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Extreme rainfall events in Morocco: spatio-temporal characteristics and climate drivers

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Extreme precipitation drives a series of natural disasters such as floods, flash floods, landslides, or crop losses. These disasters directly impact people's lives, their homes, and their food security. Located at the edge of the subtropics, on the northern edge of the Sahara desert, Morocco is particularly vulnerable to extreme precipitation. Indeed, between 1951 and 2015, Morocco experienced more than 35 major floods, which resulted in significant material and human losses. Understanding the spatio-temporal characteristics of extreme precipitation is key to better predicting and mitigating the risks associated with extreme precipitation events (EPEs). Yet, the spatio-temporal distribution and physical drivers of extreme precipitation in Morocco remain poorly understood. To address this gap, we apply temporal and spatial clustering methods to precipitation data from the ERA5 database as well as from observational databases to identify the main drivers of EPEs in Morocco. We find that Morocco exhibits five spatially coherent regions in terms of EPE timing, corresponding to mixed influences of large-scale extratropical and tropical weather systems. Indeed, EPEs in northern regions are caused by weather patterns similar to the negative phase of the North Atlantic Oscillation (NAO), associated with strong upper air flow enhanced by Greenland blocking and Rossby wave breaking (RWB). By contrast, extreme precipitation in southern regions is associated with tropical-extratropical interactions. There, EPEs are linked to an intense water vapor transport from the tropics and a relatively weak upper air flow.