

Statistical Predication of Hurricane Occurrence at Three Different Cities on Gulf of Mexico Using Maximum and Minimum Temperatures

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Abstract: In this study, the maximum and minimum temperatures of three different cities (Galveston-TX, New Orleans-LA, and Tampa-FL) for three consecutive years before Hurricane events in each city have been studied using different statistical methods. Furthermore, the maximum and minimum temperatures for the past three years in each city have been studied as well. Based on the overall evaluation of statistical methods, Galveston-TX has the lowest chance of hurricane in 2014 compared to New Orleans-LA and Tampa-FL.

1. Introduction

Hurricanes are tropical cyclones with sustained winds of at least (119 km/h, 74 mph) (noaa.gov). On an average, more than 5 tropical cyclones become hurricanes in the United States each year causing great human and economic losses. All current estimation techniques begin with historical compilations of hurricane tracks and intensities, such as the so-called “best track” data compilations maintained by forecasting operations such as the National Oceanic and Atmospheric Administration’s (NOAA’s) Tropical Prediction Center (TPC) and the U.S. Navy’s Joint Typhoon Warning Center (JTWC). The screening-multiple linear regression statistical method has been used first by Veigas et al. (1959) for Hurricane forecasting problem analysis. In addition, analyses of global surface air temperature and sea surface temperature has been studied by many researchers (Hansen et al., 1999 and Smith and Reynolds, 2004). Most of the previous works has used either a single statistical method or the studied area was limited to one location. It is a point of interest to compare several powerful statistical methods for Hurricane predication in different cities using maximum and minimum recorded temperatures.

2. Objectives

The objective of this study was to predict the Hurricane occurrence probability in three different cities (Galveston-TX, New Orleans-LA, and Tampa-FL) on Gulf of Mexico using different statistical methods (regression analysis, error estimation analysis, classical statistical analysis, and cumulative probability function).

3. Model

The following mathematical model has been used to predict the maximum and minimum temperature for time period of three years before the hurricane event in each city and for the past three years:

$$y - y_o = A * Sin(B(t - t_o)) \dots \dots \dots (1)$$

Where: A and B are model parameters, y_o = initial correction factor for average temperature, and t_o = initial correction factor for the time.

4. Methods of Analysis

- (1) Regression Analysis: It used R^2 (coefficient of correlation) as an evaluating parameter.
- (2) Error Estimation Analysis: It used RSME (root square mean error) as an evaluating parameter.
- (3) Classical Statistical Analysis: It used mean as an evaluating parameter. Cumulative Probability
- (4) Function: It used (T at P_{50}) and (P_{90} - P_{50}) as an evaluating criteria.

5. Results

In the following Tables 1 and 2 the analysis of the statistical results of the maximum and minimum temperature for the three years before hurricane event in each city and for the last three years can be seen, respectively.

Table 1 Statistical Analysis of the Data for Three Years before the Hurricane Event in Each City.

Location		Regression Analysis		Error Estimation Analysis		Classical Statistical Analysis		Cumulative Probability Function			Overall Evaluation	
		R ²	r ₁ Rank	RSME	r ₂ Rank	Mean of T	r ₃ Rank	T at P ₅₀	P ₉₀ -P ₅₀	r ₄ Rank	r _g gross rank	E
Galveston, TX	Max.	0.62	3	22.4	3	1.0156	2	1.0232	0.0698	3	11	3
	Min.	0.51	3	13.6	3	0.9799	2	0.9837	0.2212	1	9	2
New Orleans, LA	Max.	0.98	2	4.6	2	0.9565	3	0.9980	0.0215	2	9	2
	Min.	0.79	2	7.03	2	1.0810	3	1.0289	0.3216	2	9	2
Tampa, FL	Max.	0.99	1	2.6	1	0.9935	1	0.9973	0.0323	1	4	1
	Min.	0.83	1	5.8	1	0.9871	1	0.9702	0.2299	3	6	1

Table 2 Statistical Analysis of the Data for the Past Three Years Each City.

Location		Regression Analysis		Error Estimation Analysis		Statistical Analysis		Cumulative Probability Function			Overall Evaluation	
		R ²	r ₁ Rank	RSME	r ₂ Rank	Mean of T	r ₃ Rank	T at P ₅₀	P ₉₀ -P ₅₀	r ₄ Rank	r _g gross rank	E
Galveston, TX	Max.	0.96	3	6.9	3	1.0225	3	1.0329	0.0778	3	12	3
	Min.	0.86	1	5.7	2	0.9839	2	0.9820	0.2029	2	7	2
New Orleans, LA	Max.	0.98	2	4.5	2	0.9994	1	0.9968	0.0795	2	7	2
	Min.	0.83	3	6.4	3	1.0815	3	1.0616	0.2258	3	12	3
Tampa, FL	Max.	0.99	1	2.6	1	0.9966	2	0.9979	0.0419	1	5	1
	Min.	0.84	2	5.4	1	1.0003	1	0.9824	0.2141	1	5	1

6. Conclusions

From the statistical analysis of the data for the maximum and minimum temperature of the three studied cities and based on the overall evaluation, the chances for hurricane occurrence in Galveston, TX in 2014 is the lowest compared to New Orleans, LA and Tampa, FL.

7. Acknowledgement

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8. References

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