Institute of Actuaries of Australia

Storm Insurance Costs:

How have weather conditions impacted recent profitability?

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Abstract

In recent years the general consensus within the insurance industry seems to be that storm experience has been favourable and in many cases has resulted in above normal insurance profits. With this in mind, this paper will investigate and report on the following:

- How recent weather patterns compare with averages over the longer term
- Relationships between weather data collected by the Bureau of Meteorology and actual insurance claims
- Quantification of the level of "above normal" profits
- Expectations for the future, with regard to both storm experience and the expected impact on future insurance costs

Keywords: General Insurance, Storms, Bureau of Meteorology, Domestic and Commercial Property Pricing

Storm Insurance Costs

1 Introduction

The insurance industry has delivered excellent profitability in recent years. The generally benign weather conditions are thought to be one of the contributors to the favourable underwriting performance.

- *"As a Group, we exceeded all operating targets for the year………our existing business also performed strongly, underpinned by……… largely benign weather conditions which sustained a reduced claims frequency."* : IAG 2003 Annual Report
- *"The excellent result is largely attributable to lower small claims frequency due to generally favourable weather conditions and the general absence of large commercial losses"* : Promina 2003 Annual Report
- *"In general, the pleasing underwriting result is largely attributable to benign weather conditions experienced during the year, a lower incidence of large losses, favourable claims development ………..."* : Promina 2004 Annual Report
- *"Lumley General (Australia) achieved a strong result...... The result was characterised by a generally benign claims environment despite a severe storm event in Victoria in December 2003."* : Wesfarmers 2004 Annual Report

This paper attempts to quantify the impact that weather conditions have had on insurers' commercial and domestic property insurance claims costs. **We have excluded catastrophes from this analysis** as they are well covered elsewhere. Throughout the paper we use the term "storm cost" to describe weather related claims paid by insurers, excluding catastrophes and bush fires.

Over the three years ending December 2003 storms cost insurers roughly $2 billion, equivalent to 13% of property premiums for domestic and commercial combined, based on 2003/04 average premium levels. This paper investigates and reports on the following:

• Is it possible to identify a link between weather data and storm claims costs?	Yes, although the match is not perfect
• How does recent weather experience compare with the longer term experience?	Recent weather experience has been favourable, with the number of days producing storm costs below the long term average
• What is the level of above average profits?	Difficult to quantify with certainty, but potentially around $200m p.a. , or 4% of premiums averaged across the 2000 – 2003 period
• What are expectations for the future, in terms of weather experience and insurers' response to it?	Changes in claims cost resulting from enhanced global warming will probably be gradual and disguised by short term volatility, linked to El Nino and other influences. In our view, pricing on the basis of the historical long term risk continues to be appropriate. Potentially that implies loading some of the recent costs for the better than normal experience.

1.1 Data

We have utilised data from a number of sources, including insurers, the Bureau of Meteorology (BoM) and Insurance Statistics Australia (ISA).

Insurer claims data

We would like to acknowledge the support that we received from Allianz and CGU in providing data for our study.

For each insurer we received details of the dates and costs associated with all weather related property claims for as long a history as accurate claim type classifications were available. In addition, the claims were also classified by region.

We also received broad summaries of each insurer's earned premiums, gross sums insured and policies in force, by region, for the most recent annual period.

Bureau of Meteorology data

We used data of daily readings of both maximum wind gust and 24 hr rainfall available from the BoM. These readings can be obtained for in excess of 100 different sites around Australia.

The accuracy of the rainfall measurements is not believed to have changed over the history of available data. This may not be the case with maximum wind gust data. The BoM note that changes in mean wind speed over time as represented by historical wind data may not necessarily represent an equivalent change in the wind climate of the region around the observing station. Changes in the (apparent) wind speed can be caused by a number of factors, including:

- deterioration in the anemometer (for example bearing corrosion)
- growth in vegetation or an increase in buildings surrounding the site
- a change in observer, especially when wind speed is estimated (if this occurs it is often represented by a step change and not a gradual shift in mean wind).

Following discussion with BoM representatives we have concluded that the "deterioration in anemometer" issue will not impact our results as this issue mainly impacts the lower wind readings, rather than the more extreme readings observed during storm periods.

In addition we have decided to base our results on measurements taken at each of the major domestic airports in each capital city. The reasons for using these particular sites are;

- they are, and have always been, wide open spaces and are therefore the least likely of the sites to be significantly impacted by changes in the surrounding area over the period in which we are interested
- the major airport sites have always used anemometer wind readings rather than manual readings, and are therefore largely unaffected by the "change in observer" issue
- they generally have the longest history of available data.

In this regard we believe that both the wind and rain analyses presented in this paper are based on a consistent basis of measurement over time.

Insurance Statistics Australia data

ISA provided summaries of the weather related insurance data. From this data, we were able to obtain trends in weather related claim frequencies, claim sizes and loss ratios for the past 10 years, by state and metro/country region. We would like to thank ISA for providing this data. Note, throughout this paper we have used the term loss ratio to describe the ratio of claims costs to premiums.

We would also like to thank Risk Frontiers, Allianz, and IAG for their input and feedback, and the contribution of our peer reviewer, Colin Brigstock. The views expressed in the paper are, however, our own.

1.2 Structure of this Report

The remainder of this report is set out as follows:

- *Section 2:* Estimates the average cost of storms
- *Section 3:* Assesses if a link exists between BoM data and insurer data
- *Section 4:* Looks at what the BOM data suggests about recent vs long term experience
- *Section 5:* Considers the implications for pricing?
- *Section 6:* Considers further uses for the BoM data used within this paper.

The information in the report is supported by a series of attachments.

