Predicting Hurricanes by Analyzing the Average Monthly Inland Temperature Trends in Houston, Texas

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Abstract: This study compares the highest, average, and lowest monthly temperatures in Houston, Texas over a year for non-hurricane year and the year of Hurricane IKE in the year 2008. With the analysis, it was observed that the monthly average temperature trend for the period of July 2022 to June 2023, representing the year 2023, is closer to the IKE hurricane year of July 2007 to June 2008 compared to the non-hurricane year of 2014.

1. Introduction:

The Gulf of Mexico in the United States includes five states with 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). Hurricane IKE caused flooding and significant damage with an estimated cost 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 hurricane intensity.

2. Objectives:

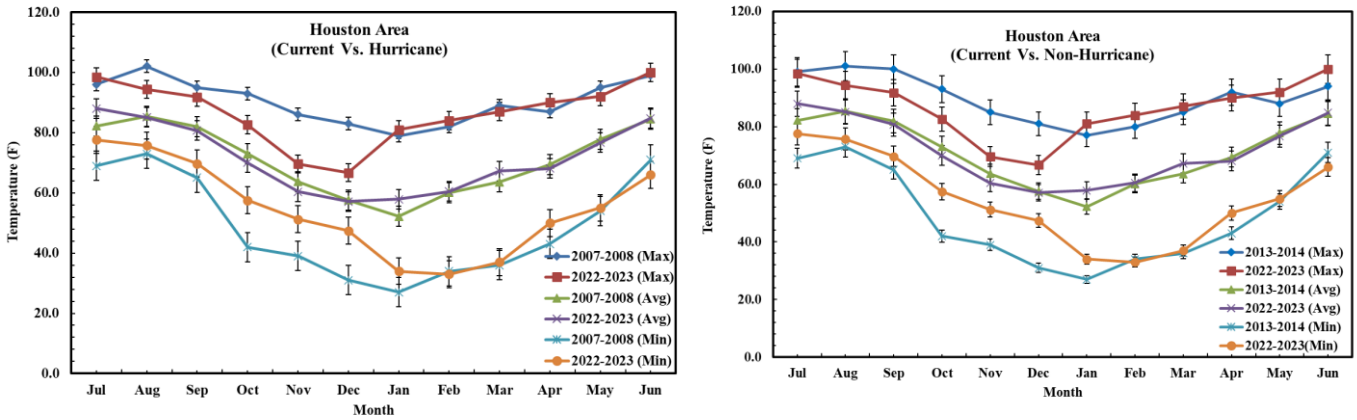
The overall objective of this study was to compare the trend for the average monthly temperature in Houston-Texas. The specific objectives of this study are the following:

a) Investigate the monthly average temperature in the Years 2022/2023 (Current year) and 2013/2014 (Non-Hurricane year) with the temperature pattern in the IKE hurricane in 2007/2008 (Reference).
b) Compare the mean temperature difference, and root means square difference (RMSD) for the the Year 2022/2023 (Current year) to 2013/2014 (Non-Hurricane year) with the hurricane year 2007/2008 (representing Hurricane IKE).

3. Temperature Analyses:

Located on the southeastern coast of Texas, Houston resides along the Gulf of Mexico. This region experiences sporadic occurrences of significant tropical storms and hurricanes. To explore the connection between these weather events and temperature patterns, data was gathered from the National Climate and Data (www.ncds.noaa.gov) and meticulously analyzed. This study aims to establish correlations between hurricanes and the average, maximum, and minimum temperatures.

Figure 1 illustrates the fluctuation of average, maximum, and minimum temperatures in the Houston area for various time periods. These include the current year (July 2022-June 2023) compared to both the hurricane year (July 2007-June 2008) and the non-hurricane year (July 2013-June 2014). Furthermore, the temperature trend observed during the current year aligns closely with that of the previous 2008 hurricane season.



(a) (b)

Figure 1. Variation of mean, maximum, and minimum temperatures (a) Houston area in 2023 & 2008, and (b) Houston area in 2023 & 2014.

Table 1 showcases the computed mean errors and root mean square deviations (RMSD) for temperatures in the present year (2023) when compared to both the non-hurricane year (2014) and the hurricane year (2008). In terms of the average, maximum, and minimum temperatures in the Houston area, both the mean error and RMSD in the current year (2023) relative to the hurricane year are lower than those in the current year (2023) relative to the non-hurricane year (2012). This suggests a higher likelihood of a hurricane occurring in the Houston area during the present year.

Table 1: Calculated mean difference and root mean square difference for temperatures in the current year (2023) compared to the non-Hurricane year (2014) and the Hurricane year (2008) in Houston and area.

Area	Difference	Year	Max Temp. (°F)	Avg Temp. (°F)	Min Temp. (°F)
Houston	Mean	2022-2023 Compared to Hurricane year	4.03	0.42	5.84
	RMSD		2.28	0.85	2.48
	Mean	2022-2023 Compared to Non-Hurricane year	3.12	2.91	9.43
	RMSD		2.29	1.31	3.17
Remark			The non-Hurricane year is closed	The Hurricane year is closed	The Hurricane year is closed

4. Conclusions:

Based on the analyses, it was observed that in Houston, the maximum temperature difference was lower with the non-hurricane year 2014 indicating no hurricane for the year 2023. But the average temperature and minimum temperature differences were close to the hurricane year 2008 indicating the possibility of a hurricane in year 2023.

5. Acknowledgments:

This study was supported by the Texas Hurricane Center for Innovative Technology (THC-IT), University of Houston, Houston.

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