Analysis of Spatial Dependence Patterns in Precipitation Extremes

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Abstract

Extreme value theory concerns the application of statistical methodologies to understand low-frequency but high-impact extreme events in climate data. In particular, spatial modeling of climate extremes has been investigated to account for regional patterns of extremes and to characterize the dependence among locations based on the extreme value theory. However, there has been relatively little study of changes in the spatial dependence of extreme precipitation from CMIP5 projections by season and across emissions scenario.

In this study we analyze the dependence structure of extreme precipitation with annual maximum precipitation from CMIP5 model experiments, and we estimate extremal coefficients to quantify the spatial tail dependence. The analysis provides statistically significant evidence of changes on the dependence pattern under different emission scenarios. We also focus on the patterns of spatial dependence in northern and central California to understand the influence of Atmospheric Rivers (ARs), narrow atmospheric systems with elevated water vapor that cause severe downpours and flooding over much of the western coastal United States. This study yields the connections between the spatial dependence in extreme precipitation and the properties of the ARs making landfall along the Pacific coast.