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The Decadal Variability of Extreme European Heat

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We evaluate the contribution of the decadal to multidecadal variability in the North Atlantic climate system to impact-relevant extreme heat metrics over Europe, and how this contribution evolves in a warming world. To do this, we use the largest existing ensemble of a comprehensive, fully-coupled climate model: the 100-member Max Planck Institute Grand Ensemble (MPI-GE). MPI-GE has been shown to have one of the most adequate representations of the variability and forced response in observed temperatures in the historical record. Furthermore, the large ensemble size of MPI-GE provides the robust sampling of internal variability that is required to evaluate the contribution of variability on decadal to multidecadal timescales to low-probability, high-impact extreme events.

In our evaluation, we go beyond common metrics defining heatwave intensity or duration, and employ heat excess metrics that account for the cumulative intensity and persistence of heat per Summer beyond given thresholds. We use these cumulative heat metrics to assess excess dry heat as well as other impact-relevant aspects of heatwaves, such as hot and humid conditions and lack of night time cooling. Our preliminary results indicate that the contribution of the decadal variability in the North Atlantic, represented by the Atlantic Multidecadal Variability (AMV), contributes to differences in these metrics between positive versus negative AMV phases that are comparable to the forced changes due to anthropogenic global warming in parts of Europe. This potential for the exacerbation of such extreme conditions under positive AMV phases highlights the necessity for considering these decadal variations both in the attribution of past events as well as in our projections of future extreme heat.