FORECAST OF ATLANTIC SEASONAL HURRICANE ACTIVITY FOR 1996

(A Year of expected average hurricane activity — Next page gives forecast numbers)

(as of 6 June 1996)

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(This forecast is based on ongoing research by the authors, together with meteorological information through May 1996)

[A more complete explanation of this forecast with figures and tables is available on the World Wide Web at the following URL:
http://tropical.atmos.colostate.edu/forecasts/index.html] — also,

Thomas Milligan, Media Representative for Colo. State Univ., (970-491-6432) is available to answer questions concerning this forecast

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Summary of 6 June 1996 forecast of seasonal Atlantic hurricane activity.

Forecast Parameter	Forecast 1996 Seasonal Activity	Long-term (1950-1990) Average
Named Storms (NS)	10	9.3
Named Storm Days (NSD)	45	46.1
Hurricanes (H)	6	5.7
Hurricane Days (HD)	20	23
Intense Hurricanes (IH)	2	2.1
Intense Hurricane Days (IHD)	5	4.5
Hurricane Destruction Potential (HDP)	60	68.1
Net Tropical Cyclone Activity (NTC)	95%	100%
Maximum Potential Destruction (MPD)	60	66

DEFINITIONS

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

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 accures as four 6-hour periods during which a tropical cyclone is observed or estimated to have hurricane intensity winds.

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.

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.

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.

Millibar - (mb) A measure of atmospheric pressure which is often used as a vertical height designator. Average surface values are about 1000 mb; the 200 mb level is about 12 kilometers and the 50 mb is about 20 kilometers altitude. Monthly averages of surface values in the tropics show maximum summertime variations of about $\pm$ 2 mb which are associated with variations in seasonal hurricane activity.

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.

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

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

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.

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

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.

Net Tropical Cyclone Activity (NTC) - Average seasonal percentage sum of NS, NSD, H, HD, IH, IHD. Gives overall indication of Atlantic basin seasonal hurricane activity (see Appendix B).

Maximum Potential Destruction - (MPD) - A measure of the net maximum destruction potential during the season compliled as the sum of the square of the maximum wind observed for each named storm (see Appendix A for a listing of values for 1950-1995).

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

ABSTRACT

This paper presents details of the authors' forecast of the amount of tropical cyclone activity expected to occur in the Atlantic Ocean region including the Caribbean Sea and the Gulf of Mexico during 1996. This forecast is based on the authors' ongoing research relating the amount of seasonal Atlantic tropical cyclone activity and a number of basic predictive parameters. Among the most important predictors are: 1) the Quasi-Biennial Oscillation (QBO) of equatorial stratospheric winds; 2) the El Niño-Southern Oscillation (ENSO); 3) West African Rainfall (AR) anomalies during the previous year, 4) anomalous west to east gradients of surface pressure and surface temperature (ΔP, ΔT) in West Africa during February through May, and 5) Caribbean Basin Sea Level Pressure and Upper Level Zonal Wind Anomalies (SLPA) and (ZWA), respectively.

Information received by the authors through 5 June 1996 indicates that the overall 1996 hurricane activity should be about average with about 6 hurricanes (average is 5.7), 10 named storms (average is 9.3) of at least tropical storm intensity, a total of about 20 hurricane days (average is 23), 45 named storm days (average is 46) and a total Hurricane Destruction Potential (HDP) of 60 (average is 68). It is also expected that there should be 2 intense or major hurricanes of Saffir/Simpson intensity category 3, 4 or 5 this season (average is 2.1) and about 5 major hurricane days (average is 4.5). These parameters represent an overall measure of total hurricane and tropical cyclone activity which is about 95 percent of the 1950-1990 average. The amount of expected hurricane activity in this forecast has been decreased somewhat from that in the authors' 4 April 1996 forecast but is higher than our earlier 30 November 1995 forecast.

This forecast will again be updated on 6 August 1996, just before the beginning of the most active part of the hurricane season. The updated August forecast will make use of June and July African rainfall and Caribbean surface pressure data and will provide a more reliable forecast, particularly with regard to intense hurricane activity.

1 Introduction

The Atlantic basin, including the Atlantic Ocean, Caribbean Sea and Gulf of Mexico, experiences more season-to-season variability of hurricane activity than any other global hurricane basin. The number of hurricanes per season in recent years has ranged as high as 12 (as in 1969), 11 (as in 1950 and 1995) and 9 (as in 1980, 1955), and as low as 2 (as in 1982) and 3 (1994, 1987, 1983, 1972, 1962, 1957). Until recently there has been no objective method for determining whether a forthcoming hurricane season was likely to be active, inactive, or near normal. Recent and ongoing research by the author and colleagues (see Gray, 1984a, 1984b, 1990; Landsea, 1991; Gray *et al.*, 1992, 1993a, 1994) indicates that there are surprisingly skillful 3 to 11 month (in advance) predictive signals for Atlantic basin seasonal hurricane activity.

2 Factors Known to be Associated With Atlantic Seasonal Hurricane Variability

This early June Atlantic seasonal hurricane forecast is based on the current values of indices derived from various global and regional scale predictive factors which the author and his colleagues have previously shown to be statistically related to seasonal variations of hurricane activity. Successive sets of values for these predictive factors are obtained by late November of the previous year, by early April of the concurrent year, by early June (the official start of the hurricane season) and by early August (at the start of the most active portion of the hurricane season). These predictive factors include the following:

(a) The stratospheric Quasi-Biennial Oscillation (QBO) influence. The QBO refers to variable east–west oscillating stratospheric winds which circle the globe near the equator. On average, there is nearly twice as much intense Atlantic basin hurricane activity during seasons when equatorial stratospheric winds at 30 mb and 50 mb (23 and 20 km altitude, respectively) are more westerly as compared to when they are easterly.

(b) El Niño-Southern Oscillation (ENSO) influence: ENSO characterizes the presence of either warm or cold sea surface temperature anomalies in the eastern equatorial Pacific. The effects of a moderate or strong El Niño (warm water) event in the eastern equatorial Pacific act to reduce Atlantic basin hurricane activity. By contrast, seasons with cold sea surface temperatures, or La Niña years, have enhanced hurricane activity. These differences are related to alterations of upper tropospheric (200 mb or 12 km) westerly winds over the Caribbean basin and western Atlantic. These westerly winds are enhanced during El Niño seasons. This condition creates strong vertical wind shear over the Atlantic which inhibits hurricane activity. During La Niña (or cold) years, these westerly winds and the associated vertical wind shear are reduced and hurricane activity is typically greater.

(c) African Rainfall (AR) influence: The incidence of intense Atlantic hurricane activity is typically enhanced during those seasons when the Western Sahel and Gulf of Guinea regions of West Africa (shaded area in Fig. 1) had above average late summer and fall precipitation during the previous year (in this case during the fall of 1995). Hurricane activity is typically suppressed if the prior fall rainfall in these two regions was below average.

