Newsletter

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Sydney Hailstorm: December 20, 2018

by Salomé Hussein and Foster Langbein

On December 20, 2018, a severe hailstorm struck the greater Sydney region in the mid-afternoon. The most impacted areas were Liverpool in Sydney's southwest and further to the north, Castle Hill and Berowra. Hail sizes as large as 8cm diameter were reported (examples shown in Figure 1) and Chipping Norton, near Liverpool, experienced up to 10cm. More minor damage was reported over much of metropolitan Sydney.

The event caused an estimated $1.04 billion in damages (Insurance Council of Australia (ICA) as at February 14, 2019). This ranks as the 8th most costly hailstorm in the ICA Disaster List in terms of normalised insured losses (2017/18 dollars[1], Table 1), just above the Melbourne 2011 Christmas storm, and the 3rd costliest for the Sydney region. The largest volume of claims was for motor vehicles with these contributing around 30% of the total loss. Figure 2 shows the distribution of numbers of claims made for residential, commercial and motor vehicle lines of business.

The event generated a substantial emergency response with the SES receiving 3600 calls, of which 1100 came from the Liverpool area alone. There were 2400 jobs attended by 600 volunteers, mainly to place tarps on roofs.

Figure 1: Images of extreme hail in Berowra, courtesy of Andrew Gissing (Risk Frontiers) and Graham Jose.

Name/Region	Date	Cost (2017/18, $million)
Eastern Sydney Hailstorm	April 14, 1999	$5,575
Brisbane	January 18, 1985	$2,274
Northern Sydney Hailstorm	March 18, 1990	$1,682
Melbourne Storm	March 6, 2010	$1,626
Brisbane	December 19, 1967	$1,596
Brisbane Hailstorm	November 27, 2014	$1,535
Perth Storm	March 22, 2010	$1,345
Sydney Storm	**December 20, 2018**	**$1,039***
Melbourne Christmas Storm	December 25, 2010	$988
Western Sydney	October 03, 1986	$796

Table 1. Date, location, and normalised losses for the top 10 costliest hail events from the ICA Disaster List.
*ICA estimate as at February 14, 2019

[1]Based on Risk Frontiers' normalisation methodology *Normalised insurance Losses and Weather-Related Australian Natural Disasters: 1966-2017* available at: https://disasters.org.au/data

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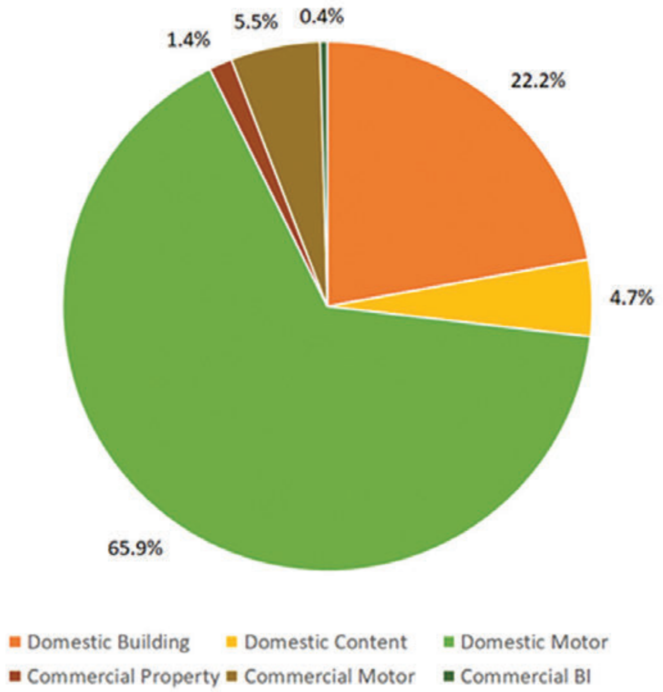


Figure 2: Chart showing proportion of numbers of claims made, using data from the ICA Disaster List.

