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EXTENDED RANGE FORECAST OF ATLANTIC SEASONAL HURRICANE ACTIVITY FOR 1997

(A year of slightly above average hurricane activity is expected)

(This forecast is based on ongoing research by the authors along with meteorological information through November of 1996)

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[This summary is also available on the World Wide Web at the following URL: http://tropical.atmos.colostate.edu/forecasts/index.html] — also,

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DEFINITIONS

Atlantic Basin - The area including the entire North Atlantic Ocean, the Caribbean Sea, and the Gulf of Mexico.

El Niño - (EN) A 12-18 month period during which anomalously warm sea surface temperatures occur in the eastern half of the equatorial Pacific. Moderate or strong El Niño events occur irregularly, about once every 5-6 years or so on average.

Hurricane - (H) A tropical cyclone with sustained low level winds of 74 miles per hour (33 ms^{-1} or 64 knots) or greater.

Hurricane Day - (HD) A measure of hurricane activity, one unit of which occurs as four 6-hour periods during which a tropical cyclone is observed or estimated to have hurricane intensity winds.

Hurricane Destruction Potential - (HDP) A measure of a hurricane's potential for wind and storm surge destruction defined as the sum of the square of a hurricane's maximum wind speed (in 10^4 $knots^2$)for each 6-hour period of its existence.

Intense Hurricane - (IH) A hurricane which reaches a sustained low level wind of at least 111 mph (96 kt or 50 ms^{-1}) at some point in its lifetime. This constitutes a category 3 or higher on the Saffir/Simpson scale (also termed a "major" hurricane).

Intense Hurricane Day - (IHD) Four 6-hour periods during which a hurricane has intensity of Saffir/Simpson category 3 or higher.

MATL - Sea surface temperature anomaly in the sub-tropical Atlantic between 30-50°, 10-30°W

MPD - Maximum Potential Destruction - A measure of the net maximum destruction potential during the season compiled as the sum of the square of the maximum wind observed for each named storm.

Named Storm - (NS) A hurricane or a tropical storm.

Named Storm Day - (NSD) As in HD but for four 6-hour periods during which a tropical cyclone is observed (or is estimated) to have attained tropical storm intensity winds.

NATL - Sea surface temperature anomaly in the Atlantic between 50-60°N, 10-50°W

NTC - Net Tropical Cyclone Activity - Average seasonal percentage mean of NS, NSD, H, HD, IH, IHD. Gives overall indication of Atlantic basin seasonal hurricane activity.

ONR - previous year October-November SLPA of subtropical Ridge in eastern Atlantic between 20-30°W.

QBO - Quasi-Biennial Oscillation - A stratospheric (16 to 35 km altitude) oscillation of equatorial east-west winds which vary with a period of about 26 to 30 months or roughly 2 years; typically blowing for 12-16 months from the east, then reverse and blowing 12-16 months from the west, then back to easterly again.

Saffir/Simpson (S-S) Category - A measurement scale ranging from 1 to 5 of hurricane wind and ocean surge intensity. One is a weak hurricane whereas 5 is the most intense hurricane.

SLPA - Sea Level Pressure Anomaly - The deviation of Caribbean and Gulf of Mexico sea level pressure from observed long term average conditions.

SOI - Southern Oscillation Index - A normalized measure of the surface pressure difference between Tahiti and Darwin.

SST(s) - Sea Surface Temperature(s).

SSTA(s) - Sea Surface Temperature(s) Anomaly(s).

Tropical Cyclone - (TC) A large-scale circular flow occurring within the tropics and subtropics which has its strongest winds at low levels; including hurricanes, tropical storms, and other weaker rotating vortices.

Tropical Storm - (TS) A tropical cyclone with maximum sustained winds between 39 (18 ms^{-1} or 34 knots) and 73 (32 ms^{-1} or 63 knots) miles per hour.

Delta PT - A parameter which measures anomalous east to west surface pressure (ΔP) and west to east surface temperature (ΔT) gradients across West Africa.

