Summary of 2008 NW Pacific Typhoon Season and Verification of Authors' Seasonal Forecasts

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Summary

A very inactive year with the basin ACE index and intense typhoon numbers approximately 45% below the 1965-2007 climate norm, although tropical storm numbers were close to normal. 2008 had the lowest basin ACE index since 1999 and the fourth lowest since reliable records began in 1965. The TSR deterministic forecasts overpredicted typhoon activity although the forecasts were skilful with respect to climatology. The TSR probabilistic forecasts showed modest positive skill.

The Tropical Storm Risk (TSR) consortium presents a validation of their seasonal probabilistic and deterministic forecasts for the NW Pacific basin ACE index, and deterministic forecasts for the numbers of intense typhoons, typhoons and tropical storms in 2008. These forecasts were issued on the 10th March 2008, 6th May 2008, 4th July 2008 and the 5th August 2008 for the 2008 NW Pacific typhoon season which ran from 1st January to 31st December 2008.

Features of the 2008 NW Pacific Season

- The 2008 NW Pacific season featured 26 tropical storms, 12 typhoons, 5 intense typhoons and an ACE index of 165 x10^4 knots^2. This is the lowest ACE index since 1999 and the fourth lowest since reliable records began in 1965.
- 2008 observed the lowest ever number of typhoons (12) for a year having at least 26 tropical storms.
- 2008 is the first year since 1984 that no tropical cyclone made landfall on the Japanese mainland.
- Four typhoons struck Taiwan in 2008 affecting the east and north of the country. Typhoon Kalmaegi struck with 1-min sustained winds of 105 mph, typhoon Fung-wong made landfall with 1-min sustained winds of 105 mph, typhoon Sinlaku made landfall with 1-min sustained winds of 100 mph, and typhoon Jangmi struck with 1-min sustained winds of 135 mph. At its peak intensity of 165 mph, Jangmi was the strongest storm anywhere in the world in 2008. Total damage from these four typhoons is estimated at approximately US$ 1.4bn.
- Typhoon Hagupit struck southern China with 1-min sustained winds of 135 mph. Hagupit is the first known typhoon to make landfall in Kwangtung Province as a category 4 typhoon. Hagupit was the most destructive typhoon of the 2008 season with a total damage of US$ 1bn.
- Three typhoons made landfall in the Philippines. Typhoon Nuri brushed the north coast of

Luzon with peak 1-min sustained winds of 110 mph. Typhoon Halong struck Pangasinan and Luzon with 1-min sustained winds of 80 mph. Typhoon Fengshen crossed the central Philippines with 1-min sustained winds of 110 mph. Fengshen killed over 1,300 people which could make it one of the top ten deadliest typhoons to strike the Philippines.

Tropical Storm Catalogue 2008

NW Pacific Individual Storm Summary 2008					
No.	Name	Dates	Peak wind (kts)[x]	Typhoon category	Landfall country and storm category at landfall*
1	01W	13-16 Jan	35	-	-
2	Neoguri	14-19 Apr	95	2	China (TS)
3	Rammasun	7-12 May	135	4	-
4	Matmo	14-16 May	40	-	-
5	Halong	15-20 May	70	1	Philippines (1)
6	Nakri	27 May-3 Jun	125	4	-
7	Fengshen	19-25 Jun	95	2	Philippines (2), China (TS)
8	Kalmaegi	14-18 Jul	90	2	Taiwan (2), China (TS)
9	Fung-wong	25-28 Jul	95	2	Taiwan (2), China (TS)
10	Kammuri	4-6 Aug	50	-	China (TS)
11	Phanfone	10-11 Aug	50	-	-
12	Vongfong	14-16 Aug	50	-	-
13	Nuri	17-22 Aug	95	2	Philippines (2), Hong Kong (TS)
14	14W	26-28 Aug	35	-	-
15	Sinlaku	8-20 Sep	125	4	Taiwan (2)
16	16W	10-11 Sep	35	-	-
17	Hagupit	18-24 Sep	120	4	China (4)
18	Jangmi	23-30 Sep	145	5	Taiwan (4)
19	Mekkhala	28-30 Sep	55	-	Vietnam (TS)
20	Higos	29 Sep-4 Oct	45	-	Philippines (TS)
21	22W	14-15 Oct	35	-	-
22	Bavi	18-20 Oct	45	-	-
23	Maysak	6-10 Nov	60	-	-
24	Haishen	15-16 Nov	40	-	-
25	Noul	16-17 Nov	40	-	-
26	Dolphin	10-18 Dec	90	2	-

[x] 1-min sustained winds.

* Landfall is defined as the intersection of the surface centre of a tropical storm with a coastline.

[+] Mainland only.

TS = Tropical storm, 1-5 = Saffir-Simpson hurricane scale.

The tropical storm names and peak 1-minute sustained windspeeds are obtained from the following sources: Joint Typhoon Warning Center best track data, Gary Padgett's monthly

global tropical cyclone summaries issued through the tropical storms mailing list at *tropical-storms@tstorms.org*, Julian Heming's Met Office Tropical Cyclone Website (*http://www.metoffice.gov.uk/weather/tropicalcyclone/observations.html*) and the City University of Hong Kong (*http://weather.cityu.edu.hk/*).

