NW Pacific and Japan Landfalling Typhoons in 2000

Pre-Season Forecast Issued 26th May, 2000

Produced under contract for TSUNAMI in collaboration with the UK Met. Office
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Forecast Summary

NW Pacific typhoon activity and Japan typhoon strike numbers are expected to be slightly below average in 2000

We present pre-season forecasts for NW Pacific tropical cyclone, typhoon and intense typhoon numbers, and for tropical cyclone and typhoon strike numbers on Japan in 2000. These forecasts span the full 2000 NW Pacific typhoon season from 1st January 2000 to 31st December 2000. With over 90% of annual typhoon activity occuring after 1st June they are effectively 'pre-season'. The forecasts are based on data available through the end of April 2000. Hindcast testing for 1990-1999 shows that our May predictions are able to anticipate around 50% of the year-to-year variance in seasonal basin numbers, and about 30% of the year-to-year variance in seasonal Japan strikes. Our predictors are a mix of current and forecast sea surface temperatures.

1. NW Pacific Total Numbers in 2000

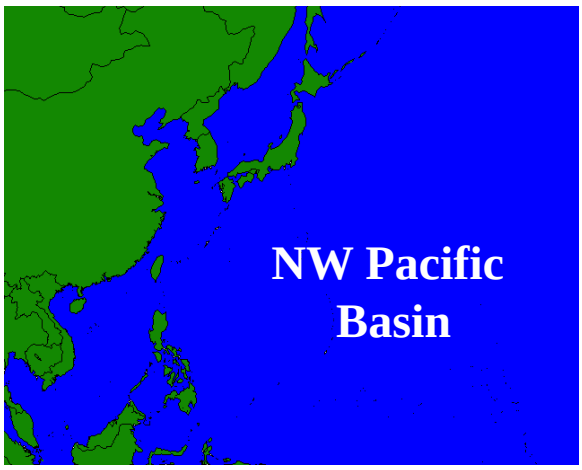
		Intense Typhoons	Typhoons	Tropical Storms
TSUNAMI Forecast (±SD)	2000	7.0 (±2.2)	14.1 (±2.5)	25.3 (±3.2)
Chan May Forecast (±SD)	2000		22 ± 2	29 ± 3
Actual	1999	5	12	25
Average (±SD)	1972-1999	7.9 (±3.2)	16.4 (±3.8)	26.3 (±4.2)

Key: Intense Typhoons = Sustained Wind > 95Kts = Category 3 to 5
Typhoons = Sustained Wind > 63Kts = Category 1 to 5
Tropical Storms = Sustained Wind > 33Kts
'Average' refers to the 1972-1999 period.

