EGU2020-2654
https://doi.org/10.5194/egusphere-egu2020-2654
EGU General Assembly 2020

Decadal Predictions of the Probability of Occurrence for Summer Temperature Extremes in the Northern Hemisphere

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We use a decadal prediction system with the Coupled Model Intercomparison Project Phase 6 version of the coupled Max Planck Institute Earth System Model to predict the probability of occurrence for extremely warm summers in the Northern Hemisphere. An assimilation run with Max Planck Institute Earth System Model shows a robust response of summer temperature extremes in northern Europe and northeast Asia to North Atlantic sea surface temperature via a circumglobal Rossby wavetrain. When the North Atlantic is warm, warm summer temperature extremes occur with a probability of 20% and 24% in northern Europe and northeast Asia, respectively. In a cold North Atlantic phase, these probabilities are 0% and 8%. A similar dependence of the probability of occurrence for summer temperature extremes in these regions to North Atlantic SST can be found in observations.

To examine this effect in decadal predictions, we pool all available realizations for any given year in the decadal prediction system. Using 10 ensemble members and 10 lead years, we therefore end up with 100 realizations for any year between 1970 and 2018. We find that the probability of occurrence for summer temperature extremes in the pooled initialized climate predictions shows good agreement with the observations and the assimilation run. This agreement is related to high skill of the model system in predicting North Atlantic SST. Consequently, the likelihood of a warm summer temperature extreme occurring in the examined regions in the next 10 years can be inferred from predictions of North Atlantic temperature.