2A.4 PREDICTION OF AUGUST ATLANTIC BASIN HURRICANE ACTIVITY

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1. INTRODUCTION

Seasonal forecasts of Atlantic basin Tropical Cyclone (TC) activity show skill in the 3-10 month time frame (Gray et al. 1994). However, significant month-to-month and multi-week variability exists within most seasons. Active years sometimes have very inactive 2-4 week periods embedded within them while inactive years can have short active periods. Currently there are no operational techniques for predicting the occurrence of Atlantic TCs above or below climatology over periods of a few weeks to a month. The forecast technique described below explains about 55-70 percent of the variance (hence r $\sim$ 0.8) of August TC variance one month in advance using regression techniques. This is substantially better than climatology or by assuming that August will have 26 percent (climatology) of the activity of the Gray seasonal forecast.

2. PREVIOUS WORK/METHODOLOGY

Work by Ballenzweig (1959) distinguished active from inactive months by compositing various atmospheric fields. He demonstrated that variations in the monthly to seasonal synoptic flow have significant effects on the frequency of TCs. Shapiro (1987) studied relationships between monthly trade and upper level winds with TC frequency, finding predictive skill two months in advance. Recently, DeMaria et al. (2001) developed a real-time method for diagnosing a tropical wave's probability of genesis above or below climatology.

This study focuses on a forecast of August activity because of its large average NTC and large year-to-year variability. August (and other months) can be extremely active during a relatively quiet season. For example, August 1976 was about twice as active as normal during a season wherein seasonal NTC was below normal. Other notable cases include 1997 (inactive year) and 1961 (very active year), both of which had no activity at all during August.

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Predictors identified by Gray et al. (1994) were utilized in a provisional first trial for forecasting August TC activity. This set of predictors failed to produce skillful forecasts and it was immediately clear that a new set of predictive factors would be required for skillful August-only forecasts. The analysis utilized NCEP reanalysis fields for the years 1949-1999 to identify potential predictors. One identification method is to composite the ten most active Augusts in the data record and difference versus the ten least active Augusts. Another group of provisional predictors was found by correlating TC activity indices with global reanalysis atmospheric fields for 1958-1999. Predictors so identified in the 1958-1999 data but which were ineffective for the test years of 1949-1957 were discarded.

3. HINDCAST RESULTS/DISCUSSION

Hindcast schemes were developed for 1949-1999 utilizing the best predictors for each of the eight dependent variables. Twelve monthly predictors were determined to be related to some aspect to August TC activity. The combination of three to five of these predictors typically explained about 55-70 percent of the August variance of the various TC activity parameters as shown in Table 1. Figure 1 shows a global map of the predictors and Table 2 describes each predictor. The two most utilized predictors for the August forecast are the July 200 mb u and v winds over the equatorial Pacific just west of South America, which were utilized in every forecast equation. When these areas experience winds that are anomalously westerly and southerly, TC activity is generally suppressed in the Atlantic basin. This predictor is linked to ENSO, mid-latitude features in the S.H. and the MJO.

On the large-scale, increased August Atlantic basin activity follows anomalous low pressure in the midlatitudes of the western Pacific Ocean and high pressure in the western tropical Pacific in the early summer. It is notable that a reverse (from the Pacific) synoptic-scale pattern is typically observed in the Atlantic Ocean in the early summer before active Augusts. In particular, anomalous low pressure is noted in the Atlantic tropics with a diminished

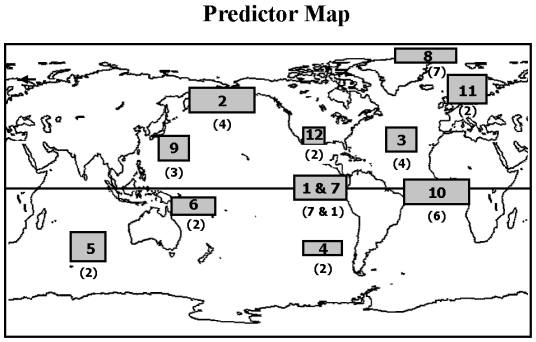

Figure 1: Global map showing locations of TC predictors. Table 2 provides a listing and descriptions of these predictors. The numbers in parentheses beneath each box indicate how many predictor equations used each predictor.

Bermuda high and slightly increased seasonal high pressure in higher latitudes. These lower pressures in the Atlantic subtropical high are usually accompanied by low vertical wind shear in the main TC development region with reduced trade winds and more easterly upper-level flow.

Table 1: Hindcast variance explained and cross validation results for each August activity parameter

Forecast Parameter	No. of Predictors	Variability Explained by Hindcast (R^2) (1949-1999)	Likely Independent Fcst. Skill (Jackknife)
NS	5	.55	.41
NSD	5	.71	.61
H	4	.57	.47
HD	5	.69	.59
IH	5	.68	.59
IHD	5	.78	.72
NTC	5	.74	.66
TONS	4	.68	.60
TOH	4	.64	.56

4. FORECASTS FOR 2000/2001

Monthly forecasts for August of 2000 and 2001 were issued at the beginning of August of these two years and discussed in the August seasonal forecast update produced by the Gray seasonal forecast team. Table 2 shows the forecast and observed values for 2000 and 2001. These forecasts verified very well, though the 2001 forecast was not as accurate as 2000. Overall, results for 2000 and 2001 test forecasts are very promising with indications of true forecasting skill far exceeding climatology. The August-only forecast will continue to be issued along with the Gray seasonal forecast in early August.

Table 2: Predictor source areas and the sign of each predictor for an active August

Predictor and Sign of Correlation	Area
1) July 200 mb v wind (–)	4°S-8°N, 105-79°W
2) July SLPA (–)	47-62°N, 156°E-164°W
3) July SLPA (–)	25-37.5°N, 47.5-25°W
4) July 200 mb u wind (–)	40-35°S, 110-85°W
5) July 500 mb height (–)	42.5-27.5°S, 72.5-95°E
6) July 200 mb u wind (+)	17.5-7.5°S, 145-180°E
7) July 200 mb u wind (–)	5°S-5°N, 110-85°W
8) June 200 mb u wind (+)	80-85°N, 45°W-10°E
9) June SLPA (+)	18-30°N, 134-154°E
10) April SLPA (–)	10°S-5°N, 35°W-15°E
11) February SLPA (–)	52.5-75°N, 5°W-35°E
12) January SLPA (–)	30-40°N, 110-95°W

Table 3: August 2000 and 2001 forecasts and observed August activity.

Forecast Parameter	2000 Fcst.	2000 Obs.	2001 Fcst.	2001 Obs.
NS	3	4	3	3
NSD	14.25	24.75	7	11.75
H	2	2	1	0
HD	8.25	14	2.5	0
IH	1	1	1	0
IHD	1.25	1	0.5	0
NTC	33.0	42.6	21.8	9.5

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