P1.53 THE ROLE OF TROPICAL CYCLONES IN THE MEXICO CLIMATE

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1. INTRODUCTION

Mexico is highly vulnerable to extreme weather events, such as tropical cyclones (TC) because of the floods, landslides and storm surges (Jauregui 2003). On the other hand, TCs play an important role in the hydrological cycle of northern Mexico, particularly over semiarid regions. A decreased tropical cyclone activity in the Caribbean region and Gulf of Mexico during El Niño years may result in negative precipitation anomalies in the northwest Mexico (Mendez and Magaña 2010). Thus, the contribution of TCs to the annual precipitation at the regional level should be quantified given the current demands for climate information. TCs tracks may be determinant in increasing or decreasing the summer rainfall, an element that is difficult to include in seasonal climate predictions.

2. DATA AND METHODOLOGY

TCs tracks for the Atlantic and northeaster Pacific oceans are obtained from the best-track data base of National Hurricane Center (HURDAT and EPA) for the 1970-2009 period. These datasets contain 6-hourly records of the low pressure center location and intensities (maximum 1-min surface wind speed and minimum central pressures) for all tropical storms and hurricanes. Tracks are grouped by means of a cluster technique as proposed by Camargo et al. (2007). Four types of clusters bother the Atlantic than northeastern Pacific are defined. Regional composites of various meteorological fields are prepared using the North American Regional Reanalysis (NARR) (Mesinger 2006). The TC-related precipitation is defined as rainfall within a radius of 5º from the center of a TC (Englehart and Douglas 2001).

3. RESULTS

3.1. Contribution to the summer rainfall

The TC cluster analysis shows that the summer precipitation over some regions of Mexico rainfall depends on the track of the systems. TCs may contribute to the summer precipitation by up to ±25%. For instance, cluster A-ATL (Fig. 1) is the most important contributor of rainfall for northeastern Mexico, where summer rainfall is around 400 mm between June and November. On the northeastern Pacific Ocean, cluster A-EPA is important for summer rain over the Baja California Peninsula. In fact, TCs over this region may contribute to more than 30% of rainfall since precipitation is around 200 mm on the average. Similarly, TCs for cluster B-EPA are important for southern Mexico (Fig. 2).

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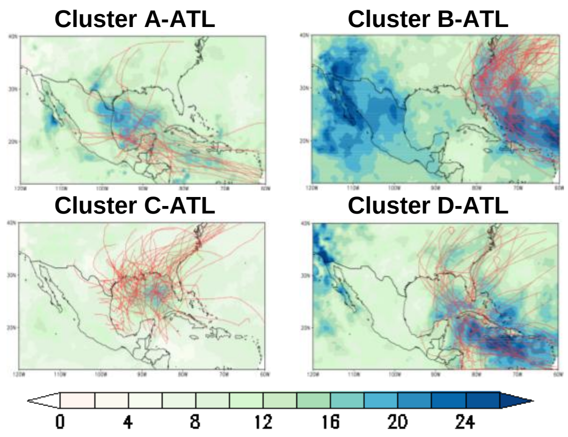

Figure 1. Clusters contribution in the Atlantic Ocean to the summer rainfall in Mexico (1979-2009)

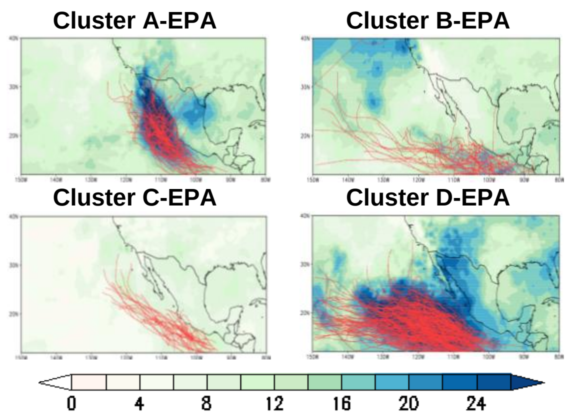

Figure 2. Clusters contribution in the Northeast Pacific Ocean to the summer rainfall in Mexico (1979-2009)

3.2. *Moisture fluxes and TCs circulation*

In order to understand the relation between TCs and precipitation anomalies, the difference in precipitation fields between consecutive periods of TC activity and no-TC activity are analyzed. TCs produce substantial precipitation over several regions of Mexico that make some years wet. However, they may be considered events that are not present every year. For instance, Hurricane Dolly, from July 20, 2008 to July 27, 2008, produced intense precipitation (positive anomalies) in the northeast part of Mexico, particularly on July 23, 2008 (Fig. 3). Consequently, the summer of 2008 was a particularly wet summer in this region (Fig. 4).

