Hurricane Prediction Using the Average Monthly Inland Temperature Trends in Two Cities; Houston and Galveston, Texas

K. Elsayed and C. Vipulanandan, PhD., P.E.
Texas Hurricane Center for Innovative Technology (THC-IT)
Department of Civil and Environmental Engineering
University of Houston, Houston, Texas 77204-4003
E-mail: keelsaye@cougarnet.uh.edu and CVipulanandan@uh.edu; Phone (713)743-4278

Abstract

In this study, the maximum, average, and minimum temperatures of two cities (Houston and Galveston-TX) for two consecutive years after the IKE hurricane event have been investigated. Based on the analyses, it was found that the trend of monthly average temperature for the year 2022 (July 2021 to June 2022) correlates with the IKE hurricane year 2008 (July 2007 to June 2008).

1. Introduction

The Gulf of Mexico in the United States includes several states most importantly Texas, Louisiana, and the west coast of Florida. Hurricanes have become a critical social and economic concern in the United States in recent years due to their short-term and long-term impacts (Ingram et al., 2006). Hurricanes have many effects including deaths, widespread damage, and impacts on the price and availability of oil and gas (Bose, 2010). In September 2008, the IKE hurricane developed from a tropical cyclone on September 1st that affected many areas including southeast Texas (Panda et al., 2019; Blake et al., 2011). It was categorized as a hurricane of category 4 with the highest winds of 145 mph (Masoomi et al., 2019). IKE hurricane caused flooding and significant damage with an estimated cost in U.S. coastal areas of $30 billion (Masoomi et al., 2019).

The effect of the ocean on tropical cyclone genesis and maintenance has been well known for decades. The ocean provides the necessary energy to establish and maintain deep convection (Vembu et al., 2010; Cione et al., 2003). Recent studies have also shown that in some cases, warm upper ocean features can significantly impact tropical cyclone intensity.

2. Objective:

The overall objective was to predict the trend for the average temperature in two cities (Houston and Galveston). The specific objectives of this study are the following:

a) Investigate the monthly average temperature in the Years 2021/2022 (Current year) and 2013/2014 (Non-Hurricane year) with the temperature pattern in the IKE hurricane in 2007/2008 (Reference).

b) Calculate the error values, mean error, and root means square deviation (RMSD) for the temperatures in the Years 2021/2022 (Current year) and 2013/2014 (Non-Hurricane year) with respect to the reference year 2007/2008 (Hurricane year).

3. Temperature Analyses:

Houston and Galveston are located on the Gulf of Mexico off the southeast coast of Texas. These two places are subjected to infrequent intervals of major tropical storms and hurricanes. The temperature data was collected from the National Climate and Data (www. Ncds.noaa.gov) and analyzed to determine the correlation between hurricanes and average, maximum, and minimum temperatures.

Figure 1 shows the Variation of mean, maximum, and minimum temperatures in Houston and Galveston