(d) West Africa west-to-east surface pressure and surface temperature gradients (Δ P, Δ T) influence. Recent project research has shown that anomalous west-to-east surface pressure and surface temperature gradients across West Africa during February through May are strongly correlated with the hurricane activity which follows later in the year (see Gray *et al.*, 1994).

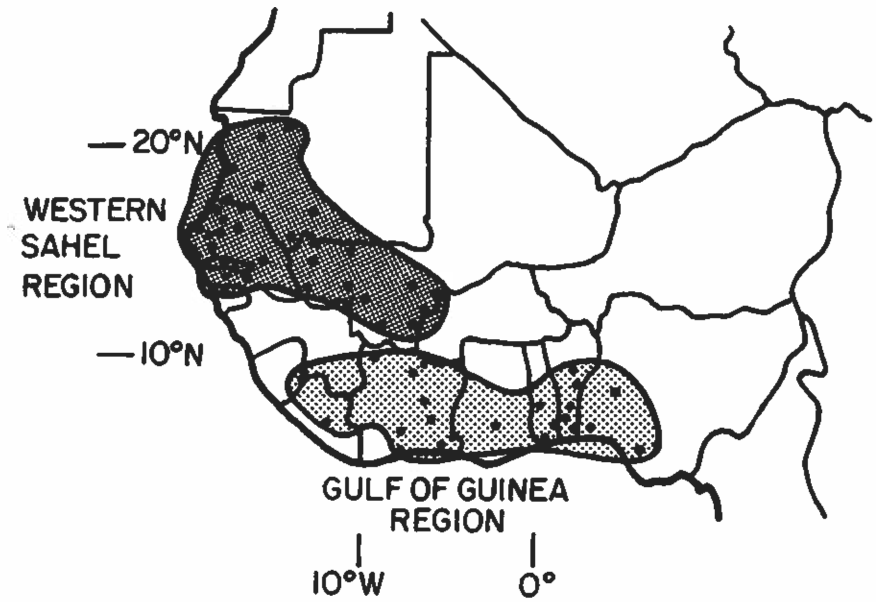

Figure 1: Locations of rainfall stations which make up the 38–station Western Sahel precipitation index and the 24-station Gulf of Guinea precipitation index. August to November rainfall within the Gulf of Guinea region provides a predictive signal for the following years hurricane activity as does prior year August-September rainfall in the Western Sahel (see Landsea, 1991; and Gray *et al.*, 1992).

We find that Atlantic hurricane activity is enhanced when the February to May east (Region B—see Fig. 2) minus west (Region A) pressure gradient is higher than normal and/or when the east minus west temperature gradient anomaly is below average.

(e) Caribbean Basin Sea Level Pressure Anomaly (SLPA) and upper tropospheric (12 km) Zonal Wind Anomaly (ZWA) influence. April and May values of SLPA and ZWA have a modest predictive potential for hurricane activity during the following season. Negative anomalies (low pressure and easterly anomalies) imply enhanced seasonal hurricane activity while positive values imply suppressed hurricane activity.

(f) Combination of Predictors. Figure 3 provides a summary of the locations of the various forecast parameters which go into the early June forecast.

Our seasonal forecast scheme has the following general form:

$$\begin{matrix} \textit{(Predicted Amount} \\ \textit{of TC Activity} \\ \textit{Per Season)} \end{matrix} = \textit{Ave. Season} + \overbrace{(QBO + EN + AR + \Delta PT + SLPA + ZWA)}^{\textit{Adjustment Factors}} \quad (1)$$

where

QBO = 30 mb and 50 mb Quasi-Biennial Oscillation zonal wind influence.

EN = El Niño influence.

AR = Western Sahel rainfall.

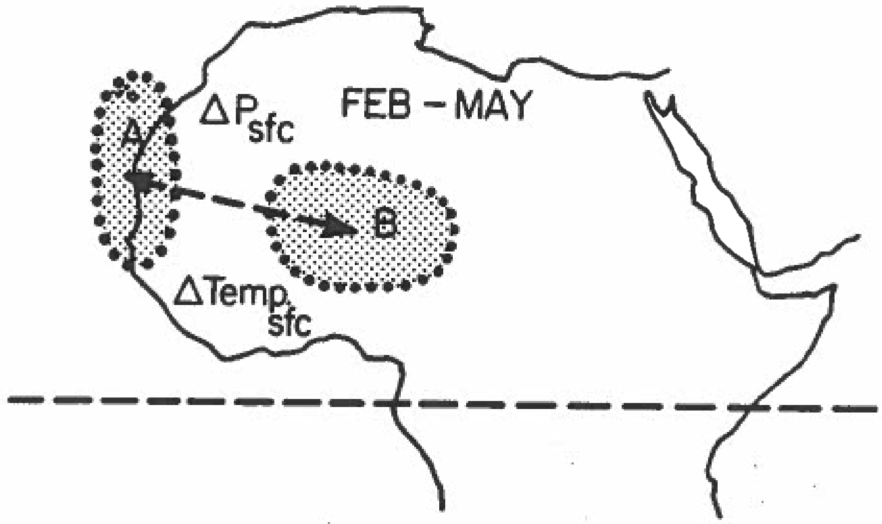

Figure 2: Map showing of the two West African regions—west (Area A) and east (Area B)—from which multi-station surface pressure and temperature values are computed to form combined west-to-east pressure and temperature gradients or Δ PT parameter. (Gray et al. 1994).

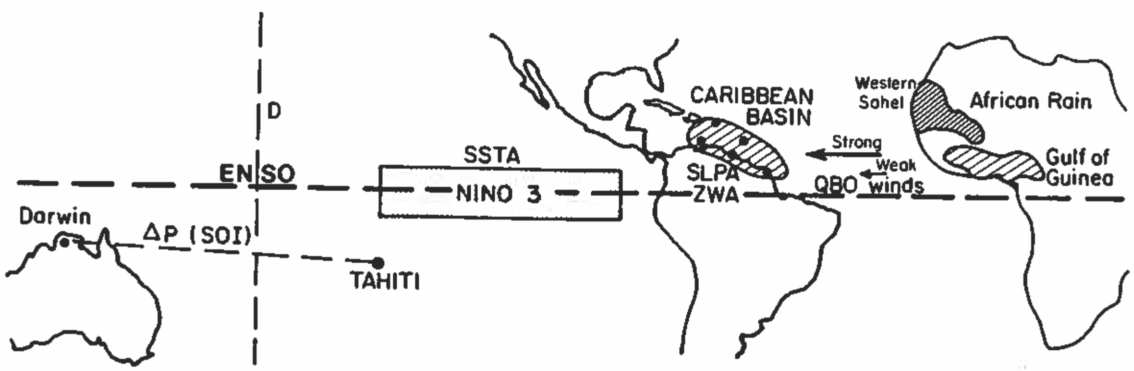

Figure 3: Locations of meteorological parameters used in the early June Atlantic basin seasonal forecast.