TATL - Sea surface temperature anomaly in Atlantic between 6-22°N, 18-80°W.

ZWA - Zonal Wind Anomaly - A measure of upper level ($\sim$ 200 mb) west to east wind strength. Positive anomaly values mean winds are stronger from the west or weaker from the east than normal.

1 knot = 1.15 miles per hour = .515 meters per second.

ABSTRACT

This paper presents details of a 6–11 month extended range seasonal forecast of the tropical cyclone activity likely to occur in the Atlantic Ocean basin during 1997. This forecast is based upon on several forecast schemes developed by the authors with several recent modifications. These schemes allow estimates of seasonal Atlantic tropical cyclone activity to be made by early December of the prior year. Our ever evolving forecast techniques are based on a variety of global and regional predictors shown to be related to future Atlantic tropical cyclone activity.

Information obtained through November 1996 indicates that 1997 Atlantic hurricane activity is likely to be slightly above the average for the 1950–1995 period with 7 hurricanes (average 5.7), 11 named storms (average 9.3), 55 named storm days (average 46), 25 hurricane days (average 23), 3 intense (category 3-4-5) hurricanes (average 2.1), 5 intense hurricane days (average is 4.5) and a hurricane destruction potential (HDP) of 75 (average 71). Collectively, net tropical cyclone activity is expected to be about 110 percent of the long term average. The 1997 season should however be much less active than the recent 1995 and 1996 seasons.

1 Introduction

Surprisingly strong long range predictive signals exist for Atlantic basin seasonal tropical cyclone activity. Our recent research indicates that a sizeable portion of the season-to-season variability of nine indices of Atlantic tropical cyclone activity can be skillfully hindcast (ie., successfully forecast in experiments with past data) by as early as late November of the prior year. We now have two separate prediction schemes for estimating hurricane activity in the following year. Forecasts are developed from 46 years of past data (1950-1995). Our extended range predictive signals include two measures of Western Sahel rainfall during the prior year, the phase of the stratospheric Quasi-Biennial Oscillation of zonal winds at 30 mb and 50 mb (which can be extrapolated ten months into the future) and similar extended range predictions for El Niño-Southern Oscillation (ENSO) variability and Western Sahel rainfall anomalies for the following summer, the October-November strength of the Azores high pressure and the configuration of the broad scale Atlantic sea surface temperature patterns (see Fig. 1). A brief summary of these predictor indices is as follows:

a) QBO–Tropical Cyclone Lag Relationship

The easterly and westerly modes of stratospheric QBO zonal winds which circle the globe over the equatorial regions have a substantial influence on Atlantic tropical cyclone activity (Gray, 1984a; Shapiro, 1989). Typically, there is 50 to 75 percent more hurricane activity (depending on the specific activity index considered) during those seasons when stratospheric QBO winds between 30 and 50 mb are anomalously westerly and, consequently, when the vertical wind shear (ie., the variation of wind speed with height) between these two levels is small. Conversely, seasonal hurricane activity is typically reduced when the stratospheric QBO is in an easterly phase and the wind shear between 30 and 50 mb is large. We project that 50 and 30 mb winds will be from a relatively westerly direction next year with small wind shear between these two levels. This should be an enhancing influence on next year's hurricane activity.

b) African Rainfall-Tropical Cyclone Lag Relationship

As discussed by Landsea (1991), Gray and Landsea (1992) and Gray et al. 1992, surprising strong predictive signals for seasonal hurricane activity can be obtained from rainfall data for

