VCCCAR Project: Framing Adaptation in the Victorian Context

The cost of disasters to Australia and Victoria – no straightforward answers

Working Paper 3

Adriana Keating & John Handmer
Centre for Risk and Community Safety
RMIT University

April 2011

Partner Universities

Project Sponsor

Authorship

This report, based on research carried out for work package 2 on the *Economic analysis of current and future climate impacts*, was prepared by Adriana Keating and John Handmer, Centre for Risk and Community Safety, School of Mathematics and Geospatial Science, at RMIT University.

Additional reviewers' input included: Rod Keenan, Hartmut Fünfgeld, and Darryn McEvoy.

Acknowledgements

In September 2010, VCCCAR held a workshop with key Victorian government representatives and academics to elicit expert opinion and guidance on the selection of an appropriate methodology for costing current and future climate change impacts in Victoria. Experts at this workshop discussed many of the issues presented in this report and their insights are much appreciated.

ISBN 978 0 7340 4429 7

Summary
This paper looks at the current cost of extreme meteorological disasters to Australia and Victoria in an effort to provide a starting point for appreciating the types of costs that may be present and increasing under climate change. There exists a confounding variety and breadth of estimates relating to the cost of weather related disasters in Victoria and Australia. Comparative analysis shows that data source and methodology have profound impacts on the conclusions drawn from both aggregate analyses of disaster costs and analyses of individual events, in this case the 1983 Ash Wednesday bushfires. Disaster cost estimates in Australia are largely drawn from insurance data or insurance data with some augmentation; the estimates that utilise insurance data are a limited proxy for disaster cost. Insurance data only account for insured losses, and these represent only a fraction of the total cost of a disaster. In particular they do not include many indirect costs, valuations for loss of life, nor intangibles such as ecosystem services which can have significant impacts on cost estimates. Analyses based on insurance data also draw conclusions influenced by which hazards and assets are or are not insured.

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Introduction

The impacts of climate change are inherently uncertain. Attempting to predict or forecast the dynamic interactions at play between constantly changing economics, uncertain geophysical impacts, and climate change mitigation and adaptation policy, adds further layers of uncertainty. Despite this uncertainty policy makers are under increasing pressure to utilise economic cost-benefit type analysis to establish the business case for climate change adaptation initiatives. Climate change is expected to increase the frequency and severity of extreme weather events in Australia and the state of Victoria (Garnaut, 2008; IPCC, 2007), this paper looks at the current cost of extreme weather events that lead to disasters in an effort to provide a starting point for appreciating the types of costs that may be present and increasing under climate change.

There exists a confounding variety and breadth of estimates relating to the cost of weather related disasters in Victoria and Australia. To the question "How much do disasters cost Victoria?" there is unfortunately no single answer. This paper provides a suite of estimates, each important within their own context, and each with their own caveats. Despite this variety in cost estimates the case for disaster risk reduction is firmly established by all approaches. With increasing wealth, population and density, improvements in disaster risk reduction are a no-regrets policy option for Victoria because they are economically warranted regardless of whether climate change increases the cost of disasters or not (Crompton & McAneney, 2008b). Under climate change such cost estimates can be seen as a conservative first pass at establishing a small part of the wider cost of climate change.

This paper starts with an examination of three studies that look at the aggregate cost and relative impacts of disasters to Australia and Victoria. A cautious comparison of these studies reveals some of the ways in which data source and methodology can have significant impacts on conclusions drawn. Six cost/loss/impact estimates of the 1983 Ash Wednesday bushfires are then examined; again large variations in estimates reveal that differences in data source and methodology can render estimates, even of the same event, incomparable. Analyses of estimates also highlight just how much of the full economic cost of disasters is not included in many figures. Finally the use of such estimates considering uncertainty in projections about the future is considered.

The 'cost' of a disaster is not a straightforward concept[1], and this comes through in the breadth of estimates presented here. Cost estimates may be economic or financial; economic impact assessments look at all costs and benefits to the whole community under consideration, whereas financial analyses estimate the financial impact on an individual or entity (BTE, 2001). Within an economic impact assessment framework cost items may be divided into costs directly resulting from the event such as damage to residential structures (often insured) or crops (often not insured). Indirect costs may also be counted, such as those resulting from business interruption (sometimes insured) or disruption to transport networks (not insured) (BTE, 2001). Benefits also need to be considered for a full economic analysis. 'Cost' can also be more broadly understood when it relates to intangibles (not directly traded in the market place) such as the cost of loss of memorabilia, cultural heritage or ecosystem services (BTE, 2001), or the benefits of community cohesion built during a disaster response. How costs and benefits are defined depends heavily on the geographical and temporal boundaries of the analysis.

