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## NOAA: 2010 Atlantic Hurricane Season Outlook

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[Atlantic Hurricane Outlook &  
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The 2010 Atlantic hurricane season outlook is an official product of the National Oceanic and Atmospheric Administration (NOAA) Climate Prediction Center (CPC). The outlook is produced in collaboration with scientists from the National Hurricane Center (NHC), and the Hurricane Research Division (HRD). The Atlantic hurricane region includes the North Atlantic Ocean, Caribbean Sea, and Gulf of Mexico.

### **Interpretation of NOAA's Atlantic seasonal hurricane outlook**

This outlook is general guide to the expected overall activity during the upcoming hurricane season. It is not a seasonal hurricane landfall forecast, and it does not predict levels of activity for any particular region.

### **Preparedness**

Hurricane disasters can occur whether the season is active or relatively quiet. It only takes one hurricane (or tropical storm) to cause a disaster. Residents, businesses, and government agencies of coastal and near-coastal regions are urged to prepare for every hurricane season regardless of this, or any other, seasonal outlook. NOAA, the Federal Emergency Management Agency (FEMA), the NHC, the Small Business Administration, and the American Red Cross all provide important hurricane preparedness information on their web sites.

### **NOAA does NOT make seasonal hurricane landfall predictions**

NOAA does not make seasonal hurricane landfall predictions. Hurricane landfalls are largely determined by the weather patterns in place as the hurricane approaches, which are only predictable when the storm is within several days of making landfall.

### **Nature of this Outlook and the "likely" ranges of activity**

This outlook is probabilistic, meaning the stated "likely" ranges of activity have a certain likelihood of occurring. The seasonal activity is expected to fall within these ranges in 7 out of 10 seasons with similar climate conditions and uncertainties to those expected this year. They do not represent the total possible ranges of activity seen in past similar years.

This outlook is based on 1) predictions of large-scale climate factors and

conditions known to be strong indicators of seasonal Atlantic hurricane activity, and 2) promising new climate models that are now beginning to directly predict seasonal hurricane activity.

### **Sources of uncertainty in this seasonal outlook**

1. Predicting El Niño and La Niña (also called ENSO) impacts is an ongoing scientific challenge facing climate scientists today. Such forecasts made during the spring generally have limited skill.
2. Many combinations of named storms and hurricanes can occur for the same general set of climate conditions. For example, one cannot know with certainty whether a given climate signal will be associated with several short-lived storms or fewer longer-lived storms with greater intensity.
3. Model predictions of sea-surface temperatures, vertical wind shear, moisture, and stability have limited skill this far in advance of the peak months (August-October) of the hurricane season.
4. Weather patterns that are unpredictable on seasonal time scales can sometimes develop and last for weeks or months, possibly affecting seasonal hurricane activity.

### **2010 Atlantic Hurricane Season Outlook: Summary**

NOAA's [2010 Atlantic Hurricane Season Outlook](#) calls for an 85% chance of an above normal season. The outlook indicates only a 10% chance of a near-normal season and a 5% chance of a below-normal season. See [NOAA definitions](#) of above-, near-, and below-normal seasons. The Atlantic hurricane region includes the North Atlantic Ocean, the Caribbean Sea, and the Gulf of Mexico.

[This outlook reflects an expected set of conditions](#) that is very conducive to increased Atlantic hurricane activity. This expectation is based on the prediction of three climate factors, all of which are conducive historically to increased tropical cyclone activity. These climate factors are: 1) the tropical multi-decadal signal, which has contributed to the high-activity era in the Atlantic basin that began in 1995, 2) exceptionally warm sea surface temperatures in the tropical Atlantic Ocean and Caribbean Sea (called the Main Development Region), and 3) either ENSO-neutral or La Niña conditions in the tropical Pacific, with La Niña becoming increasingly likely. In addition, dynamical models forecasts of the number and strength of tropical cyclones also predict a very active season.

The conditions expected this year have historically produced some very active Atlantic hurricane seasons. The 2010 hurricane season could see activity comparable to a number of extremely active seasons since 1995. If the 2010 activity reaches the upper end of our predicted ranges, it will be one of the most active seasons on record.

