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Warming and cooling in the Arctic: what can we learn from the past 100 years

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In recent decades, the Arctic has experienced rapid warming, which is more pronounced in the Atlantic sector. On top of this warming signal there is a large year-to-year variability, arising in part from dynamical linkages from the mid-latitudes, for example via the poleward transport of heat and moisture in extratropical cyclones, which can influence the sea ice extent.
The jet stream in mid-latitudes plays an important role in steering cyclones from their genesis location along the storm tracks. Moreover, the jet stream's position influences the occurrence of cold air outbreaks (CAOs), which contribute to substantial oceanic heat loss in the Arctic due to air–sea heat exchanges.

The aim of this study is to understand how the the large-scale mid-latitude atmospheric circulation (i.e. the jet stream) influences atmospheric conditions (e.g. temperature) in the polar and subpolar regions. We use the ECMWF ERA-20C reanalysis (1900-2010), focusing on the North Atlantic sector, where there is a better observational coverage, and the winter season. We identify the main North Atlantic jet stream configurations, which are closely related to quasi-stationary states of the atmosphere known as weather regimes. We examine the spatial signatures in frequency of cyclones and CAOs associated with each jet configuration, as well as their long-term variability over the 20th century. We show that regional differences in the warming and cooling patterns in the Arctic are related to changes in the mid-latitude circulation.
The atmospheric variability at mid-latitudes is thus a key player to understand present and future conditions in the Arctic.