As this paper explores, disaster cost estimates in Australia are largely drawn from insurance data (Insurance Council of Australia's National Disaster List) or insurance data with some augmentation (EMA disasters database). Importantly these estimates that utilise insurance data are a limited proxy for disaster cost. In fact, as seen in Stephenson (2010) a full economic impact assessment may classify payments from insurance as a benefit, rather than a loss/cost. Insurance cost data is used because it is often the only standardized proxy available (Crompton & McAneney, 2008a). Insurance data only account for insured losses, and these represent only a fraction of the total cost of a disaster. Table 1 below highlights just some of the costs/losses/impacts associated with many Victorian disasters that are and are not included in insurance loss estimates.

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[1] See literature review/report for further details on how costs and benefits are defined. Also see BTE (2001), Thompson & Handmer (1996), Handmer, Read & Percovich (2002), Handmer et al 2005.

Table 1: Economic analysis cost items vs insurance loss estimates

Cost item (BTE, 2001, pg. 94-95)	Usually included in ICA insured loss estimates?
Direct costs	
Residential buildings – structures and contents	Yes (except for uninsured and underinsured) Many policies do not cover flood damage.
Commercial and industrial buildings – structures and contents	Yes (except for uninsured and underinsured)
Public buildings – structures and contents	No[2]
Infrastructure	No[2]
Crops	If insurance policy is held
Pastures	No
Fences	If insurance policy is held
Livestock	No
Indirect costs	
Business disruption	If insurance policy is held
Loss of public services	No
Non-residential clean-up	No
Residential clean-up	No
Household alternative accommodation	No
Agriculture	No
Transport networks	No
Disaster response and relief	No
Intangible costs	
Fatalities	No
Injuries	No
Health effects	No
Environmental damage, memorabilia and cultural heritage	No

It is important to note that insurance penetration for cover of crops, fences and business interruption is limited, particularly for small and medium sized businesses. In fact, ICA's estimate of insured losses due to the 2009 Black Saturday bushfires in Victoria stands at $1.2 billion (2009AUD) and this includes property and contents (84%) and vehicles (16%) only (VBRC, 2009, Appendix A).

Several other cost items such as those relating to ecosystem services, such as natural water filtration and carbon sequestration, are not currently insurable. Stephenson (2010) finds that estimates of the economic value of ecosystem services can add massively to the overall cost of a disaster.

[2] Public buildings and infrastructure are often covered by insurance, such as by the Victorian Managed Insurance Authority, however these estimates are not routinely included in ICA data.

What the aggregate analyses say

The aggregate cost of disasters, or more specifically weather related disasters, to Victoria and Australia is investigated in three works – BTE (2001), Blong (2004) and Crompton & McAneney (2008a). Each report utilises different data and comes to different conclusions. The reports differ in ways too significant to allow for their results to be directly weighed against each other, however a cautious comparison highlights systemic issues with this type of analysis, and the way in which data and methodology can influence conclusions drawn. Each report, its data sources and conclusions are discussed below, followed by a comparative discussion.

BTE 2001 – Economic Costs of Natural Disasters in Australia

BTE (2001) draws its data from the EMA database (discussed below) and represents one of the only analyses of its scale into the cost of disasters in Australia. It is unfortunate that it is now becoming out of date and a follow up piece that includes trends during the last decade would be beneficial, particularly in light of several recent disasters and a demand for up-to-date data for analyses relating to climate change. Costs included in the EMA database are insured loss, 'estimated total loss' and the value of loss of life and injury[3].

The report finds that the average annual cost of disasters to Australia between 1967 and 1999 to be $1.14 billion (1998AUD). However this annual cost estimate was heavily influenced by three large scale disasters – Cyclone Tracy (1974), the Newcastle earthquake (1989) and the Sydney hailstorm (1999). While these figures are important and shed light on the order of magnitude of loss associated with disasters in Australia, the fact that they are national and heavily influenced by three non-Victorian disasters, and one non-meteorological disaster, limits their usefulness for this Victorian analysis. If these three events are removed from the analysis the average annual cost declines to $860 million (1998AUD).

