Annual Daily Temperature Prediction using the ANN with and without Hurricane.

G P Panda, and C. Vipulanandan[1], Ph.D., P.E.
Texas Hurricane Center for Innovative Technology
Department of Civil and Environmental Engineering
University of Houston, Houston, Texas 77204-4003
E-mail:gppanda@uh.edu,cvipulanandan@uh.edu Phone: (713) 743-4278

Abstract: Using ANN tool, daily temperature was modeled for the year 2016-17(Aug-July), 2017-18(Aug-July) and 2018-19(Aug-July). The observed trends with the actual occurrence of a hurricane in 2017 can serve as a template to predict future hurricanes.

1. Introduction

ANN is a branch of Artificial Intelligence which was developed in the 1950s in order to imitate the biological structure of the human brain. The ANN models work like a black box without requiring the detailed information of a system. Instead of requiring this information, they learn the relation between the input parameters and the controlled and uncontrolled variables by studying the previously recorded data like non-linear regression. One more advantage of using ANNs is the capability of managing large and complex systems with a vast number of interrelated parameters.

In 1991, Cooke and Wolfe used a neural network to predict the temperature. To predict massive consecutive rainfall estimation, Scofield presented an ANN technique in 1994. Michaelides et al. (1995) compared the performance of ANN with multiple linear regressions in estimating missing rainfall data over Cyprus. Kalogirou et al. (1997) applied a neural network to predict the rainfall over the time series in Cyprus. In a fitting problem, a neural network to map between a set of numeric inputs and a set of numeric targets is created. The Neural Fitting app helps us to select data, create and train the network, and evaluate its performance using mean square error and regression analysis.

2. **Objective**. Evaluate the prediction of annual daily temperaure variation with and without hurricane using with using the artificial neural network.

3. Methods-

The methodology includes the initial step of data mining. Temperature data is collected from different meteorological websites. The neural network is based on time as one input and temperature as the output. The variances in temperature are studied for the whole year, and trends observed in it is used to predict the hurricane.

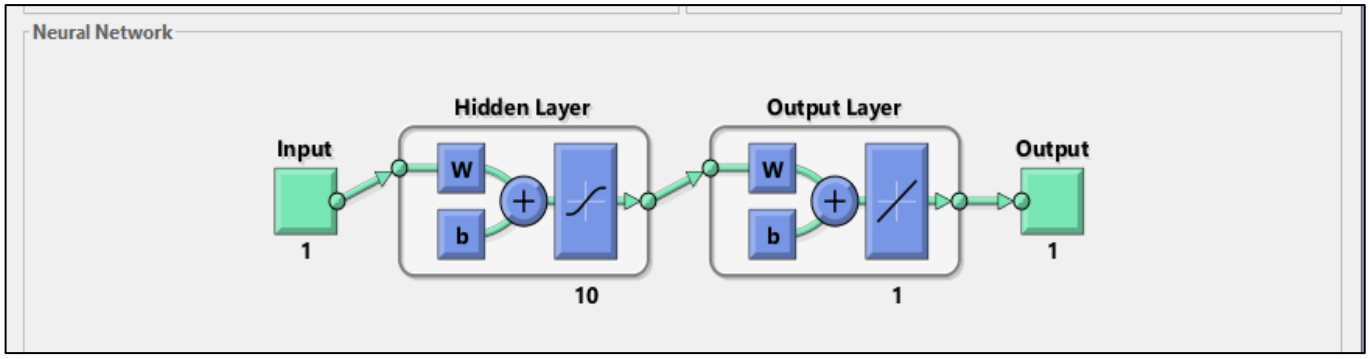

Figure 1 –Representative image of neural network used for study

Temperature data is collected for the year 2016-2017(Aug-July),2017-2018(Aug-July) and 2019(Aug-July). In parameters, time is given as input, and the temperature is provided as the output. Using ANN tool, 70% of data were trained,15% were used for validation, and 15% were used for prediction. Several combinations were tried to optimize the R^2, the optimized combination for year 2016-2017 were followed

for modelling other years.

Table 1**: Coefficient of correlation values for different for different hidden layers.**

Hidden Layers	Training	Validation	Testing	Combined
1	.45	.49	.39	.44
4	.80	.82	.81	.81
7	.83	.76	.81	.82
10	.81	.86	.81	.82
15	.83	.83	.84	.83

Although the network with 10 hidden layers showed higher R value of .83,we chooses hidden layers of 10 to perform the modeling as it showed the highest validation R value of 0.86.