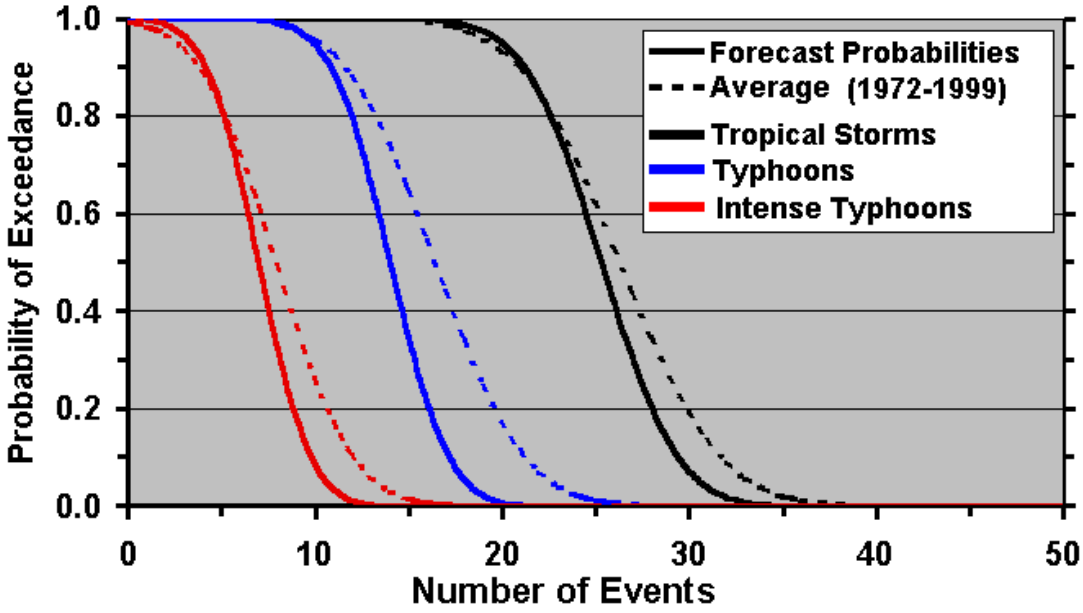
2. Japan Landfalling Numbers in 2000

		Typhoons	Tropical Storms
Forecast (±SD)	2000	1.8 (±1.4)	3.1 (±1.8)
Actual	1999	1	2
Average (±SD)	1972-1999	2.5 (±1.6)	4.1 (±1.8)

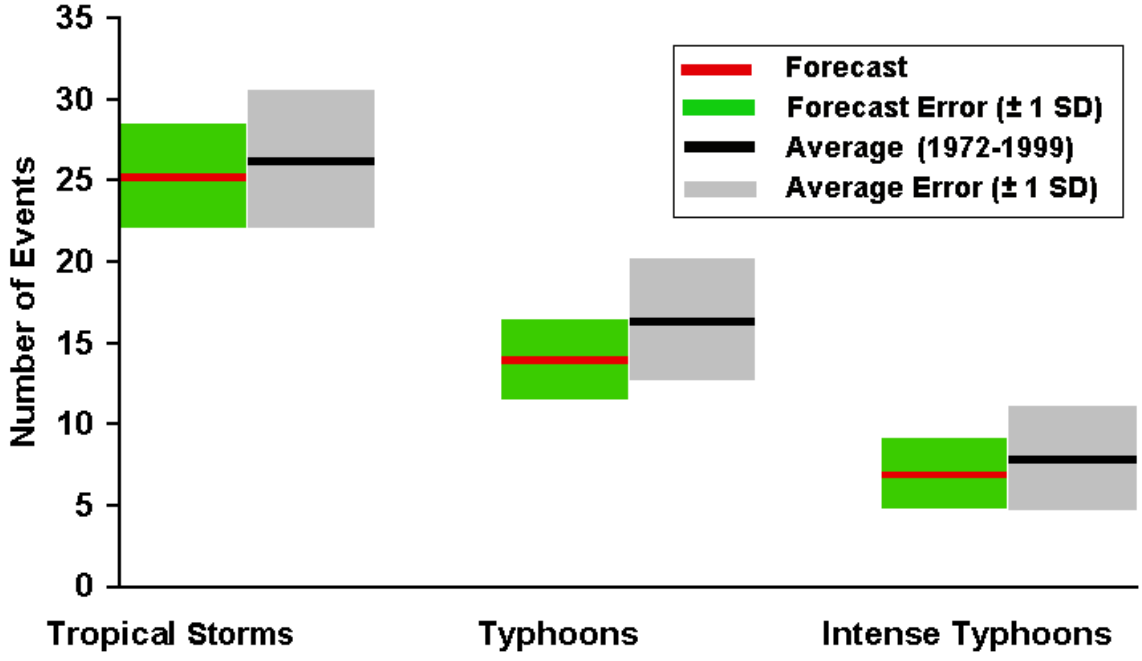
Total Number of NW Pacific Tropical Cyclones