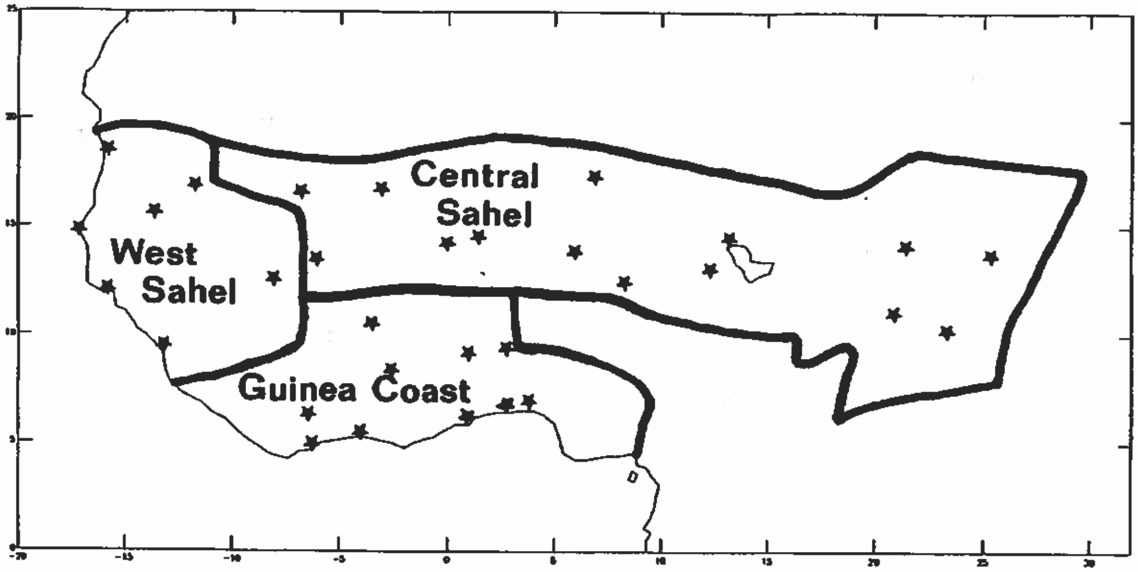

Figure 1: Locations of meteorological parameters used in 1 December Atlantic basin seasonal forecast.

Western Africa during the mid-summer to fall of the prior year. These rainfall-linked signals include:

(1) August–September Western Sahel Rainfall. The Western Sahel area (see Fig. 1) has experienced large year to year persistence of rainfall trends. Wet years tend to be followed by wet years (e.g., in the 1950s and 1960s) while dry years are typically followed by dry years (e.g., in the 1970s, 1980s and 1990s). Since the rainfall in this region is positively related to Atlantic hurricane activity, persistence alone tends to provide a moderate amount of skill for forecasting next season's African rainfall as well as the associated Atlantic hurricane activity. This year's rainfall for the West Sahel during August-September 1995 was –0.05 SD, about average (see Fig. 2).

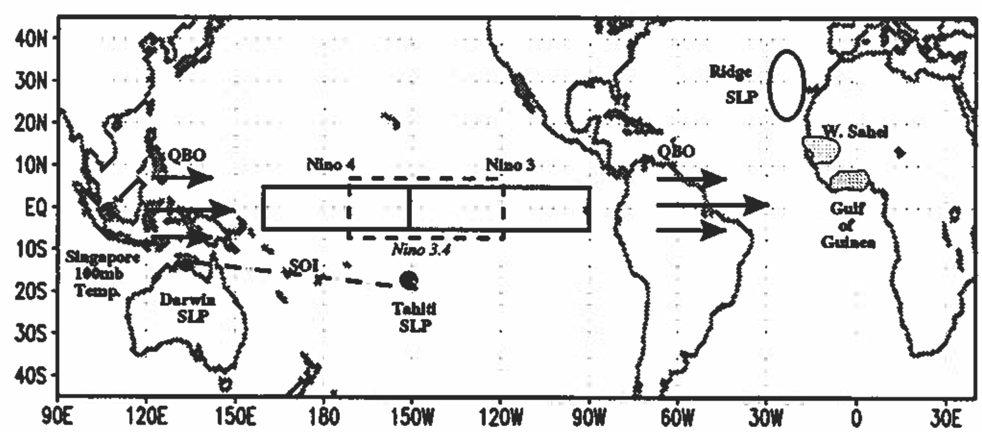

Figure 2: African rainfall regions used in our extended range forecasts.

