



April Forecast Update for Atlantic Hurricane Activity in 2011

Issued: 4th April 2011

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Forecast Summary

TSR lowers its forecast and predicts the 2011 hurricane season will see activity approximately 25% above the long-term (1950-2010) norm. Users should note that the precision of TSR's April outlook for Atlantic hurricane activity since 1980 is fairly low.

The TSR (Tropical Storm Risk) April forecast update for Atlantic hurricane activity in 2011 anticipates an active hurricane season to moderate probability. Based on current and projected climate signals, Atlantic basin and US landfalling tropical cyclone activity are forecast to be about 25% above the 1950-2010 norm in 2011. There is a moderate (55%) likelihood that activity will be in the top one-third of years historically. The forecast spans the period from 1st June to 30th November 2011 and employs data through to the end of March 2011. TSR's two predictors are the forecast July-September 2011 trade wind speed over the Caribbean and tropical North Atlantic, and the forecast August-September 2011 sea surface temperature in the tropical North Atlantic. At present TSR anticipates the trade wind predictor having a moderate enhancing effect on activity and the sea surface temperature having a neutral effect.

Atlantic ACE Index and System Numbers in 2011

| | | ACE Index | Intense Hurricanes | Hurricanes | Tropical Storms |
|-------------------------------|-----------|-----------------|--------------------|------------------|-------------------|
| TSR Forecast (\pm FE) | 2011 | 124 (\pm 56) | 3.6 (\pm 1.6) | 7.5 (\pm 2.8) | 14.2 (\pm 3.9) |
| 61yr Climate Norm (\pm SD) | 1950-2010 | 102 (\pm 60) | 2.7 (\pm 1.9) | 6.2 (\pm 2.7) | 10.5 (\pm 4.1) |
| Forecast Skill at this Lead | 1980-2010 | 17% | 10% | 11% | 13% |

- Key: ACE Index = Accumulated Cyclone Energy Index = Sum of the Squares of 6-hourly Maximum Sustained Wind Speeds (in units of knots) for all Systems while they are at least Tropical Storm Strength. ACE Unit = $\times 10^4$ knots².
- Intense Hurricane = 1 Minute Sustained Wind > 95Kts = Hurricane Category 3 to 5.
 Hurricane = 1 Minute Sustained Wind > 63Kts = Hurricane Category 1 to 5.
 Tropical Storm = 1 Minute Sustained Wind > 33Kts.
 SD = Standard Deviation.
 FE (Forecast Error) = Standard Deviation of Errors in Replicated Real Time Forecasts 1980-2010.
 Forecast Skill = Percentage Improvement in Mean Square Error over Running 10-year Prior Climate Norm from Replicated Real Time Forecasts 1980-2010.

There is a 55% probability that the 2011 Atlantic hurricane season ACE index will be above average (defined as an ACE index value in the upper tercile historically (>117)), a 28% likelihood it will be near-normal (defined as an ACE index value in the middle tercile historically (71 to 117)) and a 17% chance it will be below-normal (defined as an ACE index value in the lower tercile historically (<71)). The 61-year period 1950-2010 is used for climatology.

- Key: Terciles = Data groupings of equal (33.3%) probability corresponding to the upper, middle and lower one-third of values historically (1950-2010).
 Upper Tercile = ACE index value greater than 117.
 Middle Tercile = ACE index value between 71 and 117.
 Lower Tercile = ACE index value less than 71.

ACE Index & Numbers Forming in the MDR, Caribbean Sea and Gulf of Mexico in 2011

| | | ACE Index | Intense Hurricanes | Hurricanes | Tropical Storms |
|-------------------------------|-----------|-----------------|-----------------------|------------------|--------------------|
| TSR Forecast (\pm FE) | 2011 | 100 (\pm 53) | 3.3 (\pm 1.5) | 5.4 (\pm 2.4) | 9.3 (\pm 3.3) |
| 61yr Climate Norm (\pm SD) | 1950-2010 | 80 (\pm 59) | 2.4 (\pm 1.8) | 4.4 (\pm 2.5) | 7.3 (\pm 3.5) |
| Forecast Skill at this Lead | 1980-2010 | 18% | 14% | 19% | 18% |

The Atlantic hurricane Main Development Region (MDR) is the region 10°N - 20°N, 20°W - 60°W between the Cape Verde Islands and the Caribbean Lesser Antilles. A storm is defined as having formed within this region if it reached at least tropical depression status while in the area.

