

## Changes in North American and European Heatwave Characteristics

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Heat waves are a serious threat to ecosystems, society and the economies of the world. By calculating specific threshold values from daily maximum 2 m temperatures of the NCEP/NCAR reanalysis data (Kalnay et al. 1996), the frequency of heat waves during summer months (JJA) in Europe and the US is determined for the period of 1982 to 2017. The differences between the first and the second half of the 36-year period are discussed, and the results are compared to the North American Multi-Model Ensemble (NMME) forecast with specific focus on recent heat waves in the Pacific Northwest of North America and Central Europe. The connection between heat waves and known climate variability (i.e., the NAO, PNA) is analyzed. We strive to assess the importance of natural variability, such as the NAO, in the frequency of heat waves by comparing the first and last half of the studied 36-year period. We also examine how well the NMME retrospective and real-time forecasts capture heat waves (and cold spells), and the sources of predictability (i.e., sea surface temperature anomalies, land surface conditions), and how the predictability connects to the various modes of climate variability.