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Skillful predictions of Eurasian winter climate by constraining variability in CMIP6 simulations using NAO-temperature teleconnections

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Accurate and reliable future climate information is key for successful implementation of climate change adaptation plans especially on regional scales. Predicting the winter climate over Eurasia is challenging as both the initialized predictions and uninitialized climate projections show limited skill in reproducing observed variability on multi-annual to decadal timescales. It has been long recognized that the climate over Eurasia is strongly influenced by the North Atlantic Oscillation (NAO), especially in winter. The observed NAO indices show strong year to year variations that can be associated with climate conditions in Europe and Asia. Numerous efforts have been made to use NAO as one of the major predictors for European climate. However, the strength and spatial patterns of the NAO-related teleconnections vary with time, for example on multi-annual to decadal timescales, resulting in limited success in predictions on these time scales.

This study presents a novel approach to constrain variability in projection simulations over Eurasia by exploiting the teleconnection between the North Atlantic Oscillation (NAO) and the surface air temperature in the northern hemisphere. The constrained ensemble shows significantly higher skill and added value in predicting the multi-annual winter surface air temperature over Eurasia as compared to both the unconstrained ensemble of historical simulations and the initialized decadal predictions. The sensitivity analysis suggests that the constraining based on teleconnection during the previous 15 to 20 winter seasons is optimum for skillful predictions of multi-annual to decadal mean winter climate over Eurasia.