There is a 56% probability that in 2011 the MDR, Caribbean Sea and Gulf of Mexico ACE index will be above average (defined as an ACE index value in the upper tercile historically (>92)), a 30% likelihood it will be near-normal (defined as an ACE index value in the middle tercile historically (43 to 92)) and a 14% chance it will be below-normal (defined as an ACE index value in the lower tercile historically (<43)). The 61-year period 1950-2010 is used for climatology.

USA Landfalling ACE Index and Numbers in 2011

| | | ACE Index | Hurricanes | Tropical Storms |
|-------------------------------|-----------|------------------|------------------|--------------------|
| TSR Forecast (\pm FE) | 2011 | 3.1 (\pm 2.1) | 1.9 (\pm 1.5) | 4.4 (\pm 2.2) |
| 61yr Climate Norm (\pm SD) | 1950-2010 | 2.4 (\pm 2.2) | 1.5 (\pm 1.3) | 3.1 (\pm 2.0) |
| Forecast Skill at this Lead | 1980-2010 | 8% | 9% | 7% |

Key: ACE Index = Accumulated Cyclone Energy Index = Sum of the Squares of hourly Maximum Sustained Wind Speeds (in units of knots) for all Systems while they are at least Tropical Storm Strength and over the USA Mainland (reduced by a factor of 6). ACE Unit = $\times 10^4$ knots².

Landfall Strike Category = Maximum 1 Minute Sustained Wind of Storm Directly Striking Land.
USA Mainland = Brownsville (Texas) to Maine.

USA landfalling intense hurricanes are not forecast since we have no skill at any lead.

There is a 59% probability that in 2011 the USA landfalling ACE index will be above average (defined as a USA ACE index value in the upper tercile historically (>2.61)), a 26% likelihood it will be near-normal (defined as a USA ACE index value in the middle tercile historically (1.15 to 2.61)) and a 15% chance it will be below-normal (defined as a USA ACE index value in the lower tercile historically (<1.15)). The 61-year period 1950-2010 is used for climatology.

Caribbean Lesser Antilles Landfalling Numbers in 2011

| | | ACE Index | Intense Hurricanes | Hurricanes | Tropical Storms |
|-------------------------------|-----------|------------------|-----------------------|------------------|--------------------|
| TSR Forecast (\pm FE) | 2011 | 1.7 (\pm 2.0) | 0.3 (\pm 0.4) | 0.6 (\pm 0.6) | 1.3 (\pm 0.9) |
| 61yr Climate Norm (\pm SD) | 1950-2010 | 1.4 (\pm 2.0) | 0.2 (\pm 0.5) | 0.5 (\pm 0.7) | 1.1 (\pm 1.0) |
| Forecast Skill at this Lead | 1980-2010 | 2% | 2% | 14% | 0% |

Key: ACE Index = Accumulated Cyclone Energy Index = Sum of the Squares of hourly Maximum Sustained Wind Speeds (in units of knots) for all Systems while they are at least Tropical Storm Strength and within the boxed region (10°N-18°N, 60°W-63°W) (reduced by a factor of 6). ACE Unit = $\times 10^4$ knots².

Landfall Strike Category = Maximum 1 Minute Sustained Wind of Storm Directly Striking Land.
Lesser Antilles = Island Arc from Anguilla to Trinidad Inclusive.

