Newsletter
Volume 18, Issue 4- October 2019

What areas of Australia are most at risk from natural perils?

by Andrew Gissing and Foster Langbein

The Commonwealth Government recently released a National Disaster Risk Reduction Framework. A key priority of the framework is accountable decision making which includes a strategy to identify highest priority disaster risks and mitigation opportunities. The strategy is based on the principle that it is not possible to reduce all identified risks and that investments must be targeted to minimise risks with the greatest potential impacts. The Australian Prudential Regulation Authority has also recently outlined the importance of mitigation investment in increasing insurance affordability across Northern Australia. The Commonwealth Government in October announced an additional $50 million dollars annually in mitigation funding.

Catastrophe loss models can be used to develop an understanding of the relative risk profile of Australia. Catastrophe loss models are decision support systems used extensively in the (re) insurance industry to assist in pricing risk and aggregate exposure management. Risk Frontiers has developed a suite of Australian probabilistic catastrophe loss models to quantify the impacts of flood, bushfire, hail, tropical cyclones and earthquake. These hazards contribute the majority of disaster losses in Australia as shown in Table 1. Risk Frontier's catastrophe loss models have national coverage and are comprised of hazard, exposure and vulnerability modules (read more in Briefing Note 399). The models provide scientifically based damage estimates that can be used to rank the risk profiles of different communities nationally.

Table 1: Breakdown of normalised losses by peril based on ICA disaster list (1966-2017). (Source: (McAneney et al., 2019))

Peril	Nominal loss (millions AUD)	Normailised loss (millions (AUD)	Proportion of normalised losses (%)
Cyclone	5384	26,132	29
Hail	9672	25,060	27
Flooding	5276	13,658	15
Bushfire	3067	11,184	12
Storm	5089	9475	10
Earthquake	941	4652	5
Tornado	263	357	0
Other	505	645	1

To identify what areas of Australia pose the greatest risk of financial loss to insurable assets such as residential and commercial property we have used the full suite of Risk Frontiers catastrophe models (hail, flood, tropical cyclone, earthquake and bushfire) to calculate average annual losses (AAL) for each Australian postcode based on exposure information derived from the NEXSIS database. The results of this analysis are illustrated in Figure 1 from which we can identify the top 20 priority postcodes nationwide as listed in Table 2.

All the highest rated postcodes are in WA, QLD or NSW, with flood and cyclone being the most significant perils. Bundaberg (4670) is rated as the postcode with the highest AAL relative to other post codes, with its total AAL contributing 0.02% of the nation's overall total AAL. The total AAL for Bundaberg is over twice that of the estimated AAL for 10th placed Townsville (4814) and over two hundred times greater than the lowest ranked postcode of Cooladdi (QLD) (4479). Such information about relative disaster risks is useful in determining national mitigation investment priorities.

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Table 2: Postcodes ranked based on total average annual loss including damages from flood, bushfire, cyclone, earthquake and hail.

Rank	Post code	Postcode description	State	Most significant peril
1	4670	Bundaberg	QLD	Flood
2	2480	Lismore	NSW	Flood
3	4870	Cairns	QLD	Cyclone
4	6714	Karratha	WA	Cyclone
5	4106	Rocklea (Brisbane)	QLD	Flood
6	6722	South Headland (Port Headland)	WA	Cyclone
7	4740	Mackay	QLD	Cyclone
8	4305	Ipswich	QLD	Flood
9	2460	Grafton	NSW	Flood
10	4814	Townsville (Western Suburbs)	QLD	Cyclone
11	6718	Roebourne (near Karratha)	WA	Cyclone
12	4650	Maryborough	QLD	Flood
13	6725	Broome	WA	Cyclone
14	4306	Western suburbs of Brisbane	QLD	Flood
15	2756	Windsor / Pitt Town / McGraths Hill	NSW	Flood
16	6728	Derby	WA	Cyclone
17	6721	Port Headland	WA	Cyclone
18	6720	Wickham	WA	Cyclone
19	4818	Townsville (Eastern Suburbs)	QLD	Flood
20	4810	Townsville (Surrounding Suburbs)	QLD	Cyclone

Results can also be dissected by peril. Table 3 provides the highest rated postcode for each of the five modelled perils nationally.

Table 3: Top postcode for each peril.

