Extended Range Forecast for Northwest Pacific Typhoon Activity in 2002

Issued: 6th March 2002

by Drs Paul Rockett and Mark Saunders
Benfield Greig Hazard Research Centre, UCL (University College London), UK

Forecast Summary

Northwest Pacific typhoon and intense typhoon activity are anticipated to be 10-20% above average in 2002.

The TSR (Tropical Storm Risk) consortium presents its first extended range forecast for northwest Pacific tropical storm, typhoon and intense typhoon activity in 2002. The forecast spans the full northwest Pacific season from 1st January to 31st December 2002 and is based on data available through the end of February 2002. Our main predictor is the forecast anomaly in August-September Nino 4 sea surface temperature (SST). We expect above average activity in 2002 because we anticipate Nino 4 being slightly warmer than normal this summer. Monthly forecast updates for northwest Pacific typhoon activity in 2002 will be issued through to early August 2002.

1. NW Pacific Total Numbers in 2002

		Intense Typhoons	Typhoons	Tropical Storms
TSR Forecast (±FE)	2002	9.3 (±2.5)	18.7 (±4.0)	28.6 (±4.8)
10yr Climate Norm (±SD)	1992-2001	8.4 (±2.7)	16.9 (±4.3)	27.4 (±4.6)
30yr Climate Norm (±SD)	1972-2001	7.9 (±3.0)	16.4 (±3.6)	26.3 (±4.0)
Forecast Skill at this Lead	1987-2001	13%	11%	2%

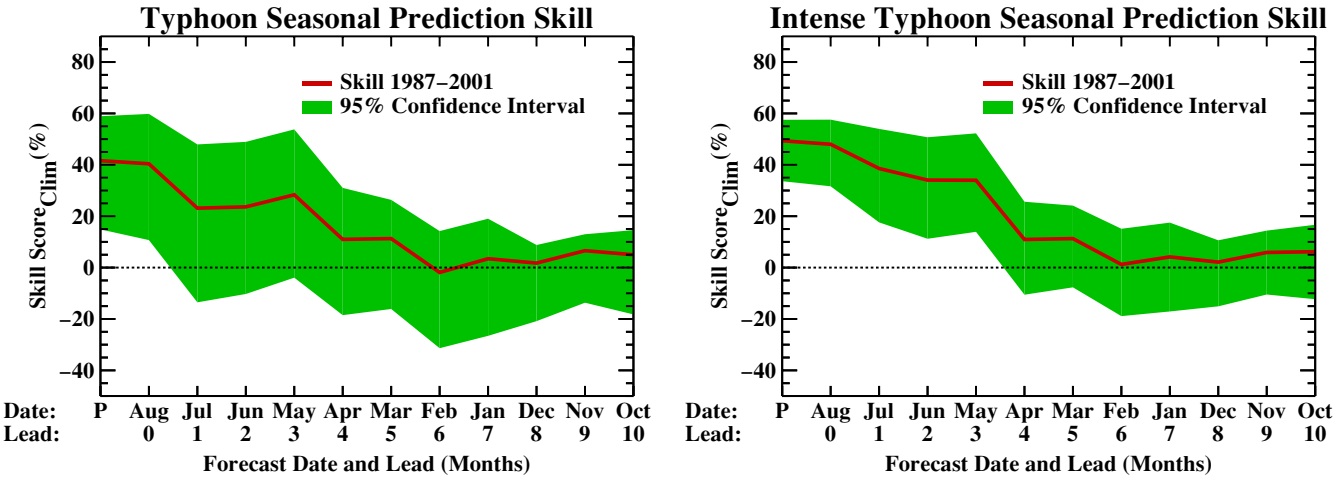
Key:

Intense Typhoon	=	1 Minute Sustained Wind > 95Kts = Hurricane Category 3 to 5
Typhoon	=	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 Simulated Real Time Forecasts 1992-2001
Forecast Skill	=	Percentage Improvement over Running 10-year Prior Climate Norm from Simulated Real Time Forecasts 1987-2001
Northwest Pacific	=	Northern Hemisphere Region West of 180°W Including the South China Sea. Any Tropical Cyclone (Irrespective of Where it Forms) Which Reaches Tropical Storm Strength Within this Region Counts as an Event.