The conditions at the time of the event were favourable to see hail fall. The synoptic weather pattern was described as a 'southeasterly change' and there was also a sea-breeze present on the day as determined from our analysis of local weather station data, specifically wind direction, wind speed, and relative humidity. This combination of synoptic pattern and sea-breeze occurrence was found to be the most conducive to severe hail in southeast Queensland in research conducted by Soderholm et al. (2017).

Our post-event analysis included estimating a damage footprint using the Bureau of Meteorology (BoM) radar station data (recently made open source) and Maximum Estimated Size of Hail (MESH) algorithm (originally due to Witt et al. 1998). The MESH algorithm estimates hail sizes from radar measurements of reflectivities combined with temperatures over the scanned altitude. We applied this to the nearby Wollongong Radar (Appin station) data and by combining all frames of MESH output over the event time period and averaging the maximum expected hail size we produced a spatial map of hail intensity (Figure 3). This intensity map was then used as input for further analysis, allowing the use of image thresholding techniques to obtain damage footprint contours over the affected areas (see Figure 4.). Fitting ellipses to these contours then allowed us to make a direct comparison with our Risk Frontiers HailAUS CAT loss model, a fully stochastic loss model for hail covering all of Australia.

HailAUS 7.0 includes a catalogue of hailstorms reflecting activity from local radar station data and the frequency and severity of 'high storm potential days' derived from reanalysis data and the observed historical record. It calculates losses for residential, commercial, industrial and motor portfolios using an approximation of elliptical storm footprints. If we take the approximated ellipses in Figure 4 for this event the estimated loss from HailAUS is $1.6 billion using the PERILs Hail Industry Exposure Database for 2018 and the Redbook Motor portfolio.

There are several factors that limit the accuracy of the HailAUS modelled loss estimate. The first two are related to the Wollongong Radar being a single polarisation instrument (only sends horizontal polarisation of radio wave). This required us to employ the MESH algorithm rather than more modern hail size estimating algorithms, such as the Hail Size Discrimination Algorithm (HSDA, Ortega et al. 2016), that can be applied to dual-pol (uses both horizontal and vertical polarisations of radar signal) stations such as the main Sydney (Terrey Hills) station. We also expect the sea-breeze produced drift, which in turn influenced the location of the damage footprint. Although not available for our analysis, the Terrey Hills Radar data is likely to be released in the near future.