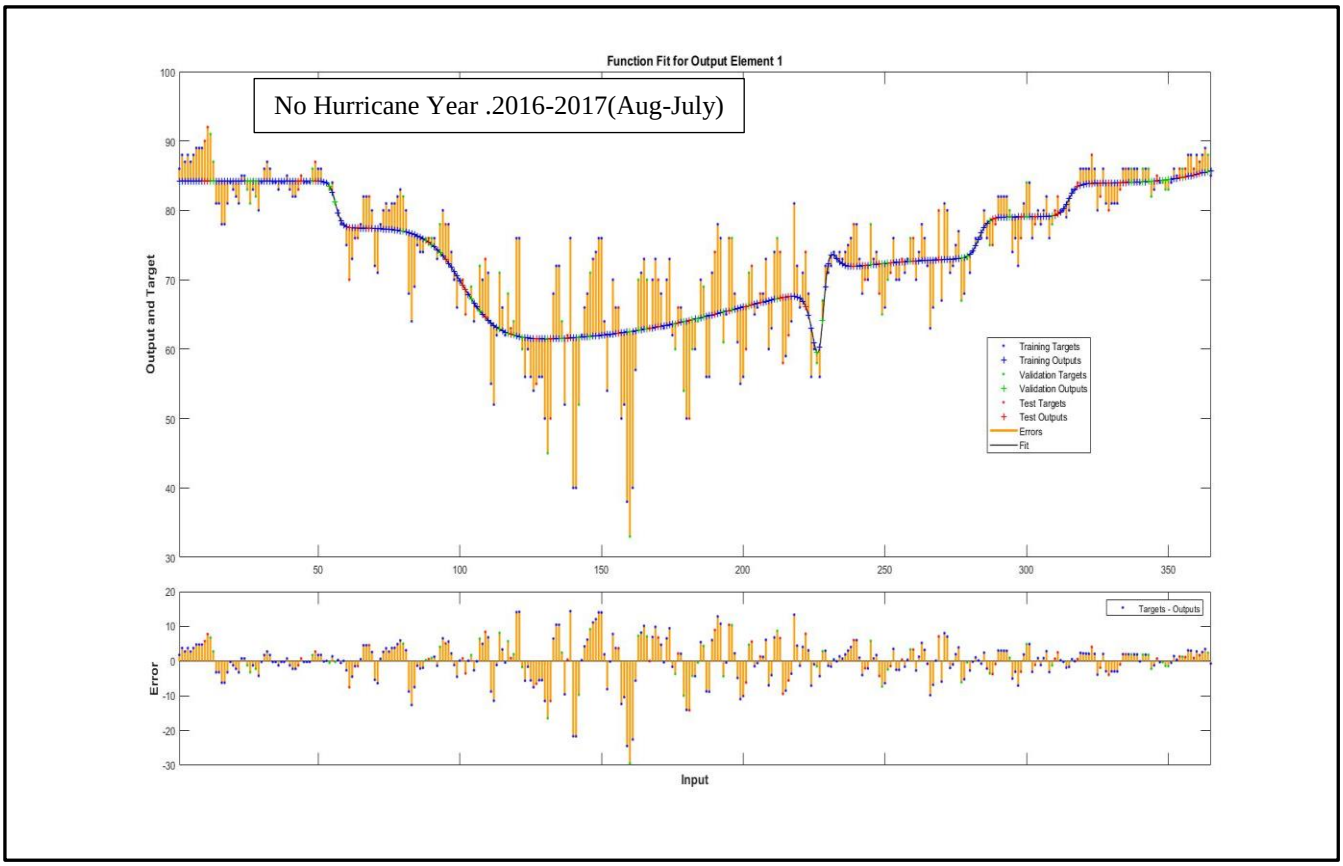

Figure 2: Temperature Data for 2016-2017(Aug-July).

Temperature data for the year 2016-2017(Aug-July) were modelled based on the ANN,it can be observed that wide fluctuation were observed in predicted and modelled data in winter. Higher average temperature was observed in winter for the year 2016-2017(Aug-July).Based on the optimized model for the year 2016-2017(Aug-July), other years were modeled.