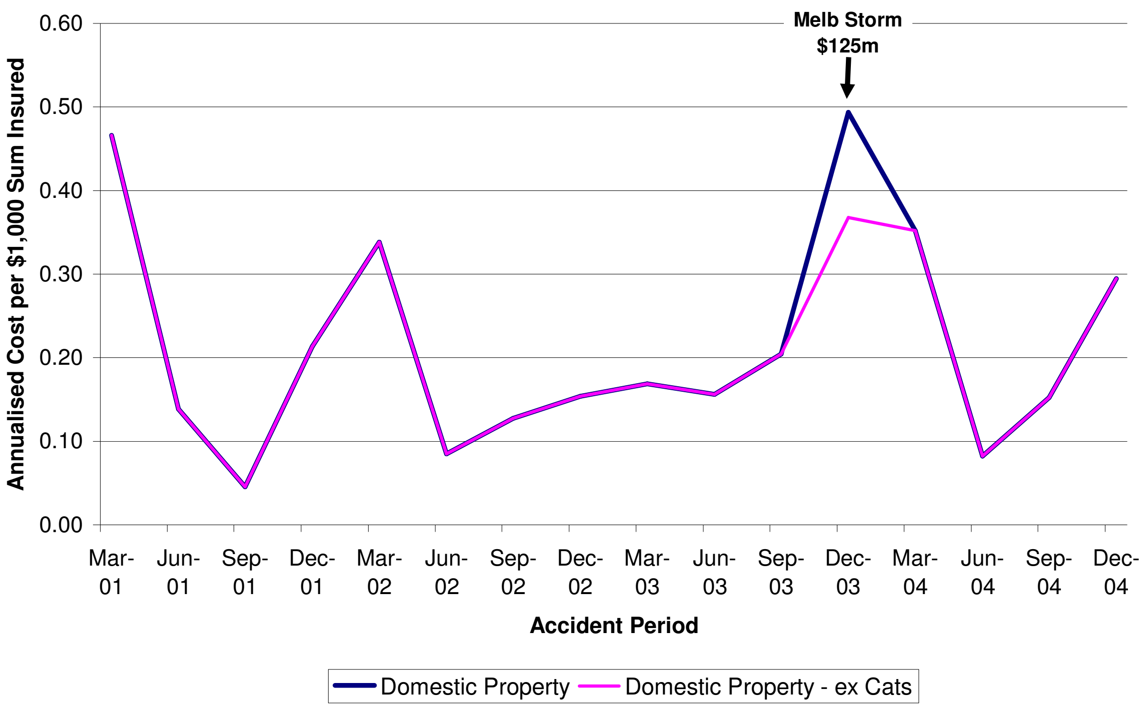
2 What do storms cost insurers?

The starting point in our analysis was to assess the average level of storm costs in recent years. Our assessment is based on ISA data spanning the period 2001 to 2004 for domestic property. The domestic ISA data represents around 60% of the total market across this period.

We have removed the impact of catastrophes from the data on an approximate basis, using data on the cost of each event shown in the Insurance Disaster Response Organisation (IDRO) catastrophe register. We have defined a catastrophe as any event causing more than $50m of insured losses. The only event exceeding $50m during the 2001 to 2004 period was the December 2003 Melbourne storms ($125 million industry loss).

Figures 2.1 shows the average storm cost by period, expressed as a % of the exposed sums insured, for the domestic property class of business.

Figure 2.1 – Trend in Domestic Storm Costs



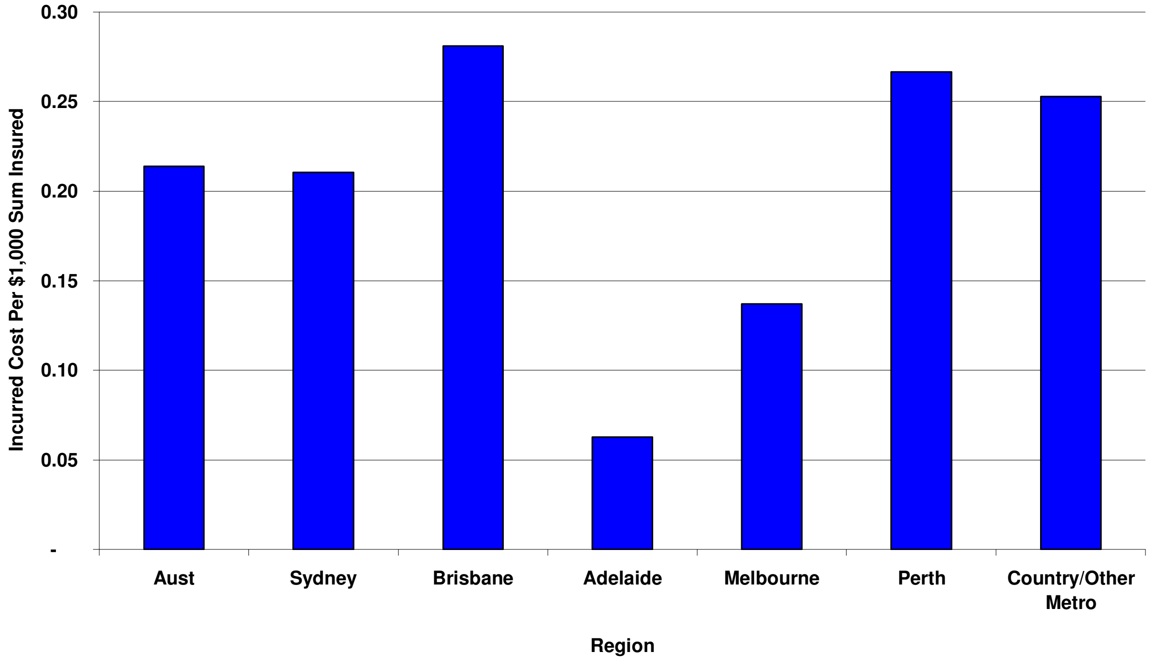
The average cost over the period of the ISA data – using a simple average across years so that equal weight is given to each year's data – is $0.2 per $1,000 sum insured for domestic. Based on 2003/04 average premium rates, the corresponding average storm loss ratio is 13% for domestic property.

We have been unable to accurately calculate the cost of storms for the commercial property industry due to limitations in the available data, however we have analysed the losses from numerous commercial portfolios and conclude that the storm loss ratio for commercial risks is likely to also be around 13%.