(2) August–November Rainfall in the Gulf of Guinea. Landsea (1991) and Gray and Landsea (1992) have documented an even stronger African rainfall - intense hurricane lag relationship using August through November rainfall along the Gulf of Guinea (see Fig. 1). Intense hurricane activity during seasons following the ten wettest August–November Gulf of Guinea years is many times

greater than that which occurred during those hurricane seasons following the ten driest August-November periods in the Gulf of Guinea. This association suggests a very strong relationship between hurricane activity and this August to November rainfall during the prior year. The Gulf of Guinea 1996 August-November rainfall was below average (–0.54 SD). These trends and near average Sahel during August-September 1996 rainfall indicate that the long running and severe Western Sahel drought conditions appear to be coming to an end.

c) The El Niño-Southern Oscillation (ENSO) lag relationship

ENSO is one of the principal global scale environmental factors affecting Atlantic seasonal hurricane activity. Hurricane activity is usually much suppressed during those seasons when anomalously warm water temperatures are present in the equatorial eastern and central Pacific. And, activity is usually enhanced during seasons with cold (or La Niña) water conditions. Hurricane activity during the four seasons (1991-1994) was much suppressed because of persistent warm water conditions in the Nino-3 and NINO-4 regions of the equatorial Pacific and the associated negative values of the Southern Oscillation Index (SOI or Tahiti minus Darwin surface pressure).

We have recently devised a scheme for making extended range predictions of next summer's Nino-3 and Nino-3.4 sea surface temperature anomaly (SSTA) conditions. These new ENSO prediction schemes add qualitative improvements to the extended range seasonal hurricane forecasts which Gray et al. (1992) developed previously but which lacked an ENSO prediction component. Forecast for Nino-3 and Nino-3.4 for August through October 1997 are for cool water conditions ($\sim$ –0.5 to –0.03°C). Cool ENSO should be an enhancing influence on next year's hurricane activity.

d) Strength of the November Atlantic Subtropical Ridge (Azores High) Between 20-30°W

High surface pressure associated with this atmospheric ridge feature cause stronger east Atlantic trade winds which enhance upwelling of cold water off the northwest African coast. Colder surface water temperatures due to this enhanced ocean upwelling cause higher surface pressures which creates a self enhancing (positive feedback) response. The long term memory and feedback in this association make it a useful parameter for predicting next year's seasonal hurricane activity. The ridge strength this November was significantly higher (+1.45 SD) than the average strength during the 1950 to 1990 period and should be an inhibiting influence on 1997 hurricane activity.

e) Other Potential Long Range Predictors

Our analyses have also shown that other global parameters have some value for extended range Atlantic basin seasonal hurricane prediction and often improve our extended range forecasts. These include:

1. Singapore 100 mb (16.5 km) temperature anomalies during July to November of the prior year. These temperatures have been much below normal during summer and fall of 1996, indicating above normal hurricane activity for 1997.

2. North Atlantic minus South Atlantic Sea Surface Temperature Anomalies (SSTA). The recent configurations of these SSTA patterns are favorable for 1997 Atlantic Basin hurricane activity.

2 8-11 Month Extended Range Prediction Schemes

2.1 Outline of Basic (Gray et al. 1992) Scheme

Our original extended range forecast scheme had the following form:

$$(Seasonal\ Forecast) = \beta_o(1 + a_1U_{50} + a_2U_{30} + a_3|U_{50} - U_{30}| + a_4R_s + a_5R_G \quad (1)$$

where

1. U_{50}	= 10 month extrapolated 50 mb September QBO zonal wind near 10°N
2. U_{30}	= 10 month extrapolated 30 mb September QBO zonal wind near 10°N
3. $\|U_{50} - U_{30}\|$	= 10 month extrapolated 50 mb minus 30 mb September QBO zonal wind shear
4. R_s	= Measured standard deviation of previous year August-September Western Sahel rainfall
5. R_G	= Measured standard deviation of previous year August-November Gulf of Guinea rainfall

The β_o and "a" coefficients are determined to maximize the hindcast predictive signals. Different β_o and "a" coefficients are determined for each predictor. These equations were developed on data from the 41 years of 1950-1990. They explain about 40-50 percent of the variance of each of the nine forecast parameters in non-independent hindcasts.

