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Changes in mechanisms and intensity of Western U.S. floods, 1960-2013

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Extreme precipitation, a critical factor in flooding, has selectively increased with warmer temperatures in the Western U.S. Despite this, the streamflow measurements have captured no noticeable increase in large-scale flood frequency or intensity. As flood studies have mostly focused on specific flood events in particular areas, analyses of large-scale floods and their changes have been scarce. For floods during 1960-2013, we identify six flood generating mechanisms (FGMs) that are prominent across the Western U.S., including atmospheric rivers and non-atmospheric rivers, monsoons, convective storms, radiation-driven snowmelt, and rain-on-snow, in order to identify to what extent different types of floods are changing based on the dominant FGM. The inconsistency between extreme precipitation and lack of flood increase suggests that the impact of climate change on flood risk has been modulated by hydro-meteorological and physiographic processes such as sharp increases in temperature that drive increased evapotranspiration and decreased soil moisture. Our results emphasize the importance of FGMs in understanding the complex interactions of flooding and climatic changes and explain the broad spatiotemporal changes that have occurred across the vast Western U.S. for the past 50 years.