

## **Analysis of Inland Relative Humidity Data to Predict the Hurricane in Houston and Galveston Area in Year 2022**

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### **1. Abstract**

It is important to predict the possibility of hurricane in the Galveston-Houston area in year 2022. Here in this study on relative humidity (RH) of current year (2021-2022), a hurricane IKE year (2007-2008), and a non-hurricane year (2014-2015) to predict the possibility of hurricane for the year 2022. From the study the RMSD and Average error values are larger between current year and a non-hurricane (2014-2015) year than current year and hurricane year (2007-2008).

### **2. Introduction**

Hurricane prediction is carried out by many organizations in each year. The National Hurricane Center use data from satellite, 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 (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 & 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 2022.

### **4 Materials and Methods**

Daily Maximum, Mean and Minimum Relative Humidity (%) values were collected for 3 years.

- 2007-2008 – Ike hurricane year
- 2014-2015 – Non-hurricane year
- 2021-2022 – Current year

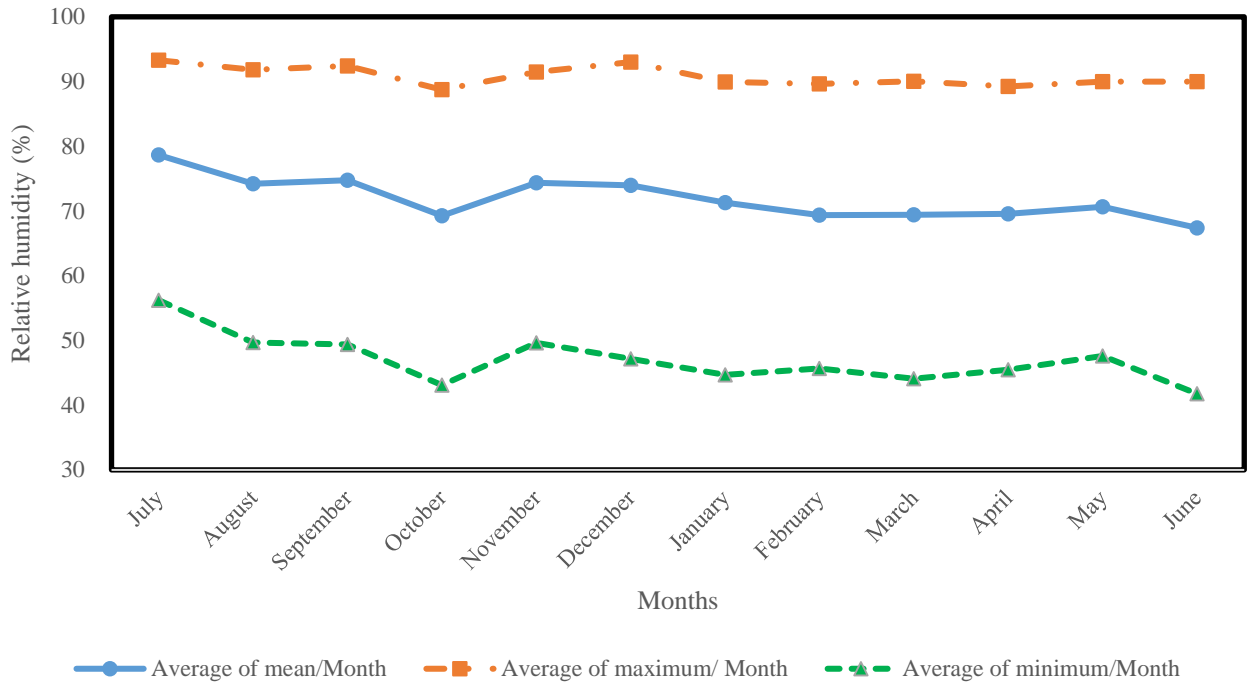
Monthly average of maximum RH, monthly average of average RH and monthly average of minimum RH were calculated using the collected data.