Values of the forecast parameters used for prediction of the next year's 1997 Atlantic hurricane activity are given in Table 1. Substitution of the forecast predictors in Table 1 into Eq. 1 yields the forecast for the amount of next year's Atlantic basin seasonal hurricane activity shown in Table 2. This forecast indicates somewhat below average hurricane activity during 1997. Table 2 also gives the hindcast skill associated with each prediction.

Table 1: Values of the five (input) parameters for 1997 forecast are as follows:

1. U_{50} = –1 m/s
2. U_{30} = –2 m/s
3. $|U_{50} - U_{30}|$ = 1 m/s
4. Sahel (R_s) = –0.05 S.D.
5. Gulf of Guinea (R_G) = –0.54 S.D.

2.2 New (and Improved) Extended Range Forecast Scheme

A new version of our extended range forecasting scheme differs from the original scheme in that it involves a pool of predictors to which we apply a leaps and bounds regression method. This procedure iteratively chooses the best two predictors, the best three predictors, etc. up to ten predictors. Variability explained by the resulting forecast equations typically increases as we add predictors, but at an ever decreasing rate of improvement. Given the limited pool of hindcast years (46) from which to develop our scheme, degradation of true skill occurs when the scheme is applied to independent data if too many predictors are used (i.e., over curve-fitting). Consequently, we optimize the number of predictors, in this case we limit the number of 1997 predictors to between three and seven.

Table 3 shows the pool of ten potential predictors and their numerical value for this year's forecast. Table 4 shows the predictors which are chosen for each forecast of our nine forecast

Table 2: Statistical prediction for the 1997 season as obtained with Eq. 1 and the final amount of undegraded variance explained in the 41-year hindcast developmental data set.

Forecast Parameter	Gray et al. (1992) Statistical Forecast for 1997	Amount of Undegraded Hindcast Variance Explained
Named Storms (NS)	10.19	.44
Named Storm Days (NSD)	50.19	.51
Hurricanes (H)	6.29	.45
Hurricane Days (HD)	23.56	.49
Intense Hurricanes (IH)	1.87	.47
Intense Hurricane Days (IHD)	3.77	.45
Hurricane Destruction Potential (HDP)	60.39	.44
Net Tropical Cyclone Activity (NTC)	91.13	.53

hurricane activity parameters. Table 5 shows the predictions for the 1997 hurricane season with this new extended range forecast scheme, along with the amount of undegraded variance explained within the 46-year developmental data sets. This newer forecast scheme also indicates a somewhat below average 1997 hurricane season. But, we believe this forecast underestimates 1997 activity because of the very positive nature of two other factors noted previously (100 mb temperatures and north-south SST differences) which are not yet incorporated in our forecast scheme. These adjustments are discussed in the following section.

Table 3: Predictor values for 1997 forecast.

Predictor No.	Predictor	Predictor Values for 1997 Fcst
	Pool of 10 Potential Predictors	
1 =	U_{50}	-3 m/s
2 =	U_{30}	-2 m/s
3 =	$\|U_{50} - U_{30}\|$	1 m/s
4 =	Guinea Rain (Aug-Nov)	-0.54 SD
5 =	West Sahel rain (Aug-Sept)	-0.05 SD
6 =	Atlantic Ridge	+1.45 SD
7 =	Darwin (May-Jul)	0.0 °C
8 =	Nino-4 Trend (Aug-Oct)-(May-Jul)	+17 $\times 10^{-2}$oC
9 =	SOI (Aug-Oct)	$\times 10^{-1}$ mb
10 =	SOI Trend (Aug-Oct)-(May-Jul)	-0.1 SD

<u>Real Forecast Skill</u>. Application of both forecast schemes to independent data (i.e., the future) will usually entail a forecast skill degradation such that the amount of real forecast skill will be degraded from that specified in our experimental hindcast examples. However, on average this degradation should be on the order of no more than 15-25 percent from the values shown above. In some years it will be larger than this and in some years no degradation or even an improvement will occur. It is impossible to judge the degree of statistical degradation in any individual coming year.