Are prices formed on the basis of a 13% storm loss ratio (i.e. the 3 years ended December 2003) adequate to cover claims costs? Would ten years' data be better? Are variations in storm claims cyclical, or has there been structural change. We suggest answers to some of these questions later in the paper.

It should also be noted that the cost varies by region, as shown in Figure 2.3 below (only includes domestic data as we were unable to split commercial data accurately by zone):

Figure 2.3 – Cost Per $1,000 Sum Insured for Domestic Non Cat Weather Claims, by Region



As would be expected, there is a significant difference in the costs of storm claims by city and also for metro versus country areas. The storm cost experience would be expected to vary by insurer according to the profile of their business by region.

It should also be noted that roughly 50% of all weather losses relate to the five main capital cities shown in the above chart. These are the losses covered by our paper. Around 70% of this metro cost relates to Sydney and Brisbane.

3 How does weather impact the cost of storms?

Having established the average cost of storm claims in recent years, the next stage of our analysis was to use BoM data of daily wind speed and rainfall in an effort to identify the nature of the recorded weather conditions that appear to be associated with insured losses arising. Assuming a link can be shown to exist between BoM data and insured storm costs, it is possible to estimate the level of insurance losses that would emerge from a repetition of weather conditions over the longer term – say the last 50 years.

As a starting point, we reviewed existing studies of the relationship between wind speeds / rainfall and damage to property. This research suggested that damage to property usually starts with wind speeds of around of 70km/hr. The damage experienced at this level will tend to be light and often relate to chimney’s, TV antennas and damage associated with shallow rooted or old trees falling over. As would be expected the most costly storm events (excluding catastrophes) are usually those associated with a combination of high wind and heavy rain. The wind causes the initial external structural damage, with the rain providing internal water damage. In addition, a high proportion of storm costs relate to wind driven rain (for example, wind forcing rain up under eaves).

Matching insured losses with BoM data on an Australia-wide basis presents considerable challenges, not the least the difficulty in dealing with more than 100 separate weather stations. To simplify the analysis our review has been limited to the five major capital cities. Typically, each city has 2 or 3 weather stations that show weather data spanning a long period (say around 50 years). For reasons mentioned already we have used data from the major airport in each capital city.

For each city, we have looked at the link between the level of storm losses (using the insurer data of weather claims by date and location), and various different combinations of the maximum wind gust and 24 rainfall data. Our objective was to identify the BoM measures most closely linked to storm claims costs.

In each of our measures, we have combined wind and rainfall and ranked days from least to most “stormy”. We then measured the proportion of storm insurance costs that related to the most stormy 10% of days. Figure 3.1 summarises the results of this analysis, which was performed on data from a large domestic insurance portfolio (spanning the period 1996 to 2004). It should be noted that we again removed the impact of any catastrophe losses (greater than $50 million industry loss).

Figure 3.1 - Proportion of Weather related Claim Costs explained by worst 10% of "stormy" days

Storm Definition	Syd	Bris	Perth	Melb	Ade
Wind Only	45%	43%	45%	<u>*19%*</u>	47%
24 hr Rain Only	<u>*35%*</u>	<u>*25%*</u>	<u>*40%*</u>	27%	<u>*39%*</u>
48 hr Rain only	43%	57%	57%	**53%**	61%
Wind plus 24 hr Rain	49%	47%	50%	28%	50%
Wind plus 48 hr Rain	**57%**	**73%**	**54%**	**39%**	**59%**
Wind plus 72 hr Rain	**55%**	**74%**	**59%**	**39%**	**59%**
Wind plus 120 hr Rain	44%	70%	53%	39%	58%
Wind plus Rain (ranked)	48%	46%	46%	26%	44%
Wind plus 72 hr Rain (ranked)	47%	**75%**	55%	31%	55%
Wind plus 0.5*48 hr Rain	50%	72%	52%	36%	56%
Wind plus 2*24 hr Rain	47%	44%	49%	35%	53%
Wind plus 2*48 hr Rain	**51%**	**72%**	**57%**	**44%**	**61%**
Wind plus 2*72 hr Rain	49%	71%	**59%**	43%	61%

Our aim was to find the "storm" measure for which the worst 10% of stormy days appeared to consistently predict a high proportion of storm claims costs. As can be seen, the storm definitions which explain the least proportion of claims costs (shown underlined) are generally related to storm definitions involving rain only. This is in line with our expectations and discussions with insurers. The best storm definitions (shown in bold) generally relate to combinations of both wind and rain in the following 48 to 72 hours.

For the purposes of the subsequent analyses we decided to use a storm definitions based on wind, plus rain in the following 48 hours.

Having established a basis for estimating the relative storm severity for a given historical day (maximum wind gust in km/hr, plus 48 hr rainfall in mm) we are then able to rank each day based on the likelihood of generating weather related insurance costs. This is shown in figure 3.1 and 3.2 for each of the main cities and domestic and commercial respectively.

Figure 3.1 – Domestic Insurance Gains Chart : BoM storm days vs. Insurer cost days