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

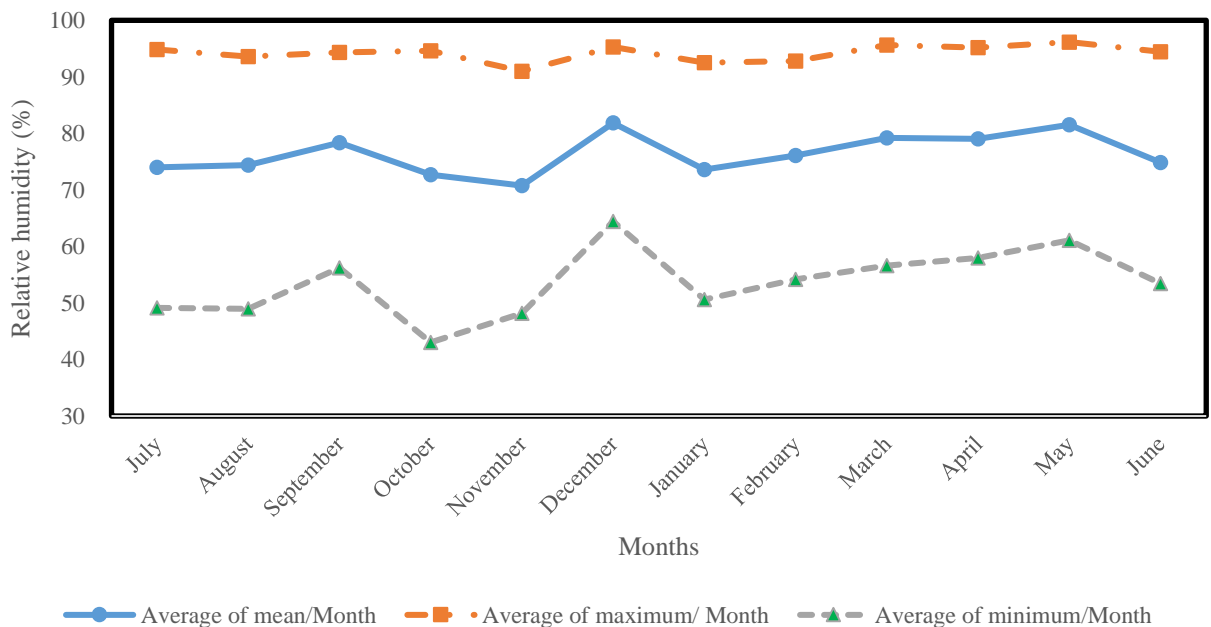
### **5 Results**

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

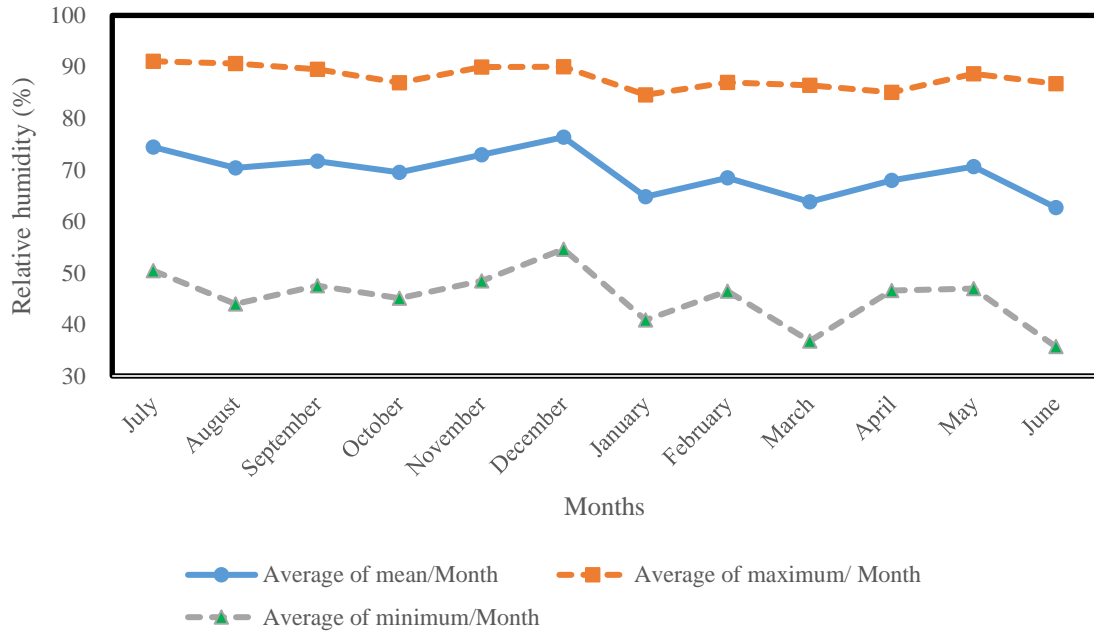
The comparison of average of maximum/month, average of mean/month and average of minimum/month of year 2007-2008, 2014-2015 and 2021-2022 of relative humidity in George Bush Intercontinental Airport, Houston are shown in Figure 1-3.



