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Stratospheric Pathways to Enhanced Persistence of European Surface Temperatures

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In recent years, severe weather anomalies in Europe have received considerable attention, mostly due to their detrimental impacts on human and natural systems, but also because of the apparent persistence of weather patterns over weeks and even months. The cold winter of 2009–2010 is a case in point. It is of great interest to improve our ability to forecast such events. Weather forecasts at mid-latitudes generally show low skill beyond 5–10 days ahead, but long-range forecast skill may increase during tropospheric blocking or sudden stratospheric warmings, which appear to affect midlatitude weather out to several weeks ahead. Here we use a simple approach to identify previously undocumented persistence in northern European summer and winter temperature anomalies in an ensemble of 18 pre-industrial climate model simulations, corroborated by actual observations. For instance, the probability of experiencing cold anomalies in February to April when the preceding months are anomalously cold and have a weak polar vortex is raised threefold compared to when the preceding months are not cold and the vortex is not weak. The persistence is observed irrespective of the data source or driving mechanisms, but is always enhanced when the stratospheric polar vortex or the NAO is also perturbed. Another interesting result is that an existing surface temperature anomaly is a necessary precondition; a weak vortex alone is a relatively poor predictor on the intraseasonal time scales considered here. Our results have a potential to conditionally improve the skill of long-range forecasts and to enhance recent advancements in dynamical seasonal prediction.