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The relation between European heat waves and North Atlantic SSTs: a two-sided composite study

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- The occurrence of extreme weather events has increased during the two last decades. European heat waves are responsible for social, economic and environmental damage and are projected to increase in magnitude, frequency and duration under global warming, heightening the interest about the contribution of different drivers.
- By using the ERA5 Re-analysis product, we performed a two-sided composite analysis to investigate a potential relation between North Atlantic sea surface temperatures (SSTs) and the near-surface air temperature (T2m) over the European continent. Here, we show that in the presence of cold North Atlantic SSTs during summer, the distribution of European T2m shifts towards positive anomalies a few days later, increasing the likelihood for heat waves. During these events a predominant wave number three pattern in addition to regionally confined Rossby wave activity contribute to a trough-ridge pattern in the North Atlantic-European sector. Specifically, five of 17 European heat waves within the period of 1979 to 2019 could be related to a cold North Atlantic SST event a few days in advance. In the upstream analysis we identify eleven of 17 European heat waves co-existent with cold North Atlantic SSTs.
- In order to confirm the crucial role of North Atlantic SSTs for European heat waves, we analysed output from a coupled climate model, HadGEM3, with three different horizontal resolutions. The high-resolution run revealed the closest resemblance to the ERA5 data, suggesting that mechanisms on the mesoscales (<50 km) play a role in the relationship between North Atlantic SSTs and European T2m. Results also highlight the importance of using a climate model with a high horizontal resolution for the purpose of studying the variability of European heat waves.
- Based upon our results, conducted with ERA5 Re-analysis and HadGEM3 data, North Atlantic SSTs provide potential predictive skill of European heat waves.