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Factors influencing subseasonal predictability of Northern Eurasian cold spells

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The study focuses on identifying potential “windows of opportunity” for the enhanced predictability of extreme events, such as severe Northern Eurasian cold air outbreaks as these events have significant impacts on human health, energy use, agriculture and welfare. The extended-range predictability of extreme events is closely related to the preceding large-scale circulation patterns and remote teleconnections. To assess the predictability of these events and attribute their causes we use ensemble hindcasts (i.e., reforecasts for dates in the past) from five prediction systems from the S2S database – namely, from the European Centre for Medium□range Weather Forecasts (ECMWF), the United Kingdom Met Office (UKMO), Météo□France (CNRM), Bureau of Meteorology (BoM), Japan Meteorological Agency (JMA). These models have long re-forecast periods and big ensemble sizes necessary to establish statistically robust results. Moreover, the comparison of the forecasts from these six models evaluates the ability of modern prediction systems to forecast extreme events well in advance and highlights the main sources of predictability. We subsample the hindcasts into two groups according to their skill to predict an extreme event beyond weather predictability horizon (lead time week 2 and 3) in order to study the systematic relationship between preceding conditions and the onset of extreme events. Next, we evaluate the flow configurations in the initial conditions: the state of the stratospheric polar vortex (SPV), the phase and amplitude of the Madden-Julian Oscillation (MJO) in the tropics, and the weather regimes over the North Atlantic and Europe. This analysis provides a systemic evaluation and understanding of the large-scale patterns that can potentially contribute to the onset of extreme events over Eurasia, therefore, extending their predictability. Our results show that in overall models tend to over-predict cold conditions after certain states of the remote drivers but there is case-to-case variability in the predictability of the individual events. Moreover, this study assesses and compares the results from several state-of-art predicting systems which provides useful information for model developers as well as for forecast users.