Unfortunately the State level analysis is limited. BTE (2001, pg. 30) shows that between 1967 and 1999 the total cost of disasters to Victoria was approximately $3 billion (1998 dollars), approximately $500 million of which was insured loss. The average annual cost of disasters to Victoria was $93.6 million (BTE, 2001, pg. 35).

Three key disaster types account for losses in Victoria – 41.1% is due to flood, 34.6% is due to bushfires and 24.3% is due to severe storms (BTE, 2001, pg. 33). In relation to bushfires, approximately 20% of the total cost is due to death and injury; while bushfires represent only a third of the total cost of disasters to Victoria in this study, they are the most hazardous disaster type in relation to death and injury.

EMA database[4]

The Emergency Management Australia disasters database is utilised by many researchers, and was utilised in BTE (2001), because it contains the largest depository of somewhat standardised statistics on Australian disasters; it also includes more costs than insurance data only. Events are included in the database if they induced three or more deaths, and/or 20 or more injuries or illnesses, and/or more than $10 million in total estimated cost of damage.

The EMA database has several limitations as identified by BTE (2001, pg. xiv):

- Reliance on media reports inhibits the accuracy of the statistics;
- Smaller and earlier events may not be recorded in the database because they were not reported by the media;
- Estimates of total cost are sometimes calculated by using a multiple of insurance costs, and this is held to be a potentially inaccurate method; and
- Some problems associated with indexing to 1998 dollars; although BTE (2001) does not find this to be especially problematic due to low inflation between 1998 and 2001.

3 See BTE (2001) for exact definitions.

4 For a full description of the database see http://www.ema.gov.au/ema/emadisasters.nsf/

Despite the fact that EMA data estimates attempt to include costs other than insured losses, estimates are not based on economic principles of disaster loss assessment as described by BTE (2001, Chapter 4) or Handmer, Read & Percovich (2002).

Furthermore, the EMA database does not classify heat waves as disasters, despite the fact that they can be 'disastrous' to large numbers of people and have significant economic impacts. Heat waves are discussed below.

Data limitations mean that the EMA database is heavily dependent on insurance data for estimating the costs of disasters. Insurance data is a useful part of this type of analysis, however as discussed above it only provides a portion of the real cost. Hazards that are not covered by insurance, people that are not insured or are under-insured, and assets and impacts that are not covered by insurance are all omitted from insurance data. As highlighted above, total cost estimates that are calculated by using a multiple of insurance costs are potentially inaccurate.

Blong 2004 – Natural Hazards Risk Assessment: An Australian Perspective

Blong (2004) does not enumerate the cost of disasters to Australia but is more concerned with looking at where and by which hazard people and buildings are damaged by disasters. While this type of analysis does not provide numbers on the cost of disasters to Victoria, the alternative approach taken leads to different conclusions which highlight some salient points about the complexities of disaster impact assessment. These are discussed below.

Blong's (2004) national assessment found that across Australia between 1788 and 2003, tropical cyclones and floods account for more than 70% of fatalities. Between 1900 and 2003 it was found that tropical cyclones, floods, thunderstorms and bushfires caused 93.6% of building damage.

Blong (2004) identifies four Victorian disasters in the 20 disasters that caused the most building damage, as measured by housing equivalents[5], between 1900 and 2003. These were the Ash Wednesday bushfires of February 1983, the North Eastern Victorian floods of September – October 1993, the Black Friday Fires of January 1939 and the Victorian Bushfires of January 1944. Blong found that in order of impact[6], bushfires (60% of building damage), floods (25%) and thunderstorms (15%) were the most costly to Victoria. Note that Blong's data do not include the 2009 Black Saturday bushfires, which were devastating both in terms of fatalities and damage.

Risk Frontiers database[7]

Similar to the EMA database, the Risk Frontiers database has several limitations, highlighted by Risk Frontiers themselves. These include the reliance on news paper reports, underestimation of building damage and incomplete records – particularly for earlier disasters. The building damage index developed for the database is novel and the analysis drawn is illuminating, particularly when compared with more traditional measures. However the focus on structural assets means that many of the cost items outlined in Table 1 above would not be included in the analysis.