We estimate a 70% probability for each of the following ranges of activity this

season:

- 14-23 Named Storms,
- 8-14 Hurricanes
- 3-7 Major Hurricanes
- An ACE range of 155%-270% of the median.

The seasonal activity is expected to fall within these ranges in 7 out of 10 seasons with similar climate conditions and uncertainties to those expected this year. They do not represent the total possible ranges of activity seen in past similar years.

#### Hurricane Landfalls:

It only takes one storm hitting your area to cause a disaster, regardless of the activity predicted in the seasonal outlook. Therefore, residents, businesses, and government agencies of coastal and near-coastal regions are urged to prepare every hurricane season regardless of this, or any other, seasonal outlook.

While NOAA does not make an official seasonal hurricane landfall outlook, the historical probability for multiple U.S. hurricane strikes, and for multiple hurricane strikes in the region around the Caribbean Sea, increases sharply for exceptionally active (i.e. hyperactive) seasons (ACE > 175% of median). However, predicting where and when hurricanes will strike is related to daily weather patterns, which are not predictable weeks or months in advance. Therefore, it is currently not possible to reliably predict the number or intensity of landfalling hurricanes at these extended ranges, or whether a given locality will be impacted by a hurricane this season.

## **DISCUSSION**

### 1. Expected 2010 activity

Known climate signals and evolving oceanic and atmospheric conditions, combined with dynamical model forecasts, indicate a high likelihood of above normal activity during the 2010 Atlantic hurricane season. This outlook calls for an 85% chance of an above-normal season, only a 10% chance of a near-normal season, and a 5% chance of a below normal season.

An important measure of the total overall seasonal activity is the NOAA [Accumulated Cyclone Energy \(ACE\) index](#), which accounts for the intensity and duration of named storms and hurricanes during the season. We estimate a 70% chance that the 2010 seasonal ACE range will be 155%-270% of the median. According to [NOAA's hurricane season classifications](#), an ACE value above 117% of the 1950-2000 median reflects an above-normal season. An ACE value above 175% of the median reflects an exceptionally active (or hyperactive) season.

Consistent with the expected ACE range, the 2010 Atlantic hurricane season is expected (with 70% chance) to produce 14-23 named storms, 8-14

hurricanes, and 3-7 major hurricanes. Therefore, this season could see activity comparable to a number of extremely active seasons since 1995. If the 2010 activity reaches the upper end of our predicted ranges, it will be one of the most active seasons on record.

For the U.S. and the region around the Caribbean Sea, the historical probability of a hurricane strike generally increases with increasing seasonal activity. During exceptionally active seasons, the historical probabilities increase markedly for multiple hurricane strikes in these regions. Nonetheless, predicting the location, number, timing, and strength, of hurricanes landfalls is ultimately related to the daily weather patterns, which are not predictable weeks or months in advance. As a result, it is currently not possible to reliably predict the number or intensity of landfalling hurricanes at these extended ranges, or whether a given locality will be impacted by a hurricane this season. Therefore, NOAA does not make an official seasonal hurricane landfall outlook.

Because of the ongoing oil crisis in the Gulf of Mexico, we are including some historical statistics of tropical cyclone activity for this region (excluding the Bay of Campeche) based on past above normal seasons. These statistics do not represent an explicit forecast for tropical cyclones in the Gulf of Mexico during 2010, as it is impossible to reliably predict such activity so far in advance. Historically, all above normal seasons have produced at least one named storm in the Gulf of Mexico, and 95% of those seasons have at least two named storms in the Gulf. Most of this activity (80%) occurs during August-October. However, 50% of above normal seasons have had at least one named storm in the region during June-July.