Table 6 provides a comparison of both hurricane prediction schemes and our qualitative upward

Table 4: Most skillful predictor values for 1997 forecast.

Number Predictors	Top predictors chosen for each forecast variable									
	1	2	3	4	5	6	7	8	9	10
NS (3)		2		4		6				
NSD (6)	1	2		4	5	6				10
H (5)	1		3	4	5	6				
HD (5)	1	2		4	5	6				
IH (4)	1		3	4		6				
IHD (3)			3	4	5					
HDP (5)	1	2		4	5	6				
NTC (4)			3	4	5	6				
MPD (4)	1		3	4	5	6		8	9	

Table 5: Newer extended range forecast scheme for 1997 hurricane activity with the amount of undergraded forecast variance explained. Developmental data indicates the years of 1950-1995.

Forecast Parameter	Lower 25%	Best Forecast Forecast	Upper 25%	Amount of Undegraded Variance Explained
NS	7.29	8.46	9.64	.519
NSD	33.49	36.89	48.13	.547
H	4.58	5.33	6.24	.494
HD	12.53	17.14	20.84	.536
IH	1.31	1.93	2.60	.436
IHD	2.47	3.78	6.11	.417
HDP	31.74	46.96	70.87	.492
NTC	59.77	73.07	91.78	.528
MPD	51.43	54.90	60.83	.660

adjustment to the actual 1997 seasonal forecast. The right hand columns show the 1950-1990 climatology and the 1997 forecast. The hurricane seasons activity expressed as percent of the 1950-1990 average season. Net tropical cyclone activity is expected to be about 110 percent of the average of the last 45 seasons.

Table 6: Comparison of our two objective forecast schemes with our qualitative upward adjustment due to changing atmosphere-ocean conditions not explicitly in our forecasts.

Forecast Parameter	Older 1 Dec Fcst Scheme	Newer 1 Dec Fcst Scheme	Qualitatively Adjusted 1997 Fcst	1950–1990 Average	Percent of 1950–1990 Period
Named Storms (NS)	10.19	8.46	11	9.3	118
Named Storm Days (NSD)	50.19	36.89	55	46.6	118
Hurricanes (H)	6.29	5.33	7	5.8	121
Hurricane Days (HD)	23.56	17.14	25	23.9	105
Intense Hurricanes (IH)	1.87	1.93	3	2.3	130
Intense Hurricane Days (IHD)	3.77	3.78	5	4.7	106
Hurricane Destruction Potential (HDP)	60.39	46.96	75	71.2	105
Net Tropical Cyclone Activity (NTC)	91.1	73.07	110	110	110
Maximum Potential Destruction (MPD)	—	54.9	70	66.0	106

3 Reasons for Upward Adjustment of the 1997 Forecast Values

There are two basic reasons for qualitatively adjusting of our 1997 forecast upward. They involve cold 100 mb (16.5 km) Singapore temperature anomalies and recent rearranging of Atlantic basin SST patterns.

a) Singapore 100 mb temperature anomalies: Very cold 100 mb temperature anomalies (TA) were observed at Singapore (1.4°N) during June-November 1996. There is a very strong inverse relationship between summer and fall Singapore 100 mb TA and Atlantic basin hurricane activity during the following year. Table 7 compares the ten lowest versus the ten highest Singapore summer and fall 100 mb TA months with the following year annual average Atlantic Basin hurricane activity. Note the 3.7 and 3.9 modulation ratios. This is a strong indicator of an active 1997 hurricane season. We have yet to incorporate Singapore information in our forecast scheme.

