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Analyzing Arctic Heat Transport Using Self-Organizing Maps

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Through the disproportional temperature increase of the high-latitude troposphere in recent years, the so called Arctic Amplification, the meridional temperature gradient between mid and high latitudes is decreasing. It is assumed that through this decrease the large-scale circulation is changing and therefore the meridional transport of heat and moisture increases. This in turn may increase the Arctic warming even further.
To investigate patterns of Arctic temperature, horizontal fluxes, and their changes in time, we analyzed ERA-Interim surface winter temperature data from 1979/80 through 2015/16 using Self-Organizing Maps (SOM). This method maps similar data points into an arrangement of a 2-dimensional output field of distinct patterns. It was found that during the time interval analyzed, a warmer central Arctic and colder continents are getting more common, while patterns with a colder central Arctic are getting less frequent. Furthermore, the heat transport corresponding to these changing temperature patterns shows pathways that are connected to an increased heat transport through the North Atlantic for the warmer central Arctic pattern. For pattern with a colder central Arctic the transport is mostly directed through northern Siberia. This points to a change of transports pathways with increasing Arctic temperatures. Additionally, the SOM method was also performed on the horizontal heat transport itself. It was found that there are patterns that feature stronger transport through the North Atlantic into the central Arctic region and patterns where the transport into the central Arctic originated from central or east Siberia. For the latter the frequency of occurrence is decreasing, while for the former the frequency is increasing. Temperatures corresponding to the patterns of the heat transport showed that for heat transport patterns with pathways through the North Atlantic favor warmer temperatures (+6 °C) in the central Arctic region. With this methodology it can be shown that with increasing temperature more heat is transported from the North Atlantic and vice versa.