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The Role of the North Atlantic for Heat Wave Characteristics in Europe

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The recent severe European summer heat waves of 2015 and 2018 co-occurred with cold subpolar North Atlantic (NA) sea surface temperatures (SSTs). However, a significant connection between this oceanic state and European heat waves was not yet established.

We investigate the effect of cold subpolar NA SSTs on European summer heat waves using two 100-year long AMIP-like model experiments: one that employs the observed global 2018 SST pattern as a boundary forcing and a counter experiment for which we removed the negative NA SST anomaly from the 2018 SST field, while preserving daily and small-scale SST variabilities. Comparing these experiments, we find that cold subpolar NA SSTs significantly increase heat wave duration and magnitude downstream over the European continent. Surface temperature and circulation anomalies are connected by the upper-tropospheric summer wave pattern of meridional winds over the North Atlantic European sector, which is enhanced with cold NA SSTs. Our results highlight the relevance of the subpolar NA region for European summer conditions, a region that is marked by large biases in current coupled climate model simulations.