ΔP, ΔT = West Africa west-to-east gradients of surface pressure and surface temperature during February through May.

SLPA = Average Caribbean Sea Level Pressure Anomaly (SLPA) for Spring and early Summer.

ZWA = Zonal Wind Anomaly at 200 mb (12 km) for five low latitude upper air stations in the Caribbean.

3 Discussion of the Current Characteristics of the Five Primary Early June Predictors (QBO, ENSO, AR, ΔP, ΔT, and SLPA-ZWA) as Regards the Amount of Anticipated 1996 Seasonal Hurricane Activity

3.1 QBO

Tables 1 and 2 show the absolute and relative values of the current and extrapolated 30 mb (23 km) and 50 mb (20 km) stratospheric QBO zonal winds near 11 to 13°N for 1996 during the primary hurricane period of August through October. These estimates are based on a combination of the current trends in the QBO winds combined with the annual wind cycle variations for low latitude stations at Curacao (12°N), Trinidad (11°N), and Barbados (13°N). Note that during the primary August through October hurricane season that 30 mb and 50 mb zonal winds will be from a relative easterly direction. This should be a suppressing influence for this year's hurricane activity. There are, on average, only abut half as many intense or major category 3-4-5 hurricanes during those years of strong easterly QBO winds as 1996 will be.

Table 1: March through October 1996 observed and extrapolated absolute values of stratospheric QBO zonal winds (U) in the critical latitude belts between 11-13°N as obtained from Caribbean stations at Curacao (12°N), Barbados (13°N), and Trinidad (11°N). Values are in ms^{-1} (data supplied by James Angell and Colin McAdie).

	Observed			Extrapolated				
Level	March	April	May	Jun	Jul	Aug	Sept	Oct
30 mb (23 km)	–16	–21	–27	–32	–34	–32	–31	–28
50 mb (20 km)	+8	+4	–6	–13	–19	–22	–20	–18

3.2 ENSO

A weak La Niña or cool water event is currently in place. April-May 1996 SSTA conditions and our forecast of these conditions on 30 November of last year indicate that the El Niño-Southern Oscillation (ENSO) should be a neutral or slightly enhancing factor in the season's hurricane activity. Equatorial East and Central Pacific water temperatures are expected to be on the cool side (~ 0 *to* -0.5°C) during August through October of this year.

Table 2: As in Table 1 but for the "relative" (or anomalous) zonal wind values wherein the annual wind cycle has been removed. Values are in ms^{-1}.

	Observed			Extrapolated				
Level	March	April	May	Jun	Jul	Aug	Sept	Oct
30 mb (23 km)	−12	−13	−14	−15	−16	−16	−15	−15
50 mb (20 km)	+8	+5	0	−3	−5	−8	−10	−12

3.3 West African Rainfall (AR)

Substantially more intense Atlantic hurricane activity occurs when June through September West Sahel rainfall is above average as compared to those seasons when rainfall is below average (Gray, 1990; Landsea and Gray, 1992). The long running Sahel drought of 1970-93 has been associated with a great suppression of intense (or major) hurricane activity during that 24-year period. A temporary (two year) interruption of African drought conditions occurred in 1988–89, concurrent with a substantial increase in intense hurricane activity, including five Saffir/Simpson category 4-5 hurricanes. However, drought conditions returned again during 1990-1993. But these drought conditions were broken for 1994 and 1995. Rainfall was close to the long-term average for the Western Sahel. Our current forecast (see Landsea et al. 1996) for June through September Western Sahel rainfall is that drought conditions will not occur this year. We forecast (see accompanied paper by Landsea et al. 1996) Western Sahel rainfall values of −0.11 S.D., or about average rainfall conditions.

This Sahel rainfall forecast is based on most of the same factors as the current seasonal hurricane forecast and indicates that Western Sahel rainfall conditions will be distinctly above those of a typical drought year. We are not in agreement with the recently issued 1996 experimental West African rainfall forecast which was issued by the UK Meteorological Office (1996) using data through April, which is suggesting a high probability of drought conditions for this year.

Western Sahel rainfall is judged not to be an inhibiting influence on Atlantic intense hurricane activity during 1996 in comparison to what it has been for most of the last 25 years.

Our last winter forecast of Western Sahel rainfall (based on data through November 1994) also indicated near average rainfall conditions for this year. This forecast of non-drought conditions for the Western Sahel indicates an enhanced probability of Atlantic basin intense hurricane activity.

3.4 West Africa Δ P and Δ T

The anomalous west-to-east surface pressure and temperature gradients which become established across West Africa during February through May are good indicators of the hurricane activity to be expected during the late summer-fall period. Figure 2 showed the west-and-east areas of Africa from which these surface pressure and temperature gradients are taken.

Hurricane activity is greatest when the east (Region B) minus west (Region A) pressure gradient deviations are most positive and/or when the west-minus-east temperature gradients are positive.

Given the typical inverse relationship between land surface temperature and surface pressure, positive west-to-east pressure gradients are typically associated with positive east-to-west temperature gradients and vice versa. More Sahel rainfall and more Atlantic intense hurricane activity would result. When west to east ΔP and east to west Δ T are negative, West Africa tends to have anomalously northerly and dry winds; this is conducive to dry Western Sahel rainfall conditions and fewer Atlantic intense seasonal hurricanes. February through May 1996 Δ P and Δ T were near average. Taken together, these values are indicative of an approximate neutral influence on this season's hurricane activity in comparison to average activity of the last 45 years.

3.5 SLPA and ZWA

SLPA. Table 3 shows April–May 1996 Sea Level Pressure Anomaly (SLPA) values for the relevant tropical Atlantic stations. The April–May SLPA was above average (+1.0 mb) for this special 5–station low latitude area and also for our six-station Gulf of Mexico and Caribbean average. Pressure anomalies are based on deviations from the last 40–year average. The higher pressures of the low latitude stations of Table 3 are indicative of a reduction in this year's hurricane activity. It is frequently observed that high April-May pressure do not maintain themselves through the hurricane season however. This has been the case through much of the 1980s and 1990s. We do not expect these high values of SLPA to be maintained through the hurricane season. During late May and early June the pressures have gone down considerably.

Table 3: April-May average lower Caribbean Basin and Gulf of Mexico Sea-Level Pressure Anomalies (SLPA) for 1996 in mb (as kindly supplied by Colin McAdie of NHC and from our CSU analysis).

