



August Forecast Update for Atlantic Hurricane Activity in 2010

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by Professor Mark Saunders and Dr Adam Lea
 Dept. of Space and Climate Physics, UCL (University College London), UK

Forecast Summary

TSR continues to predict an active or very active 2010 hurricane season with basin activity ~80% above the 1950-2009 long-term average.

The TSR (Tropical Storm Risk) August forecast update for Atlantic hurricane activity in 2010 anticipates an active hurricane season to high probability. Based on current and projected climate signals, Atlantic basin and US landfalling tropical cyclone activity are forecast to be ~80% above the 1950-2009 norm in 2010. There is a very high (89-96%) likelihood that activity will be in the top one-third of years historically. The forecast spans the period from 1st June to 30th November 2010 and employs data through to the end of July 2010. TSR's two predictors are the forecast July-September 2010 trade wind speed over the Caribbean and tropical North Atlantic, and the forecast August-September 2010 sea surface temperature in the tropical North Atlantic. At present TSR anticipates both predictors having a moderate to strong enhancing effect on activity. US landfalling activity is predicted from the persistence of July steering winds (*Saunders and Lea, 2005*).

Atlantic ACE Index and System Numbers in 2010

		ACE Index	Intense Hurricanes	Hurricanes	Tropical Storms
TSR Forecast (\pm FE)	2010	183 (\pm 39)	4.5 (\pm 1.2)	9.7 (\pm 1.7)	17.8 (\pm 2.8)
60yr Climate Norm (\pm SD)	1950-2009	101 (\pm 60)	2.7 (\pm 1.9)	6.1 (\pm 2.6)	10.4 (\pm 4.0)
Forecast Skill at this Lead	1980-2009	57%	47%	64%	51%

- 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 1980-2009.
 Forecast Skill = Percentage Improvement in Mean Square Error over Running 10-year Prior Climate Norm from Replicated Real Time Forecasts 1980-2009.

There is a 96% probability that the 2010 Atlantic hurricane season ACE index will be above average (defined as an ACE index value in the upper tercile historically (>117)), only a 4% likelihood it will be near-normal (defined as an ACE index value in the middle tercile historically (71 to 117)) and no chance it will be below-normal (defined as an ACE index value in the lower tercile historically (<71)). The 60-year period 1950-2009 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 (1950-2009).
 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 2010

		ACE Index	Intense Hurricanes	Hurricanes	Tropical Storms
TSR Forecast (\pm FE)	2010	159 (\pm 42)	4.2 (\pm 1.1)	7.6 (\pm 1.5)	12.8 (\pm 2.4)
60yr Climate Norm (\pm SD)	1950-2009	79 (\pm 58)	2.4 (\pm 1.8)	4.3 (\pm 2.4)	7.1 (\pm 3.3)
Forecast Skill at this Lead	1980-2009	46%	50%	64%	51%

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 94% probability that in 2010 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)), only a 6% likelihood it will be near-normal (defined as an ACE index value in the middle tercile historically (43 to 92) and no chance it will be below-normal (defined as an ACE index value in the lower tercile historically (<43)). The 60-year period 1950-2009 is used for climatology.

USA Landfalling ACE Index and Numbers in 2010

		ACE Index	Hurricanes	Tropical Storms
TSR Forecast (\pm FE)	2010	4.6 (\pm 1.6)	2.6 (\pm 1.4)	5.7 (\pm 1.9)
60yr Climate Norm (\pm SD)	1950-2009	2.5 (\pm 2.2)	1.5 (\pm 1.3)	3.2 (\pm 2.0)
Forecast Skill at this Lead	1980-2009	42%	23%	19%

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 an 89% probability that in 2010 the USA landfalling ACE index will be above average (defined as a USA ACE index value in the upper tercile historically (>2.61)), a 10% likelihood it will be near-normal (defined as a USA ACE index value in the middle tercile historically (1.15 to 2.61) and only a 1% chance it will be below-normal (defined as a USA ACE index value in the lower tercile historically (<1.15)). The 60-year period 1950-2009 is used for climatology.

