# Long-Range Forecast for Australian-Region Tropical Storm Activity in 2002/3

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## Forecast Summary

**Australian region (100°E to 170°E) tropical storm and severe tropical cyclone numbers in 2002/3 are expected to be 30-35% below the 10-year climate norm**

The Tropical Storm Risk (TSR) consortium presents a long-range forecast for Australian-region tropical storm and severe tropical cyclone numbers, and for Australian tropical storm strike numbers. The forecast spans the Australian season from December 2002 to the end of April 2003 and is based on data available through the end of July 2002. Our main predictor is the forecast anomaly in October-November Niño 4 sea surface temperature (SST) which we anticipate will be 1.04±0.22°C warmer than normal. We expect Australian basin cyclone activity to be about 1 standard deviation below average in 2002/3 and landfalling numbers to be about 0.4 of a standard deviation below normal. Monthly updated forecasts will follow through to early December 2002.

### Australian Region Total Numbers Forecast for 2002/3

| | | Severe Tropical Cyclones | Tropical Storms |
|---|---|---|---|
| TSR Forecast (±FE) | 2002/3 | 3.7 (±2.2) | 7.5 (±2.7) |
| 10yr Climate Norm (±SD) | 1992/3-2001/2 | 5.7 (±2.1) | 10.8 (±2.8) |
| 30yr Climate Norm (±SD) | 1972/3-2001/2 | 6.0 (±2.4) | 11.3 (±3.8) |
| Forecast Skill at this Lead | 1987/8-2001/2 | 25 | 29 |

Key: Severe Tropical Cyclone = 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 Replicated Real Time Forecasts 1992/3-2001/2
Forecast Skill = Percentage Improvement over Running 10-year Prior Climate Norm from Replicated Real Time Forecasts 1987/8-2001/2
Australian Region = Southern hemisphere 100°E to 170°E (Storm Must Form as a Tropical Cyclone Within to Count).

- Tropical storm and severe tropical cyclone numbers are expected to be 30-35% below average in 2002/03.
- It is 85-90% probable that Australian region tropical storm activity will be below average in 2002/3.
- Very severe tropical cyclones (hurricane category 3-5) are not forecast due to data reliability problems in the historical record.
- Our Australian region (100°E to 170°E), while slightly non-standard, is selected to provide the best overview for tropical cyclone activity around the whole of Australia.

## Australian Landfalling Numbers in 2002/3

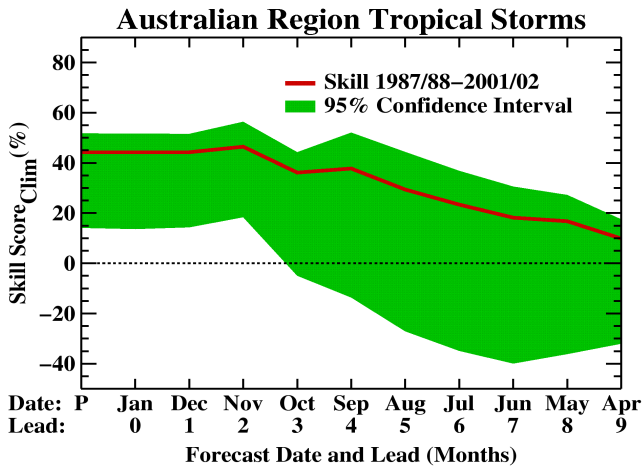
| | | Tropical Storms |
|---|---|---|
| TSR Forecast (±FE) | 2002/3 | 3.5 (±2.2) |
| 10yr Climate Norm (±SD) | 1992/3-2001/2 | 4.4 (±2.1) |
| 30yr Climate Norm (±SD) | 1972/3-2001/2 | 4.9 (±2.3) |
| Forecast Skill at this Lead | 1987/8-2001/2 | 5 |

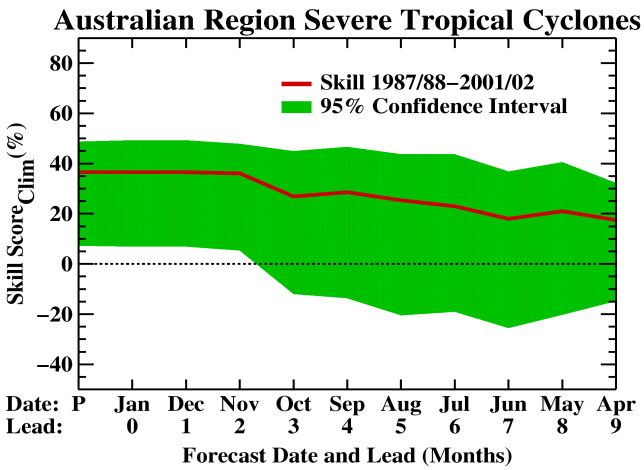
Key: Landfalling Region = Northern Australian coast from Perth around to Brisbane.

