Summary of 2002 NW Pacific Typhoon Season and Verification of Authors' Seasonal Forecasts

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Summary

A year with accumulated tropical cyclone wind energy 30% (20%) above the 30-year (10-year) climate norms. The above average activity arose from the number of intense typhoons being 1.0 standard deviation above normal. In contrast, typhoon and tropical storm numbers were close to average. The TSR forecasts anticipated the above average overall activity from early March due to skillful intense typhoon predictions.

The Tropical Storm Risk (TSR) consortium presents a validation of their seasonal forecasts for NW Pacific tropical storm, typhoon and intense typhoon numbers in 2003. These forecasts were issued monthly from 6th March 2002 to 6th August 2002, spanning the official NW Pacific typhoon season from 1st January to 31st December. In this verification we introduce the NOAA Accumulated Cyclone Energy (ACE) index to the NW Pacific for the first time. The TSR forecasts were generally correct to within 1-standard error of the observed results. They proved best for intense typhoon numbers and consequently anticipated the season's above average accumulated wind energy from early March.

Features of the 2002 NW Pacific Season

- The 2002 NW Pacific season featured 26 tropical storms, 17 typhoons, 12 intense typhoons and an ACE index of 372 x10^4 knots^2. This compares to 1972-2001 climatologies of 26.3, 16.4, 8.2 and 286 x10^4 knots^2 respectively.
- A high percentage of typhoons were intense. 46% of tropical storms developed to intense typhoon strength - the largest proportion to have done so since 1987.
- Typhoon Rusa was the deadliest typhoon to strike South Korea since Typhoon Sarah in 1959. Rusa killed 113 people and left 71 missing. The city of Gangneung, in Gangwon was swamped with 914mm of rain in less than 48 hours.
- Four people were killed when Tokyo was lashed by 105 knot gusts from Typhoon Higos. This was the third most powerful typhoon to strike Tokyo since World War II.
- Super Typhoon Pongsona struck Guam with sustained winds of 150 knots and gusts exceeding 175 knots leading to the island being decared a major disaster area.

Tropical Storm Catalogue 2002

Individual Storm Summary 2002				
No.	Name	Dates	Peak Wind (kts)	Typhoon Category
1	Tapah	09-14 Jan	50	-
2	Mitag	26 Feb-08 Mar	140	5
3	Hagibis	15-21 May	140	5
4	Noguri	06-11 Jun	85	2
5	Chataan	29 Jun-11 Jul	130	4
6	Rammasun	28 Jun-06 Jul	110	3
7	Halong	07-15 Jul	135	4
8	Nakri	08-13 Jul	40	-
9	Fengshen	14-27 Jul	145	5
10	13W	18-23 Jul	35	-
11	Fung Wong	20-27 Jul	65	1
12	Kammuri	02-05 Aug	45	-
13	Phanfone	11-20 Aug	135	4
14	18W	12-13 Aug	35	-
15	Vongfong	15-20 Aug	55	-
16	Rusa	22 Aug-01 Sep	115	4
17	Sinlaku	28 Aug-10 Sep	115	4
18	Ele	30 Aug-10 Sep	115	4
19	Hagupit	11-12 Sep	45	-
20	Mekkhala	23-27 Sep	55	-
21	Higos	26 Sep-02 Oct	135	4
22	Bavi	09-14 Oct	70	1
23	Huko	24 Oct-07 Nov	75	1
24	Maysak	28-29 Oct	55	-
25	Haishen	20-24 Nov	95	2
26	Pongsona	02-11 Dec	130	4

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* and Julian Heming's Met Office Tropical Cyclone Website (*http://www.met-office.gov.uk/sec2/sec2cyclone/tcver.html*).

Definitions

Accumulated Tropical Cyclone Wind Energy is defined by NOAA's Accumulated Cyclone Energy (ACE) index. This index is a measure of tropical cyclone total wind energy and is calculated as the 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. The ACE Index unit is $x10^4$ $knots^2$. Since the ACE Index reflects a combination of intensity and duration of all NW Pacific

tropical storm systems during a given season it is a better measure of basin 'overall activity' than the individual number of tropical storms and typhoons.