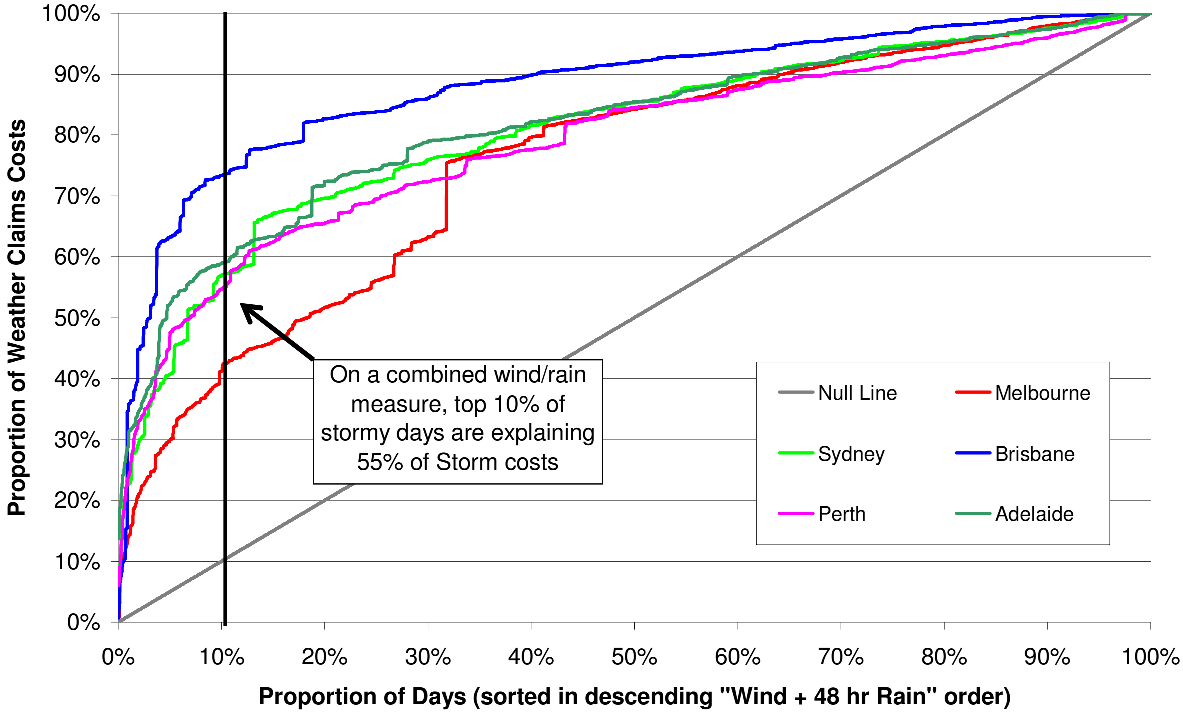
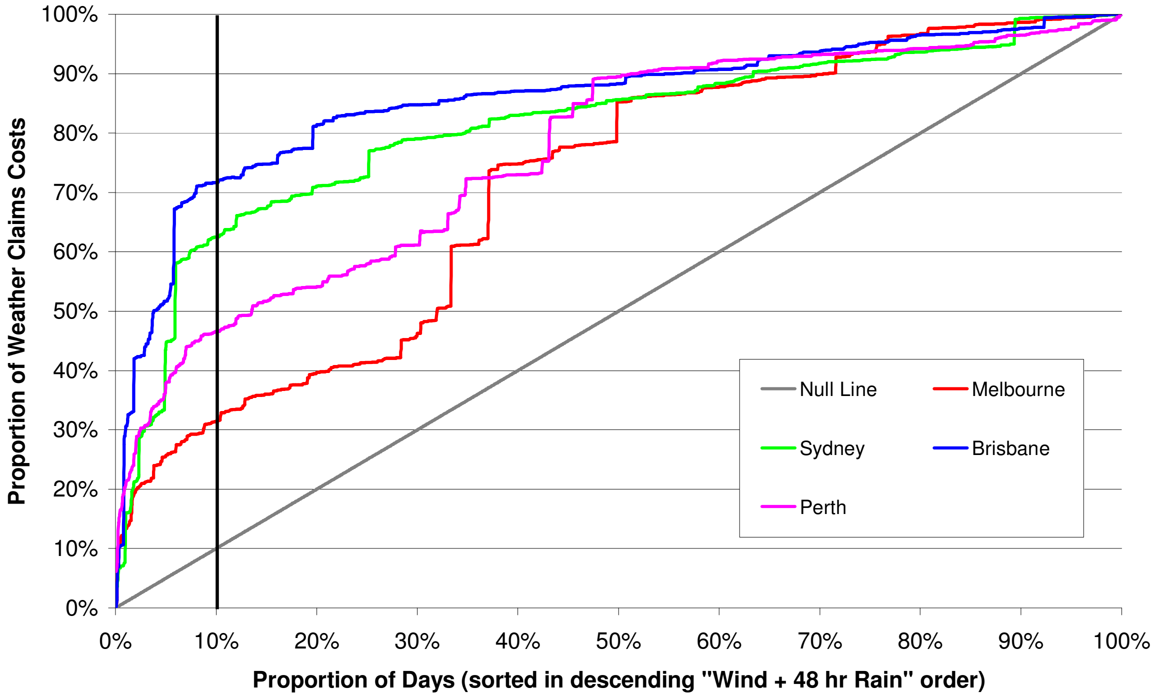


Figure 3.1 shows, for example, that for domestic insurance in Sydney, 50% of storm costs are related to the worst 7% of "stormy" days.

Figure 3.2 – Commercial Insurance Gains Chart : BoM storm days vs. Insurer cost days



The gains chart presents a similar picture for commercial losses, with the worst 10% of stormy days according to the BoM data accounting for more than 60% of the storm costs in Sydney and Brisbane. We have not shown Adelaide on the chart due to the small number of weather related commercial losses in our data set. Similarly, the commercial losses for Melbourne are reasonably small and therefore, due to a few large individual losses, the gains line doesn't appear as good for Commercial losses in Melbourne.

The 10% threshold relates to a combined wind and 48 hr rainfall score of around 70 (eg. 50km/k+20mm rain, or 70km/h+0mm rain), although this varies slightly by state. The 2% threshold relates to a combined score of around 100. These levels are broadly consistent with the expectation that insured losses commence once wind speeds exceed 70km/h.

Inevitably there are some days where the BoM data we have used suggests weather conditions are benign, yet storm claims costs are significant. For example, the lightest 40% of storm days still account for 10% of the storm cost. We have investigated this issue and conclude that:

- a proportion of storm costs relate to localised events. Because we are using a single recording station in each state, we will "miss" some of these localised events, unless they occur close to the airport. For example, the weaker correlation observed in Melbourne partially reflects a couple of localised events (1 Feb 2002 and 29/30 Jan 2004) in the South Eastern suburbs (the airport is North West of Melbourne)
- a proportion of storm costs relate to hail storms. Our measure of storms will also "miss" these events unless they correspond with periods of high wind and/or rain. This is a limitation of our paper and findings
- there is potential for some coding issues in relation to the recording of accident dates. For example, where a period of high wind is followed by 2 days of heavy rain, our storm definition relies on claims being attributed to the original period of high wind, rather than the date on which water damage occurred. Note that this example assumes the water damage occurs as a result of the original wind damage.

