

# Correlation between U.S. Gulf Coast Hurricanes and Sea Surface Temperature (SST) in the Caribbean Sea

Dongmei Pan and C. Vipulanandan, PhD., P. E.  
Texas Hurricane Center for Innovative Technology (THC-IT)  
Department of Civil and Environmental Engineering  
University of Houston, Houston, TX 77204-4003  
Tel: 713-743-4291; email: [dpan3@uh.edu](mailto:dpan3@uh.edu)

**Abstract:** The relationship between monthly mean sea surface temperature (SST) and hurricanes from the Caribbean Sea was investigated for past 63 year. It was determined that monthly SSTs in the Caribbean Sea was about 26 deg C. It's higher than the Gulf Mexico (GOM) throughout the year. There were 46 hurricanes during the period of 1948-2010 in the U.S. Gulf Coast and 16 hurricanes, over 30%, originated from the Caribbean Sea. Because of high SST compare to GOM, the hurricanes originated from the Caribbean Sea were of higher category. Also higher SST in the Caribbean Sea didn't result in higher number of hurricanes in the U.S. Gulf Coast.

## 1. Introduction

Studies have found significant correlations between Atlantic hurricane activity and SST in the Gulf of Mexico, the Caribbean Sea, and the tropical and subtropical North Atlantic Ocean (Chiodi&Harrison, 2008). Hurricanes can only form in extensive ocean areas with a surface temperature greater than 26.5 deg C. This is because the warm ocean water provides sensible heat and water vapor that fuels the intense convection of a hurricane, and assists the conversion of a cold-core tropical depression to a warm-core cyclone. One of the remarkable relationships of tropical cyclone climatology is the existence of a threshold sea-surface temperature below which tropical cyclones do not form. The most favorable regions according to the sea temperature criterion include the northwest Atlantic (including the Gulf of Mexico) and the northwest Pacific. Although it was easy to understand a positive correlation of sea-surface temperature with tropical cyclone formation, it is not at all obvious why there should be such a sharp cutoff in formation at 26.5 deg C. Because of the exponential variation of saturation vapor pressure with temperature, there is a rapid increase of saturation specific humidity and equivalent potential temperature with temperature at a constant relative humidity. It is not surprising, therefore, that oceans with temperatures of 30 deg C should produce more tropical cyclones than with 28 deg C ([http://www.newmediastudio.org/DataDiscovery/Hurr\\_ED\\_Center/Hurr\\_Structure\\_Energetics/SST/SST.html](http://www.newmediastudio.org/DataDiscovery/Hurr_ED_Center/Hurr_Structure_Energetics/SST/SST.html)).

## 2. Objectives

The objective of this study was to investigate the relationship between monthly mean of SST in the Caribbean Sea (1948-2010) and the hurricanes which originated number and intensity and landed in the Gulf of Coast in the U.S.

## 3. Temperature Analyses

The data of hurricane, monthly mean of SST in Caribbean Sea from 1948 to 2010 were collected from NOAA (<http://www.noaa.gov/>) and analyzed to determine the correlation between hurricanes and SSTs. From Figure 1(a), in 63 years, 16 hurricanes originate from Caribbean Sea reached Gulf Coast in the U.S. 35% (6 of 16) of hurricanes which originate from Caribbean Sea reached the category 1 in this region. Based on the previous results of THC-IT (Figure 1(b)), U.S Gulf Coast was struck in the past 161 years more often by hurricanes originating from the Caribbean Sea, and half of these hurricanes were category 3 or higher. But half of hurricane which reached Texas came from Gulf of Mexico and most of these hurricanes were category 1 or 2. High SSTs just reflect that more energy can stimulate a storm to become a hurricane, with higher intensity. At the same time, the cooler temperatures in the GOM apparently explains why lower intensity hurricane originated from there. Minimum and maximum mean monthly of SSTs for Caribbean sea are shown in Figure 2. Also, the percentages of hurricane making landfall in every month of

hurricane season were shown. In whole year, the SST reached the highest in May. Mean of SST of five months (from March to July) is excess to 26.5 deg C. But no hurricane made landfall in four of five months and only 18.8% of hurricanes struck GOM in July. Rest of the hurricanes (about 81.2%) (month of August through October) were produced even when the SST was below 26.5 deg C.