Crompton & McAneney 2008 – Normalised Australian insured losses from meteorological hazards: 1967-2006

Using Insurance Council of Australia data for events from 1967-2006 in Australia, this study normalises the losses to estimate what they would be under 2006 conditions. This is done to investigate any trends in losses over time. The normalisation procedure controls for changes in population, wealth and inflation, as well as building regulations. The study finds no observable trends in disaster losses over time, once population, wealth, inflation and building standards have been accounted for.

Crompton & McAneney (2008a) find that the Australian average annual weather-related (normalised) damage to be $820 million. Another significant finding was that changes in building regulations following Tropical Cyclone Tracy had a profound effect on reducing disaster costs in wind prone areas. Unfortunately a state level analysis is not undertaken, however it should be

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[5] See Blong (2004, pg. 9-12) for a discussion on the derivation of the Housing Equivalents measure.

[6] The numbers for percentage of building damage listed here are estimates only, derived from a visual examination of the graph on pg. 18 of Blong, 2004.

[7] For a full description and discussion of the database see Blong (2004, pg. 4-5)

noted that the 1983 Ash Wednesday Bushfires came in at number five as the only Victorian disaster to be rated in the ten highest ranked weather-related normalised losses.

Insurance Council of Australia Natural Disaster Event List[8]
This database includes "natural hazard events in Australia that have caused significant insured losses" (Crompton & McAneney, 2008a). Thresholds for inclusion into the database have changed over time, however most exceed AUD$10 million (in the dollars of the day). The largest limitation of this database is that it only includes insured losses. Some events, such as floods, are often not insured for and this can have significant impacts on the analysis (BTE, 2001).

Below is a table summarizing the three reports and their findings.

Table 2: Summary of three reports and their key findings

Analysis name	Data source and analysis time frame	Key Australian findings	Key Victorian findings	Distinguishing factors
Economic Costs of Natural Disasters in Australia – BTE, 2001	EMA database (insured losses from Insurance Council of Australia, plus broader cost estimates, newspaper reports). Includes earthquakes. 1967-1999	Average annual cost of disasters to Australia 1967 – 1999: $1.14 billion (1998AUD)	Average annual cost of disasters to Victoria 1967 – 1999: $93.6 million (1998AUD)	Most comprehensive and frequently cited Australian analysis.
Natural Hazards Risk assessment: An Australian Perspective – Blong, 2004	Risk Frontiers database (Scientific and government reports, other databases, BoM, Geoscience Australia, newspaper reports). Meteorological hazards only. 1900-1998	1788 – 2003: tropical cyclones and floods account for 70%+ fatalities. 1900 – 2003: tropical cyclones, floods, thunderstorms and bushfires caused 93.6% of building damage.	Bushfires caused the most building damage to Victoria, followed by floods and thunderstorms.	Looks at deaths and building damage, rather than dollar value economic cost estimates.
Normalised Australian insured losses from meteorological hazards: 1967-2006 – Crompton & McAneney, 2008	Insurance Council of Australia Natural Disaster Event List. Meteorological disasters only. 1967-2006	Australian average annual weather-related (normalised) damage, 1967 – 2006: $820 million (2006AUD)	None.	Normalises damage estimates to 2006 conditions by adjusting for population, wealth, inflation and building standards.

Discussion of aggregate loss estimates
Both BTE (2001) and Crompton & McAneney (2008a) estimate the average annual cost of weather related disasters to Australia. BTE's estimate of $1.14 billion is in 1998 dollars and relates to damages from 1967 – 1999. Crompton & McAneney's estimate of $820 million is in 2006 dollars and is from 1967 – 2006. If we convert[9] both of these estimates to 2009 dollars they become $1.58 billion and $892 million respectively. Fundamentally important to this comparison is the fact that

[8] For a full description see Crompton & McAneney (2008, pg. 372)
[9] These figures have been converted using the RBA inflation calculator http://www.rba.gov.au/calculator/ and rounded to the nearest million.

BTE's figure relates to actual damages normalised only for inflation (to standardise into 1998 dollars), whereas Crompton & McAneney's relates to estimated damages under 2006 societal conditions as normalised to inflation, population, wealth and building standards.

Crompton & McAneney (2008a) utilise only data on insurance claims in their analysis, whereas BTE's (2001) estimates include other data sources as well as insurance data, and inflations of insurance data used in an effort to capture more costs. Furthermore, BTE's analysis included the significant costs of the 1989 Newcastle Earthquake, which was not included in Crompton & McAneney. These factors would likely have meant that BTE's estimates would be larger than Crompton & McAneney's.