A further issue that emerged in the course of our work involved days of particularly high storm cost. Although there was generally a link between these high cost days to bad "stormy" days, it is not possible to differentiate a "stormy" day which generated an industry loss of $30 million from a similarly characterised day that only generated small levels of loss. This limits the predictive power of using the BoM data to accurately predict the insurance costs, especially for short time periods (say a year or less).

Given the limitations with both apparently benign storm days involving costs and the variability caused by some individual storm events, care needs to be taken in applying the outcomes of the analysis – ie. there is not an exact match between the weather data and insured losses.

3.1 Conclusion

We have established that a link exists between BoM wind and 48 hr rain levels and insurer storm claims costs. Whilst the correlation is not 100%, the BoM nevertheless provides a useful basis for considering how insurer claims costs in recent years compare to that which might be expected given a repetition of the last 50 years experience. This is explored in the next section.

4 Has recent weather been benign?

Having established that a link exists between "stormy" days indicated by the BoM data and the level of insured storm claim costs, we can then use the BoM data to indicate the level of claim costs that might arise from a repetition of say the last 50 years weather conditions.

This has been done by assigning a "weather claim score" to each day which falls within the worst 10% of stormy days. The worst 10% of stormy days has been measured based on the "storm score" (wind plus 48 hour rain) and as previously mentioned, the worst 10% of days implies "storm scores" of above 70 and explains in excess of 50% of the storm insurance costs within our sample.

The table below shows the "weather claim score" assigned to each percentile of our "storm scores".

Worst x% of Stormy Days	Weather Claim Score
1%	20.0%
2%	10.0%
3%	8.0%
4%	6.0%
5%	5.0%
6%	4.0%
7%	3.0%
8%	2.0%
9%	1.5%
10%	1.0%
10% +	0.0%

The "weather claim scores" have been selected to represent the relative proportion of costs attributable to each percentile of stormy days. The actual "scores" are based roughly on the gains charts shown in figure 3.1 and figure 3.2.

Figures 4.1 and 4.2 shows the total "weather claim scores" for Sydney and Brisbane across the last 50 years and also the 50 year average "score".

Figure 4.1 – Observed "Weather Claim Scores" for Sydney

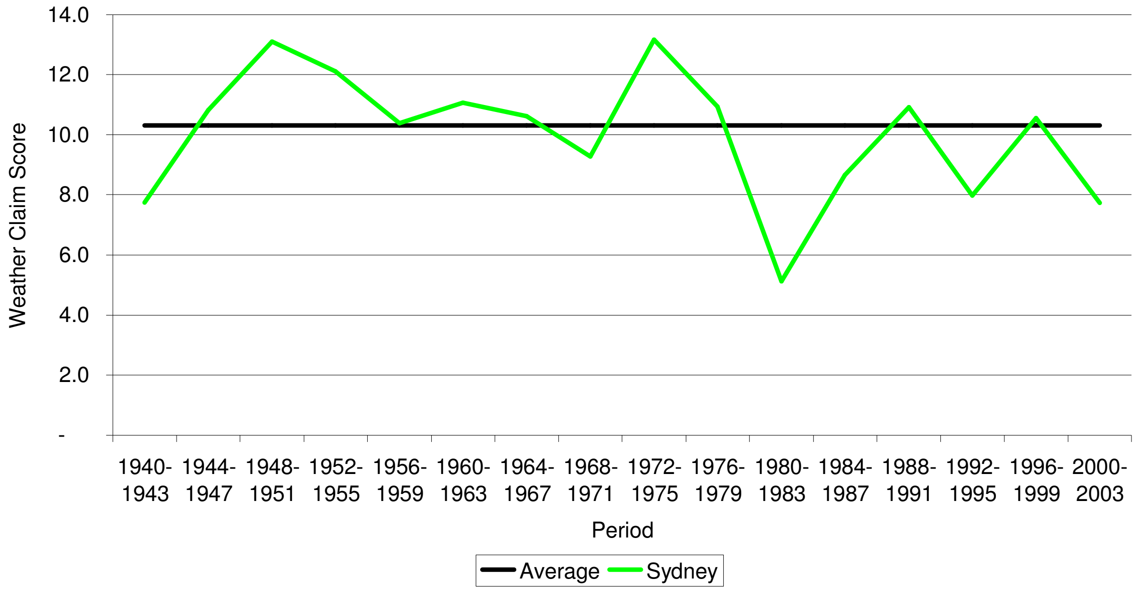
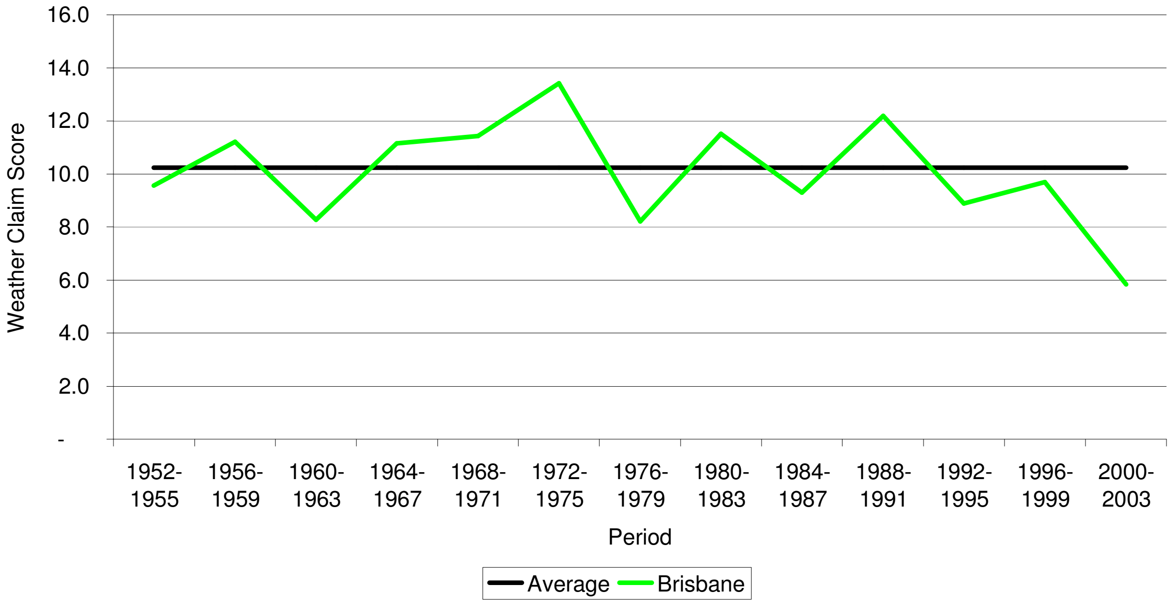