**Figure 1 Comparison of average of maximum/month, average of mean/month and average of minimum/month of year 2007-2008 in Houston**

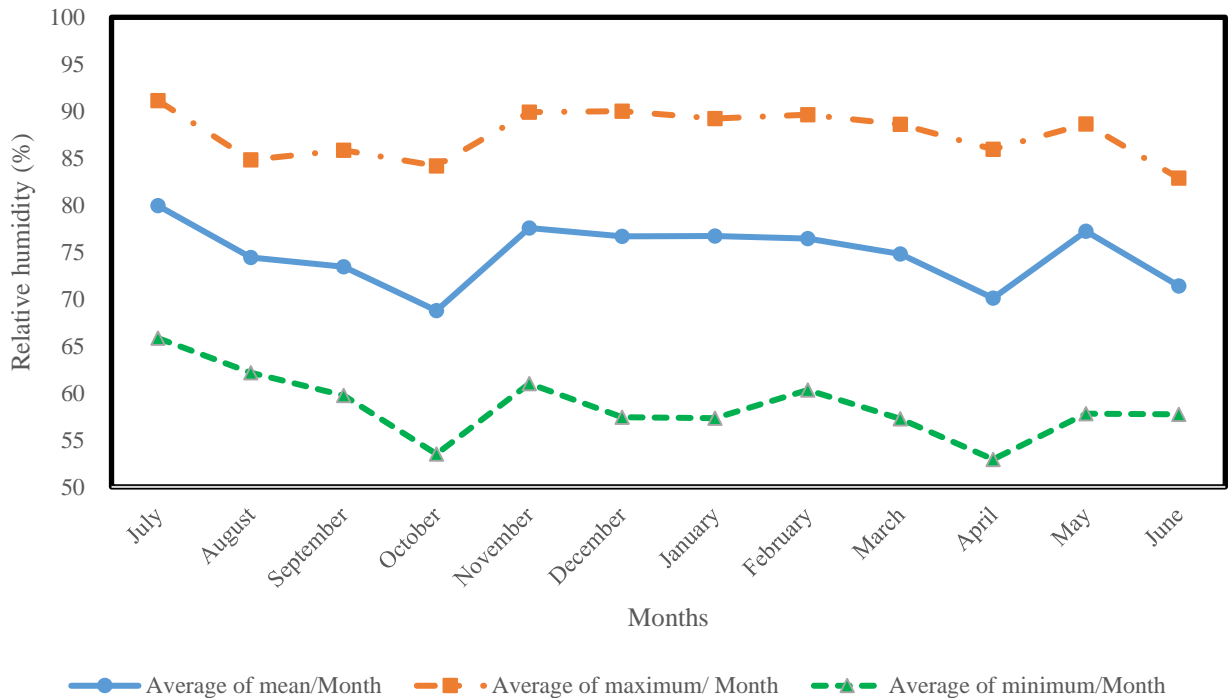


**Figure 2 Comparison of average of maximum/month, average of mean/month and average of minimum/month of year 2014-2015 in Houston**