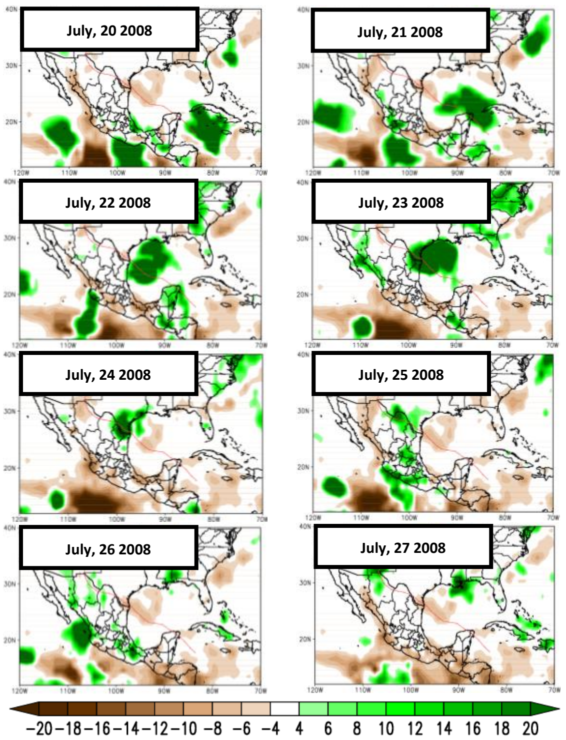

Figure 3. Precipitation anomalies (mm) associated with Hurricane Dolly

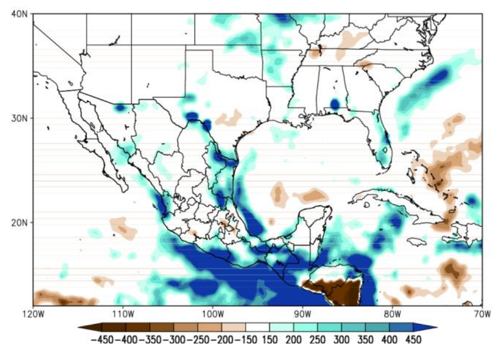

Figure 4. Precipitation differences (mm) between the summer climatology (1979-2009) and the year of 2008

Years with no TCs landfalling over northeastern Mexico happen to be dry years, with negative precipitation anomalies during the summer rainy season.

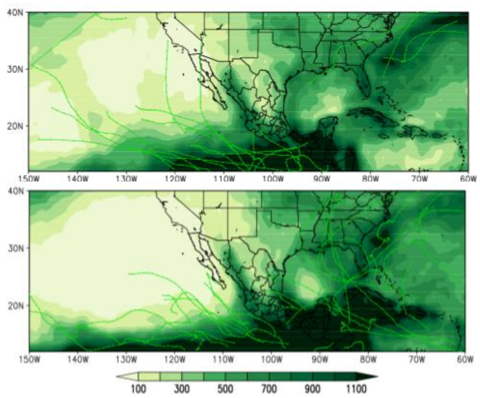

Figure 5. Summer rainfall and the tropical cyclone activity during 1997(El Niño) and 2005 (the most active year)

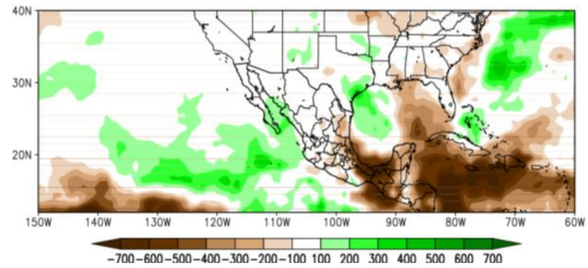

Figure 6. Precipitation differences between the summer rainfall of 1997 and 2005

In addition to the existence or absence of TC landfalling, the TC may enhance subsidence and moisture divergence, depending on the TC. The *subsidence* is shown in brown color in the figure 5. This effect is not large, compared to the amount of precipitation in a region, but acts to produce negative precipitation anomalies even when a TC passes nearby to a coastal region (Fig. 5). So that, TCs not only produce heavy rainfall, they cause a drying effect in surroundings regions by means the divergence of moisture.

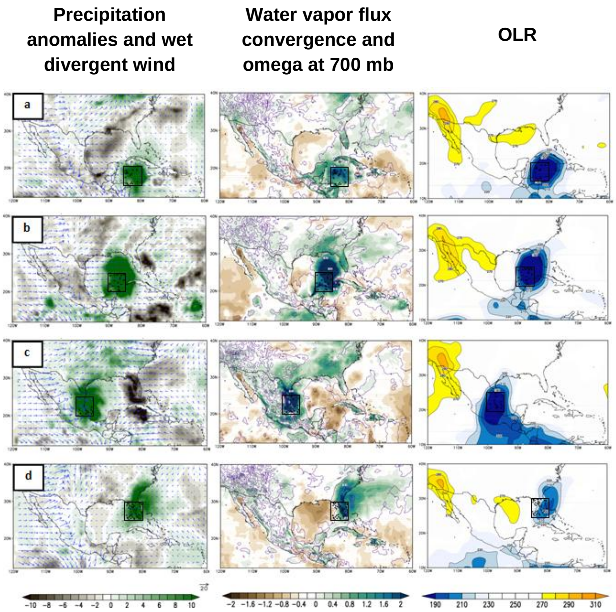

Figure 5. Precipitation anomalies and wet divergent wind at 850 mb, water vapor flux convergence and omega at 700 mb, OLR in the grid a)15º-20ºN,80º-85ºW b)20º-25ºN, 90º-85ºW, c) 20-25º,100º-95ºW, d)25º-30ºN,85º-80ºW

4. CONCLUSIONS

TCs contribution to seasonal precipitation in Mexico varies from one cluster to another; its contribution is ±25% of summer rainfall in regions where precipitation no exceeds more than 400 mm. TCs circulation plays two roles: the moistening and drying effect a Mexican region that depend on both, distance of the system to Mexico and intensity.

The relevance of the analyses is focused on seasonal climate forecasts that should take account which track are more likely to occur and their contribution to the summer rainfall.

5. REFERENCES

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