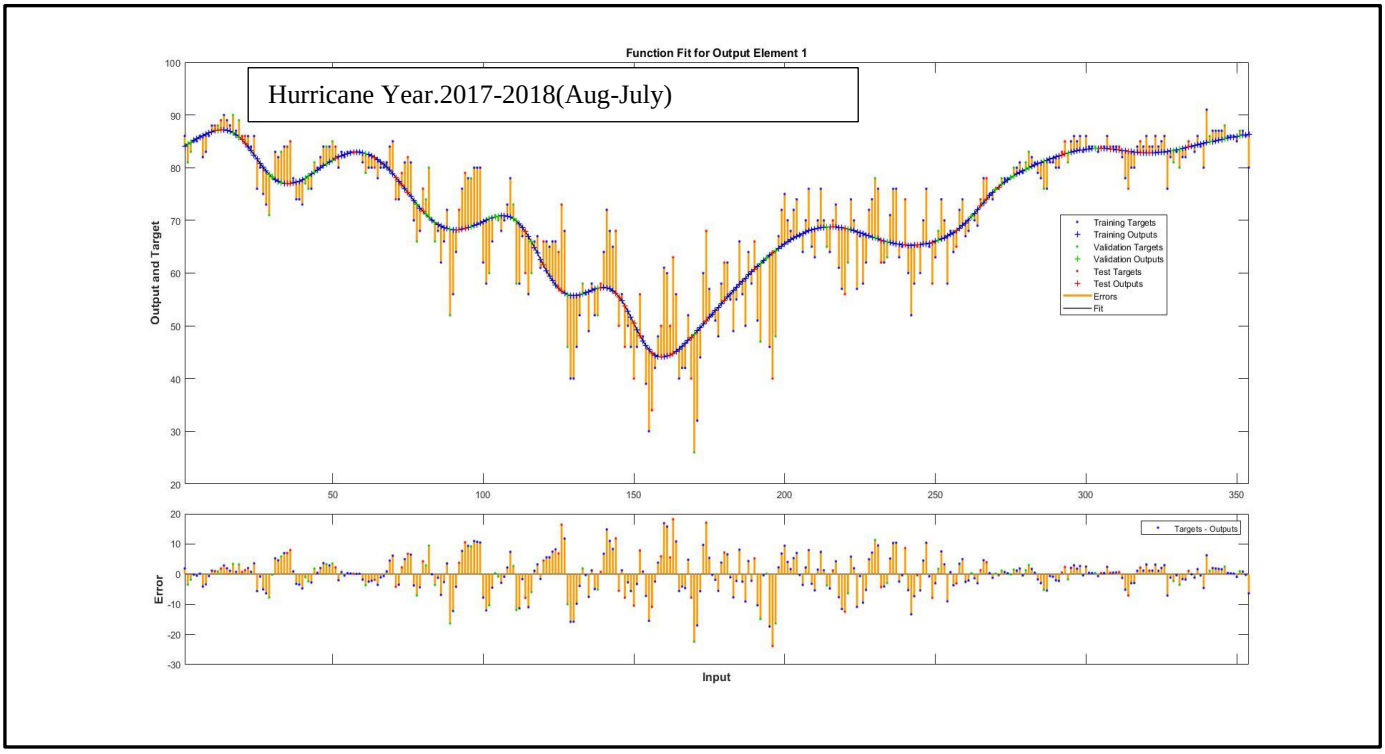

Figure 3-Temperature Data for 2017-2018(Aug-July).