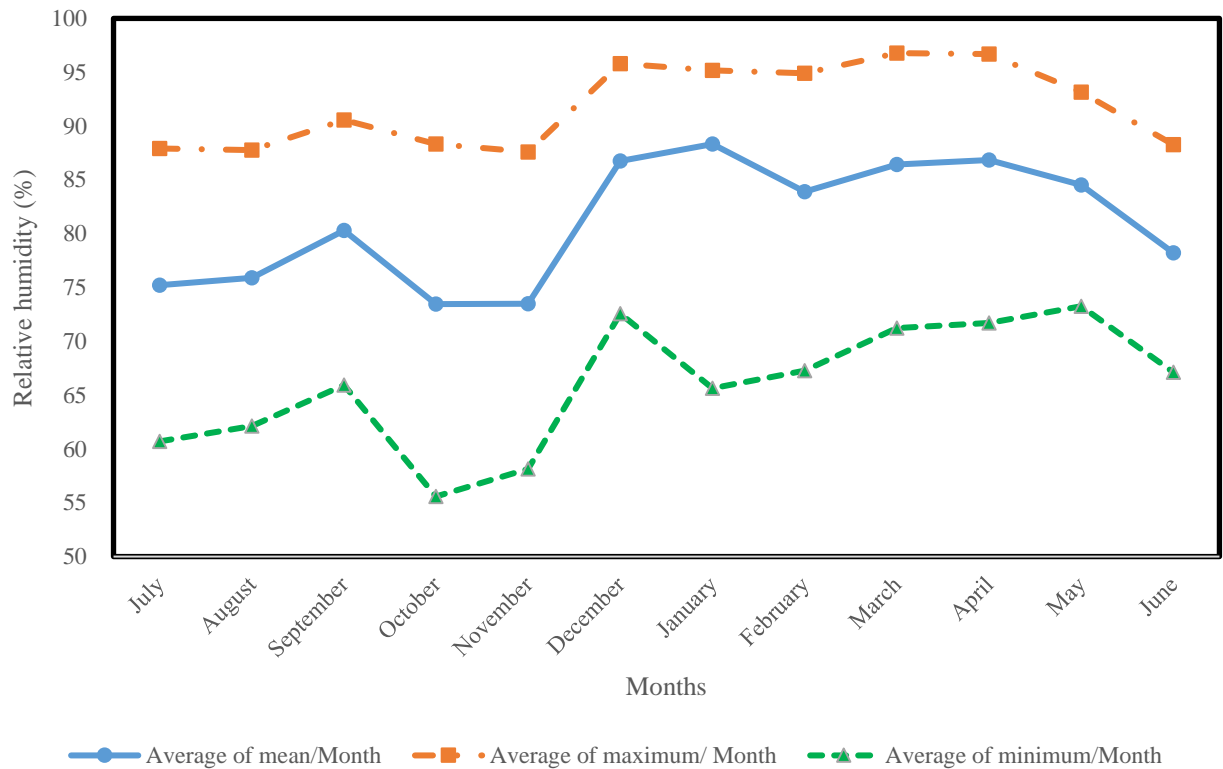


**Figure 3 Comparison of average of maximum/month, average of mean/month and average of minimum/month of year 2021-2022 in Houston**

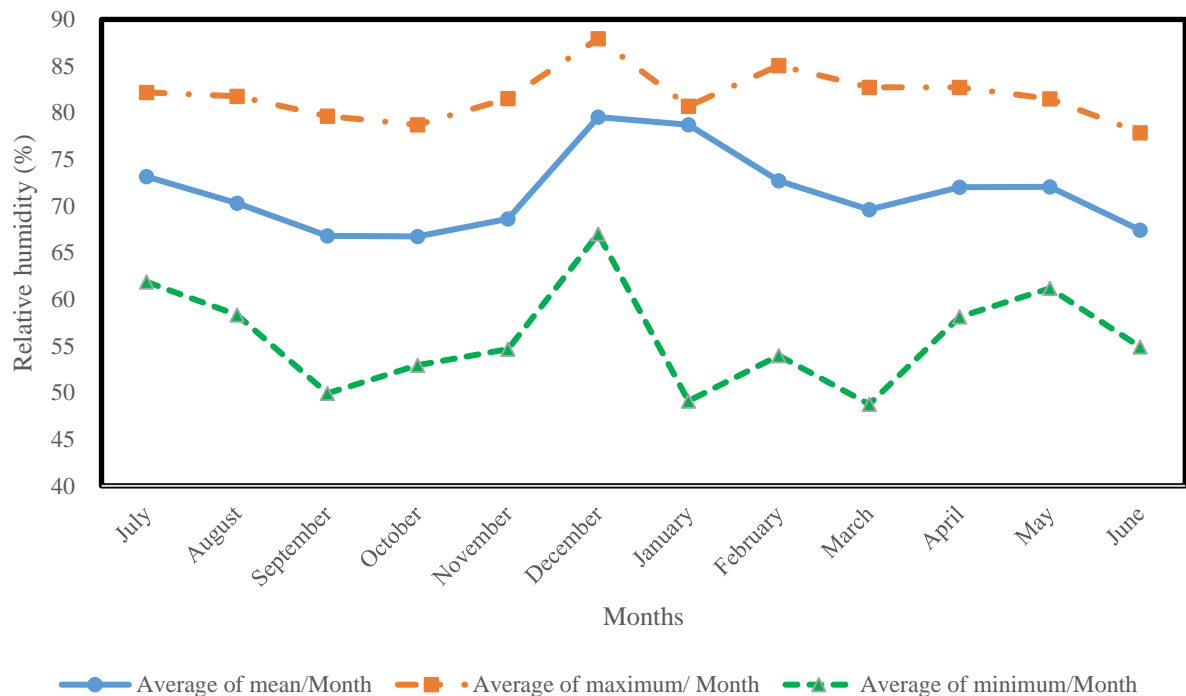
The comparison of average of maximum/month, average of mean/month and average of minimum/month of year 2007-2008, 2014-2015 and 2021-2022 of relative humidity in Galveston are shown in Figure 4-6.



**Figure 4 Comparison of average of maximum/month, average of mean/month and average of minimum/month of year 2007-2008 in Galveston**



**Figure 5 Comparison of average of maximum/month, average of mean/month and average of minimum/month of year 2014-2015 in Galveston**