## 2. Science behind the 2010 Outlook

The 2010 Atlantic hurricane season outlook primarily reflects [an expected set of conditions during the peak months \(August-October\) of the season](#) that is very conducive to increased Atlantic hurricane activity. This expectation is based on the prediction of three climate factors, all of which are conducive historically to increased tropical cyclone activity. These climate factors are: 1) [the tropical multi-decadal signal](#), which has contributed to the ongoing high-activity era for Atlantic hurricanes that began in 1995, 2) a continuation of exceptionally warm sea surface temperatures (SSTs) in the Main Development Region (MDR, which includes the Caribbean Sea and tropical Atlantic ocean between 9°N-21.5°N; Goldenberg et al. 2001), and 3) either ENSO-neutral or La Niña conditions, with La Niña becoming increasingly likely.

The outlook also takes into account dynamical model predictions from new models such as the NOAA Climate Forecast System (CFS), the European Centre for Medium Range Weather Forecasting (ECMWF), the United Kingdom Meteorology (UKMET) office model, and the EUROpean Seasonal to Inter-annual Prediction (EUROSIP) ensemble. All of these models are indicating a high likelihood of an extremely active season.

### *a. Expected continuation of tropical multi-decadal signal*

One primary factor guiding this outlook is an expected continuation of the tropical multi-decadal signal, which has contributed to the current high-activity era in the Atlantic basin that began in 1995. This signal is associated with a coherent set of atmospheric conditions, all of which are conducive to increased Atlantic hurricane activity.

During 1995-2009, some key aspects of the tropical multi-decadal signal within the MDR have included warmer than average SSTs, [reduced vertical wind shear and weaker easterly trade winds](#), below-average sea-level pressure, and a configuration of the African easterly jet that is more conducive to hurricane development from tropical waves moving off the African coast. Many of these atmospheric features typically become evident during late April and May, as the atmosphere across the tropical Atlantic and Africa begins to transition into its summertime monsoon state.

[Several of these conditions are now present](#), and they are expected to persist through the hurricane season because we anticipate they are linked in part to the tropical multi-decadal signal. These conditions include 1) weaker (i.e. anomalous westerly) trade winds in the lower atmosphere, anomalous easterly winds in the upper atmosphere, anticyclonic circulation (i.e. streamfunction) anomalies in the upper atmosphere in both hemispheres, and reduced vertical wind shear.

It is impossible to know with certainty whether the multi-decadal signal is indeed continuing during 2010, and current climate models cannot skillfully forecast the multi-decadal variability of the Atlantic climate system. Nonetheless, given that key anomaly patterns now present have also been present for the past 15 years, and have previously been linked to the tropical multi-decadal signal, it is reasonable to expect that they are again linked to this signal. If so, this would reflect a continuation of the active Atlantic phase of the tropical multi-decadal signal that began in 1995.

#### *b. Above average SSTs in the Main Development Region*

The second factor guiding the outlook is the expectation of above-average to near-record SSTs in the MDR during August-October. It is very possible that the SST anomalies will be much larger than that typically associated with the multi-decadal signal. [Record warm SSTs are now present in the MDR](#), with departures exceeding +1.5°C nearly everywhere east of the Caribbean Islands. [Record warm temperatures were also present during March and April](#), with area-averaged departures of +1.3°C observed in April. This monthly value is much larger than the previous record departure of +0.95°C seen in 1958. [This warmth is much larger than anywhere else in the global tropics](#), and is further indication that climate conditions are favorable for hurricane development in the Atlantic basin.

A set of factors likely combined to produce the record warmth now in the Atlantic. Based on the observations, the likely cause of the extreme Atlantic warming is [a pronounced weakening of the northeasterly trade winds](#) that led to a sharp increase in Atlantic SSTs during February and March. This increase

occurred in combination with the typical warming associated with El Niño. It is also superimposed upon the background warming associated with the warm Atlantic phase of the multi-decadal signal that has been in place since 1995, and with longer term trends.

Based on the observations, a key to the development of this record warmth was a sharp increase in SST anomalies during February and March, in response to a significant [weakening of the normal northeasterly trade winds](#) and low-level ridge over the eastern tropical Atlantic north of the MDR. These overall anomaly patterns are consistent with El Niño (Knaff 1997, Chelliah and Bell 2004). However, their amplitude is more strongly related to a persistent upper-level jet stream pattern that featured blocking activity at high-latitudes of the North Atlantic and a [strong jet stream](#) across the southern North Atlantic. This pattern was associated with a persistent [negative North Atlantic Oscillation and positive East Atlantic circulation pattern](#), which at times was linked to a hemispheric circulation pattern called the negative phase of the Arctic Oscillation.