Probability of Exceedance Forecast for 2000

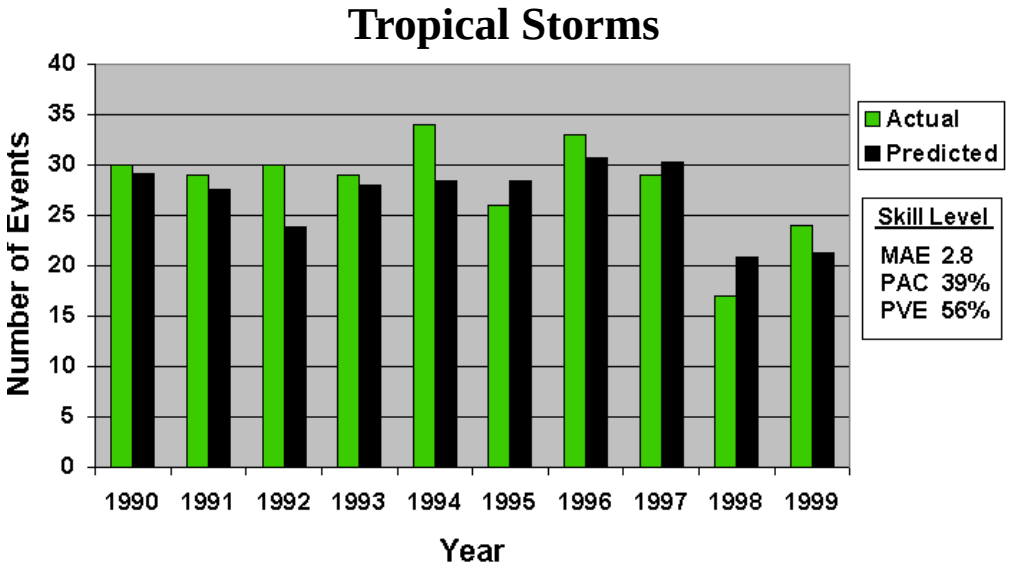


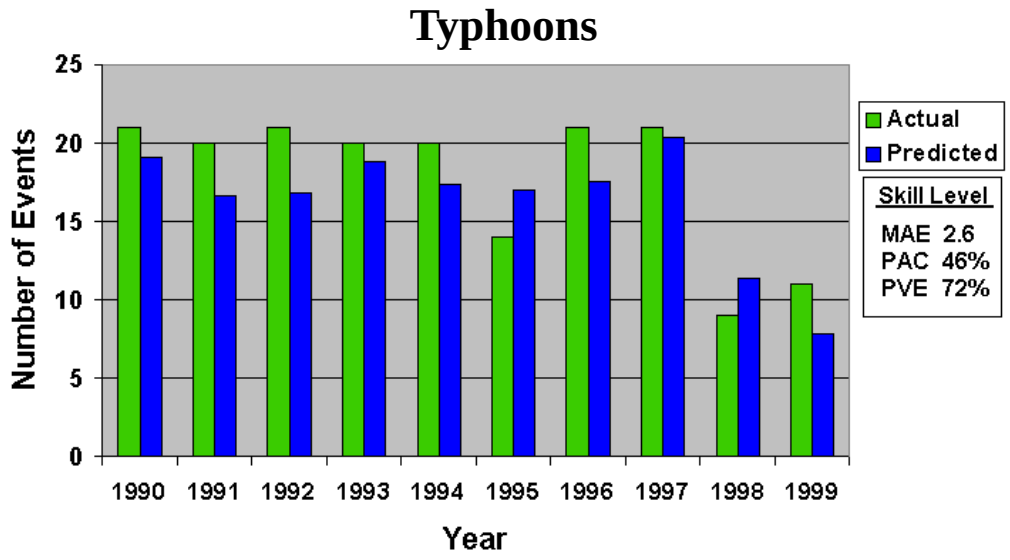
Frequency and Severity Distribution for 2000