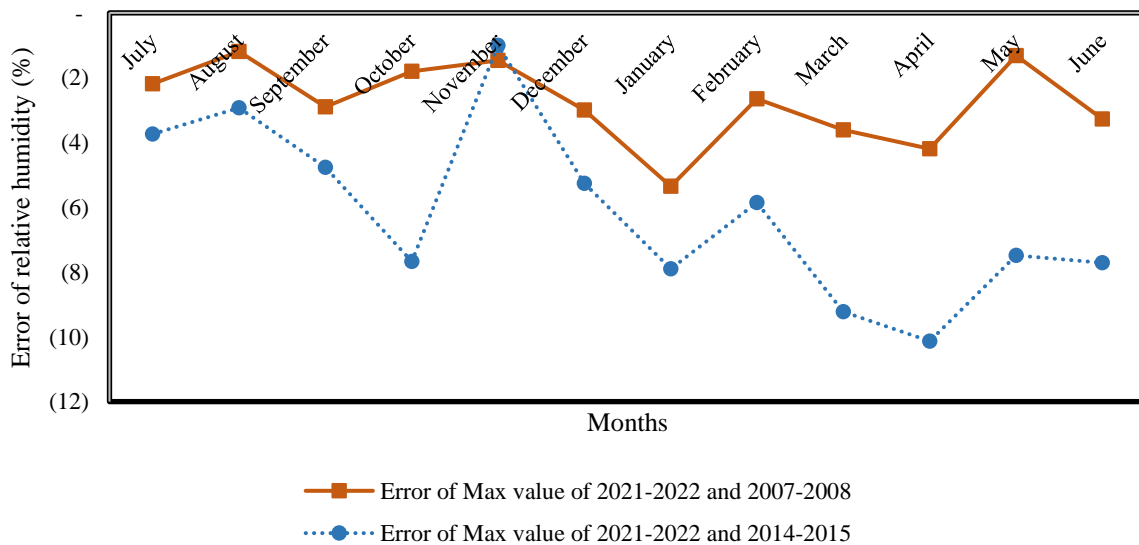


**Figure 6 Comparison of average of maximum/month, average of mean/month and average of minimum/month of year 2021-2022 in Galveston**

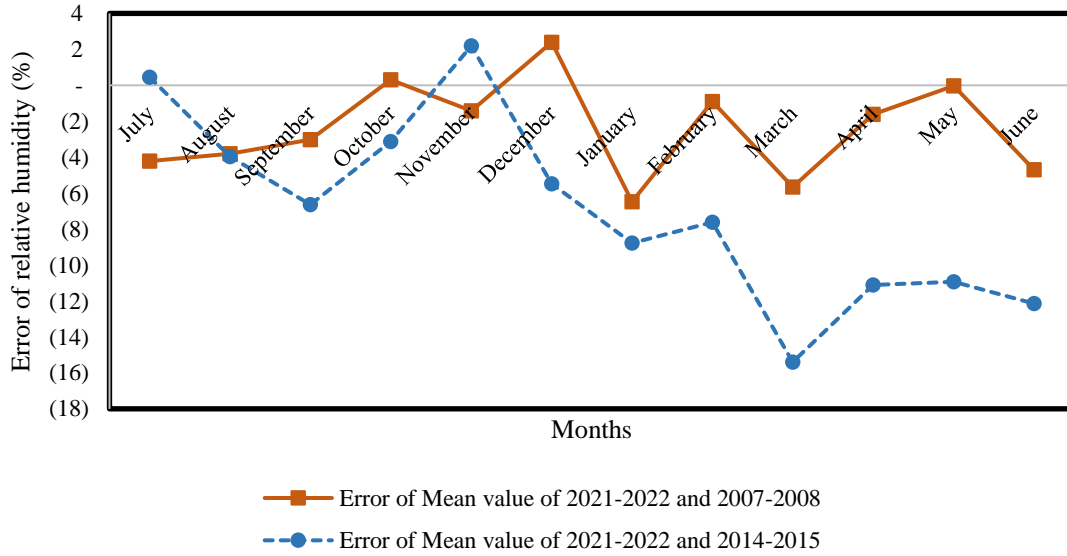
**5.2 Comparison of Average of Error Between current and hurricane year, non-hurricane and hurricane year, current and non-hurricane year based on average of daily mean, average of daily maximum and average of daily minimum Relative Humidity in George Bush Intercontinental Airport and Galveston**

The Average of Error Between current and hurricane year, current and non-hurricane year based on average of mean/month, average of maximum/month and average of minimum/month relative humidity in George Bush Intercontinental Airport, Houston are shown in Figure 7-9. Based on Figure 7, for 11 months error of maximum relative humidity between 2021-2022 and 2007-2008 are lesser than error of relative humidity between 2021-2022 and 2014-2015 in Houston. As per Figure 8, for 9 months error of mean relative humidity between 2021-2022 and 2007-2008 are lesser than error of relative humidity between 2021-2022 and 2014-2015 in Houston. From Figure 9 for 9 months error of minimum relative humidity between 2021-2022 and 2007-2008 are lesser than error of relative humidity between 2021-2022 and 2014-2015 in Houston.