The average annual cost estimates may also have been impacted by the level of disaster cost experienced between 1999 and 2006, which was included in Crompton & McAneney (2008a) but not in BTE (2001). Furthermore, Crompton & McAneney's normalisation procedure that accounted for changes in population and wealth may well have increased their cost estimates (assuming wealth and population are increasing). Similarly Crompton & McAneney's normalisation for building codes reduced their normalised loss estimates.

The magnitudes of the relative impacts of these factors on the final estimate numbers and their relative size are not known. However they do highlight important points about how the differing data sources and methodologies may impact the outcome.

Fatalities

BTE (2001, pg. 48) identifies bushfires as the most hazardous disaster type to human life, accounting for 39% of natural disaster fatalities in Australia between 1967 and 1999. Conversely, Blong (2004, pg. 6) found that bushfires account for only 11.4% of Australian fatalities due to natural hazards between 1788 and 2003. The reasons for this striking difference could be related to the different time periods analysed; as Blong (2004) points out, that death rates from all natural hazards have been steadily declining since the late 1700s, possibly due to better disaster management, and this could impact the results.

The most hazardous hazard?

BTE (2001) ranks the average annual cost of hazard types to Victoria as 1) Flood – 38.5%; 2) Bushfires – 32.4%; and 3) Severe storms – 22.8%. Blong (2004) on the other hand ranks total building damage by hazard type to Victoria[10] as 1) Bushfires – 60%; 2) Flood – 25%; and 3) Thunderstorms – 15%. While these numbers are not strictly comparable they highlight the way in which different reports with different methodologies may give very different answers to a question such as "What are the relative impacts of hazard types to Victoria?"

A comparison of Crompton & McAneney (2008a) and Blong (2004) also highlights the way in which different data sources and methodologies can produce quite different results. Below is a table of the top 10 ranked disasters as assessed by the two reports:

10 These figures are obtained by a visual examination of the graph in Blong (2004, pg. 18) and are estimates only.

Table 3: Comparison of top 10 ranked disasters as assessed by Crompton & McAneney (2008) and Blong (2004)

Hazard type	Crompton & McAneney (2008, pg. 374) No. events in 10 highest ranked weather-related normalised losses	Blong (2004, pg. 17) No. of events in 10 highest ranked events by housing equivalents[11]
Cyclones	2	1
Hailstorms	5	1
Floods	2	4
Bushfires	1	3
No. of Victorian disasters in top 10	1 Ash Wednesday fires 1983	3 Ash Wednesday fires 1983 NE Victorian floods 1993 Black Friday fires 1939

Note that Blong's (2004) top 10 list contains one flood and one fire from before 1967, which would not have been considered in Crompton & McAneney (1998).

It is clear from Table 3 above that the answer to the question of "Which hazards have been the most catastrophic to Australia?" depends on the data and methodology used. Crompton & McAneney's (1998) use of insurance data shows a strong preference for hailstorms and to a lesser extent cyclone damage, whereas Blong's (2004) physical measure of housing equivalents favors flood and bushfire damage.

Heat waves and droughts

Blong (2004) suggests that heat waves have killed approximately 70% as many people, often the elderly, as all other hazards combined. Alexander & Arblaster (2009), in their analysis of the capacity of climate models to predict extremes in Australia, find reliability in the projection that Australia is facing an increased number of warm nights and heat waves under all SRES climate scenarios.

An important omission of all databases and analyses is that of heat waves. Heat waves have been estimated to have caused more deaths than any other disaster type (BTE, 2001), and are particularly relevant for Victoria. A case in point is that the heat wave that accompanied the devastating February 2009 bushfires in Victoria killed 374 people (Department of Human Services, 2009), whereas the bushfire itself saw 173 deaths (VBRC, 2009). The bushfire is recorded as a disaster, the heat wave is not. The omission of heat waves from these aggregate disaster cost estimates is a relevant point for policy makers now, and particularly under climate change.