Caribbean Lesser Antilles Landfalling Numbers in 2010

		ACE Index	Intense Hurricanes	Hurricanes	Tropical Storms
TSR Forecast (\pm FE)	2010	2.7 (\pm 1.7)	0.4 (\pm 0.4)	0.8 (\pm 0.5)	1.8 (\pm 0.8)
60yr Climate Norm (\pm SD)	1950-2009	1.3 (\pm 2.0)	0.2 (\pm 0.5)	0.5 (\pm 0.7)	1.1 (\pm 1.0)
Forecast Skill at this Lead	1980-2009	26%	20%	38%	29%

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 2010

The key factors behind the TSR forecast for an above-average hurricane season in 2010 are the anticipated moderate-to-strong 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, 45°W - 85°W), and 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 $1.35 \pm 0.49 \text{ ms}^{-1}$ (down from the July forecast value of $1.63 \pm 0.59 \text{ ms}^{-1}$) weaker than normal (1980-2009 climatology) and $0.63 \pm 0.13^\circ\text{C}$ (down from the July forecast value of $0.71 \pm 0.17^\circ\text{C}$) warmer than normal (1980-2009 climatology). The forecast skills (assessed for the period 1980-2009) for these predictors at this lead are 69% and 83% respectively.

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.

Forecast Model for US ACE Index and US Landfalling Hurricane Numbers

The TSR early August forecast for the US ACE index and US landfalling hurricane and tropical storm numbers in 2010 is predicted from the July 2010 tropospheric wind anomalies between heights of 925mb and 400mb over North America, the east Pacific and the North Atlantic (*Saunders and Lea, 2005*). Wind anomalies in these regions in July are indicative of persistent atmospheric circulation patterns that either favour or hinder evolving hurricanes from reaching US shores during August and September.

Saunders, M. A. and A. S. Lea, Seasonal prediction of hurricane activity reaching the coast of the United States, *Nature*, 434, 1005-1008, 2005.

The Precision of Seasonal Hurricane Forecasts

The 2004, 2005 and 2008 North Atlantic and U.S. landfalling hurricane seasons were all predicted to have 'high activity' (i.e. within the top one third of years historically) to high (65-70%) probability from the previous December. However, the extended range forecasts for the 2006, 2007 and 2009 hurricane seasons proved less impressive. The precision of seasonal Atlantic hurricane forecasts as a function of issue time is assessed over many years in this recent article:

Saunders, M. A., Winds of change, *Post Magazine Risk Report*, pp28-29, 9 November 2006, <http://www.tropicalstormrisk.com/docs/Hurricanes-Post09112006.pdf>

Further Information

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>. This is the final TSR forecast update for the 2010 Atlantic hurricane season. A summary of the 2010 Atlantic hurricane season and a verification of the TSR seasonal forecasts will be issued in early January 2011.

Appendix - Predictions from Previous Months

1. Atlantic ACE Index and System Numbers

Atlantic ACE Index and System Numbers 2010					
		ACE Index	Named Tropical Storms	Hurricanes	Intense Hurricanes
Average Number (\pm SD) (1950-2009)		101 (\pm 60)	10.4 (\pm 4.0)	6.1 (\pm 2.6)	2.7 (\pm 1.9)
TSR Forecasts (\pm FE)	4 Aug 2010	183 (\pm 39)	17.8 (\pm 2.8)	9.7 (\pm 1.7)	4.5 (\pm 1.2)
	6 Jul 2010	203 (\pm 45)	19.1 (\pm 3.3)	10.4 (\pm 2.2)	4.8 (\pm 1.5)
	4 Jun 2010	182 (\pm 48)	17.7 (\pm 3.5)	9.5 (\pm 2.5)	4.4 (\pm 1.5)
	9 Apr 2010	159 (\pm 58)	16.3 (\pm 4.1)	8.5 (\pm 2.8)	4.0 (\pm 1.7)
	7 Dec 2009	135 (\pm 59)	13.9 (\pm 4.9)	7.4 (\pm 3.1)	3.4 (\pm 1.8)
CSU Forecasts	4 Aug 2010	185	18	10	5
	2 Jun 2010	185	18	10	5
	7 Apr 2010	150	15	8	4
	9 Dec 2009	100-162	11-16	6-8	3-5
NOAA Forecast	27 May 2010	136-236	14-23	8-14	3-7
Met Office Forecast	17 Jun 2010	204 (\pm 114)	20 (\pm 7)	-	-

