August Forecast Update for Atlantic Hurricane Activity in 2011

Issued: 4th August 2011

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

Forecast Summary

TSR raises its forecast and predicts the 2011 hurricane season will see activity about 45% above the long-term (1950-2010) norm.

The TSR (Tropical Storm Risk) early August forecast update for Atlantic hurricane activity in 2011 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 about 45% above the 1950-2010 norm in 2011. There is a high (77%) likelihood that basin 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 July 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. TSR anticipates both predictors having a moderate enhancing effect on activity. US landfalling activity is predicted from the persistence of July steering winds (Saunders and Lea, 2005) and from the total basin activity. The forecast has risen from last month due to the trade winds now expected to be more favourable for activity than thought before.

Atlantic ACE Index and System Numbers in 2011

		ACE Index	Intense Hurricanes	Hurricanes	Tropical Storms
TSR Forecast (±FE)	2011	146 (±39)	4.2 (±1.2)	8.5 (±1.7)	16.1 (±2.8)
61yr Climate Norm (±SD)	1950-2010	102 (±60)	2.7(±1.9)	6.2 (±2.7)	10.5 (±4.1)
Forecast Skill at this Lead	1980-2010	58%	48%	65%	52%

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 = $x10^4$ knots^2.
	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 77% 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 20% likelihood it will be near-normal (defined as an ACE index value in the middle tercile historically (71 to 117) and only a 3% 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 (±FE)	2011	122 (±42)	3.9(±1.1)	6.4 (±1.5)	11.2 (±2.4)
61yr Climate Norm (±SD)	1950-2010	80 (±59)	2.4(±1.8)	4.4 (±2.5)	7.3 (±3.5)
Forecast Skill at this Lead	1980-2010	47%	51%	65%	53%

The Atlantic hurricane Main Development Region (MDR) is the region 10^{o}N - 20^{o}N, 20^{o}W - 60^{o}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 76% 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 21% likelihood it will be near-normal (defined as an ACE index value in the middle tercile historically (43 to 92) and only a 3% 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 (±FE)	2011	3.4 (±1.8)	2.2 (±1.5)	5.2 (±2.1)
61yr Climate Norm (±SD)	1950-2010	2.4 (±2.2)	1.5 (±1.3)	3.1 (±2.0)
Forecast Skill at this Lead	1980-2010	32%	18%	11%

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 = x10^4 knots^2.

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 67% 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 25% 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 an 8% 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 (±FE)	2011	2.1 (±1.7)	0.3 (±0.4)	0.7 (±0.5)	1.5 (±0.8)
61yr Climate Norm (±SD)	1950-2010	1.4 (±2.0)	0.2 (±0.5)	0.5 (±0.7)	1.1 (±1.0)
Forecast Skill at this Lead	1980-2010	29%	17%	39%	32%

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^{o}N-18^{o}N,60^{o}W-63^{o}W) (reduced by a factor of 6). ACE Unit = x10^4 knots^2.

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 a moderately 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^{o}N - 17.5^{o}N, 30^{o}W - 100^{o}W), and of August-September forecast sea surface temperature (SST) for the Atlantic MDR (10^{o}N - 20^{o}N, 20^{o}W - 60^{o}W). The current forecasts for these predictors are 1.07±0.48 ms^{-1} (up from the July forecast value of 0.25±0.61 ms^{-1}) weaker than normal (1980-2010 climatology) and 0.22±0.16^{o}C (up slightly from the July forecast value of 0.20±0.17^{o}C) warmer than normal (1980-2010 climatology). The forecast skills (assessed for the period 1980-2010) for both these predictors at this lead are 71% and 85% 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.

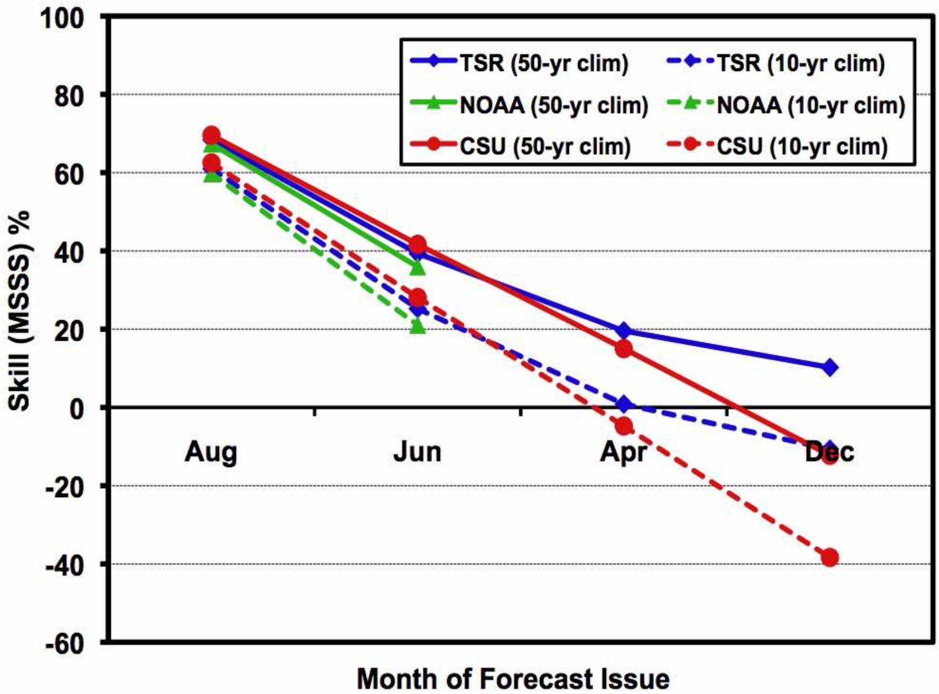
Forecast Model for US ACE Index and US Landfalling Hurricane Numbers