Low Latitude	SLPA	Gulf of Mexico–Caribbean Basin	SLPA
San Juan (19.5°N, 66°W)	+0.9	Brownsville (26°N, 17.5°W)	+ 0.7
Curacao (12°N, 69°W)	+1.5	Merida (Mex.) (21°N, 89.5°W)	+1.5
Barbados (13.5°N, 60°W)	+1.2	Miami (26°N, 80°W)	+0.5
Trinidad (11°N, 62°W)	+1.2	San Juan	+0.8
Cayenne (5°N, 52.5°W)	+ 0.4	Curacao	+1.2
		Barbados	+1.2
Average	+1.0	Average	+1.0

ZWA. The Lower Caribbean Basin 200 mb (12 km) zonal wind anomaly (ZWA) for April-May 1996 give an indication of future tropospheric wind shear conditions for the region. ZWA conditions also act as a monitor for the possible influence of Pacific ENSO conditions on Caribbean Basin upper tropospheric wind conditions. Data in Table 4 show that the upper tropospheric ZWAs for April and May are near normal. These zonal wind values are not in agreement with the very high surface pressure. Usually high surface pressure anomalies are associated with westerly wind anomalies.

4 1 June Forecast Scheme

The first author made his first Atlantic Basin hurricane forecast in 1984. This original forecast made use of El Niño conditions, the stratospheric QBO wind conditions and Atlantic Basin surface pressure. This original 1 June forecast scheme has been evolving and been improving over recent years as we study the forecast problem in greater depth and learn of other potential predictors.

Table 4: April-May 1996 lower Caribbean Basin 200 mb Zonal Wind Anomaly (ZWA) in ms^{-1} (as supplied by Colin McAdie of NHC and from our CSU analysis).

Station	
Kingston (18°N, 77°W)	+1.3
Curacoa (12°N, 69°W)	–3.1
Barbados (13.5°N, 60°W)	–0.2
Trinidad (11°N, 62°W)	–0.8
Average	–0.7

Four years ago we developed a new 1 June hurricane forecast scheme (Gray et al. 1994) which took the following form:

(Hurricane Activity) =

$$\begin{aligned} &\beta_0 + \beta_1(a_1U_{50} + a_2U_{30} + a_3|U_{50} - U_{30}|) \\ &\quad + \beta_2(a_4R_s + a_5R_g + a_6\Delta_x\mathrm{P} + a_7\Delta_x\mathrm{T}) \\ &\quad + \beta_3(a_8\mathrm{SLPA} + a_9\mathrm{ZWA} + a_{10}\mathrm{SST} + a_{11}\Delta_t\mathrm{SST} + a_{12}\mathrm{SOI} + a_{13}\Delta_t\mathrm{SOI}) \end{aligned} \tag{1}$$

where

β's and α's are empirically derived coefficients for prior years of data
U_{50}, U_{30} are extrapolated September QBO zonal winds at 30 and 50 mb at 10°N
$|U_{50} - U_{30}|$ absolute value of the extrapolated vertical wind shear between 50 and 30 mb
R_s is the western Sahel precipitation in the previous August and September
R_g is the previous year August to November precipitation in the Gulf of Guinea region
ΔP is West African anomalous east-west pressure gradient deviation in Feb. through May
ΔT is West African anomalous west-east temperature deviation in February through May
SLPA is the April-May Sea Level Pressure Anomaly in the lower Caribbean basin
ZWA is the April-May Zonal Wind Anomaly in the Caribbean basin
SOI is the April-May normalized Tahiti minus Darwin Sea Level Pressure differences
SSTA is the April-May Sea Surface Temperature Anomaly in Nino 3
ΔSOI is the recent months change in SOI from Jan-Feb to April-May
ΔSSTA is the recent months change in SSTA from Jan-Feb to April-May.

We have had success with this updated version of our 1 June forecast the last two years. But newer statistical studies (Mielke et al 1996, 1997) and analysis by Elsner and Schmertmann (1993, 1994) indicate that the least sum of absolute deviation (LAD) cross validation hindcasting is not a complete cross validation and is likely to provide inflated estimates of our true independent forecast skill. To overcome the problem we have since developed a new 1 June forecast scheme (Landsea et al. 1997) which, unlike our 1994 1 June forecast, does not use the same predictors for each forecast variable. Rather, it chooses from a suite of 11 potential predictors the best four to seven predictors (see Table 5). This procedure allows us to maximize our true skill and to minimize potential overfitting resulting from too many variables.

Table 5: Listing of the pool of eleven potential predictors used in our most recent 1 June forecast scheme.

1 JUNE PREDICTORS

U50: 50 hPa zonal winds over the Caribbean Sea extrapolated from May to September in ms^{-1}.

U30: 30 hPa zonal winds over the Caribbean Sea extrapolated from May to September in ms^{-1}.

Shear: Absolute zonal wind shear between extrapolated 30 and 50 hPa values in ms^{-1}.

R_S: June to September rainfall in North Africa's Western Sahel from the previous four years in standardized deviations.

R_G: August through November rainfall along North Africa's Gulf of Guinea from the previous year in standardized deviations.

$\Delta_x P$: North African interior to coastal sea level pressure gradient anomalies from February through May in standardized deviations.

$\Delta_x T$: North African coastal to interior surface temperature gradient anomalies from February through May in standardized deviations.

SLPA: April to May sea level pressure anomalies in hPa around the Caribbean Sea.

ZWA: April to May 200 hPa zonal wind anomalies in ms^{-1} around the Caribbean Sea.

SST3.4: April to May NINO–3.4 sea surface temperature anomalies in °C.

Δ_tSST3.4: April to May minus January to February NINO–3.4 sea surface temperature anomalies in °C.

Eight of the eleven predictors (U50, U30, Shear, R_G, $\Delta_x P$, $\Delta_x T$, SLPA, and ZWA) of the newer scheme are identical to our 1994 forecast version except for the anomalies being based on the fixed long–term period (1950–1990). The R_s predictor had previously used August and September Western Sahel rainfall anomalies from the year previous as a measure of the persistence of the Western Sahel rainfall decadal time scale regime. It was found that a four year running average of the June through September rainfall for the same region provided a better estimate of this persistence. And, two new predictors – SST3.4 and Δ_tSST3.4 – now replace the four previous predictors that provided indications of ENSO variability: the Niño 3 SST anomalies, the Southern Oscillation Index, and the time rate of change of these two quantities. Recent work by Goldenberg and Shapiro (1995) have identified that the region 5 °S to 5 °N and 170 to 120 °W best captures the ENSO variability and its effect upon the Atlantic basin tropical cyclones. It was found that SST3.4 and Δ_tSST3.4 provided the same predictive ability as all four of the previous predictors.

