CyclAUS

Risk Frontiers' new stochastic Australian tropical cyclone (TC) wind loss estimation model, *CyclAUS,* provides estimates of event loss as a function of exceedance probability for residential building and contents portfolios. The model domain extends over all Australian coastal regions north of latitude 30ºS, and includes the major settlements of Brisbane, Gold Coast, Nambour, Bundaberg, Gladstone, Rockhampton, Mackay, Townsville, Cairns, Darwin, Port Hedland and Broome. It calculates Probable Maximum Loss (PML) curves and associated statistics for whole-of-portfolio calculations.

CyclAUS incorporates the following features:

- Updated TC event set including:
  - central pressure decay model developed by Risk Frontiers for Australia;
  - state-of-the-art fine-scale roughness & topographic wind factors;
  - site-validated wind speeds (Wind Standard & publications);
  - consistency with palaeotempestology research.
- Modelled uncertainties:
  - central pressure;
  - building vulnerability.
- Damage function development guided by international and local claims experience.
- Data input at CRESTA or Postcode levels.
- All calculations undertaken at Census Collection District (CCD) level. CCDs are as small as 175m × 175m in densely populated areas.

CyclAUS has been constructed in a modular form in order to facilitate the inclusion of new scientific knowledge as it becomes available. Such improvements may include: better TC wind field models, building vulnerability (fragility) curves for wider classes of buildings, addition of a storm surge module for key concentrations of exposure and a portfolio management module.

The residential building and content version of *CyclAUS* is currently available for licencing. An upgrade that calculates TC losses to commercial and industrial portfolios will be available in the first half of this year.

In terms of sheer devastation, Cyclone Tracy undoubtedly remains Australia's worst natural disaster. 90% of the dwellings in Darwin were destroyed or severely damaged, requiring the evacuation of more than 25,000 people. Photo courtesy of News Ltd.

March 2006, Volume 5 Issue 3

quarterly newsletter **Risk Frontiers**

This Issue

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Indexing the Insurance Council of Australia Natural Disaster Event List: What would an event cost today?

The Insurance Council of Australia's (ICA) Natural Disaster Event List is a unique and valuable resource. Most useful applications of this List require losses to be expressed in current values (2004 conditions and dollars). In other words, it is not simply a case of adjusting for inflation, what is needed is an estimation of the loss that would be sustained if the event under consideration were to recur today. Here we describe a simple indexation process for achieving this. The previous indexation methodology implemented by the ICA was developed many years ago and specific detail about it is no longer accessible.

According to Chris Henri (Insurance Disaster Response Organisation), first formal publication of the Disaster List was in 1985 when it appeared as an addendum to a paper presented to the Australian Academy of Technology Sciences by Mr J. K. Staveley, former Managing Director of AMP General Insurances. Initially, events with an insured loss of $50 million and above (in 1985 dollar terms) were listed, however, this benchmark was subsequently reduced to $25 million and then again in the 1990's to $10 million.

The Disaster List has been continually modified and updated as more and better data became available. In 1985, the AMP actuary scaled up original dollar losses to 1985-dollar values. This work enabled the inclusion of many previous events that met the $25 million benchmark and then again when the $10 million benchmark was adopted. The 1990's saw the inclusion of all insured events that had been declared natural disasters by State governments. For this reason, some events are listed despite having an overall insured loss below the $10 million benchmark.

Risk Frontiers explored a number of different indexation methodologies, each incorporating a range of surrogate factors to account for changes in population, wealth and the value of the dollar since the date of the original event. The preferred approach (see Inset) possesses important attributes of simplicity; easy accessibility of the underpinning information; and, by adjusting only for changes in building value, is *independent* of land value. Since damage to dwellings often makes up a major component of most catastrophe losses, this approach assures close alignment to insured losses.