Storm Strength Definitions				
Tropical Cyclone Type	Category	Peak 1-Min Sustained Wind		Minmum Pressure (mb)
		knots	mph	
Tropical Storm	TS	34-63	39-73	-
Typhoon	1	64-82	74-95	>980
Typhoon	2	83-95	96-110	965-980
Typhoon*	3	96-113	111-130	945-965
Typhoon*	4	114-135	131-155	920-945
Super Typhoon*	5	>135	>155	<920
* Denotes Intense Typhoon Strength (Category 3 and Above)				

Verification of Forecasts

NW Pacific Total Numbers and ACE Index

NW Pacific Total Numbers and ACE Index in 2002					
		ACE Index ($x10^4$ knots^2)	Tropical Storms	Typhoons	Intense Typhoons
Average Number (±SD) (1992-2001)		310 (±124)	27.4 (±4.6)	16.9 (±4.3)	9.0 (±3.1)
Average Number (±SD) (1972-2001)		286 (± 98)	26.3 (±4.0)	16.4 (±3.6)	8.2 (±3.3)
Actual Number 2002		372	26	17	12
TSR Forecast (±FE)	6 August 2002	-	28.4 (±4.2)	19.0 (±3.4)	11.5 (±1.7)
	11 July 2002	-	28.6 (±4.4)	19.2 (±3.7)	11.8 (±2.2)
	7 June 2002	-	30.8 (±4.5)	21.1 (±3.5)	10.5 (±2.2)
	7 May 2002	-	30.5 (±4.6)	20.9 (±3.4)	10.3 (±2.2)
	5 Apr 2002	-	29.6 (±5.0)	19.8 (±4.1)	9.8 (±2.6)
	6 Mar 2002	-	28.6 (±4.8)	18.7 (±4.1)	9.3 (±2.5)
Chan Forecast (±SD)	28 June 2002	-	27 (±3)	18 (±2)	-
	7 May 2002	-	27 (±3)	17 (±2)	-

In 2002, the NW Pacific accumulated tropical cyclone wind energy (ACE Index) was 30% (20%) higher than the 30-year (10-year) climate norms. This above average activity arose from the number of intense typhoons being 1.0 standard deviation above normal. In contrast, typhoon and tropical storm numbers were close to average. The TSR forecasts anticipated the above average activity from early March due to its skillful (better than climatology) intense typhoon predictions.

TSR overpredicted typhoon and tropical storm numbers although its forecasts were generally accurate to within 1 standard forecast error (FE). Chan's predictions for tropical storm and

typhoon numbers were better than TSR's but since Chan does not forecast intense typhoon numbers he did not anticipate the above average overall activity. Further details on the Chan forecasts and their verification may be obtained from *http://aposf02.cityu.edu.hk/~mcg/tc_forecast/2002_Verification.htm*. The TSR models used to forecast typhoon and tropical storm numbers changed with the July forecast update to use regression from intense typhoon numbers. This accounts for the fall in the forecast numbers for typhoons and tropical storms from the June forecast.

Environmental Factors in 2002

The principle of sound seasonal typhoon prediction work is to forecast the key environmental conditions at the height of the NW Pacific typhoon season. We find that the most important contemporaneous factor influencing the overall activity of the NW Pacific typhoon season is the August-September (AS) Niño 4 SST [Region 150 W-160 E, 5 S-5 N]. The Table below verifies our forecasts for this predictor.

Predictor Forecasts 2002		
		AS Niño 4 SST (C)
Actual Value 2002 (1972-2001 Anomaly)		0.91
TSR Forecasts (±FE)	6 August 2002	0.80 (±0.15)
	11 July 2002	0.88 (±0.24)
	7 June 2002	0.53 (±0.29)
	7 May 2002	0.49 (±0.30)
	5 Apr 2002	0.35 (±0.41)
	6 Mar 2002	0.21 (±0.43)

All the TSR AS Niño 4 predictor forecasts were skillful compared to climatology with accuracy increasing at shorter leads. However, the forecasts from March to June underpredicted the actual value by more than one standard forecast error.

Future Forecasts and Verifications

1. The TSR extended range forecast for the 2003 NW Pacific typhoon season will be issued in early March 2003 followed by monthly forecast updates through to early August. These forecasts will include predictions for NOAA's Accumulated Cyclone Energy (ACE) index.
2. The extended-range forecast for Australian-region tropical storm activity in 2003/04 will be issued in April 2003 followed by monthly updates through to early December 2003. An end-of-season summary for the 2002/03 Australian-region tropical storm season will be released in May 2003.

Tropical Storm Risk.com (TSR)

Tropical Storm Risk.com (TSR) is a venture which has developed from the UK government-supported TSUNAMI initiative project on seasonal tropical cyclone prediction. The TSR consortium comprises experts on insurance, risk management and seasonal climate forecasting.

The TSR industry expertise is drawn from the *Benfield Group*, the leading independent reinsurance intermediary, *Royal & SunAlliance*, the global insurance group, and from *Crawford & Company*, a global provider of risk management services. The TSR scientific grouping brings together climate physicists, meteorologists and statisticians at *UCL* (University College London) and the *Met Office*. TSR forecasts are available from *http://tropicalstormrisk.com*.

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