Similarly drought, because it is slower onset and does not directly result in death, injury or much building damage, is not often considered in the same class of disasters as bushfires or floods. Despite this it is considered to be the most economically costly extreme weather event Australians face (Blong, 2004). For example, despite the fact that the farm sector accounts for only 3.5% of GDP, the 2002 drought is estimated to have cost approximately 1 percentage point in GDP growth and approximately ¾ of a percentage point in employment growth during the 2002-03 period (Lu & Hadley, 2004; Horridge *et al*, 2003). Drought is expected to increase under climate change (Garnaut, 2008).

[11] Note the Newcastle earthquake is second in Blong's (2004) list but is omitted here because of the focus on meteorological hazards.

What the event analyses say

The 1983 Ash Wednesday bushfires were one of the most devastating disasters in Victoria's history. A comparison of several analyses of this event further highlights how data and methodology impact outcomes. Six cost/loss/impact estimates are compared below and demonstrate just how profoundly different estimates of the same event can vary.

ICA database

The Insurance Council of Australia database lists the insured losses, in both Victoria and South Australia, from the Ash Wednesday bushfires as $176 million 1983AUD ($465 million 2009AUD). This figure is cited in Crompton & McAneney's analysis discussed above (prior to undergoing standardisation), and Munich Re's (2010) estimate of insured losses.

Legislative Assembly Ministerial Statement (1983)

The Victorian Bushfire Royal Commission Report (2009, Appendix C) cites a Legislative Assembly Ministerial Statement for its cost estimate of $190 million 1983AUD ($502 million 2009AUD). In the Ministerial Statement, Cain (1983) states that losses had not yet been fully counted, and this figure relates to only State agency asset loss, other public sector losses, lost assets to the private sector (majority of the $190 million) and State agency operating costs.

Stephenson (2010)

Stephenson (2010) utilizes several economic assessment frameworks to estimate the cost of four major bushfires in Victoria. She attempts to value all economic, social and environmental impacts and benefits of the fires. Because this analysis is from the perspective of the whole economy, and includes benefits as well as costs, the final estimate given is net, not gross. Importantly, Stephenson finds that when ecosystem service loss is estimated, it accounts for a large portion of total cost.

Stephenson's (2010) economic analysis should be understood differently from more crude estimates based on insurance data and figures drawn from newspaper reports. Stephenson defines clear geographical and temporal boundaries and applies economic theory to the analysis. It should be noted that she acknowledges the limitations associated with some valuations, however the overall cost breakdown still provides detailed and useful information to the researcher and policy-maker.

Included in Stephenson's (2010) analysis are items such as business interruption to the agricultural sector, which are often called for in disaster impact assessments but are more rarely carried out. She includes environmental losses which adds much to the analysis. Importantly, and according to the economic theory applied, payments by government, donations and insurance are counted as economic benefits of the fires. Stephenson estimates the cost of the Ash Wednesday bushfires to be $807 million 2009AUD. Note that this is the cost to Victoria only and does not, like other analyses considered, include South Australian impacts.

Munich Re (2010)

Munich Re (2010) cited the overall losses from the Ash Wednesday bushfires to be $335 million in 1983AUD, or $885 million 2009AUD. The re-insurer also lists insured losses, which account for 52.2% of overall losses. These estimates are for damage to both Victoria and South Australia.

EMA database (2010)

The estimate pulled directly from the EMA database entry for the Ash Wednesday bushfires cites insured losses of $324 million 1983AUD. However the discussion attached to the entry suggests that the total estimated cost is in excess of $400 million 1983AUD ($1057 million 2009AUD).

BTE (2001) Ash Wednesday analysis

BTE (2001) applied the principles espoused in their report to the Ash Wednesday 1983 bushfires to conduct an economic analysis of the impact of the fires. Data are derived from a range of sources and BTE notes problems with lack of data, as well as lack of clarity in what data is available. For example, BTE notes that lack of clarity in records meant it was unable to ascertain just how many houses were destroyed in the fires, and ultimately had to utilise an average from several estimates. Despite this the analysis does cover more than the standard insurance based analysis, including direct costs relating to infrastructure and agriculture, indirect costs such as household alternative accommodation and the cost of fatalities and injuries. BTE estimates the total cost of the Ash Wednesday bushfires to be $967 million 1999AUD ($1320 million 2009AUD).

Similar to Stephenson (2010), this BTE (2001) analysis should be understood differently from the other estimates because it is an attempt at an analysis from the perspective of the whole economy.

The table below summaries the Ash Wednesday cost/loss/impact estimates.

