



Summary of 2007/8 Australian-Region Tropical Storm Season and Verification of Authors' Seasonal Forecasts

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Summary

The 2007/8 season saw close to average Australian-basin tropical storm numbers and Australian-basin severe tropical cyclone numbers but below-average Australian-basin ACE index and Australian landfalling activity. The TSR deterministic forecasts for the 2007/8 season performed well for storm numbers but overpredicted the ACE index and Australian landfall activity. The TSR tercile probability forecasts performed poorly in general with only the July-September forecasts for Australian-region total storm numbers showing positive skill.

The Tropical Storm Risk (TSR) consortium presents a summary of the 2007/8 Australian-region tropical storm season and a validation of their seasonal deterministic and probabilistic forecasts for this activity. These forecasts were issued monthly from the 3rd May 2007 to the 5th December 2007 and include separate predictions for numbers of basin tropical storms, numbers of basin severe tropical cyclones, the basin ACE (Accumulated Cyclone Energy) index and numbers of Australian landfalling tropical storms.

Features of the 2007/8 Australian-Region Season

- The 2007/8 Australian-region tropical cyclone season featured 12 tropical storms of which 5 made severe tropical cyclone strength (U.S. hurricane equivalent). These figures compare to 33-year climatology values of 10.6 and 5.7 respectively. This is the ninth consecutive year without an active season.
- The total ACE index for 2007/8 was 50. This is the second consecutive year with a below-average ACE index.
- Only two tropical storms struck the Australian coastline in 2007/8. This is the lowest number of landfalling tropical storms since 2001. Since 1975/6, only four other years (1985/6, 1987/8, 1990/1 and 2001/2) have seen two or fewer tropical storm landfalls. There have been no La Niña years since 1975/6 with less than four tropical storm landfalls.
- No severe tropical cyclones made landfall along the Australian coastline in 2007/8. The last season to see no Australian severe tropical cyclone landfalls was 2002/3.
- The observed ACE index of 50 is exceptionally low for a La Niña year. The observed October-November SST anomaly for 2007 was -0.90°C . Over the last 33 years there have been eight seasons with an observed October-November Niño 4 SST anomaly below -0.4°C , for which the median value for the ACE index is 96 and the mean ACE index is 105. The only other comparable year to 2007/8 was 1999/2000, which saw 11 tropical storms, an ACE index of only 52 and a October-November Niño 4 SST anomaly of -0.88°C .

Catalogue of Storm Events in 2007/8

Individual Storm Summary 2007/8					
No.	Name	Dates	Peak Wind (kts)	Storm Category	Category at Australian Landfall
1	Guba	13-19 Nov	75	1	-
2	Melanie	28-31 Dec	60	TS	-
3	Helen	3-5 Jan	45	TS	TS
4	Funa	16-20 Jan	105	3	-
5	17S	7-10 Feb	40	TS	-
6	Nicholas	12-20 Feb	80	1	TS
7	20P	29-29 Feb	35	TS	-
8	Ophelia	1-6 Mar	65	1	-
9	24P	20-21 Mar	35	TS	-
10	Pancho	24-29 Mar	95	2	-
11	27P	18-19 Apr	35	TS	-
12	Rosie	21-24 Apr	45	TS	-

Storm categories are based on 1-minute sustained windspeeds and the Saffir-Simpson Hurricane Scale.

Verification of Forecasts for 2007/8

1. Australian Region Total Numbers and ACE Index

a) Deterministic forecasts

Australian Region (100°E to 170°E) Total Numbers and ACE Index				
		ACE Index (x10 ⁴ knots ²)	Severe Tropical Cyclones	Tropical Storms
Average Number (±SD) (1975/6-2006/7)		81 (±42)	5.7 (±2.4)	10.6 (±3.6)
Actual Number 2007/8		50	5	12
TSR Forecasts (±FE)	5 Dec 2007	90 (±37)	6.6 (±2.0)	13.7 (±2.9)
	7 Nov 2007	90 (±37)	6.8 (±2.0)	13.0 (±2.9)
	9 Oct 2007	90 (±37)	6.3 (±2.0)	12.3 (±3.1)
	7 Sep 2007	-	5.6 (±2.0)	10.8 (±2.9)
	7 Aug 2007	-	5.7 (±2.1)	10.8 (±3.0)
	6 Jul 2007	-	6.0 (±2.1)	10.7 (±3.1)
	5 Jun 2007	-	6.2 (±2.2)	11.9 (±3.3)
	3 May 2007	-	5.6 (±2.2)	10.0 (±3.4)