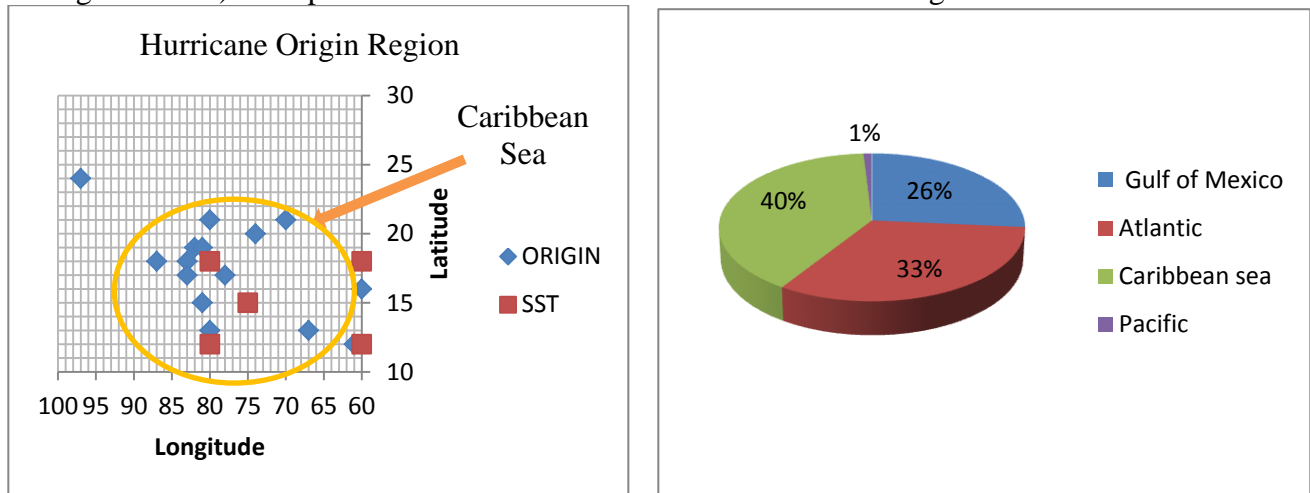


Figure 1 Hurricane origin from Caribbean sea and struck GOM (a) 1948-2010 (number) (b) 1851-2010(percentage)

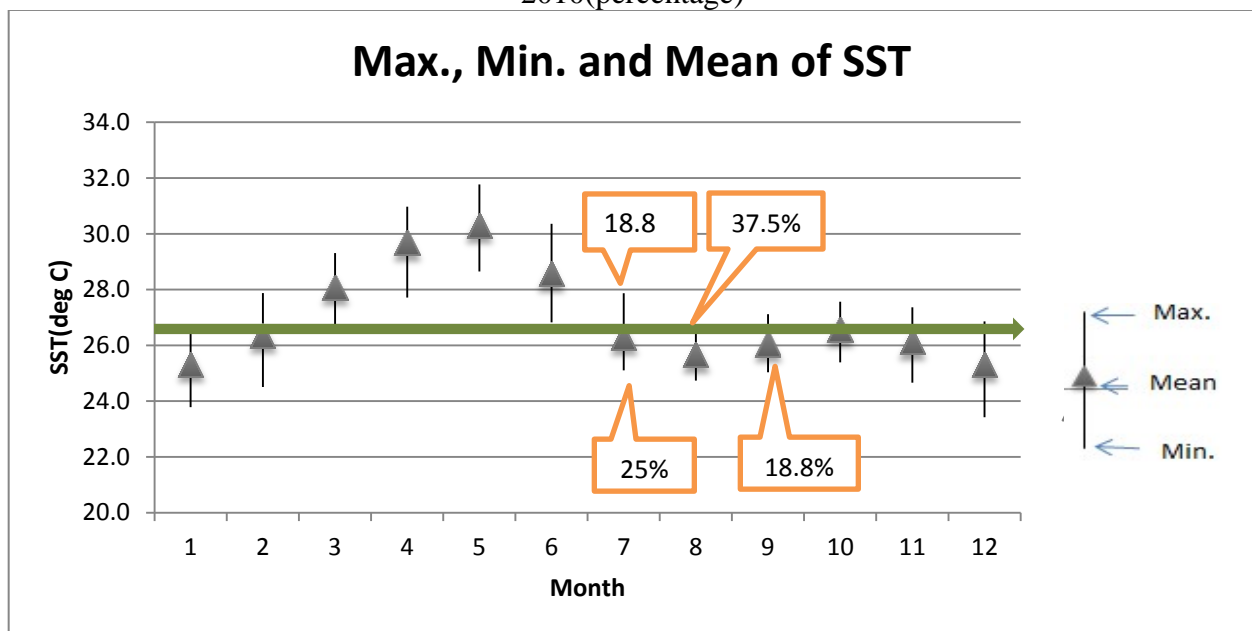


Figure 2 SST ( °C) and percentage of hurricanes came from Caribbean Sea and reached the U.S Gulf Coast in every month

#### 4. Conclusion

High SSTs in Caribbean Sea resulted higher intensely hurricane originating from the Caribbean Sea. The cooler temperatures of the GOM explain well that low level hurricane happened in high frequency in this region.

#### 5. Acknowledge

The study was supported by the THC-IT (<http://www.egr.uh.edu/hurricane/>) with funding from the industry.

#### 6. Reference

Chiodi, A. M., and Harrison, D. E.,(2008) "Hurricane Alley SST Variability in 2005 and 2006", Journal of Climate, Vol.21, PP.4710-4722