Peril	Postcode	Postcode description
Flood	2480	Lismore (NSW)
Bushfire	3381	Halls Gap (VIC)
Cyclone	6714	Karratha (WA)
Hail	2000	Sydney (CBD)
Earthquake	3175	Dandenong (VIC)

Postcodes were chosen to best represent Australian towns and suburbs. Results will vary depending upon the loss metric utilised for example a return period, AAL or probable maximum loss. They will also vary depending upon the geographic boundaries used, for example post code, statistical area, local government area or electoral boundary. Using post codes ignores potential losses attributable to wider regional scenarios. For example, potential losses due to flooding in the Hawkesbury-Nepean Valley are greater than just the post code of Windsor and are said to be the greatest nationally by the insurance industry. Such comparison of wider scenarios could be considered in a future analysis.

Understanding Future Risk

Risks are likely to change into the future due to climate change and urban development and future mitigation investment decisions should consider this. Risk Frontiers' catastrophe loss modelling framework is ideally suited to consider influences on future risk such as climate change, mitigation investment, increased development and changes to building codes. The Geneva Association, a peak insurance industry think tank, concluded that by combining catastrophe models with latest climate science an enhanced understanding of future weather-related risk impacts could be developed. Such use provides greater insights into the impacts of climate change on natural hazards not currently possible using Global Climate Models.

More information on Risk Frontiers catastrophe loss models can be found at riskfrontiers.com.

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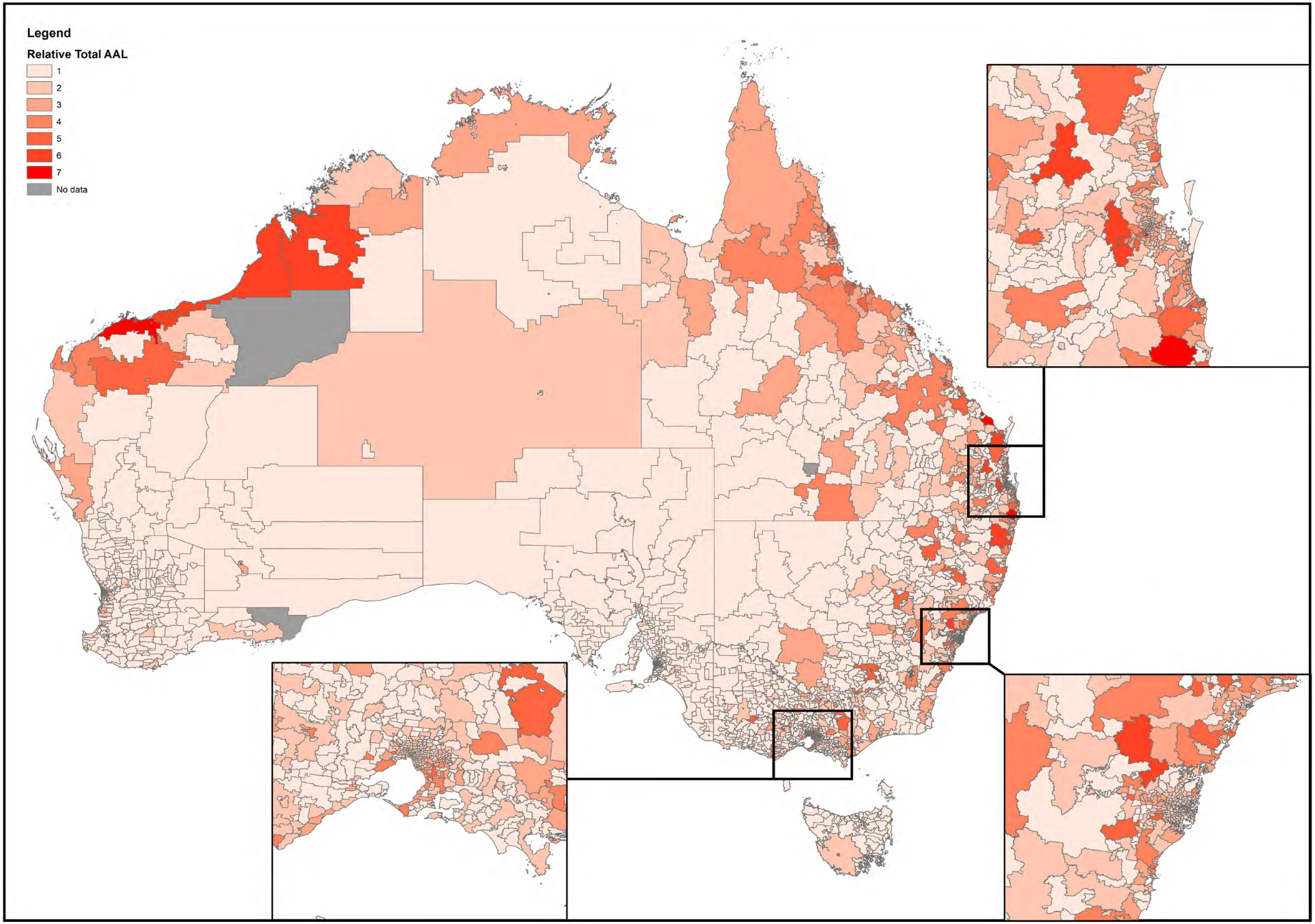

Figure 1: National natural hazards relative risk profile.