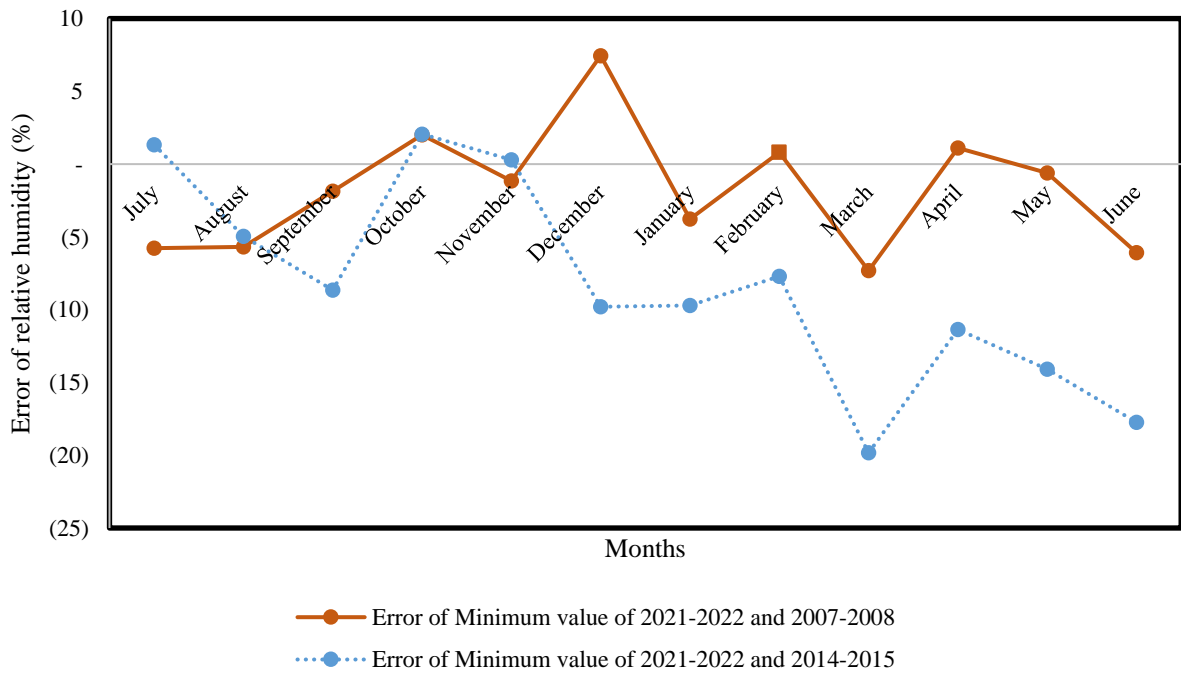
Based on Figure 10, for 10 months error of maximum relative humidity between 2021-2022 and 2007-2008 are lesser than error of relative humidity between 2021-2022 and 2014-2015 in Galveston. As per Figure 11, for 10 months error of mean relative humidity between 2021-2022 and 2007-2008 are lesser than error of relative humidity between 2021-2022 and 2014-2015 in Galveston. From Figure 12 for 9 months error of minimum relative humidity between 2021-2022 and 2007-2008 are lesser than error of relative humidity between 2021-2022 and 2014-2015 in Galveston.



**Figure 7 Average of Error Between current and hurricane year and current and non-hurricane year based on average of maximum/month relative humidity year in Houston**

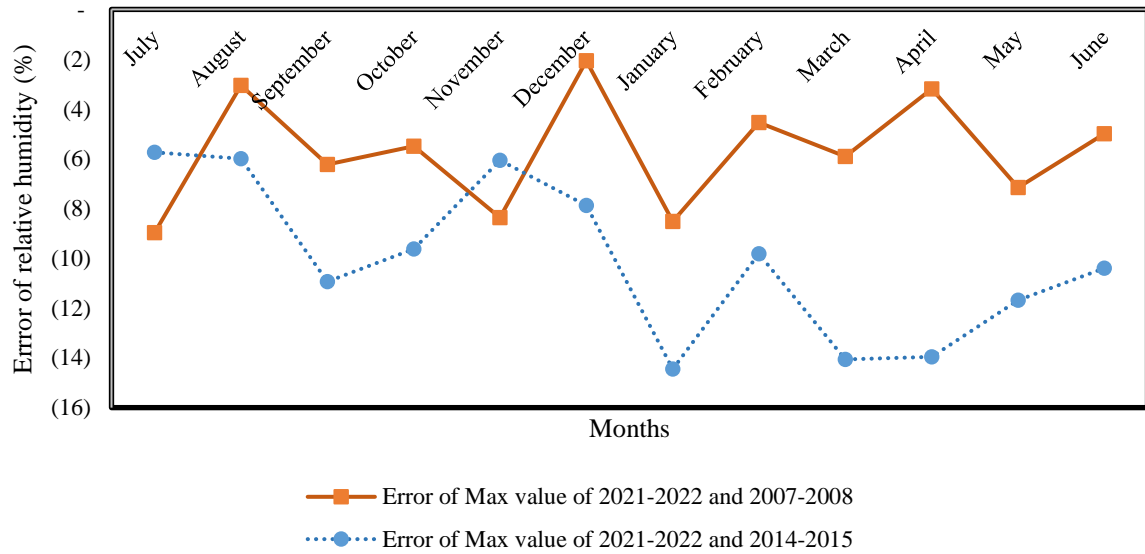


**Figure 8 Average of Error Between current and hurricane year and current and non-hurricane year based on average of mean/month relative humidity year in Houston**