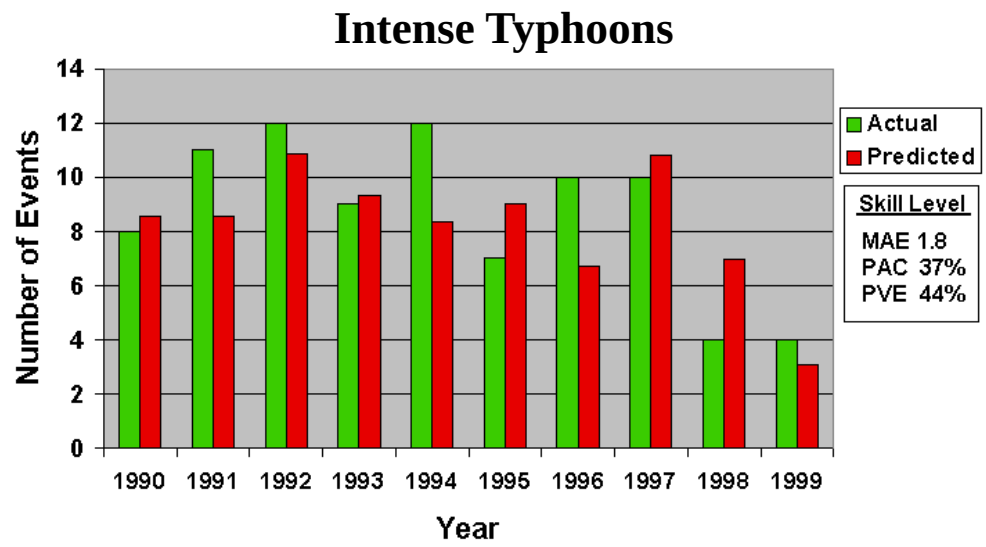


Model Hindcast Performance 1990-1999: Basin Total Numbers

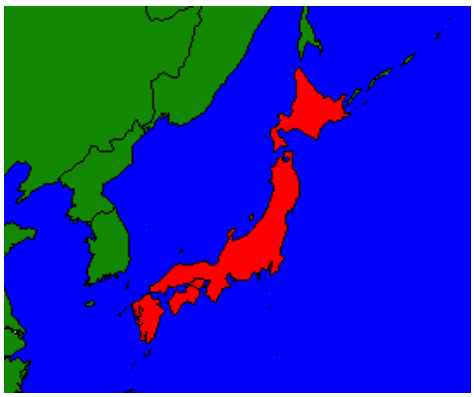
How would the pre-season model (using data up to the end of April) perform had it been available in previous years?







Japan Landfalling Tropical Cyclones



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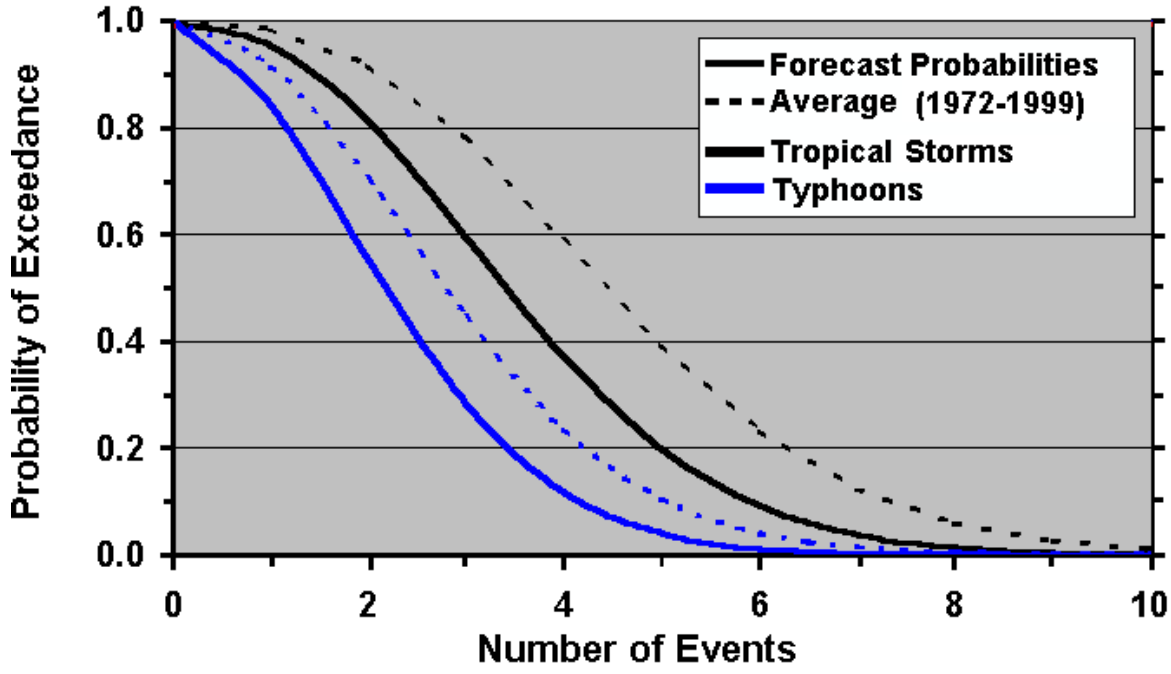