A new forecast parameter Maximum Potential Destruction (MPD) has also been added and represents the seasonal total of the square of each cyclone's peak maximum wind. Squared wind velocities better indicate the amount of damage that tropical cyclones can inflict upon property than just the winds themselves (Landsea 1993). The previously utilized HDP also included a component of duration into a similar calculation, while this new MPD is confined to the sum of the squared peak wind velocities and has no duration component.

The predictors utilized by a majority of the tropical cyclone response variables include U50, Shear, R_G, $\Delta_x T$, SLPA and SST3.4. All of the response variables include at least one of the stratospheric Quasi-Biennial Oscillation (QBO) predictors (U50, U30, and Shear), one of the two ENSO predictors (SST3.4 and Δ_tSST3.4), and one of the four African rainfall and pressure/temperature predictors (R_G, R_S, $\Delta_x P$ and $\Delta_x T$). At least one of the Caribbean predictors of ZWA and SLPA was used by all the tropical cyclone response variables except IH and IHD. Thus in the results given here, a measure of the QBO, ENSO, the amount of expected Western Sahel rainfall and (to a slightly lesser extent) the Caribbean station ZWA and SLPA remain crucial in the forecasting process.

A comparison of both hindcast skill values is given in Table 6. True forecast skill, when applied to independent data will be lower by 10 to 25 percent than the values given in Table 6. There is no way to tell in but 42 years the individual cases how degraded individual independent forecast will be. In some years there may be no degradation, even an improvement. In other years the degradation may be substantial.

Table 6: Comparison of 1 June measures of agreement (ρ) for the original hindcasts shown in Gray et al. (1994) based upon the years 1950 to 1991 and 13 predictors, the current hindcast skill based upon the years 1950 to 1995 and a listing of the predictors chosen for current methodology (number of predictors in parentheses).

Tropical Cyclone Type	Original Hindcast Skill	Current Hindcast Skill	Predictors Chosen
NS	0.514	0.478	(5) U50, Shear, $\Delta_x P$, ZWA, SST3.4
NSD	0.660	0.586	(7) U50, Shear, R_G, $\Delta_x P$, SLPA, ZWA, SST3.4
H	0.617	0.508	(5) Shear, R_S, R_G, SLPA, SST3.4
HD	0.703	0.602	(7) Shear, R_S, R_G, $\Delta_x T$, SLPA, ZWA, SST3.4
IH	0.637	0.566	(5) U50, R_G, $\Delta_x P$, $\Delta_x T$, SST3.4
IHD	0.614	0.527	(6) U50, R_G, $\Delta_x P$, $\Delta_x T$, SST3.4, Δ_tSST3.4
HDP	0.709	0.588	(6) Shear, R_S, R_G, $\Delta_x T$, ZWA, SST3.4
NTC	0.718	0.657	(8) U50, U30, R_S, R_G, $\Delta_x T$, SLPA, SST3.4, Δ_tSST3.4
MPD	—	0.588	(5) U30, R_G, $\Delta_x T$, SLPA, SST3.4

Table 7 lists the forecast predictors that are utilized in both 1 June forecasts. The top portion gives the forecast input parameters for our 1994 1 June forecast and the bottom portion gives the additional or the altered forecast parameters for the newer scheme. Our newer scheme uses most of the same parameters as the older scheme. Substituting the forecast parameters of Table 7 into each forecast scheme gives predictions as shown in Table 8. Note that both schemes give similar quantitative forecasts, but indicate a below average hurricane season. These 1 June statistical forecasts are not in good agreement with our earlier 30 November and 5 April forecasts. We question their validity.

5 Discussion

Our biggest forecast question for 1996 concerns the high values observed for the West Atlantic-Caribbean Basin Sea Level Surface Pressure Anomaly (SLPA). Are they representative

Table 7: Predictors for the early June 1996 forecast for our earlier 1994 forecast scheme and for our more recent developed forecast scheme.

1994 SCHEME

	U_{30}	–31 m/s	4-month
QBO Predictors	U_{50}	–20 m/s	extrapolation to Sept. 1996
	$\|U_{50} - U_{30}\|$	11 m/s	
West African Predictors	R_s	–0.35 S.D.	Aug.-Sept. 1995
	R_g	+0.10 S.D.	Aug.-Nov. 1995
	ΔP	–0.3 S.D.	
	ΔT	–0.3 S.D.	Feb. through May 1996
Caribbean and ENSO	SLPA	+1.0 mb	April-May 1996 value
Predictors	ZWA	–0.7 m/s	April-May 1996 value
	SOI	+2.5 10^{-1}S.D.	April-May 1996 value
	SSTA	–45 x 10^{-2} °C	April-May 1996 value
	ΔSOI	–2.0 x 10^{-1} S.D.	(Apr-May) - (Jan-Feb) 1996
	ΔSSTA	0 x 10^{-2} °C	(Apr-May) - (Jan-Feb) 1996

CURRENT SCHEME

	U_{30}	–31 m/s	4-month
QBO Predictors	U_{50}	–20 m/s	extrapolation to Sept. 1996
	$\|U_{50} - U_{30}\|$	11 m/s	
West African Predictors	R_s	–0.35 S.D.	Last Four years (June-Sept)
	R_g	+0.10 S.D.	Aug.-Nov. 1995
	ΔP	–0.3 S.D.	
	ΔT	–0.3 S.D.	Feb. through May 1996
Caribbean and ENSO	SLPA	+1.0 mb	April-May 1996 value
Predictors	ZWA	–0.7 m/s	April-May 1996 value
	Nino 3.4 SSTA	–0.20°C	April-May 1996 Value
	Δ Nino 3.4 SSTA	+0.55°C	(April-May)-(Jan-Feb) 1996

Table 8: The 1996 seasonal forecasts obtained by substitution of parameters into forecast equations. Our qualitative adjustments and actual forecast are shown on the right column.

Forecast Parameter	1994 Scheme	Newest Scheme
Named Storms (NS)	7.58	7.99
Named Storm Days (NSD)	21.09	24.88
Hurricanes (H)	3.31	4.39
Hurricane Days (HD)	10.16	14.75
Intense Hurricanes (IH)	2.04	2.00
Intense Hurricane Days (IHD)	2.43	4.10
Hurricane Destruction Potential (HDP)	36.57	57.60
Net Tropical Cyclone Activity (NTC)	74.20%	66.34%
Maximum Potential Destruction (MPD)	—	41.47

of the SLPA values of August through October? If these high values of SLPA persist through September, then we will have a very inactive hurricane season. If these SLPAs drop to near normal values, then a relatively more active hurricane season becomes likely. SLPA is one of the strongest modulators of seasonal hurricane activity.

