

The Impact of Tropical Cyclone Remnants on the Rainfall of the North American Southwest Region

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The North American southwest region has a mild, arid, or semiarid, continental climate characterized by low annual precipitation, abundant sunshine, low relative humidity, and a relatively large annual diurnal temperature range. Summer rains fall almost entirely during brief, but frequently intense thunderstorms. In general, a southerly circulation from the Gulf of Mexico brings moisture into the region, and strong surface heating combined with orographic lifting as the air moves over higher terrain produce the thunderstorms. The location of the Gulf of Mexico high-pressure system is critically important for location of the monsoonal moisture and summer precipitation in the North American southwest. July, August, and September are the rainiest months, producing, on average, anywhere from 25 to 45 percent of the annual rainfall. There is a sharp west to east gradient in the NAMS precipitation from southern California to central Arizona with the long-term maximum extending from the Mexican border in eastern Arizona and New Mexico north through Colorado. However, in years when the location of the Bermuda high is shifted to the east, and the eastern Pacific subtropical high is stronger than normal, as little as 25-30% of the annual rainfall has fallen in these months.

An additional source of tropical moisture is occasionally advected into the Southwest U.S. from the Eastern Pacific and Gulf of Mexico in the form of tropical cyclone remnants. These mesoscale systems make landfall on the Mexican and Californian coastline and, if the synoptic conditions are favorable, advect over the North American southwest. Although the tropical cyclone-strength winds rapidly diminish upon making landfall, these systems still carry a large quantity of tropical moisture and, upon interaction with mountainous topography, have the potential to drop copious amounts of precipitation. However, these systems are traditionally difficult to forecast accurately due to the nature of their interaction with the midlatitude flow.

In this study we will investigate the impact that tropical cyclone remnants from the Eastern Pacific have on precipitation in the arid North American southwest region. We will study their climatological impact, the resulting rainfall patterns, and the nature of the large-scale circulations that advect them across the southwest U.S. using both observational and model data.

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