areas in the current year (July 2021-June 2022) & Hurricane year (July 2007-June 2008), and current year (July 2021-June 202) & Non-Hurricane (July 2013-June 2014). The trend of the temperature during the current year of interest is similar to the previous 2008 hurricane season.
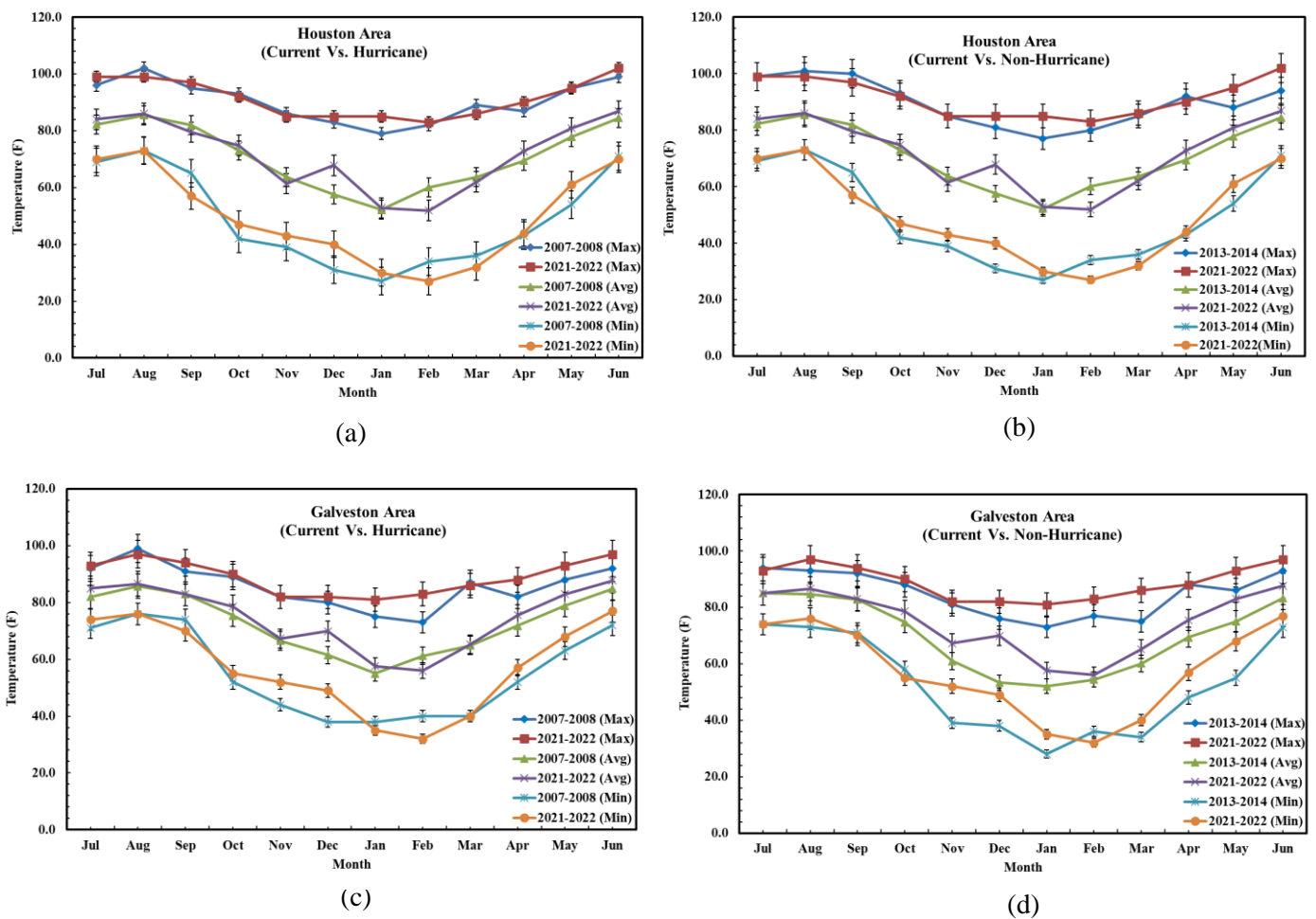

(a)

(b)

(c)

(d)

Figure 1: Variation of mean, maximum, and minimum temperatures (a) Houston area in 2022 & 2008, (b) Houston area in 2022 & 2014, (c) Galveston area in 2022 & 2008, and (d) Galveston area in 2022 and 2014.

Table 1 presents the calculated mean errors, root means square deviations (RMSD) for temperatures in the current year (2022) compared to the non-hurricane year (2014) and the hurricane year (2008). Both the mean error and RMSD of average, maximum, and minimum temperature in the Houston and Galveston areas in the current year (2022) compared to the Hurricane year are less than the current year (2022) compared to the non-Hurricane year (2012). This indicates a higher chance of having a Hurricane in the Houston and Galveston areas this current year.

Table 1: Calculated mean errors, and root means square deviations for temperatures in the current year (2022) compared to the non-Hurricane year (2014) and the Hurricane year (2008) in Houston and Galveston areas.

Area	Error Type	Year	Max Temp.	Avg Temp.	Min Temp.
Houston	Mean Error	2021-2022 Compared to Hurricane year	1.00	0.78	0.83
	RMSD		0.80	1.23	1.47
	Mean Error	2021-2022 Compared to Non-Hurricane year	1.92	3.27	4.42
	RMSD		1.26	1.68	2.03
Galveston	Mean Error	2021-2022 Compared to Hurricane year	3.00	2.05	2.08
	RMSD		1.30	1.07	1.60
	Mean Error	2021-2022 Compared to Non-Hurricane year	4.17	4.97	4.83
	RMSD		1.55	1.89	2.17

4. Conclusions:

Based on the analyses, it has been found that the Houston and Galveston areas have a lower mean error and RMSD of average, maximum, and minimum temperatures in the current year of interest (2022) with the hurricane year (2008) compared to the non-hurricane year 2014. Hence it indicates a better chance of having Hurricane in Houston and Galveston areas.

5. Acknowledgments:

6. References:

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