Table 9 shows both of our statistical season forecasts with an April-May SLPA value of 0.0 mb rather than +1.0 mb. Note that the hurricane activity of a number of forecast parameters has been appreciably raised by this change. We believe this or negative values of SLPA to be more typical of the coming season SLPA conditions. We are reluctant to accept this high SLPA value as representative of the SLPA in August and September.

Table 9: The 1996 seasonal forecasts as indicated in Table 8 but with the assumption of 0.0 mb rather than +1.0 mb April-May SLPA conditions.

Forecast Parameter	1994 Scheme	Newest Scheme
Named Storms (NS)	7.86	7.99
Named Storm Days (NSD)	40.61	39.37
Hurricanes (H)	5.89	5.58
Hurricane Days (HD)	23.29	19.07
Intense Hurricanes (IH)	2.02	2.08
Intense Hurricane Days (IHD)	3.49	4.10
Hurricane Destruction Potential (HDP)	71.40	57.60
Net Tropical Cyclone Activity (NTC)	91.22%	79.75%
Maximum Potential Destruction (MPD)	—	56.43

6 Analog Years to 1996

An application of past data sets to our forecast equations shows that typically we can explain about 50-60 percent of the season to season variability. Although this is a surprisingly high degree of hindcast skill for a seasonal prediction, there is still the 40-50 percent or more of the variability that remains unexplained. Analysis of individual season hindcast errors show that there are certain years when our set of predictors underforecast hurricane activity and other years when our predictors overforecast it. It appears that 1996 is one of those years when our forecast scheme will underforecast activity.

The best 1 June analog predictors for 1996 is 1989 — a year which was badly underforecast. Other years having April-May predictor conditions similar to 1996 include 1979 and 1954 which were also underforecast. Table 10 shows the amount of hurricane activity underhindcast during these three years. Each of these years had near identical QBO and ENSO conditions to that of 1996. Many of the other forecast parameters were also very similar. The year 1989 had a similar high April-May pressure that decreased dramatically to very low values during August and September. The comparative forecast parameter values given in Table 11 shows the similarity of our 1996 early June predictors with the three prior analog seasons. Table 12 shows the average hurricane activity which occurred during the analog years versus our 1996 forecast. All three analog years had substantial amounts of hurricane activity. Hence, it appears that 1996 is one of those years when our forecast scheme will underforecast the amount of hurricane activity. In particular, it is the high Caribbean Basin SLPA value of +1.0 mb which we believe will not hold up as the season progresses. Using a different set of variables, our earlier Atlantic basin forecast, issued 4 April 1996, indicated a higher amount of seasonal activity.

Table 10: Amount of underhindcast of four hurricane activity parameters for the three 1996 analog years.

Year	NS	H	IHD	NTC
1954	2.8	1.7	4.6	32
1979	2.0	0	3.4	23
1989	4.3	2.2	4.4	29

7 Upward Adjustment of Quantitative Forecast

We have chosen to increase the values predicted by our statistical forecast because 1) we don't believe the April-May SLPA values are representative of the SLPA conditions to follow later in the summer and 2) the greater amount of hurricane activity which occurred during these analog years and knowledge that our forecast schemes underforecast hurricane activity in such years. In addition, there are other regional and global circulation factors known to be associated with Atlantic basin seasonal hurricane variability that are not explicitly included in our forecast. These other factors also lead us in the direction of arbitrarily raising our forecast values.

These additional enhancing factors to hurricane activity include:

Table 11: Comparison of 1996 June 1 predictors with the three prior years that had similar forecast predictors.

Year	U_{50}	U_{30}	Shear	R_s	R_g	ΔT	ΔP	SLPA	ZWA	SSTA Nino 3.4	Δ SSTA Nino 3.4
1954	−22	−30	8	.23	−.14	.06	−.29	−.1	−1.5	−.13	−.63
1979	−17	−31	14	−.34	−.72	−.60	.47	0	1.5	.27	.18
1989	−21	−31	10	.44	.36	.26	.49	.90	1.6	−.51	.77
Mean of Analog Years Predictors	−20	−31	11	.11	−.17	−.09	.22	0.3	0.5	−.12	.11
1996 Predictors	−20	−31	11	−.35	.10	−0.3	−0.3	1.0	−0.7	−.35	.10

Table 12: Tropical cyclone activity which occurred during three previous analog years wherein the 1 June forecast parameters were similar to those of 1996.

Year	NS	NSD	H	HD	IH	IHD	HDP	NTC
1954	11	44	8	32	2	8.5	91	127
1979	8	44	5	22	2	5.75	73	96
1989	11	66	7	22	2	10.75	108	140
Analog Average	10	51	6.7	28	2	8.3	91	121
Adjusted 1996 Fcst	10	45	6	20	2	5	60	95

1. Atlantic area SSTA conditions during April-May between 10-20°N, 18-50°W. Positive anomalies are associated with increased hurricane activity. April-May SSTA values this year are +0.64°C, indicating enhanced activity.

2. SSTA and salinity conditions in the North Atlantic between 50-60°N, and 10-50°W. Temperature and salinity in this area have been steadily increasing in this region. It appears that conditions are becoming primed for a beginning speedup in the thermohaline circulation. Such a speedup would lead to enhanced hurricane activity.

3. Our forecast of West African Sahel rainfall conditions (Landsea et al. 1996) indicates normal to slightly below normal conditions – not major drought conditions. This should not be a suppressing influence on hurricane activity for this year.

4. New forecasts of ENSO conditions through October 1996 indicate that negative SSTA conditions of 0 to –0.5°C should prevail. This is another factor to indicating a lack of suppressed hurricane conditions.

Given all of the above considerations we have chosen to upwardly adjust the forecast values of Table 8 to those of Table 13. This is our forecast. We expect to see about an average hurricane season, but more active than the average hurricane season of the last 25 years and especially more active than the suppressed conditions of 1990-94.

Table 13: Summary of 6 June 1996 seasonal hurricane forecast.

Forecast Parameter	Total Seasonal Activity	Percent of 1950-1990 Average
Named Storms (NS)	10	108
Named Storm Days (NSD)	45	98
Hurricanes (H)	6	107
Hurricane Days (HD)	20	87
Intense Hurricanes (IH)	2	95
Intense Hurricane Days (IHD)	5	111
Hurricane Destruction Potential (HDP)	60	88
Net Tropical Cyclone Activity (NTC)	95%	95
Maximum Potential Destruction (MPD)	60	91

Table 14 compares our current forecast with our earlier 30 November and 4 April forecasts. Table 15 gives a comparison with respect to the last three years and with multi-decadal earlier periods.

