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A new perspective on the 1930s mega-heat waves across central United States

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The unprecedented hot and dry conditions that plagued contiguous United States during the 1930s caused widespread devastation for many local communities and severely dented the emerging economy. The heat extremes experienced during the aptly named Dust Bowl decade were not isolated incidences, but part of a tendency towards warm summers over the central United States in the early 1930s, and peaked in the boreal summer 1936. Using high-quality daily maximum and minimum temperature observations from more than 880 Global Historical Climate Network stations across the United States and southern Canada, we assess the record breaking heat waves in the 1930s Dust Bowl decade. A comparison is made to more recent heat waves that have occurred during the latter half of the 20th century (i.e. in a warming world), both averaged over selected years and across decades. We further test the ability of coupled climate models to simulate mega-heat waves (i.e. most extreme events) across the United States in a pre-industrial climate without the impact of any long-term anthropogenic warming.

Well-established heat wave metrics based on the temperature percentile threshold exceedances over three or more consecutive days are used to describe variations in the frequency, duration, amplitude and timing of the events. Casual factors such as drought severity/soil moisture deficits in the lead up to the heat waves (interannual), as well as the concurrent synoptic conditions (interdiurnal) and variability in Pacific and Atlantic sea surface temperatures (decadal) are also investigated. Results suggest that while each heat wave summer in the 1930s exhibited quite unique characteristics in terms of their timing, duration, amplitude, and regional clustering, a common factor in the Dust Bowl decade was the high number of consecutive dry seasons, as measured by drought indicators such as the Palmer Drought Severity and Standardised Precipitation indices, that preceded the mega-heat waves. This suggests that land surface feedbacks, resulting from anomalously dry soil prior to summer, amplified the heat extremes triggering the mega-heat waves. Using the model experiments, we assess whether the combined warm phases of the Pacific Decadal Oscillation and Atlantic Multidecadal Oscillation provide a necessary condition to trigger decade-long droughts that spawn mega-heat waves to cluster across consecutive summers.