Figure 4.2 – Observed "Weather Claim Scores" for Brisbane



The charts above shows that the 2000-2003 Sydney and Brisbane experience has been significantly lower than the long term average. Note that the 2003 calendar year was the last full year for which the BoM data was available.

The data for other states is shown in Attachment A. In all capital cities except Adelaide, the four years 2000 - 2003 have been considerably lower than the long term average and in many cases comparable with the lowest "storm" activity of any consecutive four year period in the BoM data.

Storm Insurance Costs: How have weather conditions impacted recent profitability?

Following on from this, we have compared the level of storm activity over the 2000 – 2003 period with the long term (50 year) average for each city and also a weighted approximation for all capital cities combined. This comparison is shown in Figures 4.3.

Figure 4.3 – Relative "weather claim score" (2000's vs 50 Year Average)

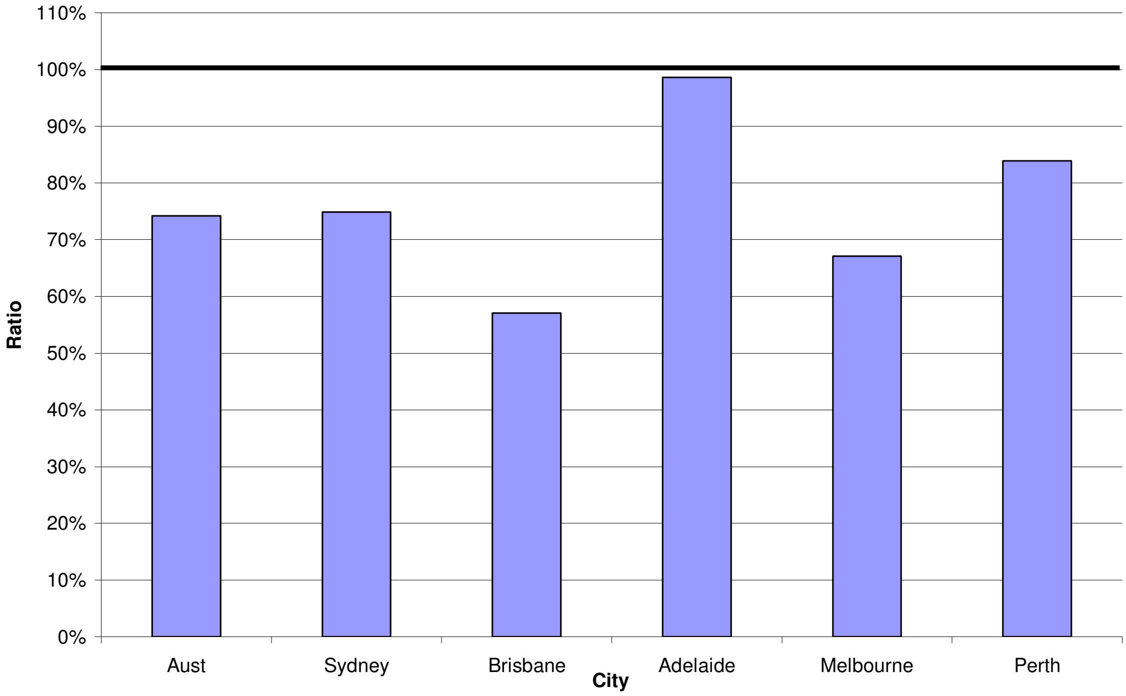


Figure 4.3 shows that the experience during the 4 years ending 2003 has been around 25% lower than the long term averages.

Assuming for a moment that the long term experience is relevant, then given 25% fewer stormy days, is it reasonable to assume that storm costs are also running at 25% below the long term average?

Due to the limitations outlined in the previous section, we believe it is difficult to draw this conclusion with certainty. However, given 25% lower storm experience in capital cities, we believe:

- it is highly likely that storm claim costs have also been lower than the long term average
- potentially the 2000-2003 level of storm claim costs might be 25% below long term levels in capital cities
- the actual level of reduction in overall costs may be more or less than 25%

To quantify the level of potential savings - for property insurance in Australia the storm loss ratio was around 13% in 2001-2003 period and therefore if the 25% saving applied across Australia it would translate into a saving to insurers of around 4% of premiums.

