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Effects of Arctic warming on Eurasian climate

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The rapid warming in the Arctic has been one of the most dramatic signs of the climate change during the last decades. Arctic warming has been at least twice as fast as the global mean. Simultaneously with the strong warming in the central Arctic, an increased occurrence of extreme weather events, often of unprecedented strength and duration, has already been observed in the northern hemisphere. In this study we address the effects of Arctic warming patterns on climate extremes in Eurasia, and on the atmospheric circulation linking the Arctic with the mid-latitudes. Our objective is to enhance the understanding of the regional differences in the Arctic-mid-latitude linkages, which is an issue that has received a little attention in previous studies.

We focus on the period since 1979, when high quality atmospheric reanalysis data are available. We apply the Self-Organizing Maps (SOMs) to extract the geographical patterns of Arctic surface temperature and relate these patterns with composites of atmospheric circulation and climate extreme indices. The extreme indices data are derived from the observational HadEX2 data set. We recognise the fact that the remote effects of Arctic warming may occur with a time lag of several weeks. Therefore we compare Arctic surface temperature patterns and temporally lagged composites of atmospheric circulation and climate extreme data. We compute the frequencies of occurrence of Arctic surface temperature patterns and decompose changes in relevant quantities, such as precipitation, into two components. The first component represents quantity changes associated with changes in frequencies of occurrence of temperature patterns, whilst the second component describes quantity changes due to the local temperature change within each surface temperature pattern.

Our preliminary results demonstrate fundamental differences in the Arctic-mid-latitude linkages between the western and central parts of the Eurasian continent. For example, in autumn and early winter, the sea ice cover and air temperatures have a different relationship in the western and central Eurasia, but in late winter their statistical relationships turn similar. Furthermore, frequencies of occurrence of Arctic temperature change significantly from the 1980s until the latest decade. These frequency changes are associated with a particularly distinct reorganisation of the atmospheric circulation over Eurasia, while elsewhere the largest contribution to the atmospheric circulation change in the Northern Hemisphere is associated with local changes in Arctic surface temperatures. We are carrying out more analysis with the SOM technique to different seasons and variables that can provide further insights on the Arctic-mid-latitude linkages.