atlantic-Eurasian sector with the k-means clustering method. The regimes include different blocking patterns, situation with strong low pressure influence and the North Atlantic Oscillation in its two phases. Their frequency of occurrence is discussed for winter months. In the reanalysis we observe an increase of blocking patterns in early winter of the most recent decades. This is reproduced by our experiments with increased SST, where blocking becomes more dominant overall. In late winter, an increased frequency of occurrence of the North Atlantic Oscillation in its negative phase is observed. This and the overall temporal behaviour of regimes in recent years is best represented if SST and SIC are changed to their more recent state simultaneously. Therefore, our results suggest that increased SSTs and reduced SIC together act on observed linkages between polar regions and mid-latitudes.

How to cite: Jaiser, R., Akperov, M., Timazhev, A., Romanowsky, E., Handorf, D., and Mokhov, I.: Regime behaviour in the Atlantic-Eurasian Arctic related to sea ice and sea surface temperature changes, EGU General Assembly 2020, Online, 4–8 May 2020, EGU2020-17763, https://doi.org/10.5194/egusphere-egu2020-17763, 2020