Tropical Cyclone Impacts in Northwest Mexico and the Southwest United States

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The Hydrometeorological Prediction Center has been involved in creating a tropical cyclone rainfall climatology over the past several years (http://www.hpc.ncep.noaa.gov/tropical/rain/tcrainfall.html). Its goals include documenting all known tropical cyclones, as well as their remnants, rainfall impacts back to 1955. Originally restricted to the lower 48 United States, data from the Comision Nacional del Agua, the parent agency of Mexico's national weather service, has allowed us to begin documenting systems in Mexico during the past year. The project has also expanded into Puerto Rico and the U.S. Virgin Islands, with plans to expand into Hawaii and Guam in the near future. As the project goes backward in time, various maps and statistics are being added as an aide in the tropical cyclone QPF process, including maximum amounts per U. S. and Mexican state which act as a sanity check for rainfall amount forecasts. In addition to the climatology, model data from the GFS is normally used to help construct tropical cyclone QPF, due to its superior verification when compared to the NAM and its normal closeness to the TPC track.

Studies from Mexico (SMN) suggest that three times as many tropical cyclones affect western than eastern Mexico. Tropical cyclones impacting northwest Mexico are able to maintain their core rainfall until landfall due to the higher SST values seen in the Gulf of California and near Baja California Sur as long as storm relative vertical wind shear remains light. A combination of vertical wind shear and lower SSTs west of Baja California Norte act to limit rainfall potential for California and the Desert Southwest to significantly lower amounts than seen at similar latitudes across the Carolinas. Despite much warmer water temperatures across the Gulf of California, the narrow width of the Sea of Cortez tends to weaken tropical cyclones as they try to move up the length of the Gulf as their circulation interacts with the neighboring landmass. This lowers rainfall potential with latitude. Still, tropical cyclones have a much better chance maintaining core convection moving over the warm waters east of Baja California than over the colder waters west of Baja California. Storms which strike northwest Mexico typically lose all their core convection while moving across the Sierra Madre Occidental mountain range.

Extratropical transition (ET) tends to expand rainfall patterns and enhances local maxima within tropical cyclones. This is mainly due to the greater amounts which focus along the frontal boundary north of the transitioning tropical cyclone. The consequence of this in the rainfall distribution is that the maximum shifts west of the path of the tropical cyclone. Systems with lesser interaction with mid-latitude troughs, or weaker upper troughs, tend to show a more concentrated distribution of rainfall near and just to the right of the cyclone's track. Topography across the region plays a significant role in where the maximum falls across northwest Mexico and the southwest United States.

While direct and indirect impacts of tropical cyclones lead to an average of 13 inches of rainfall per event for the United States as a whole, lower amounts are seen across the Desert Southwest than across most of the South and East per the reasons mentioned above. The average between 1987 and 2006 for tropical cyclones and their

remains moving across the Southwest was close to 5 inches per event, with nearly half falling within six hours and over 90 percent falling within 24 hours. While studies suggest that the median percentage of tropical cyclone contribution to annual rainfall across the area is around 5 percent, individual events can lead a significant portion of the annual rainfall for the Sonoran Desert. Also, tropical cyclones paralleling the west coast of Baja California help to enhance the monsoon across western Mexico and the Desert Southwest.