Two other instances of very warm SSTs have been observed in the MDR during February-April (1958 and 1969). In both years, the SST anomaly subsequently decreased by roughly 50% during the summer months. For 2010, although the record SST departures may well decrease somewhat, we still expect a continuation of above average SSTs throughout the Atlantic hurricane season. This outlook is consistent with the current (and expected) pattern of [reduced trade winds across the tropical Atlantic](#) in association with the expected tropical multi-decadal signal. However, it is very possible that the SST departures will be much larger than that associated with the multi-decadal signal. Several climate models are predicting either near-record or record SSTs in the MDR during August-October.

### *c. ENSO-Neutral or La Niña*

Another climate factor known to significantly impact Atlantic hurricane activity is the El Niño/ Southern Oscillation (ENSO). The three phases of ENSO are El Niño, La Niña, and Neutral. El Niño tends to suppress Atlantic hurricane activity, while La Niña tends to enhance it (Gray 1984). These typical impacts can be strongly modulated by conditions associated with a low- or high-activity era. We expect either Neutral or La Niña conditions during the 2010 Atlantic hurricane season, with La Niña now becoming increasingly likely.

The El Niño episode, which contributed to the below normal Atlantic hurricane season last year, has dissipated. [Conditions in the equatorial Pacific Ocean](#) are becoming increasingly favorable for the development of La Niña. Also, in the upper atmosphere [the pattern of circulation \(i.e. streamfunction\) anomalies during the last 30 days](#), and the last 60 days, indicates cyclonic anomalies in the central subtropical Pacific of both hemispheres (blue shading in NH, red shading in SH). This pattern suggests that the atmosphere has already transitioned out of its El Niño state observed last winter and early spring.

All [ENSO forecast models](#) currently predict either Neutral or La Niña

conditions during the Atlantic hurricane season. During the last few months, the models have been increasingly indicating the development of La Niña during the summer. La Niña contributes to reduced vertical wind shear over the western tropical Atlantic which, when combined with conditions associated with the ongoing high activity era and warm Atlantic SSTs, increases the probability of an exceptionally active Atlantic hurricane season (Bell and Chelliah 2006). NOAA's high-resolution CFS model indicates the development of La Niña-like circulation and precipitation anomalies during July.

### 3. Further analysis of the Ongoing High Activity Era in the Atlantic Basin

Atlantic hurricane seasons exhibit [extended periods lasting decades](#) of generally above-normal or below-normal activity. These fluctuations in hurricane activity result almost entirely from differences in the number of hurricanes and major hurricanes forming from tropical storms first named in the MDR.

The current high-activity era has been in place since 1995. Hurricane seasons during 1995-2009 have averaged about 14.5 named storms, 8 hurricanes, and 4 major hurricanes, with an average ACE index of 160% of the median. NOAA classifies ten of the fifteen seasons since 1995 as above normal, with seven being hyperactive (ACE > 175% of median). Only five seasons since 1995 have not been above normal, which include four El Niño years (1997, 2002, 2006, and 2009) and the 2007 season.

This high level of activity since 1995 contrasts sharply to the low-activity era of 1971-1994 (Goldenberg et al. 2001), which averaged only 8.5 named storms, 5 hurricanes, and 1.5 major hurricanes, and had an average ACE index of only 75% of the median. One-half of the seasons during this low-activity era were below normal, only three were above normal (1980, 1988, 1989), and none were hyperactive.

Within the MDR, the atmospheric circulation anomalies that contribute to these long-period fluctuations in hurricane activity are strongly linked to the [Tropics-wide multi-decadal signal](#) (Bell and Chelliah 2006). A change in the phase of the multi-decadal signal coincides with the transition in 1995 from a low-activity era to the current high-activity era.

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