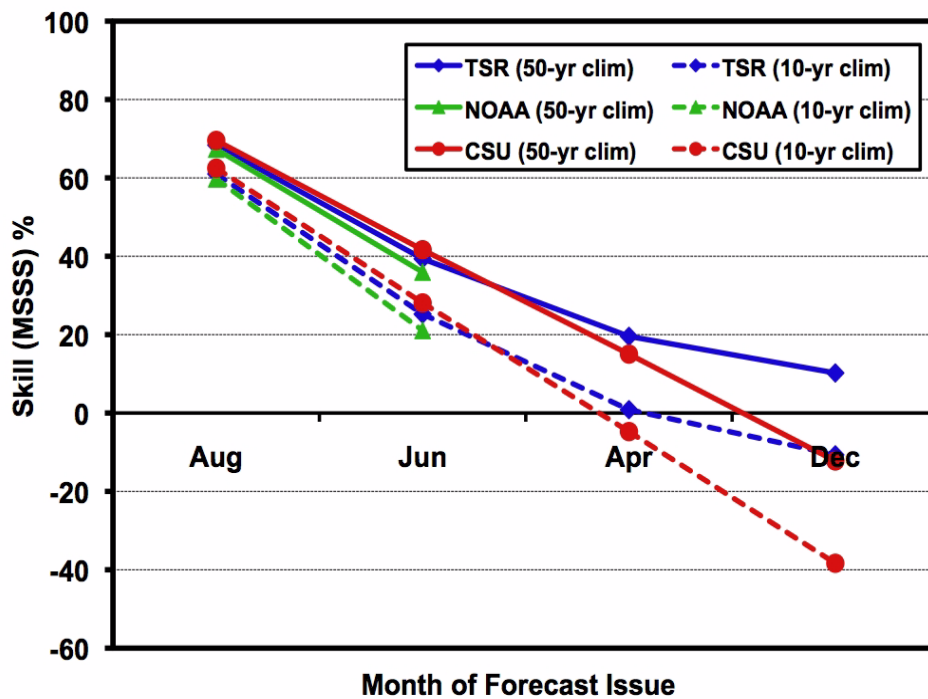
Key Predictors for 2011

The key factors behind the TSR forecast for an above-average hurricane season in 2011 are the anticipated moderate enhancing effect of July-September forecast trade winds at 925mb height over the Caribbean Sea and tropical North Atlantic region (7.5°N - 17.5°N, 30°W - 100°W), and the neutral effect of August-September forecast sea surface temperature (SST) for the Atlantic MDR (10°N - 20°N, 20°W - 60°W). The current forecasts for these predictors are $0.20 \pm 0.83 \text{ ms}^{-1}$ (down from the December forecast value of $0.70 \pm 0.83 \text{ ms}^{-1}$) weaker than normal (1980-2010 climatology) and $0.08 \pm 0.27^\circ\text{C}$ (down from the December forecast value of $0.27 \pm 0.29^\circ\text{C}$) warmer than normal (1980-2010 climatology). The forecast skills (assessed for the period 1980-2010) for both these predictors at this lead are 25% and 34% respectively. The TSR forecast has decreased since early December 2010 due primarily to the North Atlantic MDR sea surface temperatures in August-September now forecast to be cooler than before.

The July-September trade wind speed influences cyclonic vorticity (the spinning up of storms) in the main hurricane track region. The August-September MDR SST provides heat and moisture to power incipient storms in the main track region.

The Precision of Seasonal Hurricane Forecasts

The figure below shows the precision of seasonal North Atlantic hurricane forecasts as a function of issue month averaged over the last 10-year period 2001-2010.



Forecast precision is assessed using the Mean Square Skill Score (*MSSS*) which is the percentage improvement in mean square error over a climatological forecast. Positive skill indicates the model performs better than a climatology forecast, whilst negative skill indicates that it performs worse than climatology. The figure employs two different climatologies: a fixed 50-year (1950-1999) climatology and a running prior 10-year climate norm.

The figure compares the forecast skill of the TSR, NOAA (National Oceanic and Atmospheric Administration) and CSU (Colorado State University) seasonal hurricane outlooks for 2001-2010. NOAA does not issue seasonal outlooks before late May. It is clear that the skill of the extended range hurricane forecasts issued in early December, while positive, is low. Skill climbs slowly as the hurricane season approaches. Moderate skill levels are achieved in early June and good skill levels in early August.

In terms of forecast successes and failures in recent individual years, the 2004, 2005, 2008 and 2010

North Atlantic hurricane seasons were predicted to have ‘high activity’ (i.e. in the top one third of years historically) to high (60-70%) probability from the previous December. In contrast, the extended range and April forecasts for the 2006, 2007 and 2009 hurricane seasons were less impressive.