While the most important factors have been quantified and combined in the above indexation methodology, it is equally important to recognise assumptions made and factors not accounted for in the adjustment process. These include the following:

- **all indexed tropical cyclone losses have been reduced by 50% to adjust for critical building code changes in exposed locations despite the true reduction factor being unique to each tropical cyclone;**
- changes in insurance penetration;
- changes in the impact of post-event inflation (demand surge);
- possibility of no change in population or exposure for particular events even though it is automatically assumed in the adjustment - imagine a hailstorm whose footprint extended across an already densely populated area and where there have been no material changes in population or dwelling numbers since the time of the event;
- the impact of loss mitigation measures, e.g. new levees constructed near or around rivers in the case of flood;
- land use changes affecting storm paths;

Preferred Indexation Scheme

$$CL_{04} = L_a \times N_{a,b} \times D_{a,s}$$

CL_{04} - event loss converted to 2004 value (current loss);
a - year the event occurred;
L_a - event loss in year 'a' (original loss);
b - Urban Centre / Locality (UC/L) impacted by the event. The UC/L Structure groups Census Collection Districts (CCDs) together to form defined areas according to population size criteria (http://www.abs.gov.au);
$N_{a,b}$ - dwelling number factor, determined by the ratio of the number of dwellings as at 2004 in the UC/L originally impacted by the event to the number in year 'a'. This information is derived from the 1966 and 2001 Census of Population and Housing;
s - State/Territory that contains the UC/L impacted by the event;
$D_{a,s}$ - dwelling value factor, determined by the ratio of the State/Territory average *nominal* value of new dwellings in 2004 to that of year 'a'. The dwelling value factor is calculated for the State/Territory that contains the UC/L impacted by the event. State/Territory average *nominal* values of new dwelling units are calculated by dividing the value of building work completed within a year by the number of completions within the same year. Relevant values are taken from the ABS *Building Activity* reports (http://www.abs.gov.au).

Note that the increase in average dwelling value is in part due to increasing average dwelling size and marked improvements in the quality of the housing stock (http://www.abs.gov.au).

- possibility that some recent events in the Disaster List would not have met the minimum loss threshold had the same event occurred years ago, i.e. demographic changes mean that it's now possible for an event to register a loss in an area where there may not have been any people living in the past. This is particularly an issue for hailstorms, for example, as there will be no record of the event unless it impacted a populated area;
- frequency and magnitude of some of the hazards in the Disaster List are affected by meteorological and atmospheric cycles.

Figures 1 and 2 are results of an analysis of the indexed Disaster List. Annual losses have been calculated for years ending 30 June to take account of the seasonality of the main meteorological hazards. Figure 2 shows that the apparent increasing trend in unadjusted losses is largely attributable to changes in the number of dwellings and dwelling values. When correctly indexed, the time series of insured losses exhibit no obvious trend over time.

Analysing successive 5 year event frequency above a given threshold (Figure 3.) shows that there is a decreasing trend in moderate / severe events over time. Further analysis may well reveal that this trend is attributable to meteorological and atmospheric cycles (the list contains only 5 non-weather related events – 4 earthquakes and 1 tsunami). Population growth across Australia largely accounts for the increasing trend in the number of frequent events (>$10 million) over time. The frequency of the most severe events (>$1billion) exhibits no trend over time though the reliability of this result is limited owing to the small number of events in this category.

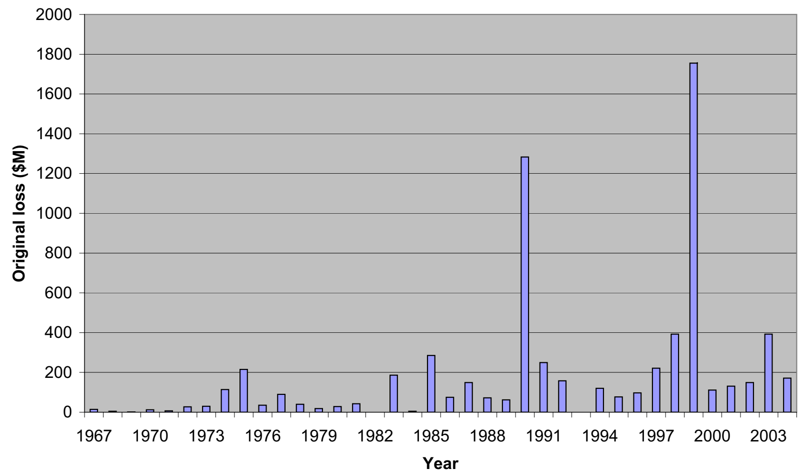

Figure 1: Original annual aggregate losses ($M) for years ending 30 June.

