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Synoptic Characteristics of 14-Day Extreme Precipitation Events across the United States

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Abstract

Although significant improvements have been made to the prediction and understanding of extreme precipitation events in recent decades, there is still much to learn about these impactful events on the subseasonal time scale. This study focuses on identifying synoptic patterns and precursors ahead of an extreme precipitation event over the contiguous United States (CONUS). First, we provide a robust definition for 14-day "extreme precipitation events" and partition the CONUS into six different geographic regions to compare and contrast the synoptic patterns associated with events in those regions. Then, several atmospheric variables from ERA-Interim (e.g., geopotential height and zonal winds) are composited to understand the evolution of the atmospheric state before and during a 14-day extreme precipitation event. Common synoptic signals seen during events include significant zonally oriented trough–ridge patterns, an energized subtropical jet stream, and enhanced moisture transport into the affected area. Also, atmospheric-river activity increases in the specific region during these events. Modes of climate variability and lagged composites are then investigated for their potential use in lead-time prediction. Key findings include synoptic-scale anomalies in the North Pacific Ocean and regional connections to modes such as the Pacific–North American pattern and the North Pacific Oscillation. Taken together, our results represent a significant step forward in understanding the evolution of 14-day extreme precipitation events for potential damage and casualty mitigation.

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