- Severe tropical cyclone strikes are not forecast due to their low occurrence rate and to their lack of correlation with tropical storm strike numbers.

## TSR Hindcast Skill Versus Lead Time 1987/8-2001/2

How would the TSR Australian-region forecasts have performed as a function of lead time had they been available in previous years? The figures below show the model skill and associated 95% confidence interval for tropical storm and severe tropical cyclone numbers as a function of forecast lead time. Leads extend to the prior April. Skill is assessed over the recent fifteen years 1987/8 to 2001/2. For an early August forecast of tropical storm numbers the mean skill is 29% better than a climatological forecast. For severe tropical cyclone numbers at this lead, model skill is 25% better than a climatological forecast.




## Skill Score and Uncertainty

Several methods are in use to assess the skill of forecast models. We employ the percentage improvement in root mean square error over a climatological forecast ($RMSE_{cl}$). For simplicity we denote this skill measure as 'Skill Score $_{Clim}$ (%)' in the above figures. We consider this is a robust skill measure which is immune to the bias problems associated with the correlation and percentage of variance explained skill measures. For climatology we employ the running 10-year period prior to each forecast year. 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 standard bootstrap method. This tests the hypothesis that the model forecasts are more skilful than those from climatology to some level of significance. We apply the bootstrap by randomly selecting (with replacement) 15 actual values together

with their associated predicted and climatology forecast values to provide a fresh set of hindcasts for which the $RMSE_{cl}$ skill measure can be calculated. This process is repeated many times (2,000 in this case) and the results histogrammed to give the required skill score. Provided that the original data are independent (in distribution and in order), the distribution of these recalculated values maps the uncertainty in the forecast skill about the original value over a 15-year period. 95% two-tailed confidence intervals for this uncertainty are then obtained.

## Predictors and Key Influences for 2002/3

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 predictors in our model for tropical storm and severe tropical cyclone numbers are:

a) The forecast October-November SST for the El Niño Southern Oscillation (ENSO) Niño 4 region 5°N-5°S, 150°W-160°E. (Main predictor for leads up to October).
b) The observed October Niño 4 SST. (Main predictor for November forecast).
c) The observed October-November SST for the region 5°N-5°S, 170°W-160°E. (Main predictor for December and January forecasts).

The predictor in our model for Australian landfalling tropical storm numbers is the forecast December-March SST for the extended Niño region 5°N-5°S, 120°W-177.5°W.

The Niño 4 and extended Niño forecast SSTs come from an in-house extension of the Knaff and Landsea (1997) ENSO-CLIPER model.

The main climate factor influencing our forecast for below average activity in 2002/3 is the projected warmer than average October-November SST for the Niño 4 region of 1.04±0.22°C. Warmer than normal waters in this region lead to increased atmospheric vertical wind shear over the Australian region during austral summer; a condition favouring below average tropical storm activity.

## Forecast Methodology

Our forecast model is statistical. We model the interannual variability in Australian region tropical storm activity using a Gaussian distribution. Forecast skill is assessed by rigorous hindcast testing over the period 1987/8-2001/2. We use only prior years in identifying the predictors and in calculating the regression relationship for each future year to be forecast - ie the hindcasts are performed in replicated real-time 'forecast' mode. Thus 1987/8 activity is forecast using 1960/61-1986/87 data, 1988/89 activity using 1960/61-1987/8 data, etc.

## Monthly Updated Forecasts

For the 2002/03 Australian season, TSR will be offering monthly updated forecasts through to early December for Australian-region tropical storm and severe tropical cyclone activity and for Australian tropical storm strikes. A summary and forecast verification for the 2002/3 Australian season will be issued in May 2003.

## Potential Benefits

Tropical storms are a costly natural disaster for northern Australia and adjacent southwest Pacific islands between latitudes 10°S and 30°S and longitudes 100°E and 170°E. The average storm damage bill per year 1990/1-2000/1 for this region is US $55 million (2001 $). By providing a lead time on storm forecasts, TSR helps governments, administrators and businesses plan ahead, thereby reducing the risk

and uncertainty from varying active and inactive storm seasons.

## 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 Offic*e. TSR forecasts are available from http://tropicalstormrisk.com.

## Acknowledgements

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