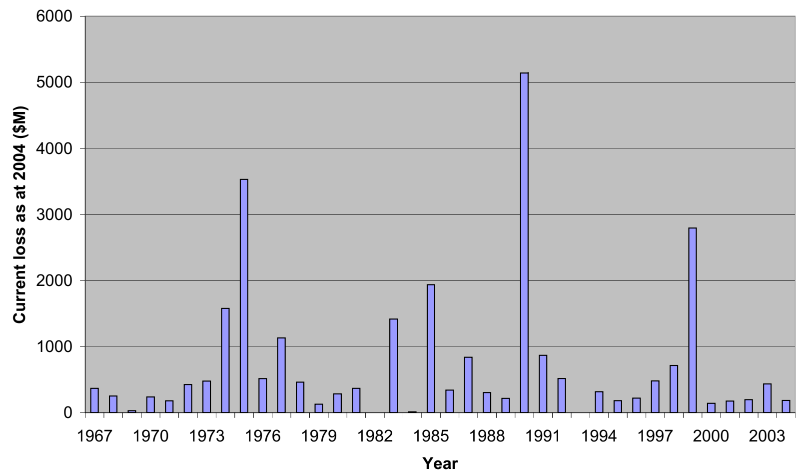

Figure 2: Annual aggregate current losses ($M) for years ending 30 June.

Table 1: Top 10 current losses ($M)

Rank	ICA Cat No.	Type	Month	Year	Location	State	Original loss ($M)	Current loss as at 2004 ($M)
1	80	Earthquake	12	1989	Newcastle	NSW	862	3567
2	15	Cyclone	12	1974	Darwin	NT	200	3277
3	128	Hail	4	1999	Sydney	NSW	1700	2735
4	59	Bushfire	2	1983		VIC	176	1335
5	84	Hail	3	1990	Sydney	NSW	319	1221
6	63	Hail	1	1985	Brisbane	QLD	180	1185
7	46	Cyclone	1	1974	Brisbane	QLD	68	740
8	20	Hail	11	1976	Sydney	NSW	40	612
9	68	Hail	10	1986	Western Sydney	NSW	104	588
10	62	Flood	11	1984	Sydney	NSW	80	551

The top 10 ranked indexed losses are presented in Table 1 with the 1989 Newcastle earthquake leading the way. As can be inferred from the table there is a wide spread of natural hazard risk in Australia with 5 different hazard types represented in the top 10. Except for the Newcastle earthquake, all are of a meteorological persuasion.

Our analysis also revealed that 10 of the top 20 indexed losses result from events occurring before 1980. This is the case for only two events when ranking the original losses. Note that the Ash Wednesday bushfires have been combined into one event loss (they appear as two separate events in the Disaster List) as have the two events occurring on 24/10/99 and another two on 30/6/05.