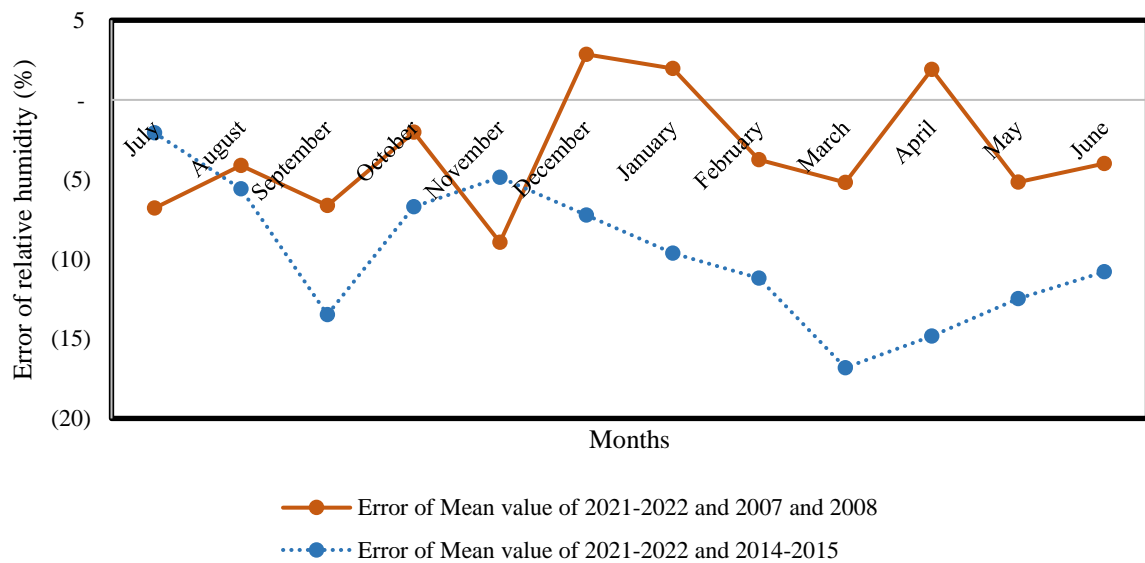


**Figure 9 Average of Error Between current and hurricane year and current and non-hurricane year based on average of minimum/month relative humidity year in Houston**

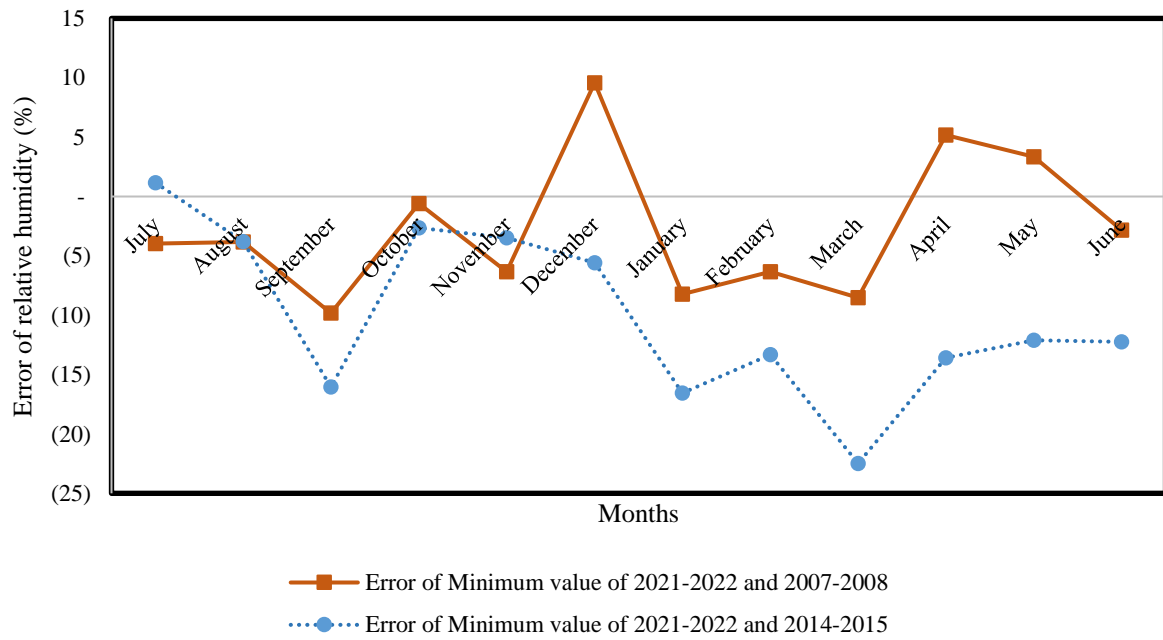
The Average of Error Between current and hurricane year, current and non-hurricane year based on average of mean/month, average of maximum/month and average of minimum/month relative humidity in George Bush Intercontinental Airport, Houston are shown in Figure 10-12