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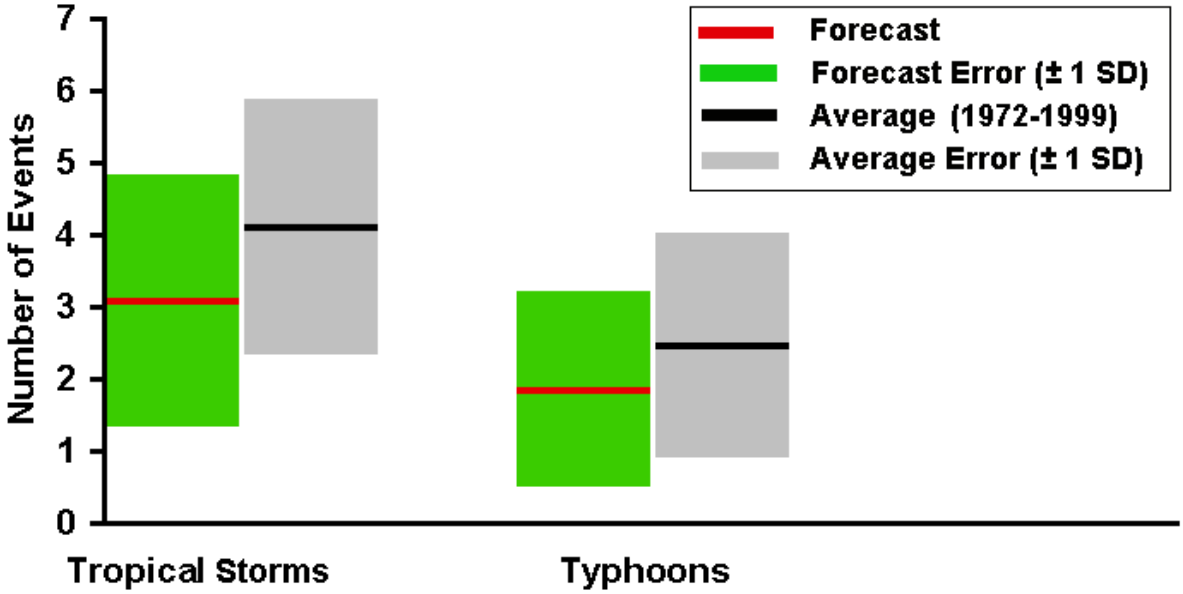

Potential Benefits and Methodology

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 1990-1998 averages respectively US $3.1 billion (1997 $) per year and 740 deaths [information from Munich Re]. Intense tropical cyclones - or typhoons - are responsible for the vast majority of this damage. Typhoon Bart, which struck Japan on 22nd September 1999, caused economic (insured) losses of US $3.3 billion ($ 3.0 billion) respectively, and ranks as the second worst natural catastrophe insurance loss of 1999 . With the advent of satellites, numerical models provide warnings of impending landfall up to a week ahead. However, efforts are now being given to the seasonal probabilistic forecasting of these landfalls many months in advance. Such long-range forecasts - if skilful - would benefit a range of industry including insurance, energy and power, and agriculture.

These forecasts focus on the NW Pacific, defined (eg see Chapter 1 in *Global Guide to Tropical Cyclone Forecasting*, World Meteorological Organisation Report No.560, 1993) as the northern hemisphere region west of 180°E including the South China Sea. We use tropical cyclone best track data provided by Dr C J Neumann and focus on records from 1972 due to doubts over data quality in earlier periods (Chan and Shi, *Geophys. Res. Lett.*, **23**, 2765-2767, 1996).

The forecast model builds on our experience in forecasting seasonal Atlantic hurricane, NW Pacific typhoon, SW Pacific cyclone, and UK winter gale activity. It is statistical,and includes innovative features for testing model stability. A Gaussian distribution is used to model the tropical cyclone random variability, and a Poisson distribution is used to model the variability of landfalling storms.The predictors we use are forecast sea surface temperatures (SSTs) for the Nino 4 Pacific region in August-September 2000, and lagged SSTs from February/March/April taken from the tropical and extratropical north Pacific. The forecast and hindcast values for Nino 4 are computed in-house. The lagged correlation predictors are identified using random, field significance, and model stability tests. Different predictors are used in different forecasts. A fundamental principle underlying our approach is to forecast probability distributions for tropical cyclone occurrence. In this way, imperfection in the forecast is recognised while still providing quantitative information.

The tropical cyclone and SST forecast skill is assessed by hindcast testing over the period 1990-1999. We use constant predictor sets throughout but only use prior years to calculate the regression relation for each future year to be forecast - ie the hindcasts are performed in ‘forecast’ mode. Thus 1990 is forecast using 1972-1989 data, 1991 using 1972-1990 data, etc. We do not employ the jackknife method of cross-validation which inflates skill. The hindcast values are compared against verification, and the model skill is quantified using the following standard measures:

MAE (Mean Absolute Error) defined as the mean absolute difference between the predicted and actual values. The lower this value, the more skilful the model.

PAC (Percentage Agreement Coefficient) defined as the mean absolute difference between the predicted and actual values relative to the level expected under the model. A PAC of 100% indicates perfect skill, a PAC value of 0% indicates no forecast skill.