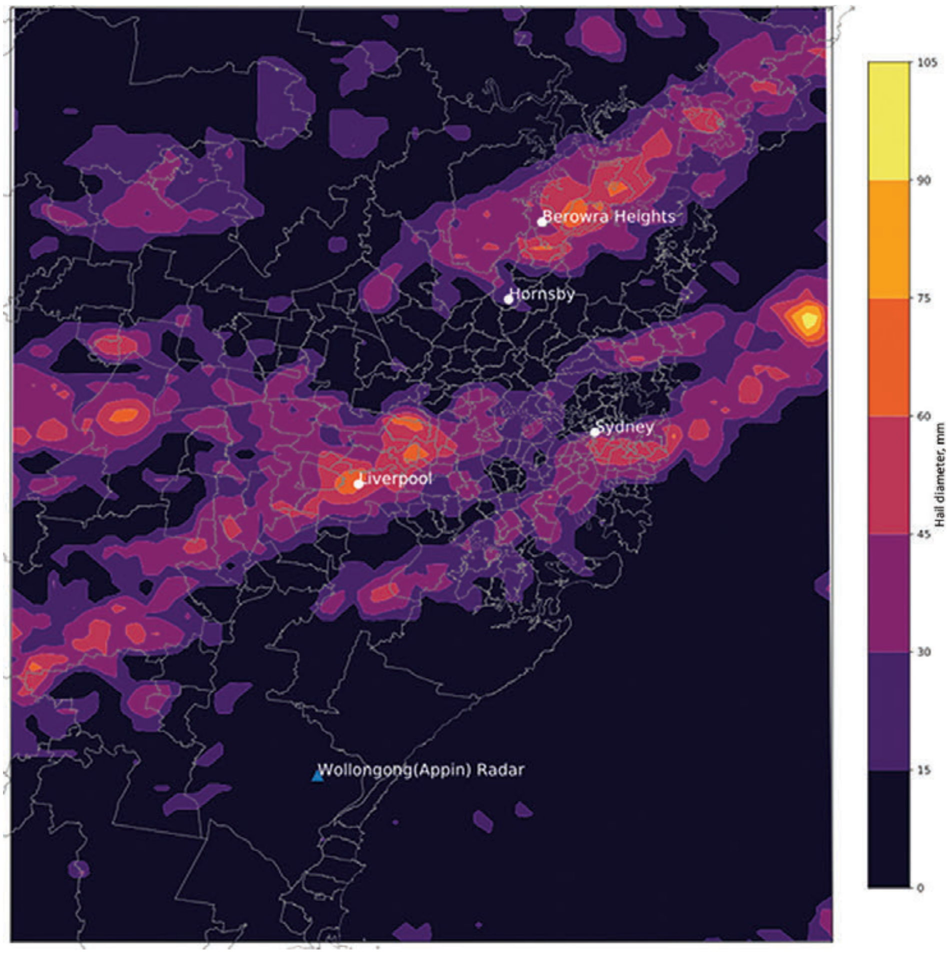
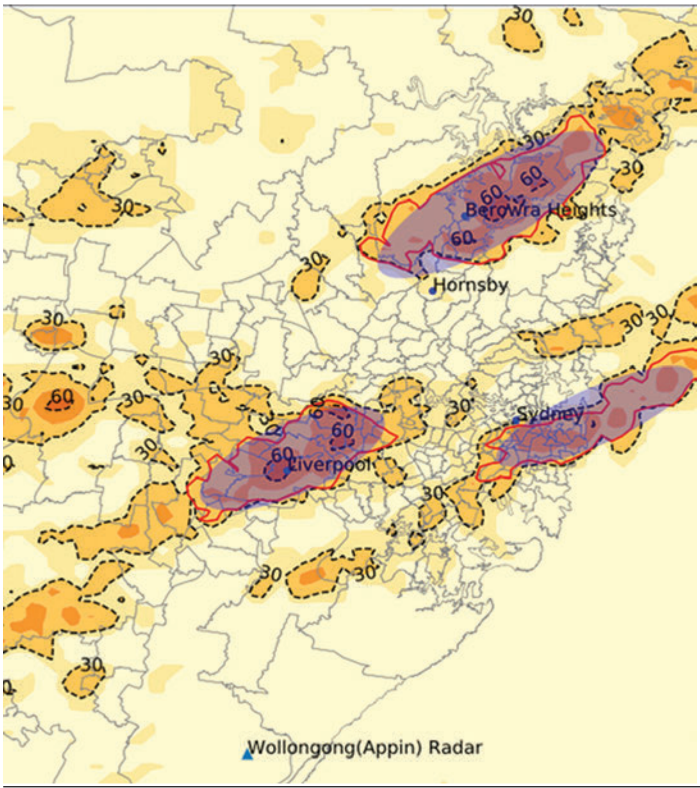


Figure 3: Mean Maximum Estimated Size of Hail from 02:00 to 10:00 UTC using the Wollongong Radar and Joshua Soderholm's (BoM) PyHail software. White solid lines are postcode boundaries. Analysis used the second tilt (0.9 degrees from horizontal).



Other limiting factors include the consistency and reliability of the motor vehicle market portfolio and that the damage footprint used for cars will likely be larger due to a lower threshold for car-damaging hailstones than that used in the Figure 4 contours. The latter would act to increase the amount of loss attributed to cars.

Finally, while the elliptical damage footprints in HailAUS are a very reasonable representation, they limit the accuracy of the distribution of damage compared to what is observed in the radar data and we plan to improve this in a future model update.

Figure 4: Storm footprints extracted from contours of mean Maximum Estimated Size of Hail algorithm output over the entire event. Dashed lines represent contour levels of 30mm diameter. The maximum predicted over the entire event was 104mm diameter hail. Grey solid lines are postcode boundaries. Red solid lines are extracted hail cell boundaries with a lower threshold of 35mm, and the overlain blue ellipses are fitted to those boundaries for comparison with storm events within HailAUS.

