

Analysis of Inland Relative Humidity Data to Predict the Hurricane in Houston and Galveston Area in Year 2023

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1. Abstract

It is important to predict the possibility of hurricane in the Galveston-Houston area in the year 2023. In this study on relative humidity (RH) was used as a parameter for the current year (2022-2023), a hurricane IKE year (2007-2008), and a non-hurricane year (2014-2015) to predict the possibility of hurricane for the year 2023. Based on the analyses, root mean square (RMSD) and the average difference values were larger between current year and the non-hurricane (2014-2015) year compared to the current year and hurricane year (2007-2008).

2. Introduction

Hurricane prediction is carried out by many organizations in each year (Mayooran and Vipulanandan 2017). The National Hurricane Center (NHC-NOAA) uses data from the satellites, ships, radar, and reconnaissance aircraft to forecast the hurricane probability (URI 2020).

Hurricane development requires high humidity value. High relative humidity values from the surface to mid-level atmosphere has influence in hurricane formation in 2 ways. First, dry air causes evaporation of liquid water and it reduces the warm core structure of the hurricane. Second dry air in the mid-levels can create trade wind inversion. Inversion layer act as a barrier to upward movement of air. (WeatherGov 2022).

In a study by Hill and Lackmann (2009) it was concluded that the tropical cyclone size is related to the extent and intensity of spiral bands, which are related to the Environmental humidity (Hill and Lackmann 2009). High intensity of the Tropical cyclone has high relative humidity than lower intensity cyclone (Wu, et al. 2012).

3. Objective

The objective was to investigate the monthly variation of relative humidity (RH) to predict the possibility of hurricane in year 2023 in the Houston and Galveston, Texas.

4 Methods

Monthly Maximum, Mean and Minimum Relative Humidity (%) values were collected for 3 selected for the following years.

- 2007-2008 – Ike hurricane year
- 2014-2015 – Non-hurricane year
- 2022-2023 – Current year

Monthly average of maximum RH, monthly average of average RH and monthly average of minimum RH were calculated using the collected data (Weather Underground; Inc 2023).

Data collected in 2 locations, George Bush Intercontinental Airport Station and Galveston. Statistical tools: Total Difference, Average Difference and Relative Mean Square Deviation (RMSD) were used to analyze the data. Data collected by a commercial organization, **Weather Underground Inc** was used in this study.

The monthly values were obtained using the daily values (y_i). Maximum, mean and minimum values over the month (N) as follows.

$$Y = \sum y_i / N$$

5 Results

5.1 Comparison of the maximum/month, mean/month and minimum/month in George Bush Intercontinental Airport and Galveston

The comparison of the maximum/month, the mean/month, and the minimum/month of year 2007-2008, 2014-2015 and 2022-2023 of relative humidity in George Bush Intercontinental Airport, Houston is shown in Figure 1.