Verification of Forecasts

NW Pacific ACE Index and System Numbers

a) Deterministic forecasts

NW Pacific ACE Index and System Numbers in 2008					
		ACE Index ($x10^4$ knots^2)	Intense Typhoons	Typhoons	Tropical Storms
Average Number (±SD) (1965-2007)		303 (±97)	8.7 (±3.0)	16.8 (±3.6)	26.6 (±4.4)
Actual Number 2008		165	5	12	26
TSR Forecasts (±FE)	5 Aug 2008	277 (±76)	7.8 (±2.4)	18.2 (±2.9)	28.3 (±3.7)
	4 July 2008	268 (±82)	7.5 (±2.4)	18.2 (±2.9)	28.3 (±3.7)
	6 May 2008	281 (±79)	7.7 (±2.5)	18.2 (±2.9)	28.3 (±3.7)
	10 Mar 2008	237 (±90)	6.4 (±2.9)	-	-
Chan Forecasts	24 June 2008	-	-	19	30
	18 April 2008	-	-	19	30

b) Probabilistic forecasts

NW Pacific ACE Index 2008					
		Tercile Probabilities			RPSS
		below normal	normal	above normal	
Actual 2008		100	0	0	1
Climatology 1965-2007		33.3	33.3	33.3	0
TSR Forecasts	5 Aug 2008	33	49	18	0.14
	4 July 2008	38	45	17	0.26
	6 May 2008	35	48	17	0.19
	10 Mar 2008	53	36	11	0.58

All the TSR forecasts overpredicted the NW Pacific activity this year. The reason for the overprediction was that NW Pacific typhoon activity in 2008 was much lower than what can be explained by the observed August/September Niño 3.75 SSTanomaly (which was -0.37°C). For all years back to 1965 only those years with an observed Niño 3.75 SSTanomaly below -0.8°C have recorded an ACE index below 200. All probabilistic forecasts showed modest positive skill. The March forecast performed best overall, the reason being the March forecast used the February surface pressure in the tropical Pacific region 10°N-20°N, 145°W-165°W as a predictor for the ACE index and intense typhoon numbers, which happened to work better this year than the August/September Niño 3.75 SSTanomaly predictor used in the May-August forecasts.

Chan, like TSR, overpredicted tropical storm and typhoon numbers this year, however TSR predicted one less typhoon and two fewer tropical storms than Chan so the TSR forecasts were slightly better than Chan's forecasts this year. Further details on the Chan forecasts and their verification may be obtained from *http://weather.cityu.edu.hk/tc_forecast*

Environmental Factors in 2008

The principle underlying sound seasonal typhoon predictions is to forecast the key environmental conditions at the height of the NW Pacific typhoon season. TSR finds that the most important contemporaneous factor influencing the overall activity of the NW Pacific typhoon season is the August-September (AS) Niño 3.75 SST [region 180°-140°W, 5°S-5°N]. This predictor influences cyclonic vorticity (the spinning up of storms) in the main typhoon formation region. The Table below verifies our forecasts in 2008 for this predictor.

Predictor Forecasts 2008		
		AS Niño 3.75 SST (°C)
Actual Value 2008 (1965-2007 Anomaly)		-0.37
TSR Forecasts (±FE)	5 August 2008	-0.30 (±0.21)
	4 July 2008	-0.39 (±0.30)
	6 May 2008	-0.32 (±0.45)

All TSR forecasts correctly predicted the magnitude of the August/September Niño 3.75 SSTanomaly to within 0.1°C. Despite this accurate prediction, the NW Pacific ACE index and intense typhoon numbers were overpredicted. This is because NW Pacific typhoon was unusually low this year given the observed August/September Niño 3.75 SST anomaly. The average NW Pacific ACE index for all years with an August/September Niño 3.75 SST anomaly within 0.05°C of the observer 2008 value of -0.37°C is 233. The July forecast performed best and was just 0.02°C away from the observed value.

Definitions

Rank Probability Skill Score

The probabilistic skill measure employed is the rank probability skill score (*RPSS*) (Epstein 1969; Wilks 2006; 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 = x10^4 knots^2.
Intense Typhoon	=	1 minute sustained winds > 95kts (110mph).
Typhoon	=	1 minute sustained winds > 63kts (73mph).
Tropical Storm	=	1 minute sustained winds > 33kts (38mph).
SD	=	Standard Deviation.
Terciles	=	Data groupings of equal (33.3%) probability corresponding to the upper, middle and lower one-third of values historically (1965-2005).

Forecasts for 2009

The TSR extended range forecast for the 2009 NW Pacific typhoon season will be issued in early March 2009 followed by monthly forecast updates from May through to early August. Forecasts will be deterministic and probabilistic.

References

Epstein, E.S., 1969: A scoring system for probability forecasts of ranked categories. J. Appl. Meteor, **8**, 985-987.

Goddard, L., A. G. Barnston and S. J. Mason, 2003: Evaluation of the IRI's "net assessment seasonal climate forecasts". Bull. Amer. Meteor. Soc., **84**, 1761-1781.

Wilks, D., 2006: *Statistical Methods in the Atmospheric Sciences (2nd Edition)*, Academic Press, 627pp.

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 Aon Benfield, the leading reinsurance intermediary and capital advisor, 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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