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Large-scale patterns preceding Arctic warm events

Sonja Murto[1], Rodrigo Caballero[2], and Gunilla Svensson[2]
[1]Stockholm University, Department of Meteorology, Stockholm, Sweden (sonja.murto@misu.su.se)
[2]Stockholm University, Department of Meteorology, Stockholm, Sweden

Atmospheric blockings are defined as quasi-stationary synoptic-scale systems of high pressure that can influence different weather events. Previous studies have examined the role of blockings in favoring intense poleward moisture transport into the Arctic and the role of polar anticyclones to Arctic sea-ice loss (e.g. Woods et al. 2013; Wernli & Papritz 2018). However, the mechanisms and theories for blocking formation and maintenance, in combination with their contributions to the Arctic climate, are yet not fully understood. This study presents a detailed northern hemisphere climatological analysis of large-scale patterns during 50 warm events of extreme wintertime (NDJFM) Arctic surface temperature anomalies, as defined by Messori et al. (2018), for the ERA-Interim period of 1979-2016. In contrast to the previous mentioned study, the main focus in this study is to relate the warm events with atmospheric blockings, identified as upper level anticyclonic PV anomalies following a dynamically-based blocking identification algorithm (Schwierz et al. 2004). In order to classify the events by their spatially and temporally varying blocking patterns, we calculate regional averages of the blocking frequencies for sector areas defined above 50 °N. General patterns and anomalies in meteorological variables in the different area clusters are quantified. Based on the blocking fractions for 90th and 95th percentiles, we can relate up to 80 % of the warm events to strong blockings. Additionally, we show that the remaining events obtain similar patterns, though with weaker or shorter-lived blocks. Overall, it can be conducted that almost all warm events in the clusters precede with a significant blocking located in the area around the Urals and the nearby parts of the Arctic Ocean. Despite the similarities found in the high Arctic for most of the events, there are different patterns identified in the periphery between the clusters. A North-Atlantic block is often found in the same cluster as with the Ural blocking, however with some temporal lag prior to the latter one. Therefore, the connection with the NAO-index during the warm events is also investigated. Our study gives a deeper insight into the large-scale patterns and emphasizes the importance of the large-scale settings prior to the Arctic warm events, primarily focusing on the importance of the atmospheric blockings. The formation of these blockings and the dynamical processes on different scales driving these warm events are further discussed using trajectory-analysis in an upcoming study. These two studies aim to improve the understanding of the preconditions needed for these Arctic warm events to occur and, furthermore, the mechanisms that control these events in high latitudes.

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