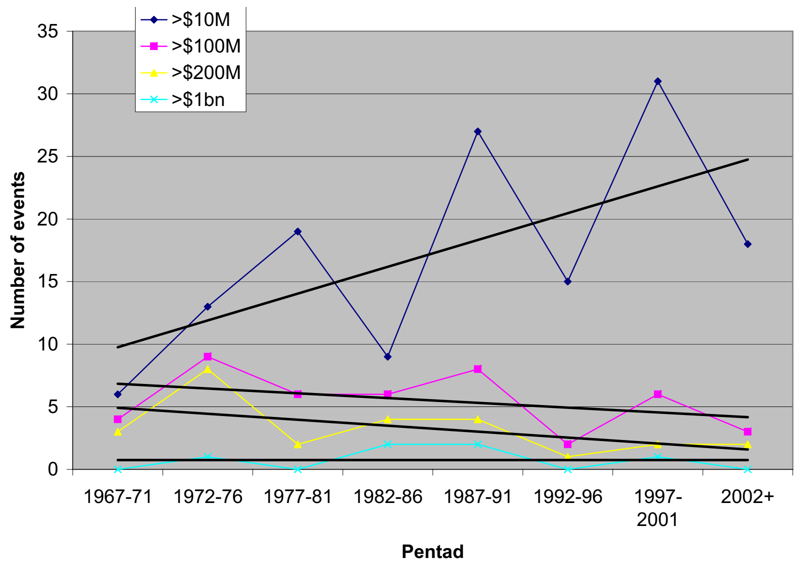

Figure 3: Five-year frequencies of indexed events exceeding a given loss threshold.

Figures 4(a) and 4(b) classify the weather-related hazards according to their contribution to the total number of events and total current loss. We see flood and storm together account for over half the number of events yet contribute less than a quarter of the total loss. Conversely, tropical cyclone and hailstorms combined represent 38% of the total number of events and 64% of the total loss; needless to say hailstorms and tropical cyclones have the highest average losses per year.

The limited length of the indexed Disaster List (post 1967) means that it is inadequate to extrapolate the impact of low probability / high severity events. Depending on what statistical distribution is used to fit to the indexed Disaster List, the return period of an $A10 billion annual aggregate loss ranges from 140 years to 1670 years. Similarly, a 10,000-year return period event varies between $A10 billion and $A1470 billion. By far the most effective way to examine company exposure to low probability / high severity events is to utilise catastrophe models wherever possible.

Despite the above shortcoming, the value of the Disaster List should by no means be underestimated. Other invaluable applications include: estimating the impact of high probability / low severity events; identifying trends in losses and the frequency of events over time; determining hazards and locations that present the greatest threat to industry; and using the indexed losses for a wide range of meteorological and climate related research.

The reader may find the full report along with indexed values available on the ICA website www.ica.com.au. For further information contact Ryan Crompton email: rcrompto@els.mq.edu.au.

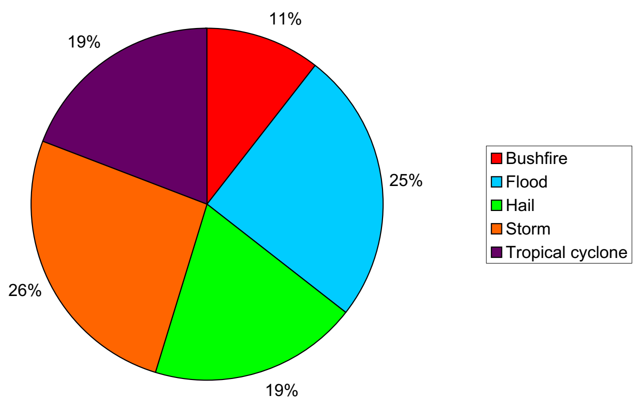

Figure 4 (a): Percentage of the number of weather-related events classified by hazard type.

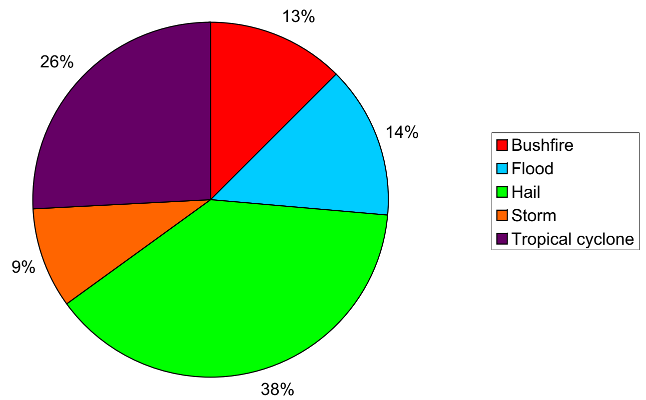

Figure 4 (b): Percentage of the total current loss as at 2004 ($M) of weather-related events classified by hazard type.