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

MDR, Caribbean Sea and Gulf of Mexico ACE Index and Numbers 2010					
		ACE Index	Named Tropical Storms	Hurricanes	Intense Hurricanes
Average Number (\pm SD) (1950-2009)		79 (\pm 58)	7.1 (\pm 3.3)	4.3 (\pm 2.4)	2.4 (\pm 1.8)
TSR Forecasts (\pm FE)	4 Aug 2010	159 (\pm 42)	12.8 (\pm 2.4)	7.6 (\pm 1.5)	4.2 (\pm 1.1)
	6 Jul 2010	179 (\pm 43)	14.1 (\pm 2.4)	8.3 (\pm 1.8)	4.5 (\pm 1.3)
	4 Jun 2010	157 (\pm 45)	12.7 (\pm 2.6)	7.4 (\pm 2.0)	4.1 (\pm 1.3)
	9 Apr 2010	134 (\pm 54)	11.3 (\pm 3.3)	6.4 (\pm 2.4)	3.7 (\pm 1.5)
	7 Dec 2009	110 (\pm 55)	9.1 (\pm 3.9)	5.3 (\pm 2.6)	3.1 (\pm 1.6)

3. US ACE Index and Landfalling Numbers

US Landfalling Numbers 2010				
		ACE Index	Named Tropical Storms	Hurricanes
Average Number (\pm SD) (1950-2009)		2.5 (\pm 2.2)	3.2 (\pm 2.0)	1.5 (\pm 1.3)
TSR Forecasts (\pm FE)	4 Aug 2010	4.6 (\pm 1.6)	5.7 (\pm 1.9)	2.6 (\pm 1.4)
	6 Jul 2010	5.4 (\pm 1.9)	6.2 (\pm 2.0)	2.8 (\pm 1.4)
	4 Jun 2010	4.8 (\pm 2.0)	5.7 (\pm 2.0)	2.5 (\pm 1.5)
	9 Apr 2010	4.1 (\pm 2.1)	5.1 (\pm 2.1)	2.3 (\pm 1.5)
	7 Dec 2009	3.5 (\pm 2.1)	4.4 (\pm 2.2)	1.9 (\pm 1.5)

4. Lesser Antilles ACE Index and Landfalling Numbers

Lesser Antilles Landfalling Numbers 2010					
		ACE Index	Named Tropical Storms	Hurricanes	Intense Hurricanes
Average Number (\pm SD) (1950-2009)		1.3 (\pm 2.0)	1.1 (\pm 1.0)	0.5 (\pm 0.7)	0.2 (\pm 0.5)
TSR Forecasts (\pm FE)	4 Aug 2010	2.7 (\pm 1.7)	1.8 (\pm 0.8)	0.8 (\pm 0.5)	0.4 (\pm 0.4)
	6 Jul 2010	3.0 (\pm 1.8)	2.0 (\pm 0.9)	0.9 (\pm 0.5)	0.4 (\pm 0.4)
	4 Jun 2010	2.7 (\pm 1.8)	1.8 (\pm 0.9)	0.8 (\pm 0.5)	0.4 (\pm 0.4)
	9 Apr 2010	2.3 (\pm 2.0)	1.6 (\pm 0.9)	0.7 (\pm 0.6)	0.4 (\pm 0.4)
	7 Dec 2009	1.9 (\pm 2.0)	1.3 (\pm 0.9)	0.6 (\pm 0.6)	0.3 (\pm 0.4)

