2A.5 FORECASTING SEPTEMBER ATLANTIC BASIN TROPICAL CYCLONE ACTIVITY AT ZERO AND ONE MONTH LEAD TIMES

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1. INTRODUCTION

Although Atlantic basin seasonal hurricane forecasting has undergone much study and predictions have been made over the past nineteen years (Gray 1984), the development of short-term forecasts on monthly and sub-monthly time scales has until recently not been attempted. Shapiro (1987) found that zonal wind anomalies could be utilized to forecast monthly tropical cyclone activity with skill exceeding climatology two months in advance; however, short-term forecasts were never made. Blake (2002) has recently begun issuing forecasts of August tropical cyclone (TC) activity with considerable success. Intraseasonal hurricane prediction is critical because many active seasons have inactive periods and vice versa. For example, 1995 was the most active hurricane season since 1950; however, only two out of the eleven hurricanes that year formed during the climatologically most active hurricane month of September. During 1997, an inactive year, there were only seven named storms, three hurricanes and one intense hurricane. Four of the named storms formed during July, and only one hurricane formed after 1 August which climatologically accounts for over 90 percent of the season. September was chosen as the month for forecast development since it accounts for nearly 50 percent of seasonal hurricane activity.

2. DATA

September tropical cyclone activity was calculated utilizing best-track data from the National Hurricane Center, and NCEP/NCAR reanalysis data was used to develop the forecast scheme.

3. METHODOLOGY

Active and inactive Septembers based upon Net Tropical Cyclone (NTC) activity (Gray et al. 1994), an overall measure of the first six TC parameters listed in Table 2, have been composited to portray differences in global patterns between years of varying NTC activity. Linear correlation maps between September NTC and various reanalysis fields such as 200 mb zonal wind, 1000 mb zonal wind and sea level pressure were constructed to find the most useful hindcast signals for forecasting September activity at the end of July and with somewhat increased skill at the end of August. Extensive evaluation of these maps showed several important precursor signals for forecasting September TC activity.

4. RESULTS

Hindcasting results indicate that approximately 40-80 percent of the variance in September TC activity can be forecast by the end of July increasing to 60-80 percent by the end of August. Figure 1 shows the locations of the global parameters used in the end of August forecast for September while Table 1 describes the location of these parameters. The most important predictor based on 51 years of hindcasting is the 1000 mb zonal wind in the tropical and subtropical Atlantic. Weaker trades in the Atlantic indicate reduced tropospheric vertical wind shear and increased likelihood that easterly waves will develop into tropical cyclones. In addition, the stronger easterlies at 1000 mb in the subtropics increases low-level vorticity anomalies which is a necessary ingredient for TC development (Gray 1979). Many of the other parameters selected relate to the condition of ENSO or to large-scale atmospheric patterns such as the PDO (Pacific Decadal Oscillation). Table 2 displays the variance explained for all September TC parameters based on the end of August forecast. Figure 2 shows a plot of the 1 September hindcast versus actual NTC from 1950-2000. The individual-year September variations of tropical cyclone activity are able to be hindcast with surprising skill.

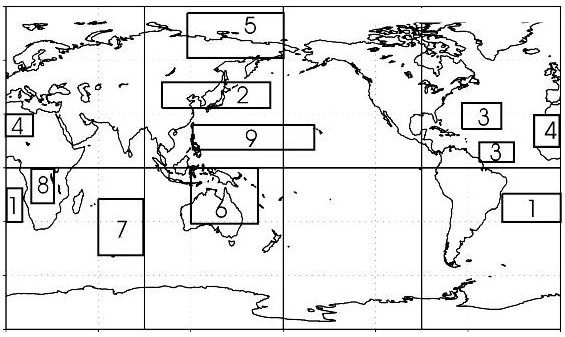

Figure 1: Map of predictors used in the 1 September forecast of September Atlantic basin TC activity.

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Table 1: Description of parameters used in the 1 September forecast.

1 Sep Forecast Parameters	Location
1) April 1000 MB U	(12.5-30S, 40W-10E)
2) July 200 MB Geo Ht.	(32-42N, 100-160E)
3) July-August 1000 MB U	(5-15N, 30-50W) - (22.5-35N, 35-65W)
4) February 1000 MB U	(20-30N, 15W-15E)
5) April 200 MB U	(67.5-85N, 110-180E)
6) August SLP	(0-30S, 120-160E)
7) August SLP	(20-45S, 60-90E)
8) May 200 MB V	(0-20S, 15-30E)
9) January-February 200 MB U	(15-25N, 120E-160W)

Table 2: Variance of September tropical cyclone activity explained by 1 September forecast based on 51 years (1950-2000) of hindcasting.

Forecast Parameter	No of. Predictors	Variance Exp.
1) Named Storms	5	0.45
2) Named Storm Days	5	0.63
3) Hurricanes	4	0.46
4) Hurricane Days	5	0.67
5) Intense Hurricanes	5	0.63
6) Intense Hurricane Days	4	0.62
7) NTC	5	0.81

5. CONCLUSION

Powerful predictive capabilities exist for forecasting September TC activity based on 51 years (1950-2000) of hindcasting NCEP/NCAR reanalysis data. Up to 80 percent of the variance in tropical cyclone activity can be forecast when these signals are combined to issue forecasts of September named storms, named storm days, hurricanes, hurricane days, etc. These predictive signals are global in nature indicating that the global oceanic and atmospheric circulation play an important role in monthly TC variability. Other monthly and sub-monthly forecasts for TC activity during the hurricane season will likely show similar forecasting skill.

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REFERENCES

Blake, E.S., 2002: Prediction of August Atlantic basin hurricane activity. Dept. of Atmos. Sci. Paper, Colo. State Univ., Ft. Collins, CO.

Gray, W.M., 1979: Hurricanes: Their formation, structure and likely role in the tropical circulation. *Meteorology over the Tropical Oceans*, D.B. Shaw, Ed., Roy. Meteor. Soc., 155-218.

—, 1984: Atlantic seasonal hurricane frequency. Part II: Forecasting its variability. *Mon. Wea. Rev.*, 112, 1669-1683.

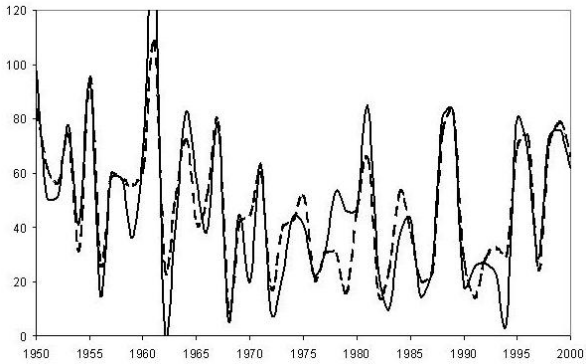

Figure 2: 1 September hindcast values versus actual Net Tropical Cyclone (NTC) activity from 1950-2000. Actual values are the solid line, and hindcast values are the dashed line.

Gray, W. M., C. W. Landsea, P. W. Mielke, Jr., and K. J. Berry, 1994: Predicting Atlantic basin seasonal tropical cyclone activity by 1 June. *Wea. Forecasting*, 9, 103-115.

Shapiro, L.J., 1987: Month-to-month variability of the Atlantic tropical circulation and its relationship to tropical storm formation. *Mon. Wea. Rev.*, 115, 2598-2614.