The TSR early August forecast for the US ACE index and US landfalling hurricane and tropical storm numbers in 2011 is predicted from an ensemble of two models: (1) 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; (2) thinning from the forecast total Atlantic basin activity.

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 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.

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*. This is the final TSR forecast update for the 2011 Atlantic hurricane season. A summary of the 2011 Atlantic hurricane season and a verification of the TSR seasonal forecasts will be issued in early January 2012.

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 (±SD) (1950-2010)		102 (±60)	10.5 (±4.1)	6.2 (±2.7)	2.7 (±1.9)
TSR Forecasts (±FE)	4 Aug 2011	146 (±39)	16.1 (±2.8)	8.5 (±1.7)	4.2 (±1.2)
	4 Jul 2011	127 (±45)	14.4 (±3.3)	7.8 (±2.2)	3.6 (±1.5)
	6 Jun 2011	123 (±48)	14.1 (±3.4)	7.6 (±2.4)	3.5 (±1.5)
	24 May 2011	124 (±52)	14.2 (±3.7)	7.6 (±2.7)	3.6 (±1.5)
	4 Apr 2011	124 (±56)	14.2 (±3.9)	7.5 (±2.8)	3.6 (±1.6)
	6 Dec 2010	141 (±58)	15.6 (±4.3)	8.4 (±3.0)	4.0 (±1.7)
CSU Forecasts	3 Aug 2011	160	16	9	5
	1 Jun 2011	160	16	9	5
	6 Apr 2011	160	16	9	5
	8 Dec 2010	165	17	9	5
NOAA Forecast	19 May 2011	96-186	12-18	6-10	3-6
Met Office Forecast	26 May 2011	151 (±61)	13 (±4)	-	-

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 (±SD) (1950-2010)		80 (±59)	7.3 (±3.5)	4.4 (±2.5)	2.4 (±1.8)
TSR Forecasts (±FE)	4 Aug 2011	122 (±42)	11.2 (±2.4)	6.4 (±1.5)	3.9 (±1.1)
	4 Jul 2011	103 (±43)	9.5 (±2.4)	5.7 (±1.8)	3.3 (±1.3)
	6 Jun 2011	99 (±45)	9.2 (±2.7)	5.5 (±2.0)	3.2 (±1.3)
	24 May 2011	100 (±49)	9.3 (±3.1)	5.5 (±2.2)	3.3 (±1.4)
	4 Apr 2011	100 (±53)	9.3 (±3.3)	5.4 (±2.4)	3.3 (±1.5)
	6 Dec 2010	117 (±55)	10.7 (±3.7)	6.3 (±2.6)	3.7 (±1.5)

3. US ACE Index and Landfalling Numbers

US Landfalling Numbers 2011				
		ACE Index	Named Tropical Storms	Hurricanes
Average Number (±SD) (1950-2010)		2.4 (±2.2)	3.1 (±2.0)	1.5 (±1.3)
TSR Forecasts (±FE)	4 Aug 2011	3.4 (±1.8)	5.2 (±2.1)	2.2 (±1.5)
	4 Jul 2011	3.2 (±2.1)	4.4 (±2.2)	1.9 (±1.5)
	6 Jun 2011	3.1 (±2.1)	4.3 (±2.2)	1.9 (±1.5)
	24 May 2011	3.1 (±2.1)	4.4 (±2.1)	1.9 (±1.5)
	4 Apr 2011	3.1 (±2.1)	4.4 (±2.2)	1.9 (±1.5)
	6 Dec 2010	3.6 (±2.1)	4.9 (±2.2)	2.1 (±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 (±SD) (1950-2010)		1.4 (±2.0)	1.1 (±1.0)	0.5 (±0.7)	0.2 (±0.5)
TSR Forecasts (±FE)	4 Aug 2011	2.1 (±1.7)	1.5 (±0.8)	0.7 (±0.5)	0.3 (±0.4)
	4 Jul 2011	1.8 (±1.8)	1.4 (±0.8)	0.6 (±0.6)	0.3 (±0.4)
	6 Jun 2011	1.7 (±1.8)	1.3 (±0.8)	0.6 (±0.6)	0.3 (±0.4)
	24 May 2011	1.7 (±1.9)	1.3 (±0.9)	0.6 (±0.6)	0.3 (±0.4)
	4 Apr 2011	1.7 (±2.0)	1.3 (±0.9)	0.6 (±0.6)	0.3 (±0.4)
	6 Dec 2010	2.0 (±2.0)	1.5 (±0.9)	0.7 (±0.6)	0.3 (±0.4)