Table 7: Comparison of intense hurricane activity in years following June through November periods with the highest (ten years) versus lowest (ten years) Singapore 100 mb TA. Results show following year average number of intense hurricanes and intense hurricane days.

	Average of Ten Lowest TA Years	Average of Ten Highest TA Years	Ratio Low/High Years
IH (category 3-4-5)	3.5	0.9	3.9
IHD (category 3-4-5)	7.4	2.0	3.7

b) Atlantic surface temperature changes: Since late 1994 an ongoing major rearrangement of the Atlantic Ocean SST features has been underway. These SST changes are broadscale and substantial in comparison with variations taking place during typical two year periods. These include a general warming of the North Atlantic and a cooling of the South Atlantic (see Figs. 3 and 4). We hypothesize that these changes are due to a major change in the Atlantic Ocean thermohaline or "conveyor belt" circulation. This hypothesis is also consistent with additional global circulation changes that have occurred during the last 1-2 years. Apparently, we are now experiencing a major shift towards a stronger Atlantic Ocean thermohaline circulation. It has been nearly three decades since the SST anomaly patterns of the Atlantic Ocean has entailed as strong a north to south SST difference as is now observed. We expect that this changing Atlantic SST pattern will lead to enhanced intense (or major) hurricane activity in coming years, more like the conditions during the mid 1940s to mid-1960s. This should manifest itself in more low latitude (forming) hurricanes which will become more intense.

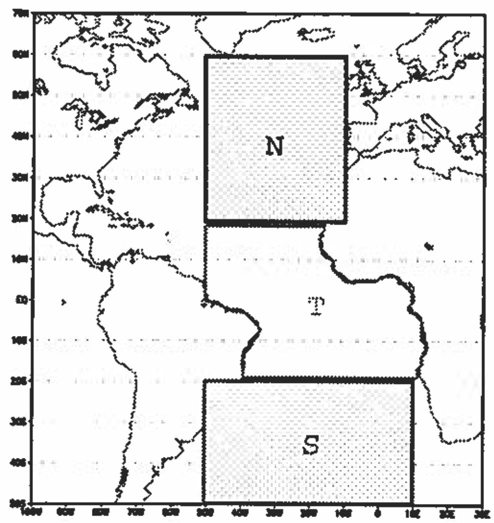

Figure 3: Areas of the Atlantic from which we average sea surface temperature anomalies.

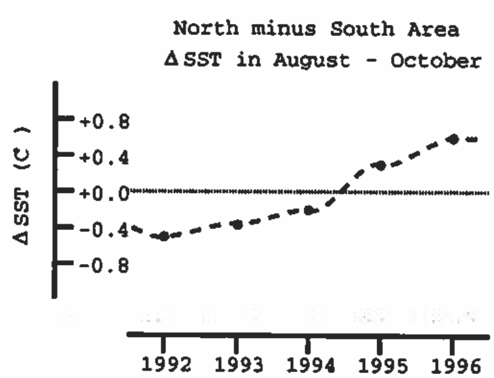

Figure 4: Difference in SST between north and south areas of Fig. 3 for the periods of August through October 1992 to 1996.

4 Discussion

There are recent reports of decreased ice flow through the Fram Strait (the North Atlantic passage between Greenland and Spitzbergen). This trend reduces the introduction of fresh water into this region, thus leading to increased surface salinity values in the North Atlantic. Related observations report also increased surface water salinity in the deep water formation areas of the North Atlantic. Rising salinity increases water density and chilling of high salinity surface water then creates dense water which is able to sink to great depth, thereby causing increased equatorward flow of deep water and engendering a northward flow of warm replacement water at or near the surface; hence - the "Atlantic Ocean Conveyor". A strong conveyor circulation increases North Atlantic water temperatures and thus transports more heat to high latitudes. The salinity values in the North Atlantic have been steadily rising over the last 15 years and recent deep water observations in the North Atlantic reveal that fairly stagnant water has been present for a decade or more. Collectively, these processes all suggest that surface salinity increases now being measured in the North Atlantic appear to be leading to a stronger Atlantic Ocean thermohaline circulation