Table 4: Six reported estimates of the cost of the 1983 Ash Wednesday bushfires

Source	Cost estimate, 2009AUD millions	Source/make-up of estimate
ICA database (2010) (VIC & SA)	465	ICA database. Insurance claims only.
Legislative Assembly Ministerial Statement (1983) [cited in VBRC, 2009, Appendix C] (VIC only)	502	State agency asset loss, other public sector losses, lost assets to the private sector (majority of the $190 million) and State agency operating costs.
Stephenson (2010) (VIC only)	807 (net)	Economic analysis from various sources. Contains direct, indirect and intangible, as well as losses and benefits – insurance is a benefit.
Munich Re (2010) (VIC & SA)	885	463 insured cost (52%) from ICA database.
EMA database (2010) (VIC & SA)	1057 +	Insurance data from ICA database, plus a wider estimate.[12]
BTE (2001, pg. 109) (VIC & SA)	1320	Economic analysis from various sources. Includes some indirect and intangible costs including fatalities.

The table below lists the cost items from BTE's (2001, Chapter 4) framework for estimating the economic costs of natural disasters, and whether or not the cost item was included in the Ash Wednesday estimates described above.

[12] It is unclear why the EMA database cites Insured Loss as $324 million 1983AUD, since this differs dramatically from ICA data, and EMA claims to draw Insured Loss data from ICA.

Table 5: Cost items included in 1983 Ash Wednesday cost estimates

Cost item (BTE, 2001, pg. 94-95)	-ICA database (2010) -Munich Re (2010) insurance loss estimate -EMA database insurance loss estimate	Legislative Assembly Ministerial Statement (1983)	Stephenson (2010)	BTE (2001)
Direct costs				
Residential buildings – structures and contents	Yes (except for uninsured and underinsured) Many policies do not cover flood damage.	Yes	Yes	Yes
Commercial and industrial buildings – structures and contents	Yes (except for uninsured and underinsured)	Yes	Yes (not contents)	Yes
Public buildings – structures and contents	No[13]	Yes (State agency asset loss)	Yes	Yes
Infrastructure	No[13]	Yes (other public sector losses)	Yes	Yes
Crops	If insurance policy is held	No	Yes	Yes
Pastures	No	No	No	Yes
Fences	If insurance policy is held	No	No	Yes
Livestock	No	No	No	Yes
Indirect costs				
Business disruption	If insurance policy is held	No	Yes (agricultural only)	No
Loss of public services	No	No	No	No
Non-residential clean-up	No	No	No	No
Residential clean-up	No	No	No	No
Household alternative accommodation	No	No	No	Yes
Agriculture	No	No	No	No
Transport networks	No	No	No	No
Disaster response and relief	No	Yes	Yes	Yes
Intangible costs				
Fatalities	No	No	Yes	Yes
Injuries	No	No	Yes	Yes
Health effects	No	No	No	No
Memorabilia and cultural heritage	No	No	No	No
Environmental damage	No	No	Yes	No

Stephenson (2010) also included the cost of lost timber and estimated this to be approximately $141 million (2008AUD) – a substantial amount. Stephenson estimates environmental losses to be worth approximately $57 million (2008AUD), again this adds substantially to the estimate. Table 5 above highlights just how many cost items are not considered in the cost estimates for the Ash Wednesday bushfires. The analyses done by Stephenson (2010) and BTE (2001) are the most comprehensive of the list because they attempted to apply economic principles to the analysis; yet even these analyses lack many potential cost items; this is likely due to lack of available data.

[13] Public buildings and infrastructure are often covered by insurance, such as by the Victorian Managed Insurance Authority, however these estimates are not routinely included in ICA data.

Discussion of Ash Wednesday figures

The estimates of the cost of the Ash Wednesday bushfires listed above range from $465 - $1320 million (2009AUD). This variation is due to the data sources and methodologies used to determine cost estimates. We see that insurance data is a conservative estimate of some costs, and full economic impact assessments often result in much higher estimates.

Firstly it is noted that the estimate of insured losses from the ICA database (2010) is the smallest estimate. This could be because insured costs often represent only a fraction of overall cost. Indeed Munich Re's (2010) estimate of insurance loss is the same as ICA's; however Munich Re also list 'overall losses' at almost double insured losses. It is interesting to note that the insurance losses cited in the EMA database is $324 million (1983AUD) compared to ICA's $176 million (1083AUD), despite the fact that each reports to be using the same source – the ICA national disasters list. Here we see that just how incomparable estimates across studies can be, even when they purport to be using the same data and similar methodologies.