Despite tropical storm and severe tropical cyclone numbers being close to average in 2007/8 the ACE index was nearly one standard deviation below the 1975/6-2006/7 climate norm. Half of

the tropical storms that formed in 2007/8 were weak, short lived systems. The TSR forecasts for tropical storm and severe tropical cyclone numbers performed well with all forecasts correct to within one standard error. The TSR forecast for the ACE index was too high which is due to the observed total ACE index being unusually low for a season with 12 tropical storms; the median ACE index for a season with 12 tropical storms based on data back to 1975 is 81 and the mean is 78.

b) Tercile probabilistic forecasts

Australian Region Tropical Storm Numbers 2007/8					
		Tercile Probabilities			RPSS
		below normal	normal	above normal	
Actual 2007/8		0	100	0	1
Climatology 1975/6-2006/7		34	38	28	0
TSR Forecasts	5 Dec 2007	3	25	72	-1.68
	7 Nov 2007	4	32	64	-1.12
	9 Oct 2007	9	38	53	-0.49
	7 Sep 2007	17	49	34	0.26
	7 Aug 2007	17	48	35	0.22
	6 Jul 2007	19	46	35	0.18
	5 Jun 2007	12	40	48	-0.26
	3 May 2007	17	42	41	-0.02

The probabilistic forecasts showed skill for forecasts between July and September but no skill otherwise. The apparent zero skill in the October to December forecasts arises because these slightly favour upper-tercile activity whereas the actual tropical storm numbers fell just in the middle tercile. If there had been one more observed tropical storm then the tropical storm numbers would have fallen in the upper tercile and the skill for the June to July and the October to December forecasts would have been positive. As the observed and forecast tropical storm numbers both fell very close to the middle and upper tercile boundary this means that the rank probability skill score shows no skill even though the deterministic forecasts performed well.

2. Australian Landfall Numbers

a) Deterministic forecasts

Australian Landfalling Numbers 2007/8		
		Tropical Storms
Average Number (\pm SD) (1975/6-2006/7)		4.6 (\pm 2.1)
Actual Number 2007/8		2
TSR Forecasts (\pm FE)	5 Dec 2007	5.7 (\pm 2.0)
	7 Nov 2007	5.5 (\pm 2.0)
	9 Oct 2007	5.2 (\pm 2.0)
	7 Sep 2007	4.7 (\pm 1.9)
	7 Aug 2007	4.7 (\pm 1.9)
	6 Jul 2007	4.6 (\pm 2.0)
	5 Jun 2007	5.0 (\pm 2.0)
	3 May 2007	4.8 (\pm 2.0)

b) Tercile probabilistic forecasts

Australian Landfalling Numbers 2007/8					
		Tercile Probabilities			RPSS
		below normal	normal	above normal	
Actual 2007/8		100	0	0	1
Climatology 1975/6-2006/7		31	44	25	0
TSR Forecasts	5 Dec 2007	8	48	44	-0.93
	7 Nov 2007	10	50	40	-0.80
	9 Oct 2007	13	53	34	-0.62
	7 Sep 2007	19	57	24	-0.33
	7 Aug 2007	19	56	25	-0.33
	6 Jul 2007	20	55	25	-0.30
	5 Jun 2007	15	54	31	-0.52
	3 May 2007	18	55	27	-0.38

Only two tropical storms made Australian landfall, which is the lowest number 2001/2. All TSR deterministic forecasts greatly overpredicted the landfalling numbers and as a result, all tercile probabilistic forecasts showed no skill at any lead. The number of observed Australian landfalling tropical cyclones is exceptionally low for a season with total tropical storm numbers close to average. Since 1975/6 only 1985/6 had as many storms as 2007/8 with just two storms making landfall.