Disclosure of climate-related financial risk

by Stuart Browning

In light of underwhelming progress at COP-24 (the annual United Nations Framework Convention on Climate Change (UNFCCC) Conference Of the Parties (COP) in Katowice 2018), it is increasingly improbable the Paris Agreement's ambitions will be achieved. Instead, it seems more likely that recommendations from the Financial Stability Board (FSB) will be the primary catalyst for effective action on climate change mitigation. Projections of the economic cost of climate change have always been somewhat dire (e.g. Stern 2006); and have been mostly ignored by policy makers. However, the FSB have recommended financial risks due to climate change be disclosed by all publicly listed companies. This is driving the financial sector to seriously consider the implications of climate change, and the results are likely to be sobering. With an understanding of risk comes investor pressure to minimise the risk, and this may well drive mitigation efforts above and beyond those achieved via the 'heads-of-state' level Paris Agreement. In Australia, this has been manifested most recently by the Reserve Bank of Australia's stark warning last week to, in effect, "change now or pay later" (see Risk Frontiers Briefing Note 391).

Publicly listed companies are legally required to disclose material risks to their investors. This disclosure is especially relevant for banks, insurance companies, asset owners and managers when evaluating the allocation of trillions of dollars in investor capital. In 2017 the FSB released the final report of the Task Force on Climate-related Financial Disclosures (TCFD), which stresses that climate change is a material risk (and/or opportunity) that should be disclosed—preferably alongside other risks in annual reporting. The TCFD proposes a framework for climate risk determination and disclosure (Figure 1) in which risk is classified into two main types: transitional and physical. Transitional risks are those that may impact business models through changing technologies and policies: examples are a carbon tax, or stranded assets associated with redundant fossil fuel exploration and extraction. Physical risks are those associated with climate change itself: these could be chronic risks such as sea-level rise, or acute risks such as more extreme storms, floods or droughts.

While climate change is expected to impact most businesses, even current exposure and vulnerability is not being adequately disclosed by most organisations. The Australian Securities and Investment Commission (ASIC) report in 2018 looked at climate risk disclosure in Australian companies and found that very few were providing adequate disclosure,

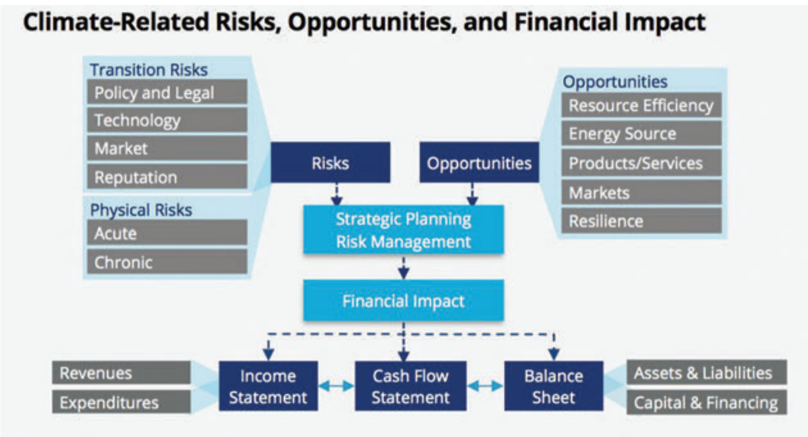


Figure 1: Factors identified in the TCFD report contributing to financial risk and opportunities under climate change (TFCD 2017).

thereby exposing themselves to legal implications; and more importantly, by failing to consider climate change as a risk, were potentially putting investor capital at risk. Companies that are attempting to disclose climate risk are typically doing so inconsistently, and with high-level statements of little use for investor decision-making (ASIC 2018). Quantifying organisational vulnerability and risk under climate change is a non-trivial task. Adequate implementation of the TCFD recommendations will likely occur over a >5 year timeframe (Figure 2) . Initially companies are expected to develop some high level information on general risk under climate change. As research progresses, disclosure should become more specific.