In their broader economic impact assessments BTE (2001) and Stephenson estimate the cost to be $1320 million (2009AUD) and $807 million (2009AUD) respectively. These outcomes are not as different as they might first appear. An examination of the items included in each analysis shows some similarities and some differences, however the overall figures turn out quite similar – once Stephenson's inclusion of insurance payments as a benefit is considered – net cost of $807 million (2009AUD) plus insurance cost (listed in Stephenson as an in-flow/benefit to the local area) of $365 million (2009AUD) equals $1172 million (2009AUD).

Projections into the future

Climate change is predicted to have a significant impact on fire hazard. Under a climate change scenario with warming of 2.9°C by mid-century, southeast Australia is expected to see an increase of catastrophic fire danger days from the current 46% of observation stations up to 85% (Munich Re, 2010). The fire season is expected to be longer and more intense which would shorten recovery and prevention time (such as to perform prescribed burning for fuel reduction). Concurrent and/or recurrent fire events may place unprecedented stress on emergency services, communities and the environment (Munich Re, 2010). Alexander & Arblaster (2009) analysed the capacity of nine climate models to predict trends in temperature and precipitation extremes in Australia. They found that the models were good at simulating the index of warm nights, and produced correct signs for trends in precipitation extremes, although with variation between individual model runs.

The estimates presented here provide an analysis of some major events and of overall national estimates. As emphasized many of these figures are believed to estimate only a fraction of the costs associated with disasters now and into the future. Extreme caution is essential in this type of forecasting. Aggregate disaster cost estimates are dominated by a few events and as such are difficult to predict. Similarly, the circumstances under which disaster will occur in the future are changing already – several factors may impact exposure to disasters in the future (see Blong, 2004):

- Uncertainty about the impacts of climate change on the frequency and severity of extreme events in specific geographical locations;
- Demographic changes such as an increased and aging population; and
- A population that is increasingly settling in coastal areas.

Conclusion

The majority of data on disaster losses in Australia come from either the Insurance Council of Australia's Natural Disaster Event List, or the Emergency Management Australia (EMA) database, which contains Insurance Council of Australia data augmented with other sources. The pros and cons of each data set must be considered and acknowledged according to the goals of the analysis. The EMA database is less accurate and standardised when compared to the Insurance Council's Natural Disaster Event List, but it has the major difference of at least attempting to consider economic costs other than insured losses.

Insured loss data is attractive because it has been collected and recorded in a more standardised manner (see Crompton & McAneney, 2008) since 1967. However insured losses represent only a fraction of the total cost of disasters to Australia. Worthington (2008, pg. 3) points out that “in Australia the proportion of insured to total loss is only 35% for severe storms and bushfires 25% for earthquakes, 20% for tropical cyclones and as little as 10% for floods.” While using these types of figures to estimate actual disaster costs is a method that is held to be inaccurate (BTE, 2001, pg. xiv), the magnitude of the percentages highlights the point. Furthermore, it is likely that these estimates do not include many indirect costs, valuations for loss of life, nor intangibles such as ecosystem services which can have significant impacts on cost estimates.

BTE (2001, Chapter 4), as well as others (Handmer, Read & Percovich, 2002) explore the costs and benefits that would ideally be included in an economic impact assessment of a disaster event. Many of the items that would ideally be valued in such an analysis are not included in insurance or other data sources utilised in the reports analysed here. These include direct costs such as many agricultural losses, indirect costs relating to business disruption, emergency response and clean-up, health impacts, loss of cultural heritage and memorabilia, and finally the cost of damage to environmental assets and ecosystem services. Sole reliance on insurance data can not only obscure the true cost of disasters, but it necessarily favours hazards and assets that can be insured for, as seen in the top 10 analysis above.

The comparisons and analysis presented here highlights just how variable aggregate cost estimates and even event specific assessments can be. As a result estimates from different sources can rarely be justifiably compared. The breadth of estimates shows that extreme caution must be taken when using these sorts of disaster cost estimates for policy and research purposes. What do disasters cost Victoria and Australia? Unfortunately there is no straight answer.

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