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Extreme Summer Temperatures in the Northern Hemisphere and their Link to the Atlantic Multidecadal Variability in Decadal Hindcasts

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It remains an unsolved challenge to predict summer temperature extremes on the seasonal-to-decadal time scale. One possible way to understand the emergence of summer temperature extremes, and therefore their prediction, is to identify connections between large-scale features of climate variability and such temperature extremes. Here, we show evidence that the phase of the Atlantic Multidecadal Variability (AMV) influences the occurrence and decadal prediction skill of summer temperature extremes on the Northern Hemisphere.

We use a 10-member ensemble of yearly initialized decadal hindcasts with the CMIP6 version of the MPI-ESM-HR model covering the period 1960-2017. Predictions of summer (JJA) temperature variability are skillful for up to 8 years ahead in regions in Scandinavia, North-East Asia and the Central-Midwest USA. Moreover, prediction skill for summer temperature in these regions strongly depends on the phase of the AMV: summer temperature in Scandinavia and the USA shows high predictive skill in positive AMV phases, while North-East Asia shows high predictive skill in negative AMV phases. Due to a large number of other mechanisms influencing summer temperature variability over Central Europe, we find no decadal prediction skill for Central European summer temperature in this model simulation.

The likelihood with which extreme summer temperatures are predicted by the hindcast ensemble depends on the phase of the AMV. The amount of summer temperature extremes predicted by the model is highly correlated between the four regions, because the AMV and the occurrence of such extremes between these regions are strongly connected via a circumglobal atmospheric Rossby Wave, the circumglobal wave train. On average, summer temperature extremes are predicted to occur every 6 years in a negative AMV phase and every 4 years in a positive AMV phase. This shows the strong link between the AMV and the prediction of surface temperature extremes on the Northern Hemisphere.