Environmental Factors in 2007/8

Sound seasonal forecasts of Australian tropical storm activity are achieved by predicting key environmental conditions prior to the Australian cyclone season. We find that the most

important contemporaneous factor influencing the overall activity of the Australian tropical cyclone season is the October-November (ON) Niño 4 sea surface temperature (SST) [region 150°W-160°E, 5°S-5°N]. Above-average (below-average) ON Niño 4 SSTs in this region lead to above-average (below-average) atmospheric vertical wind shear over the Australian region during Austral summer; a condition favouring below-average (above-average) tropical storm activity. The table below verifies our forecasts for this predictor.

Predictor Forecasts 2007		
		ON Niño 4 SST (°C)
Actual Value 2007 (1975-2006 Anomaly)		-0.90
TSR Forecasts (±FE)	9 Oct 2007	-0.54 (±0.21)
	7 Sep 2007	-0.12 (±0.24)
	7 Aug 2007	-0.14 (±0.32)
	6 Jul 2007	-0.11 (±0.42)
	5 Jun 2007	-0.42 (±0.50)
	3 May 2007	-0.24 (±0.51)

The TSR forecasts for the ON Niño 4 predictor correctly predicted a cooler than normal Niño 4 SST at all leads but underpredicted the magnitude of the anomaly. The Australian-region tropical cyclone activity was unusually low this year for such a low observed value of the ON Niño 4 SST and this meant that Australian-region tropical storm numbers were forecast well despite the large underprediction in ON Niño 4 SST. The October forecast performed best overall.

Definitions

Rank Probability Skill Score

The probabilistic skill measure employed is the rank probability skill score (*RPSS*) (Epstein 1969; Wilks 1995; Goddard et al 2003). Computation of *RPSS* begins with the rank probability score (*RPS*) which is defined as:

$$\sum_{m=1}^{N_{cat}} (CP_{Fm} - CP_{Om})^2$$

where $N_{cat} = 3$ for tercile forecasts. The vector CP_{Fm} represents the cumulative probability of the forecast up to category m , and CP_{Om} is the cumulative observed probability up to category m . The probability distribution of the observation is 100% for the category that was observed and is zero for the other two categories. For a perfect forecast $RPS = 0$. The *RPS* is referenced to climatology to give the *RPSS* which is defined as:

$$RPSS = 1 - \frac{RPS_{fcst}}{RPS_{ref}}$$

where RPS_{fcst} is the *RPS* of the forecast and RPS_{ref} ($=RPS_{cl}$) is the *RPS* of the climatology forecast. The maximum *RPSS* is 1; a negative *RPSS* indicates skill worse than climatology.

Total 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 = $\times 10^4$ knots ² .
Severe Tropical Cyclone	= 1 minute sustained winds > 63kts (73mph) = Hurricane category 1 to 5.
Tropical Storm	= 1 minute sustained winds > 33kts (38mph).
SD	= Standard Deviation.
Terciles	= Data groupings of probability corresponding to the upper, middle and lower one-third of values historically (1975/6-2006/7).
Australian Region	= Southern Hemisphere 100°E to 170°E (Storm must form as a tropical depression within to count).
Australian Strike	= Strike on Australian Coast from Perth around to Brisbane.

References

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Tropical Storm Risk.com (TSR)

Founded in 2000, *Tropical Storm Risk* (TSR) offers a leading resource for forecasting the risk from tropical storms worldwide. The venture provides innovative forecast products to increase risk awareness and to help decision making within the (re)insurance industry, other business sectors, government and society. The TSR consortium is co-sponsored by Benfield, the world's leading independent reinsurance and risk intermediary, Royal & Sun Alliance, the global insurance group, and Crawford & Company, a global claims management solutions company. The TSR scientific grouping brings together climate physicists, meteorologists and statisticians at University College London and the Met Office.

Tropical Storm Risk has won two major insurance industry awards during the past four years. In 2006 TSR was awarded the prestigious Risk Management Award at the British Insurance Awards, and in 2004 won the British Insurance Award for London Market Innovation of the Year.

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