PVE (Percentage of Variance Explained) defined as the percent of the actual variance explained by the forecast. A PVE of 100% indicates perfect skill, a PVE of 0% indicates no skill.

A key factor behind our forecast of slightly below average activity in 2000 is the predicted neutral Nino 4 conditions for the next six months. Active NW Pacific typhoon and intense typhoon seasons are associated with warm ENSO conditions (Saunders et al., *Geophys. Res. Lett.*, **27**, 1147-1150, 2000).

Future Forecasts

An extended-range forecast for Atlantic seasonal tropical cyclone activity and for US and Caribbean hurricane strike probabilities in 2001 will be issued on 1st October 2000.

End-of-year summaries and forecast verifications for the NW Pacific and Atlantic 2000 seasons will be issued in early December 2000.

The TSUNAMI Initiative

The TSUNAMI initiative was established in response to the Foresight Programme, a UK Government initiative aimed at stimulating improved dialogue between academia and industry. TSUNAMI was formed in September 1997 by Dr Dougal Goodman, Deputy Director of the British Antarctic Survey a component part of the Natural Environment Research Council (NERC). It aims to improve the competitiveness of the UK insurance industry by using UK scientific expertise to improve the assessment of risk. TSUNAMI's three year programme is funded jointly by the Government through the Department of Trade and Industry's Sector Challenge, and by a consortium from the UK insurance industry comprising:

UK Composite Companies:	CGU Group, Royal and Sun Alliance Insurance Group
Lloyd's Reinsurance Brokers:	Benfield Greig Group, Guy Carpenter
Lloyd's Managing Agencies:	Catlin Underwriting Agencies Ltd, DP Mann Ltd, Wren Syndicates Management Ltd.

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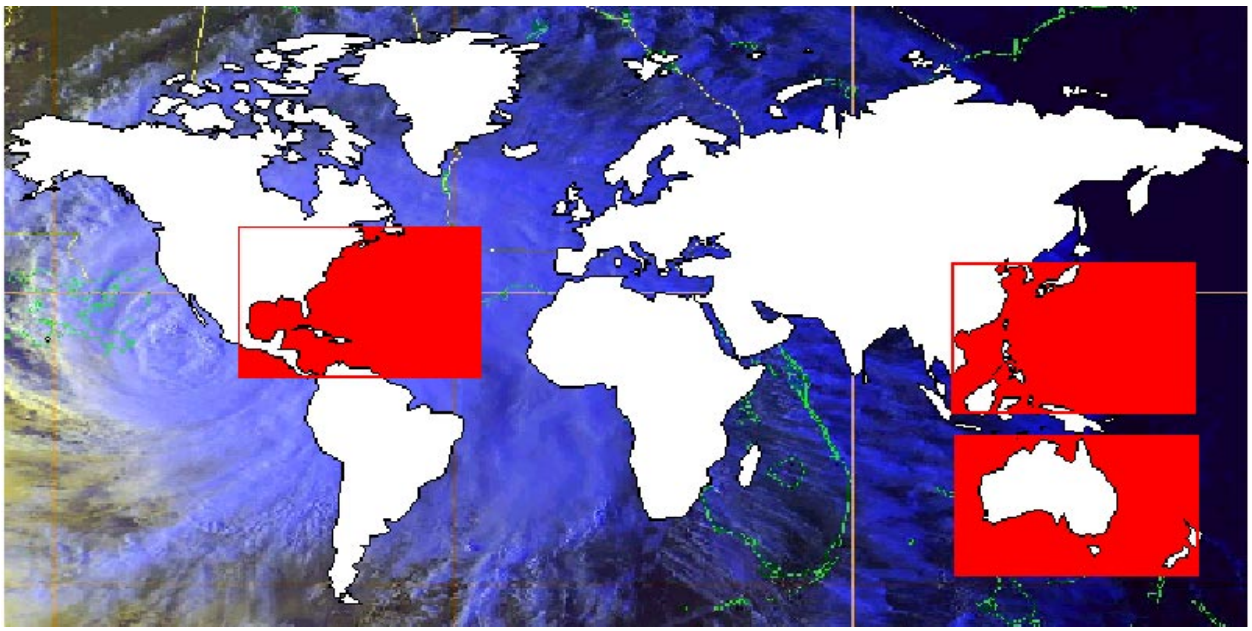

The three basins under research in the TSUNAMI Seasonal Prediction of Tropical Cyclones project.