Characterizing the Unprecedented Co-Occurrence of 2023 Boreal Summer Heat Extremes in Central America, Western Europe, and Central Asia

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Spatially co-occurring heat extremes cause aggregated and amplified socioeconomic impacts, such as disrupting global crop production and energy systems. The global mean surface temperature in 2023 was record high within the instrumental period, with the boreal summer experiencing particularly high temperatures in spatially distinct regions. We investigate how unusual such a heat extreme is with and without the influence of anthropogenic climate change, with a specific focus on the co-occurrence of heat extremes in Central America, Western Europe, and Central Asia. Using the Berkeley Earth surface temperature dataset, we quantify the collective magnitude of the summer 2023 regional anomalies, the magnitude after removing the anthropogenic influence, and the atmospheric conditions associated with this event. We find that the magnitude of the summer temperature anomaly in these regions in 2023 is the largest within the instrumental record (1850-2023). Remarkably, this co-occurring heat extreme remains one of the strongest events even after removing the background global warming signal. We also characterize the surface winds and high-pressure systems that contributed to these extremes. Our results contextualize the 2023 summer, specifically with regard to the co-occurring heat extremes in Central America, Western Europe, and Central Asia, and the driving mechanisms behind similar events, with implications for predictability and socioeconomic impacts in the context of climate change.