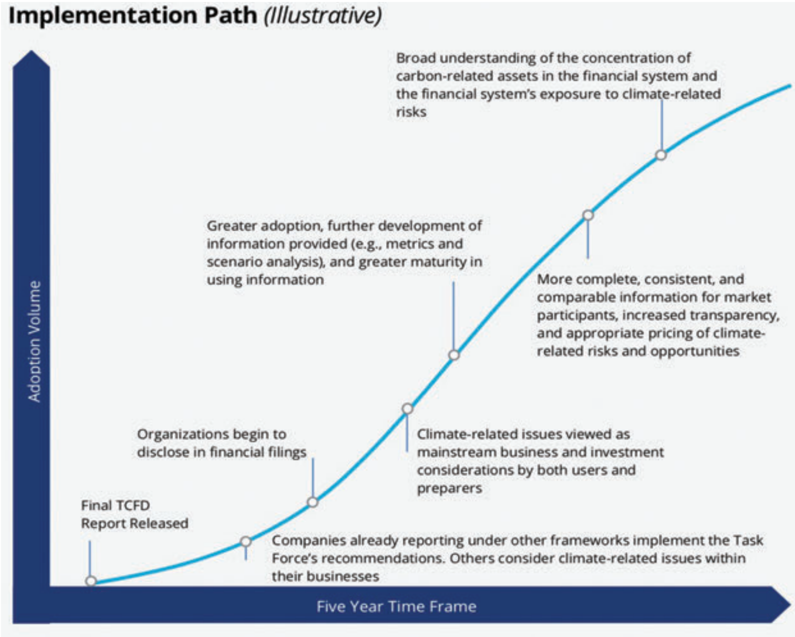


Figure 2: Milestones in the implementation of the TCFD (TCFD 2017).

Understanding risk in terms of weather and climate has long been of interest to the insurance sector, but is now something expected to be understood and disclosed by all sectors. The Actuaries Institute have recently developed The Australian Actuaries Climate Index, which tracks the frequency of occurrence of extremes in variables of interest, such as temperature, precipitation, wind speed and sea-level. The index provides a general level of information drawn from a distribution of observed variability. However, climate change will cause a shift in the distribution of events, meaning this information is of limited use for projections. The relationship between a warming climate and the frequency of extreme weather events is likely to be complex and peril and location specific. Quantifying physical climate risk requires an understanding of the physical processes driving climate variability, the technical expertise to work with petabytes of available data, and the capacity to run regional climate models for dynamical downscaling—these skills are typically restricted to research organisations and universities.

Useful risk disclosure will come from using the best available information to represent both past and projected climate variability. This means using a combination of observational and model based data. Exposure and vulnerability will need to be determined using weather station observations and reanalysis data. This will need to be organisation-specific and developed within the context of assets, operations, and physical locations. Risk projections can then be developed, and this should be done using scenario analysis across multiple time horizons: short, medium and long term. Short-term projections can be developed using established vulnerability together with seasonal forecasts. Medium- and long-term projections should be based on global climate model (GCM) projections developed within the framework of the Coupled Model Intercomparison Project (CMIP). These are the scenario-based industry-standard climate model projections used for the IPCC reports. The IPCC Fifth Assessment Report (AR5) was based on the CMIP5 suite of simulations. The next generation of simulations (CMIP6) are underway and should become publicly available from 2019-20 onwards. Projections of organisation-specific risk will need to be developed by downscaling GCM projections. The best results are likely to be achieved through a combination of statistical downscaling, dynamical downscaling, and machine learning.

Risk Frontiers utilises projections within its suite of natural catastrophe (CAT) loss models to investigate how losses may change in the future under different climate scenarios. Risk Frontiers adapts its CAT models, developed for the insurance industry to assist decision makers in estimating and managing catastrophe risk, to assess the impact of projected changes in weather-related hazard activity due to climate change, as well as changes in vulnerability and exposure (Walker et al. 2016). In November 2018, The Geneva Association reported on the benefits of the integration of climate science and catastrophe modelling to understand the impacts of climate change stating that “Cat modelling is more relevant than ever”. With CAT models being the ideal tool for this type of analysis, Risk Frontiers is strongly positioned to address the need for physical climate risk disclosure.

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