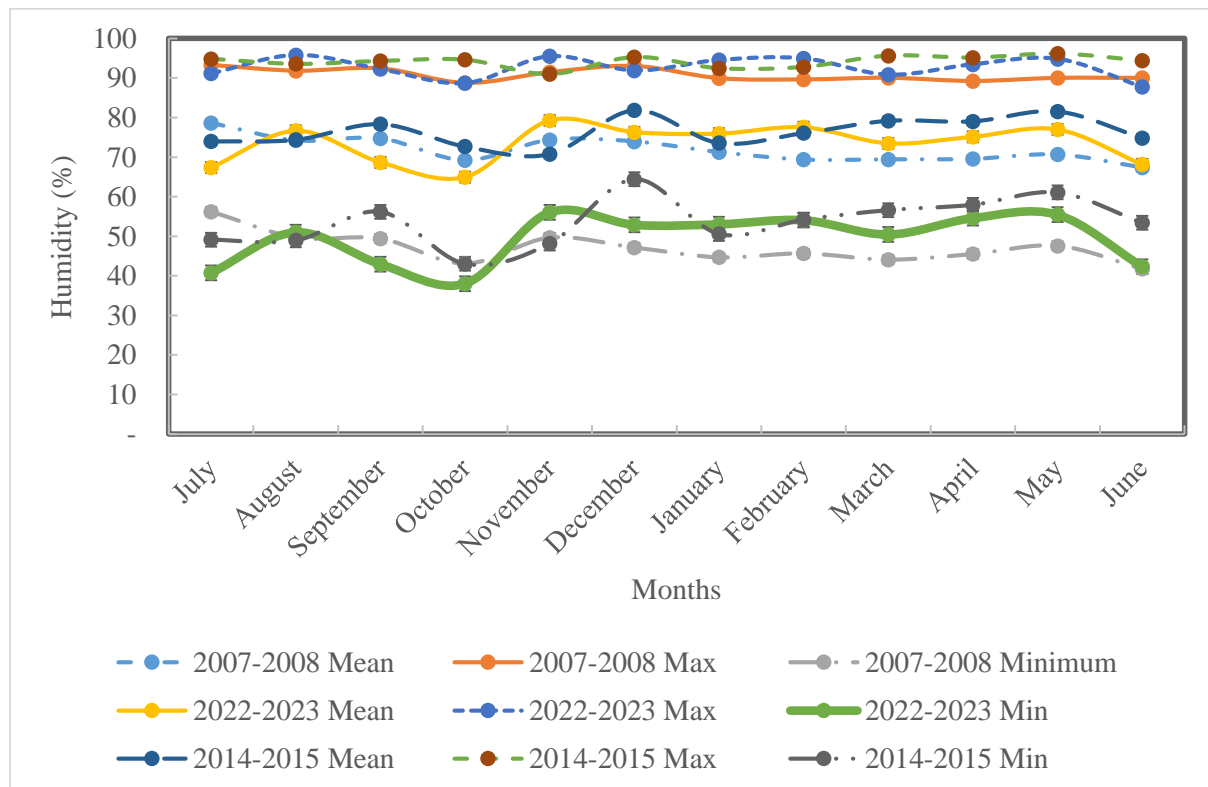


Figure 1. Comparison of the monthly maximum, mean and minimum RH of year 2007-2008, 2014-2015 and 2022-2023 in Houston

The comparison of the maximum/month, and minimum/month of year 2007-2008, 2014-2015 and 2022-2023 of relative humidity in Galveston is shown in Figure 2. The comparison of the mean/month of year 2007-2008, 2014-2015 and 2022-2023 of relative humidity in Galveston is shown in Figure 3.



Figure 2. Comparison of the monthly maximum and of minimum RH of year 2007-2008, 2014-2015 and 2022-2023 in Galveston