Bushfire and tropical cyclone activity for 2019/20

By Ryan Crompton

The most recent ENSO Wrap-Up was released by the Bureau of Meteorology (BoM) on 29 October 2019 under the headline 'Strong positive Indian Ocean Dipole persists'. The wrap-up was summarised as:

The strong positive Indian Ocean Dipole (IOD) event continues while the El Niño–Southern Oscillation (ENSO) remains neutral.

As explained in Crompton et al. 2010 a positive IOD (pIOD) event is when the eastern Indian Ocean is cooler than normal and the western Indian Ocean is anomalously warmer and often associated with a more severe fire season for southeast Australia. Their analysis of building damage due to Australian bushfires concurred with this and interestingly, in terms of the current conditions, they found that the two most damaging combined IOD and ENSO phases were pIOD/neutral and pIOD/El Ninõ in terms of average annual normalised damage for years 1925-2008.

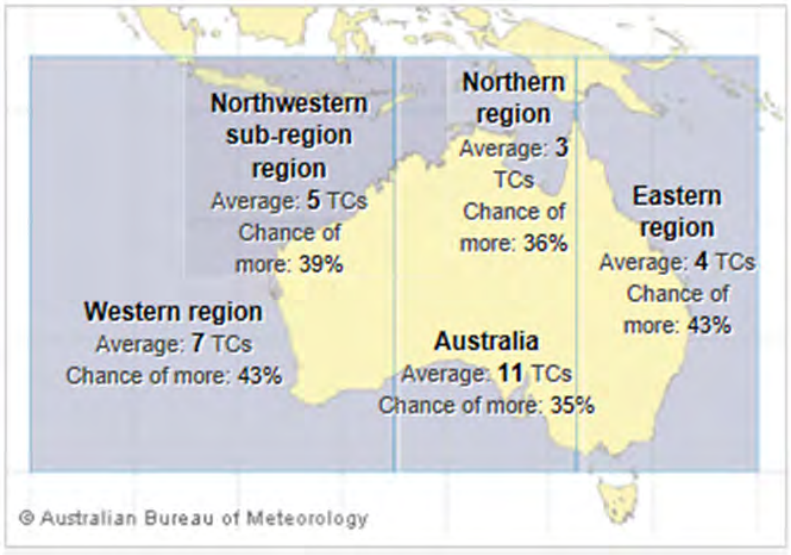

Figure 1. Long-term average number of tropical cyclones, using data from the 1969–70 season to this (2019) season and the percentage chance of more tropical cyclones than average (Source: BoM).

Compounding the bushfire risk for this season is another phenomenon called 'sudden stratospheric warming' which is when temperatures in the stratosphere high above the South Pole begin rapidly heating. (The stratosphere is the second layer above the Earth's surface and is roughly 10-50km above the ground). In a Conversation article published at the beginning of September authors from the BoM discussed how this warming commenced in the last week of August and:

Record warm temperatures above Antarctica over the coming weeks are likely to bring above-average spring temperatures and below-average rainfall across large parts of New South Wales and southern Queensland.

At the time, the BoM was predicting the strongest Antarctic warming on record, likely to exceed the previous record of September 2002, with the impacts reaching the Earth's surface during October and possibly extend through to January.

The increased risk of fire and heatwaves along eastern Australia has already been borne out with fires, at the time of writing, currently raging throughout the mid-north coast of NSW and northern NSW, including around my hometown of Forster-Tuncurry.

The ENSO phase also impacts tropical cyclone activity in the Australian region as discussed in the recently released BoM Australian Tropical Cyclone Outlook for 2019 to 2020. The outlook is 'Fewer cyclones than average likely for Australia this season' with this based on the historical relationships between the status of ENSO over the preceding July to September and the subsequent tropical cyclone season. The Outlook notes that indicators have been ENSO-neutral since April 2019 and the majority of climate models forecast neutral ENSO for the remainder of 2019 and into the first quarter of 2020.

The outlook of fewer cyclones than average not only applies to Australia but all other regions as shown in Figure 1. The Australian region has a 35% chance of more tropical cyclones than average, meaning a 65% chance of fewer tropical cyclones than average. The Outlook states that around four tropical cyclones cross the Australian coast in a season and the accuracy for the Australian region is high. Similar descriptions are presented in the Outlook for other regions.

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