**Figure 10 Average of Error Between current and hurricane year and current and non-hurricane year based on average of maximum/month relative humidity year in Galveston**



**Figure 11 Average of Error Between current and hurricane year and current and non-hurricane year based on average of mean/month relative humidity year in Galveston**



**Figure 12 Average of Error Between current and hurricane year and current and non-hurricane year based on average of minimum/month relative humidity year in Galveston**

The summary of sum of error, average of Error and RMSD values between current and hurricane year, current and non-hurricane year based on average of maximum RH/monthly, average of mean RH/monthly, and average of minimum RH/monthly in George Bush Intercontinental Airport is shown in Table 1.

**Table 1: Summary of Sum of error, Average of Error and RMSD values in George Bush Intercontinental Airport, Houston**

	Monthly Average of Maximum RH	Monthly Average of Mean RH	Monthly average of Minimum RH	Remarks
Sum of error between current and hurricane year values	-32.98	-29.14	-20.91	Monthly average of Maximum has RH has highest sum of Error value
Average of error between current and hurricane Year	-2.75	-2.43	-1.74	Monthly average of Maximum has RH has highest average of Error value
RMSD between current year and hurricane Year	3.00	3.52	4.44	Monthly average of Minimum RH has highest RMSD
Sum of error between current and non-hurricane year values	-73.69	-82.55	-100.22	Monthly average of Minimum has RH has highest sum of Error value
Average of error between current and non-hurricane Year	-6.14	-6.88	-8.35	Monthly average of Minimum has RH has highest average of Error value



RMSD between current year and non-hurricane Year	6.66	8.80	10.77	Monthly average of Minimum RH has highest RMSD
Remarks	Sum of error, average of error, RMSD of current year and non-hurricane year have higher values than current year and hurricane year for average maximum, mean and minimum RH			

The summary of sum of error, average of Error and RMSD values between current and hurricane year, current and non-hurricane year based on average of maximum RH/monthly, average of mean RH/monthly, and average of minimum RH/monthly in Galveston is shown in Table 2.

**Table 2: Summary of Sum of error, Average of Error and RMSD values in Galveston**

	Monthly Average of Mean values	Monthly Average of Maximum Values	Monthly average of Minimum values	Remarks
Sum of error between current and hurricane year values	-39.88	-68.50	-32.35	Monthly average of Mean has RH has highest sum of Error value
Average of error between current and hurricane year	-3.32	-5.71	-2.70	Monthly average of Mean has RH has highest sum of Error value
RMSD between current year and hurricane year	4.92	6.11	6.36	Monthly average of Minimum has RH has highest sum of Error value
Sum of error between current and non-hurricane year values	-115.71	-120.62	-120.66	Monthly average of Minimum has RH has highest sum of Error value
Average of error between current and non-hurricane year	-9.64	-10.05	-10.05	Monthly average of Minimum has RH has highest sum of Error value
RMSD between current year and non-hurricane year	10.53	10.50	12.11	Monthly average of Minimum has RH has highest sum of Error value
Remarks	Sum of Error, average of error, RMSD of current year and non-hurricane year have higher values than current year and hurricane year for average of maximum, mean and minimum RH			

## 6 Conclusion

Based on the study the following conclusion are made:

- The average error values between current year and hurricane year of Houston and Galveston ranged between -0.58 to -2.75 and -2.7 to -5.71, respectively.
- The average error values between current year and non-hurricane year of Houston and Galveston ranged between -6.14 to -8.35 and -9.64 to -10.05, respectively
- The largest error values are observed between current year and non-hurricane year for Houston and Galveston.
- RMSD values of current year and hurricane year of Houston and Galveston ranged between 3.0 -5.41 and 4.92- 6.36 respectively.
- RMSD values of current year and non-hurricane year of Houston and Galveston ranged between 6.66 -10.77 and 10.5- 12.11, respectively.
- The largest RMSD values are observed between current year and non-hurricane year for Houston and Galveston.
- The current year relative humidity values are closer to hurricane year value than non-hurricane year.

## 7 Acknowledgement

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