2. TSR Simulated Real Time Forecast Skill 1987-2001

How would the TSR Northwest Pacific forecast model have performed as a function of lead time had it been available in previous years? The figures on the next page show the TSR model skill and associated 95% confidence interval at monthly leads out to 10 months (the previous October) for typhoon and intense typhoon numbers. Skill is computed over the last fifteen years 1987 to 2001, and is expressed relative to a rolling 10-year prior climatology. Details of the skill score measure and confidence interval calculation are given in §3. The 'P' on the skill figures' abscissa denotes the skill with perfect predictors, that is with climate information through to the end of September. The 'Forecast Date' indicates that the

forecast is issued on about the 7th of the month in question, thus permitting climate information from the previous month to be assimilated into the model.



For each strength category the forecast skill rises steadily from March through to August. The model does not exhibit skill prior to March. Positive skill is present to 95% confidence for forecasts issued after April. The model with perfect predictors provides a 50% (40%) skill improvement over the prior 10-year climatology for intense typhoon (typhoon) seasonal numbers.

3. Skill Score and Uncertainty

Several methods are in use to assess the skill of forecast models (eg Wilks, 1995). We employ the percentage improvement in root mean square error over a climatological forecast (RMSEcl). For simplicity we denote this skill measure as 'Skill Score Clim (%)'. This is a robust and tough skill measure which is immune to the bias problems associated with other skill measures. Positive skill indicates the model does better than a climatology forecast, negative skill indicates that it does worse than climatology. We compute confidence intervals on our forecast skill using the bootstrap method (Efron and Gong, 1983). This tests the hypothesis that the model forecasts are more skilful than those from climatology to some level of significance. The skill plots include the 95% two-tailed uncertainty in our forecast skill over a 15-year period.

4. Predictor and Key Influence for 2002

Our model exploits the predictability of tropical sea surface temperatures (SSTs). Anomalous patterns of SST are the primary source of tropical atmosphere forcing at seasonal and interannual timescales. The main predictor in our model is the August-September forecast Nino 4 (150°W-160°E, 5°S-5°N) SST. This is predicted from an in-house amended version of the ENSO-CLIPER model (Knaff and Landsea, 1997). The key factor behind our forecast for an active Northwest Pacific typhoon season in 2002 is the anticipated enhancing effect of warmer than average Nino 4 SST. The forecast anomaly (1972-2001 climatology) for August-September Nino 4 SST is 0.21±0.43 °C. The 'Skill Score $_{\text{Clim}}$ (%)' for this predictor at this lead is 16% (assessed using simulated real-time forecasts over the last 15 years).

5. Forecast Methodology

Our forecast model is statistical. We model the interannual variability in typhoon numbers using a Gaussian distribution. Forecast skill is assessed by rigorous hindcast testing over the period 1987-2001. We use only prior years in identifying the Nino 4 SST predictor and in calculating the regression relationship for each future year to be forecast - ie the hindcasts are performed in simulated real-time forecast mode. Thus 1987 activity is forecast using 1970-1986 data, 1988 using 1970-1987 data, etc.. We

obtain forecasts for typhoon (tropical storm) numbers by 'thinning' the forecasts for intense typhoon (typhoon) numbers.

6. Monthly Updated Forecasts

For the 2002 northwest Pacific typhoon season, TSR will be offering monthly updated forecasts through to early August for basin tropical storm, typhoon and intense typhoon numbers. Our first monthly forecast update will be issued on the 5th April 2002.

7. Potential Benefits

Tropical cyclones are the most costly and deadly natural disaster affecting much of Japan, South Korea, Taiwan, the Philippines, and coastal areas in other southeast Asian countries. The annual damage bill and fatality rate from tropical cyclone impacts in southeast Asia 1990-2000 averages US $3.2 billion (2000 $) and 700 deaths respectively. Substantial inter-annual variability exists in regional tropical cyclone losses. For example, in 1991 and 1988 Japan experienced losses of US $7.5 billion and US $0.00 (2000 $) respectively. Skilful typhoon predictions will benefit insurers and reinsurers, as well as society, government and other business by reducing the risk, uncertainty and financial volatility inherent to varying active and inactive tropical storm seasons.

8. 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*.

9. References

Efron, B. and G. Gong, 1983: A leisurely look at the bootstrap, the jackknife, and cross-validation, *The American Statistician*, **37**, 36-48.

Knaff, J. A. and C. W. Landsea, 1997: An El Niño-Southern Oscillation climatology an persistence (CLIPER) forecasting scheme, *Wea Forecasting*, **12,** 633-652.

Wilks, D. S., *Statistical Methods in the Atmospheric Sciences*, 1995: Academic Press, London, 467pp.