Users should be aware that the skill of TSR’s April forecasts for Atlantic hurricane activity over the last 30 years, while positive, is fairly low.

Further Information and Next Forecast

Further information about TSR forecasts, verifications and hindcast skill as a function of lead time may be obtained from the TSR web site <http://www.tropicalstormrisk.com>. The next TSR forecast update for the 2011 Atlantic hurricane season will be a pre-season forecast issued on the 24th May 2011.

Appendix - Predictions from Previous Months

1. Atlantic ACE Index and System Numbers

| Atlantic ACE Index and System Numbers 2011 | | | | | |
|---|------------|-----------------|-----------------------|------------------|--------------------|
| | | ACE Index | Named Tropical Storms | Hurricanes | Intense Hurricanes |
| Average Number (\pm SD) (1950-2010) | | 102 (\pm 60) | 10.5 (\pm 4.1) | 6.2 (\pm 2.7) | 2.7 (\pm 1.9) |
| TSR Forecasts (\pm FE) | 4 Apr 2011 | 124 (\pm 56) | 14.2 (\pm 3.9) | 7.5 (\pm 2.8) | 3.6 (\pm 1.6) |
| | 6 Dec 2010 | 141 (\pm 58) | 15.6 (\pm 4.3) | 8.4 (\pm 3.0) | 4.0 (\pm 1.7) |
| CSU Forecast | 8 Dec 2010 | 165 | 17 | 9 | 5 |

2. MDR, Caribbean Sea and Gulf of Mexico ACE Index and Numbers

| MDR, Caribbean Sea and Gulf of Mexico ACE Index and Numbers 2011 | | | | | |
|---|------------|-----------------|-----------------------|------------------|--------------------|
| | | ACE Index | Named Tropical Storms | Hurricanes | Intense Hurricanes |
| Average Number (\pm SD) (1950-2010) | | 80 (\pm 59) | 7.3 (\pm 3.5) | 4.4 (\pm 2.5) | 2.4 (\pm 1.8) |
| TSR Forecasts (\pm FE) | 4 Apr 2011 | 100 (\pm 53) | 9.3 (\pm 3.3) | 5.4 (\pm 2.4) | 3.3 (\pm 1.5) |
| | 6 Dec 2010 | 117 (\pm 55) | 10.7 (\pm 3.7) | 6.3 (\pm 2.6) | 3.7 (\pm 1.5) |

3. US ACE Index and Landfalling Numbers

| US Landfalling Numbers 2011 | | | | |
|--|------------|------------------|-----------------------|------------------|
| | | ACE Index | Named Tropical Storms | Hurricanes |
| Average Number (\pm SD) (1950-2010) | | 2.4 (\pm 2.2) | 3.1 (\pm 2.0) | 1.5 (\pm 1.3) |
| TSR Forecasts (\pm FE) | 4 Apr 2011 | 3.1 (\pm 2.1) | 4.4 (\pm 2.2) | 1.9 (\pm 1.5) |
| | 6 Dec 2010 | 3.6 (\pm 2.1) | 4.9 (\pm 2.2) | 2.1 (\pm 1.6) |

4. Lesser Antilles ACE Index and Landfalling Numbers

| Lesser Antilles Landfalling Numbers 2011 | | | | | |
|---|------------|------------------|-----------------------|------------------|--------------------|
| | | ACE Index | Named Tropical Storms | Hurricanes | Intense Hurricanes |
| Average Number (\pm SD) (1950-2010) | | 1.4 (\pm 2.0) | 1.1 (\pm 1.0) | 0.5 (\pm 0.7) | 0.2 (\pm 0.5) |
| TSR Forecasts (\pm FE) | 4 Apr 2011 | 1.7 (\pm 2.0) | 1.3 (\pm 0.9) | 0.6 (\pm 0.6) | 0.3 (\pm 0.4) |
| | 6 Dec 2010 | 2.0 (\pm 2.0) | 1.5 (\pm 0.9) | 0.7 (\pm 0.6) | 0.3 (\pm 0.4) |