5 What does the future have in store?

In this section we explore whether the next five years will be:

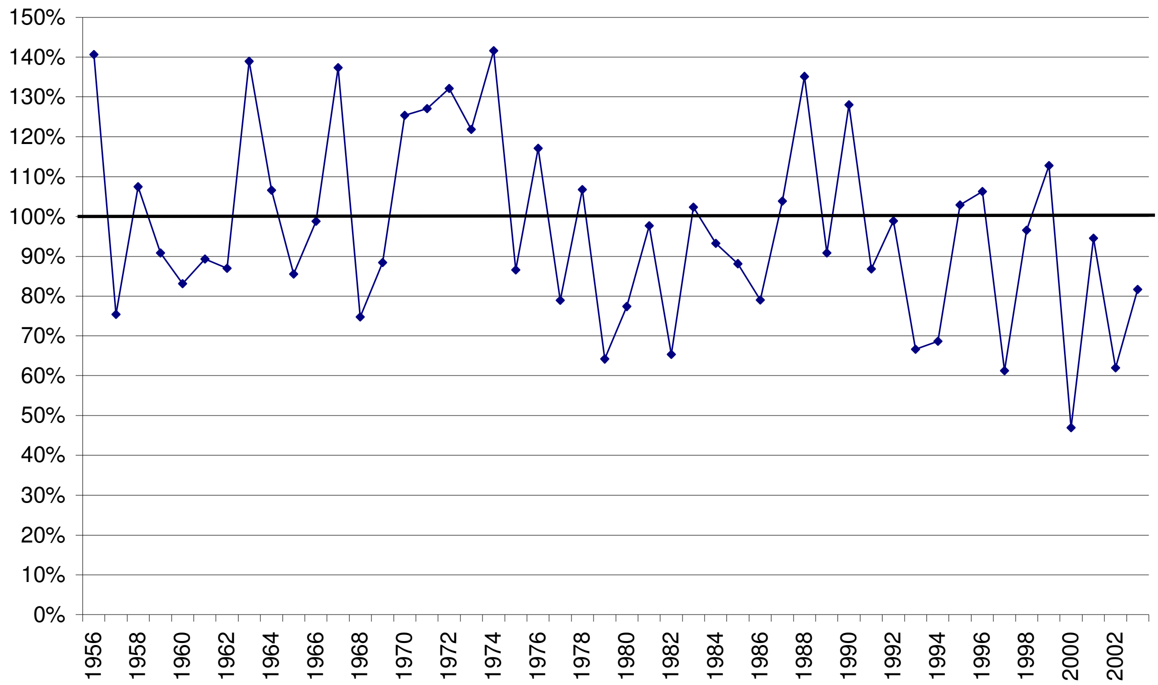
- like the last five years, or
- like the long-term average, or
- different again?

This involves consideration of issues such as the impact that climate change is having on claims costs, which puts into question the relevance of historical data, and how to deal with variations in costs caused by El Niňo incidents.

5.1 Is Long-Term Data Relevant?

The relative long term historical data for Australia wide, based on our "weather claim scores" is shown below.

Figure 5.1 – Relative "weather claim scores" for Australia in total



The figure above shows that Australia has observed some quite high periods of storm activity in the mid 1960's to mid 1970's and the late 1980's. Similarly there have been periods of low storm activity, such as the mid 1970's to mid 1980's and also in the more recent history, particularly since 2000.

Storm Insurance Costs: How have weather conditions impacted recent profitability?

Is historical data (such as the last 50 years' experience) relevant for pricing in the context of enhanced global warming and other factors affecting weather?

- CSIRO[1] note that there has not been any significant trend in the Australia-wide rainfall levels since 1910. The BoM data upon which this statement is based does show, to use their words, "a weak upwards trend", mostly in the north-west and south-east of Australia.
- CSIRO[2] note that recent decades have seen a reduction in the numbers of mid-latitude storms to the south of Australia, although the intensity of these storms has increased.

It would appear that any change in long-term storm trends, as they might impact insurers, has so far been minor. But what about enhanced global warming?

Whilst global warming is "fact[3]", the level of warming experienced to date (CSIRO[1] : 0.6°± 0.2°C since 1900) is modest in comparison to what might happen in future (CSIRO[1] : 1.0 to 6.0°C by 2070). In this regard the absence of noticeable changes in the long-term storm experience is not so surprising – ie. to a large extent it seems the impact of climate change is still to come. This view is consistent with comments expressed by Swiss Re[3], albeit in a European context, that *"At present, a direct correlation between storm losses and climate change cannot be substantiated on the basis of reliable data"*.

5.2 How will enhanced global warming impact in future?

CSIRO's projections of climate change for Australia[1] suggest that the impact of enhanced global warming will vary by region, as would be expected, with some areas experiencing higher rainfall in future, and others lower. Significantly, however, most of their models apparently simulate an increase in extreme daily rainfall. CSIRO[2] note that the warmer, moister atmosphere in coastal areas could be conducive to the development of more severe thunderstorms. This suggests that enhanced global warming can be expected to lead to a higher levels of storm costs in future.

These impacts are, however, expected to emerge over a long period – decades rather than years. The impact on insurance prices should similarly be factored in on a gradual basis.

5.3 How does El Niňo impact?

Within the long term trend, some of the variability in rainfall and storm activity, with periods of heavy rainfall and other periods of drought, can be explained by the El Niňo-South Oscillation (ENSO)[4]. The BoM state that:

> "*Dry years do occur often, and usually accompany El Niňo events"*.
>
> [The tendency for El Niňo and La Niňa episodes to last about 12 months means that] *"once we have identified that an episode is underway, we can often predict how the climate will develop in countries where the phenomenon is a major climate influence"*.

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1 CSIRO – Climate change – Projection for Australia

2 CSIRO – Climate Change and Australia's Coastal communities

3 Swiss Re Storms over Europe

4 El Niňo "droughts and flooding rains" by Neville Nicholls of Bureau of Meteorology Research Centre

Recent El Niňo episodes are likely to be one of the drivers of low rainfall and low claim costs experienced by insurers in recent years. So should insurers be pricing on the basis of long term weather predictions according to the stage of ENSO we are in?

There appear to be some significant drawbacks with such an approach at the current time, including:

- the introduction of undesirable (and unnecessary?) volatility into pricing
- questions as to the accuracy of medium term climate predictions
- whilst there is a link between ENSO and insurance claims costs, it is difficult to measure in a way that is useful to insurers (in terms of impact overall and by region). Further, the link is probably less in coastal areas where the majority of storm costs lie.

5.4 Summary

Our view is that the historical long term weather experience provides an appropriate benchmark for establishing technical premiums at the current time. This view reflects that –

- in the context of weather cycles, even 30 years is not considered a long period
- any changes in long-term weather conditions over the last 90 years appear to have been modest
- whilst enhanced global warming can be expected to impact claim costs, this is a long term impact and, in respect of the storm costs covered by this paper, can be built into prices gradually over time
- it is better to price on the basis of the long-term cost, rather than on the basis of short term experience, which can be impacted by El Niňo-Southern Oscillation and other factors in a way that is difficult to quantify.