8 Likely Increase of Landfalling Major Hurricanes in Coming Decades

There has been a great lull in the incidence of intense category 3-4-5 hurricanes striking the US East Coast, Florida and Caribbean basin (except for 1995) during the last 25 years. We see this trend as a natural consequence of the slowdown in the Atlantic Ocean (thermohaline)

Table 14: Comparison of current, 6 June 1996, seasonal predictions with the 1996 seasonal predictions made on 30 November 1995 and 4 April 1996.

Forecast Parameter	30 Nov. 1995 Fcst	5 April Fcst.	Current 6 June Fcst.
Named Storms (NS)	8	11	10
Named Storm Days (NSD)	40	55	45
Hurricanes (H)	5	7	6
Hurricane Days (HD)	20	25	20
Intense Hurricanes (IH)	2	2	2
Intense Hurricane Days (IHD)	5	5	5
Hurricane Destruction Potential (HDP)	50	75	60
Net Tropical Cyclone Activity (NTC)	80%	105%	95%
Maximum Potential Destruction (MPD)	55	66	60

Table 15: Comparison of early June 1996 seasonal prediction with activity in previous years.

	6 June Forecast 1996	Observed 1995	1994	1993	Average Season 1970-87	Average Season 1950-69	Ave. (1950-90)
Hurricanes (H)	6	11	3	4	4.9	6.5	5.7
Named Storms (NS)	10	19	7	8	8.3	9.8	9.3
Hurricane Days (HD)	20	62	7	10	15.5	30.7	23.0
Named Storm Days (NSD)	45	121	28	30	37.3	53.4	46.1
Hurr. Dest. Pot. (HDP)	60	172	15	23	42.7	100.0	68.1
Intense Hurricanes (Cat. 3-4-5) (IH)	2	5	0	1	1.6	3.4	2.1
Intense Hurricane Days (IHD)	5	11	0	0.75	2.1	8.8	4.5
Net Tropical Cyclone Activity (NTC)	95%	243%	37%	55%	73%	123%	100%
Maximum Potential Destruction (MPD)	60	110					66

Conveyor Belt circulation which appears to be responsible for a long list of concurrent global circulation and rainfall pattern changes during the last quarter century. This includes the Sahel drought, increased El Nino activity, Pacific and Atlantic middle latitude zonal wind increases among numerous other changes. Both historical and geological (proxy) records indicate that this lull in major hurricane activity is not likely to continue much longer; a return of increased major landfalling hurricane activity should be expected within the next decade or so. More research on the causes and the likely timing of this change-over to decades long period of increased intense hurricane activity is desperately needed. Increased intense hurricane activity striking US coastal areas is an assured threat to the US; hence, much more so than earthquakes, greenhouse gas warming and other environmental problems which are receiving comparatively much greater attention.

Changes in the North Atlantic. We may now be seeing the early stages of an enhanced Atlantic thermohaline (Conveyor Belt) circulation from its recent three decade long slow down. There are reports of a large decrease in ice flow through the Fram Strait (the North Atlantic passage between Greenland and Spitzbergen) which reduces the introduction of fresh water and, thereby, increases surface salinity values in the North Atlantic. Recent observations report increased surface water salinity in the deep water formation areas of the North Atlantic during the last couple of years. Rising salinity increases water density. Chilling of high salinity surface water then creates very dense water which is able to sink to great depth, thereby causing increased equatorward flow of deep dense water and engendering a northward flow of warm near surface replacement water; hence - the Atlantic Ocean conveyor. A strong conveyor increases North Atlantic water temperatures and thus transports more heat to high latitudes.

The salinity contents 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. The surface salinity increases that are now being measured in the North Atlantic will likely lead to greater Atlantic Ocean thermohaline circulation in the next few years. When this occurs, we anticipate a concurrent general increase in 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 regional North Atlantic measurements may thereby be an ominous sign of future increases in US and Caribbean basin landfalling hurricane activity.

Outlook for 1997. Baring the development of an El Niño event during the second half of next year, it is likely 1997 will see above average hurricane activity. The QBO will most likely be from the west and the severe drought conditions in the Western Sahel (which have occurred over most of the last 25 years) appear likely to be alleviated somewhat. These trends should enhance the prospects for intense hurricane activity during 1997. Also, Atlantic SST and salinity patterns are beginning to indicate the possibility of a speeding up of the Atlantic Ocean thermohaline circulation which may also enhance 1997 hurricane activity over that expected for 1996.

9 Coming Early August Updated Forecast

The last of our four forecasts of the coming 1996 hurricane season will be issued on Wednesday 7 August 1996 just before the start of the most active part of the hurricane season.

10 Cautionary Note

It is important that the reader appreciate that these seasonal forecasts are based on statistical schemes which, owing to this intrinsically probabilistic nature, must fail in some years. Moreoever, these forecasts do not specifically predict where within the Atlantic basin storms will strike. Even if 1996 should prove to be a below average hurricane season, there are no assurances that one or more hurricanes will not strike along the US or Caribbean Basin coastline and do much damage.

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APPENDIX A - YEARLY LISTINGS OF NTC and MPD

Measures of seasonal tropical cyclone activity include seasonal totals for named storms (NS), hurricanes (H), intense (or major) hurricanes (IH), named storm days (NSD), hurricane days (HD), intense hurricane days (IHD), and hurricane destruction potential (HDP). Definitions of these hurricane activity indices are given at the beginning of this report. More detailed information is contained in Gray et al. (1992, 1994) and in Landsea (1993). In view of this complexity, it is desirable to define a single number which provides a simple but comprehensive expression of net season tropical cyclone activity in terms of a percentage difference from a long term mean. To this end, we propose a new parameter of seasonal activity termed the "Net Tropical Cyclone activity" (NTC) which is defined as:

$$NTC = (\%NS + \%H + \%IH + \%NSD + \%HD + \%IHD)/6$$

where each of six of the percentage departure values from the long term means are used as component measures of seasonal activity. The resulting NTC value is useful as a measure of seasonal tropical cyclone activity because it combines most of the other tropical cyclone parameters of interest into a single index. There are many seasons during which a single parameter, as for example, the number of hurricanes, is not well representative of the actual character of the overall tropical cyclone activity for that year. This single NTC index has the highest forecast skill. Table 11 lists the values of NTC for 1950-1994.

Table 16: Listing of Seasonal Net Tropical Cyclone activity (NTC) values between 1950-1994.

