2023 PAMIP Webinar Series

The role of coupled ocean-atmosphere heat transport in the decadal variability of the Arctic amplification

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Abstract

One of the triggers of the Arctic amplification is the poleward heat transport; however, the relative contribution of its oceanic and atmospheric components remains poorly understood. In this study, we investigate the role of the Atlantic meridional oceanic and atmospheric heat transports into the Arctic for the emergence of the Arctic amplification. The meridional heat fluxes were computed using ORAS4 and ERA5 reanalyses for the Atlantic Water layer and over the lower troposphere. The horizontal and vertical boundaries of the sections in the ocean and atmosphere were selected to include only the areas, where the time mean heat transport is directed into the Arctic. It is found that the meridional heat fluxes and the regional Arctic amplification in the Eurasian Arctic are strongly coupled on the decadal time scales (10–15 years). We argue that the low-frequency variability of the Arctic amplification is regulated via a feedback, which elements include the oceanic heat transport, atmospheric heat transport and Arctic amplification. An increase (decrease) in the oceanic heat transport leads to a decrease (increase) in the atmospheric heat transport and to a decrease (increase) in the Arctic amplification. The atmospheric response to the ocean forcing occurs with a delay of three years and is attributed to the Bjerknes compensation mechanism. In turn, the atmospheric heat and moisture transport directly affects the magnitude of the Arctic amplification, with the latter lagging by one year. Thus, the variability of the oceanic heat transport at the southern boundary of the Nordic Seas might be a predictor of the magnitude of the Arctic amplification over the Eurasian Basin of the Arctic Ocean with a lead time of four years. The decadal variability of the Arctic climate, expressed in terms of the Arctic Ocean Oscillation index, supports the results obtained in this study.