Mechanisms Associated with Daytime and Nighttime Heat Waves over the Contiguous United States

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Abstract

Heat waves are extreme climate events that have the potential to cause immense stress on human health, agriculture and energy systems. Previous studies have found heat wave frequency to have increased over recent decades in many regions. There is no single accepted definition of a heat wave, but it is generally defined as temperature exceeding a threshold for a sustained amount of time. However, multiple different temperature variables can be used – daily mean, maximum and minimum temperature are potentially relevant, as are variables which account for humidity, such as apparent temperature, equivalent temperature and heat index. In this study, heat waves are examined over the United States using the NASA Modern-Era Retrospective Analysis for Research and Applications 2 (MERRA-2). We focus explicitly on the difference between heatwaves manifest during daytime versus nighttime hours. Both can be detrimental for human health, so it is important to understand the conditions leading to their onset. A daytime (nighttime) heat wave is defined as average daytime (nighttime) temperature exceeding its calendar day 90th percentile for at least 3 days, where daytime and nighttime hours are differentiated locally using hourly downward shortwave radiation at the top of the atmosphere. We characterize the large-scale circulation and identify local and remote processes associated with these two heatwave types over different regions of the United States.

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