The implications of this view together with the analysis presented in the previous section are that:

1. property claims costs have been running at better than the long-term cost in the period to 2003
2. insurers should adjust for this difference in determining technical premiums for this business.

6 Further uses for BoM Data?

In this paper we have presented an approach for utilizing BoM data to assess the level of weather related claims experience for the domestic and commercial property classes of business. At this stage these are the only types of insurance that we have researched, however the adopted approach clearly lends itself to analysis of claim costs from other types of insurance, such as Domestic and Commercial Motor and to a lesser extent Compulsory Third Party Motor.

Further, in addition to understanding how the recent experience compares to the long term, there are also alternative uses for BoM data which should be considered. Such uses include:

- to measure the distribution of weather related claims costs by year (for example, in 5% of years, storms, and therefore storm costs, will be 50% higher than the long term average. This type of analysis would be useful for calibrating stochastic models, benchmarking and reinsurance pricing
- estimating pricing relativities for weather experience which vary by city, and potentially beyond metro areas
- understanding the seasonality of weather costs for use in reserving, budgeting and pricing of non annual products

A Attachments

Figure A.1 – Observed "Weather Claim Scores" for Melbourne

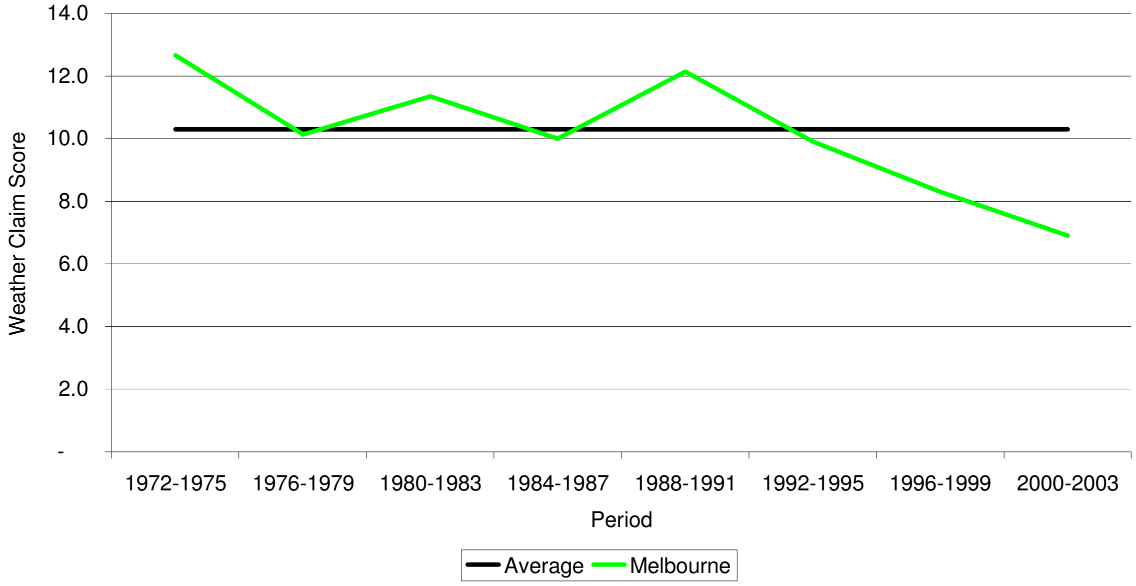

Figure A.2 – Observed "Weather Claim Scores" for Perth

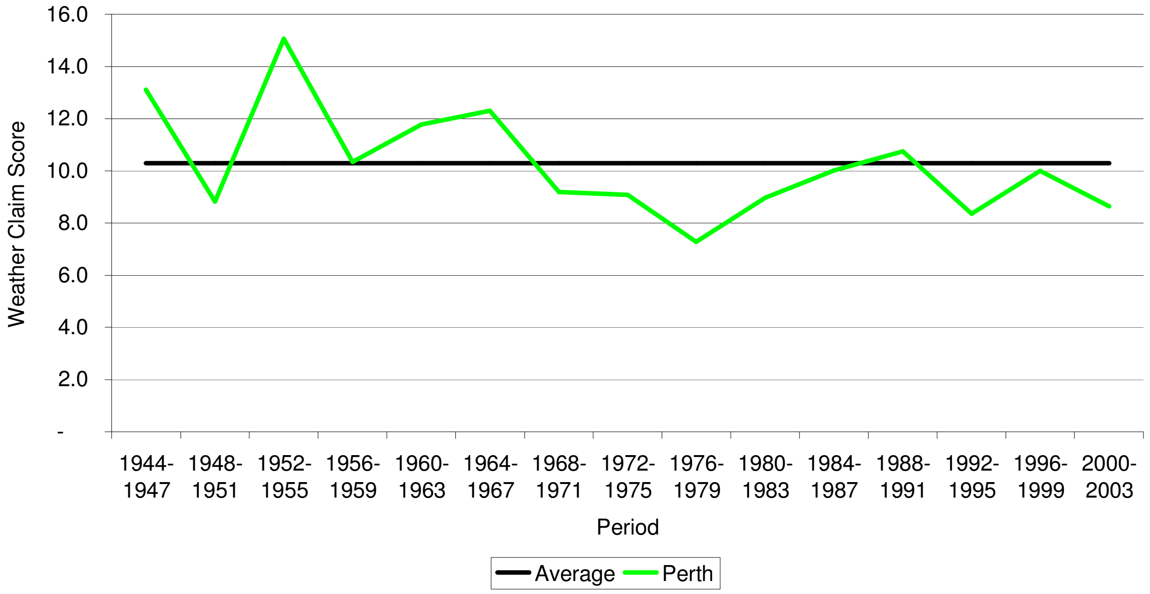

Figure A.3 – Observed "Weather Claim Scores" for Adelaide