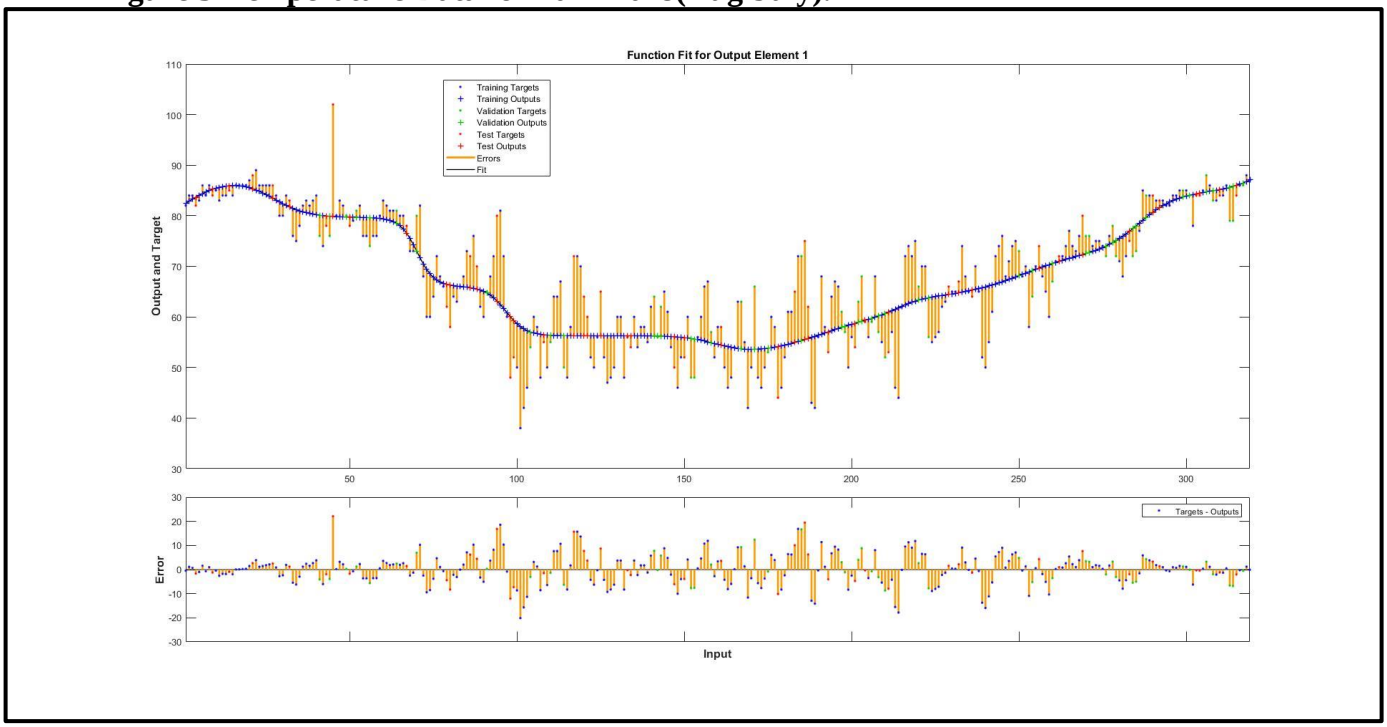

Figure 4-Temperature Data for 2018-2019(Aug-July).

The temperature trends are observed for 2016-2017(Aug-July), 2017-2018(Aug-July) and 2018-2019(Aug-July). Variation of temperature throughout the year does provide insight for predicting hurricane. For the year 2016-2017, the average temperature in winter was between 60-70 Fahrenheit and wide fluctuation is observed in daily temperatures. Around 17th, August hurricane is formed, and as a category 4, it hit Houston on 25th, August. In the year 2017-2018(Aug-July), the winter temperature

remained 50-60 Fahrenheit. Sequentially; no hurricane happened last year. Additionally, the average temperature, standard deviation and coefficient of variance for the year 2016-2017(Aug-July),2017-2018(Aug-July) and 2018-2019(Aug-June) is shown.

Table 2: **Mean, Standard Deviation and coefficient of variation for actual temperature for different years**.

	2016-2017(Aug-July)	2017-2018(Aug-July)	2018-2019(Aug-July)
Mean	74.81	71.31	67.97
Standard Deviation	10.47	13.85	14.73
COV	.14	.18	.21

It can be well observed that the average temperature on the non-hurricane year (2016-2017) was higher than the average temperature of hurricane year of 2017-2018(July-Aug). Average temperature for the year 2018-2019 is lower than that of non-hurricane year 2016-2017(July-Aug), as such there is less likelihood of hurricane in this year. Using the ANN model, the temperature was predicted for 2018-2019(Aug-Sept). The average temperature in winter is between (50-60), and the overall temperature trend does exactly follow the trends of the preceding year of 2016-2017. Although the trends do not give a definitive prediction for a hurricane, they give an insight of temperature fluctuations in winter and summer.

5. Conclusion: The temperature predicted for the year 2018-2019(Aug-July) does not follow a similar pattern observed for the year 2016-2017(July-Aug). These trends suggest there is less likelihood of hurricane in the year 2019.

6. Acknowledgments:

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7.References.

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2)Piazza A D,Piazza M C D, Vitale G."*Solar and wind forecasting by NARX neural networks"*