Our data sets show that a multi-decadal decrease of intense hurricane activity began during the late 1960s, extending to 1994. We believe that this trend is associated with a concurrent slowing of the North Atlantic thermohaline circulation during this period which resulted in North Atlantic SSTs cooling and South Atlantic SSTs warming during these decades. Presuming that the opposite ocean circulation changes are now occurring, we anticipate a concurrent forthcoming multi-decadal general increase of West African Sahel rainfall, a decrease in Atlantic summertime upper tropospheric westerly winds over the tropical Atlantic and, regarding the issue at hand, a likely multi-decadal long increase of Atlantic Basin intense hurricane activity. These new North Atlantic SST change measurements may thereby be an ominous sign of future increases of US and Caribbean Basin intense hurricane frequency and landfall.

A further example of the influence of October and November North Atlantic SST on the following year's hurricane activity is shown in Table 8. We have used the 12 highest and 12 lowest October-November SST values in the Atlantic region of 50-60°N, 10-40°W as indices for comparing the following year's Atlantic hurricane activity. It compares the differences in the annual average number of intense hurricanes (IH) and intense hurricane days (IHD). Note the two to one and 3.5 to one differences in IH and IHD in Table 8. As October and November 1996 SSTs were warm, it is another indication of a more active 1997 hurricane season. These SST conditions have yet to be incorporated in our early December forecasts but we hope to have this as part of our extended range forecast next year.

Table 8: Comparison of the average annual number of intense hurricanes and intense hurricane days for the 12 highest and 12 lowest prior year October-November North Atlantic (50-60°N, 10-40°W) SST values. Data are taken during 1951-1996.

	Average of 12 Highest SST Values	Average of 12 Lowest SST Values	Ratio of High to Low Years
IH (category 3-4-5)	2.7	1.3	2.0
IHD (category 3-4-5)	6.7	1.9	3.5

In addition, our primary negative factors, high surface pressure of the Northeast Atlantic and lower than normal rainfall in the Gulf of Guinea may have had their magnitude exaggerated. There have been a middle latitude trough in the West Atlantic during much of October and November which has elevated the northeast ridge. This may not be a permanent feature. Also, the arrangement of higher than normal SST patterns off the Northwest Africa Coast during August through October may have contributed to the lower rainfall conditions measured along the Guinea Coast.

Our forecasts are based on the premise that the atmosphere will behave in 1997 as it has in the past; that is, those global environmental conditions which proceed active or inactive hurricane seasons of the past give meaningful information about the future. This hurricane forecast has also benefited from our separate and independent 1997 forecasts of ENSO conditions and of African Sahel rainfall. The atmosphere operates is a single entity and hence, each separate forecast aids our physical interpretation of the complete atmosphere-ocean-land system and in the making of other forecasts. The hurricane seasons of 1995 and 1996 were the two more active consecutive hurricane seasons on record. Should our present 1997 forecast hold up, then the period of 1995-97 will be the most active three consecutive hurricane seasons on record. It appears that we are entering a new era of hurricane activity.

5 Cautionary Note

It is important that the reader appreciate that these seasonal forecasts are based on statistical schemes which, owing to their intrinsically probabilistic nature, will fail in some years. Moreover, these forecasts do not specifically predict where within the Atlantic basin storms will strike. Regardless of whether 1997 should prove to be an average hurricane season or not, the probability exists that one or more hurricanes may strike along the US or Caribbean Basin coastline and do much damage.

6 Schedule of Updated Seasonal Hurricane Forecasts for 1997

This early December 1996 forecast will be updated in early April 1997, early June 1997 and early August 1997. This will allow us to make pre-season forecast corrections from more recent information. Seasonal verification of the 1997 forecasts will be issued in late November 1997. In addition, new seasonal forecasts of 1998 will be issued in early December, 1997.

7 Acknowledgements

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8 Additional Reading

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