Year	NTC (%)	MPD	Year	NTC (%)	MPD	Year	NTC (%)	MPD
1950	237	130	1965	85	38	1980	134	86
1951	119	80	1966	138	65	1981	112	70
1952	96	59	1967	96	54	1982	36	29
1953	119	81	1968	40	28	1983	31	22
1954	128	66	1969	154	120	1984	77	53
1955	195	103	1970	63	57	1985	109	73
1956	68	46	1971	94	72	1986	38	29
1957	84	46	1972	28	22	1987	47	28
1958	137	82	1973	51	39	1988	122	82
1959	97	59	1974	75	50	1989	135	78
1960	96	53	1975	91	65	1990	101	65
1961	218	106	1976	83	51	1991	59	43
1962	33	30	1977	46	44	1992	66	48
1963	115	61	1978	85	60	1993	53	33
1964	165	88	1979	94	59	1994	36	31
						1995	229	108

MAXIMUM POTENTIAL DESTRUCTION (MPD)

Maximum Potential Destruction (MPD) is computed as the seasonal total of the squared values of each cyclone's peak maximum wind. Squared wind velocities better indicate the amount of damage that tropical cyclones can inflict upon property than do the winds themselves (Landsea 1993). The previously utilized HDP includes a component of duration into a similar calculation, while this new MPD parameter is confined to the sum of the squared peak wind velocities and has no duration linked component. Values of NTC and MPD are given in Table 16.

APPENDIX B: Verification of All Past Seasonal Forecasts

The first author has now issued seasonal hurricane forecasts for the last 12 years. In most of the prior forecasts, predictions have been superior to climatology, which was previously the only way to estimate future hurricane activity (see Table 16). The eight late May and early June seasonal forecasts for 1985, 1986, 1987, 1988, 1991, 1992, 1994 and 1995 were more accurate than climatology. The forecasts for 1984 and 1990 were only marginally successful and the two seasonal forecasts for 1989 and 1993 were failures. The 1989 forecast was a failure because of processes associated with the excessive amounts of rainfall which fell in the Western Sahel that year. Prior to 1990, our seasonal forecast did not include African rainfall as a predictor. We have corrected this important omission and forecasts since 1990 have incorporated Western Sahel rainfall estimates and we have developed a new Sahel rainfall prediction scheme. The failure of the 1993 seasonal forecast is attributed to our failure to anticipate the resurgence of El Niño conditions. In particular, the first author failed to anticipate the re-emergence of stronger El Niño conditions after the middle of August 1993. It is very unusual to have an El Niño last so long as the recent 1991-94 event. This failure motivated us to develop a new extended range ENSO prediction scheme, which is used as a quantitative first guess as to upcoming El Niño conditions.

Table 17: Verification of the authors' previous seasonal predictions of Atlantic tropical cyclone activity for 1984-1995.

1984	Prediction of 24 May and 30 July Update		Observed
No. of Hurricanes	7		5
No. of Named Storms	10		12
No. of Hurricane Days	30		18
No. of Named Storm Days	45		51
1985	**Prediction of 28 May**	**Updated Prediction of 27 July**	**Observed**
No. of Hurricanes	8	7	7
No. of Named Storms	11	10	11
No. of Hurricane Days	35	30	21
No. of Named Storm Days	55	50	51
1986	**Prediction of 29 May**	**Updated Prediction of 28 July**	**Observed**
No. of Hurricanes	4	4	4
No. of Named Storms	8	7	6
No. of Hurricane Days	15	10	11
No. of Named Storm Days	35	25	23
1987	**Prediction of 26 May**	**Updated Prediction of 28 July**	**Observed**
No. of Hurricanes	5	4	3
No. of Named Storms	8	7	7
No. of Hurricane Days	20	15	5
No. of Named Storm Days	40	35	37
1988	**Prediction of 26 May and 28 July Update**		**Observed**
No. of Hurricanes	7		5
No. of Named Storms	11		12
No. of Hurricane Days	30		21
No. of Named Storm Days	50		47
Hurr. Destruction Potential(HDP)	75		81
1989	**Prediction of 26 May**	**Updated Prediction of 27 July**	**Observed**
No. of Hurricanes	4	4	7
No. of Named Storms	7	9	11
No. of Hurricane Days	15	15	32
No. of Named Storm Days	30	35	66
Hurr. Destruction Potential(HDP)	40	40	108
1990	**Prediction of 5 June**	**Updated Prediction of 3 August**	**Observed**
No. of Hurricanes	7	6	8
No. of Named Storms	11	11	14
No. of Hurricane Days	30	25	27
No. of Named Storm Days	55	50	66
Hurr. Destruction Potential(HDP)	90	75	57
Major Hurricanes (Cat. 3-4-5)	3	2	1
Major Hurr. Days	Not Fcst.	5	1.00

1991	Prediction of 5 June	Updated Prediction of 2 August	Observed
No. of Hurricanes	4	3	4
No. of Named Storms	8	7	8
No. of Hurricane Days	15	10	8
No. of Named Storm Days	35	30	22
Hurr. Destruction Potential(HDP)	40	25	22
Major Hurricanes (Cat. 3-4-5)	1	0	2
Major Hurr. Days	2	0	1.25

1992	Prediction of 26 Nov 1991	Updated Prediction of 5 June	Updated Prediction of 5 August	Observed
No. of Hurricanes	4	4	4	4
No. of Named Storms	8	8	8	6
No. of Hurricane Days	15	15	15	16
No. of Named Storm Days	35	35	35	39
Hurr. Destruction Potential(HDP)	35	35	35	51
Major Hurricanes (Cat. 3-4-5)	1	1	1	1
Major Hurr. Days	2	2	2	3.25

1993	Prediction of 24 Nov 1992	Updated Prediction of 4 June	Updated Prediction of 5 August	Observed
No. of Hurricanes	6	7	6	4
No. of Named Storms	11	11	10	8
No. of Hurricane Days	25	25	25	10
No. of Named Storm Days	55	55	50	30
Hurr. Destruction Potential(HDP)	75	65	55	23
Major Hurricanes (Cat. 3-4-5)	3	2	2	1
Major Hurr. Days	7	3	2	0.75

1994	Prediction of 19 Nov 1993	Updated Prediction of 5 June	Updated Prediction of 4 August	Observed
No. of Hurricanes	6	5	4	3
No. of Named Storms	10	9	7	7
No. of Hurricane Days	25	15	12	7
No. of Named Storm Days	60	35	30	28
Hurr. Destruction Potential(HDP)	85	40	35	15
Major Hurricanes (Cat. 3-4-5)	2	1	1	0
Major Hurr. Days	7	1	1	0
Net Trop. Cyclone Activity	110	70	55	36

1995	Prediction of 30 Nov 1994	14 April Qualit. Adjust.	Updated Prediction of 7 June	Updated Prediction 4 August	Obs.
No. of Hurricanes	8	6	8	9	11
No. of Named Storms	12	10	12	16	19
No. of Hurricane Days	35	25	35	30	62
No. of Named Storm Days	65	50	65	65	121
Hurr. Destruction Potential(HDP)	100	75	110	90	173
Major Hurricanes (Cat. 3-4-5)	3	2	3	3	5
Major Hurr. Days	8	5	6	5	11.5
Net Trop. Cyclone Activity	140	100	140	130	229