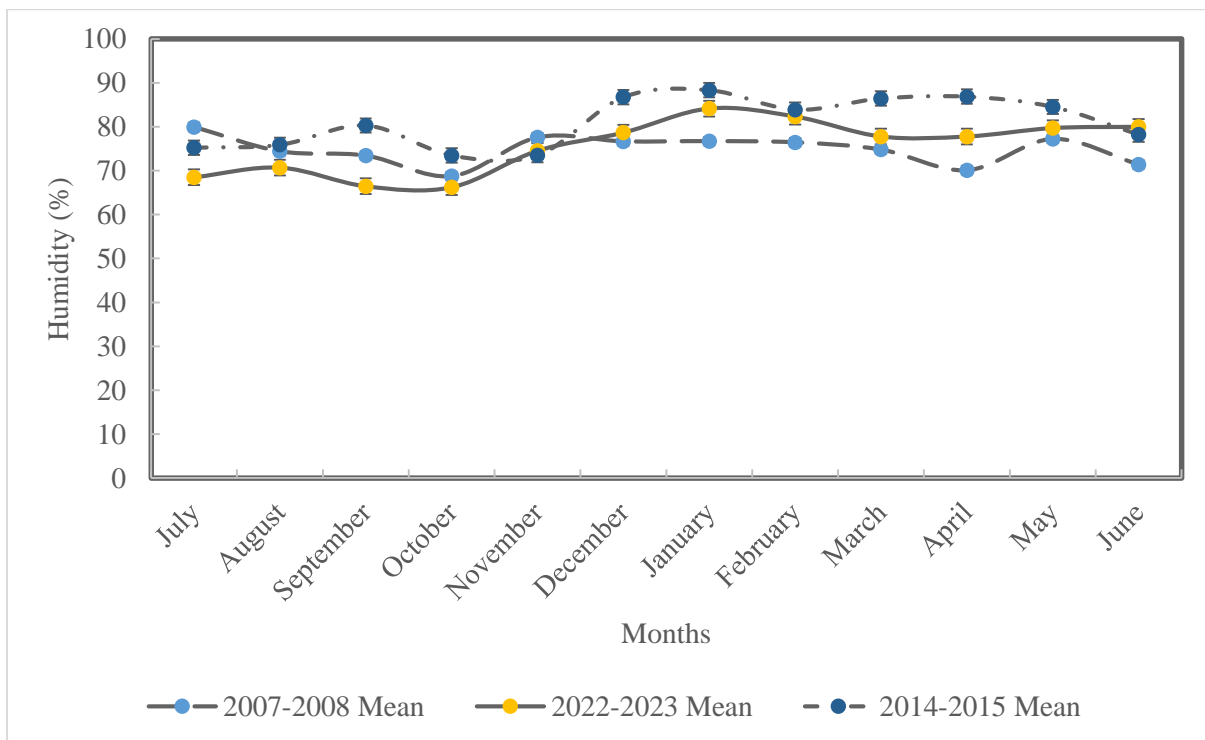


Figure 3. Comparison of the monthly mean RH of year 2007-2008, 2014-2015 and 2022-2023 in Galveston

5.2 Comparison of Sum of Difference and RMSD between current and hurricane year, non-hurricane and hurricane year, current and non-hurricane year based on monthly maximum, mean and minimum Relative Humidity in George Bush Intercontinental Airport Houston, and Galveston

The summary of sum of difference and RMSD values between current and hurricane year, current and non-hurricane year, non-hurricane and hurricane year based monthly maximum RH, mean RH, and minimum RH in George Bush Intercontinental Airport are shown in Table 1.

Table 1. Summary of Sum of differences and RMSD values in George Bush Intercontinental Airport, Houston

Current year and Hurricane year						
Sum of Differences			RMSD (%)			Remarks
Maximum	Mean	Minimum	Maximum	Mean	Minimum	
22.17	17.62	27.14	3.34	5.72	7.68	Monthly Minimum RH has highest sum of Difference value and RMSD
Current year and Non-hurricane year						
Sum of Differences			RMSD (%)			Remarks
Maximum	Mean	Minimum	Maximum	Mean	Minimum	
-18.53	-35.78	-52.17	3.76	6.40	7.53	Monthly Minimum RH has highest sum of Difference value and RMSD
Non-Hurricane year and Hurricane year						
Sum of Differences			RMSD (%)			Remarks
Maximum	Mean	Minimum	Maximum	Mean	Minimum	
40.71	53.41	79.31	3.39	6.65	9.73	Monthly Minimum RH has highest sum of Difference value and RMSD

The summary of sum of difference and RMSD values between current and hurricane year, current and non-hurricane year, non-hurricane and hurricane year based on monthly maximum RH, mean RH, and minimum RH in Galveston are shown in Table 2.

Table 2: Summary of Sum of differences and RMSD values in Galveston

Current year and Hurricane year						
Sum of Differences			RMSD (%)			Remarks
Maximum	Mean	Minimum	Maximum	Mean	Minimum	
-5.87	9.07	11.75	5.60	6.12	6.63	Monthly Minimum RH has highest sum of Difference value and RMSD
Current year and Non-hurricane year						
Sum of Differences			RMSD (%)			Remarks
Maximum	Mean	Minimum	Maximum	Mean	Minimum	
-57.99	-66.76	-76.56	6.62	7.00	7.47	Monthly Minimum RH has highest sum of Difference value and RMSD
Non-Hurricane year and Hurricane year						
Sum of Differences			RMSD (%)			Remarks
Maximum	Mean	Minimum	Maximum	Mean	Minimum	
52.12	75.84	88.31	4.34	8.74	10.41	Monthly Minimum RH has highest sum of Difference value and RMSD

6 Conclusion

Based on the study the following conclusions are made:

- The sum of the difference values between current year and hurricane year of Houston and Galveston ranged between 17.62 to 27.14 and 9.07 to 11.75, respectively.
- The sum of the difference values between the current year and non-hurricane year of Houston and Galveston ranged between -18.53 to -52.17 and -57.99 to -76.56, respectively.
- The largest sum of the differences was observed between the current year and non-hurricane year for Houston and Galveston.
- RMSD values of current year and hurricane year of Houston and Galveston ranged between 3.35-7.69 and 5.60-6.64 respectively.
- RMSD values of current year and non-hurricane year of Houston and Galveston ranged between 3.76-7.53 and 6.62-7.47, respectively.
- The largest RMSD values were observed between the current year and non-hurricane year for Houston and Galveston.

- The current year relative humidity values were closer to hurricane year value than non-hurricane year.

7 Acknowledgement

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8 References

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