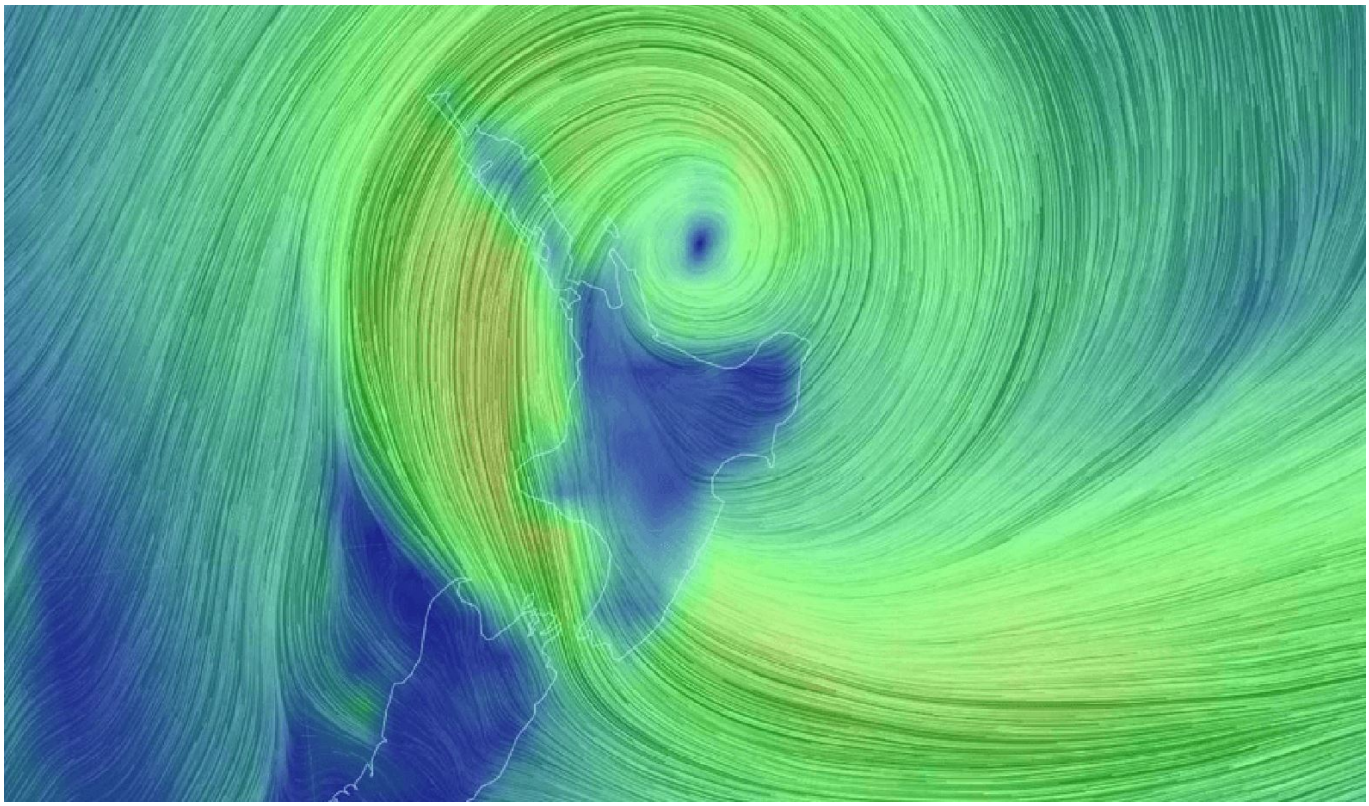
PUBLIC HEALTH COMMUNICATION CENTRE AOTEAROA



Embracing downward counterfactual analysis to navigate future cyclones

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Summary

In this *Briefing* we apply 'downward counterfactual analysis' to Cyclone Gabrielle, considering how it could have been worse, to derive valuable insights for future disaster mitigation. The ‘worse case’ scenarios include higher storm severity (as per aspects of some previous cyclones), worse timing, hitting Auckland directly, and poorer response by the public and authorities. This type of downward counterfactual analysis should be conducted for other disasters to better inform a wider range and depth of future disaster mitigation efforts.

In February 2023, Cyclone Gabrielle did massive damage around Aotearoa New Zealand (NZ). It caused an estimated 1720 injuries,[1] 11 deaths,[2] damaged water infrastructure,[3] and the overall economic cost is estimated to up to $14.5 billion.[4]

In this *Briefing* we apply a relatively novel process to examine this disaster – involving 'downward counterfactuals'.[5] This is the process of considering hypothetical scenarios in which the outcome of a disaster event is imagined to be worse than what actually occurred. It is a form of counterfactual thinking that can inform consideration of a wider range and depth of future disaster prevention and mitigation efforts – especially for less common disasters for which there may only be a small dataset of historical events. This approach has some similarities to examining 'near misses' for improving safety in such domains as aviation, nuclear power technology, petrochemical and steel production, military operations, and health care (for details see:[6] [7]). In contrast to envisaging downward counterfactuals, it is much more common for post-hoc analysis to look at what went well with disaster response, or what went badly (and resulted in bad outcomes), but not very common to ask “what could have been worse?”.

How might Cyclone Gabrielle have been worse?

The cyclone’s peak rainfall and wind speed could have been worse: Aspects of previous cyclones have been worse than Gabrielle in terms of the highest amount of rainfall on one locality (eg, Bola), and top wind speed (eg, Giselle and Bola, see Table). Also, two of these listed cyclones had higher death tolls than Gabrielle: both Giselle and the 1936 cyclone. Indeed, Giselle killed 59 people, mainly due to sinking of the inter-island ferry *MS Wahine*. So if Gabrielle had coincided with one of the recent inter-island ferry breakdowns at sea (including one involving a mayday call)[8] – there could have been far more injuries and deaths.

Table: Major cyclones impacting NZ in the past 100 years

Name of cyclone & main data source	Year	Deaths	Maximal rainfall in one locality (mm)	Top wind speed recorded (km/h)	Lowest pressure in hectopascals (hPa)
Gabrielle [9]	2023	11 [2]	540 (Glengarry, Hawke's Bay)	146 (Cape Turnagain, Wairarapa, also at Mt Kaukau, Wellington)	967 (at Great Mercury Island)
Bola [10]	1988	7	917 (for Glenross Station, Gisborne in 4 days; Tolaga Bay had 916 mm in 3 days)	180 (Oakura, Taranaki)	980

Name of cyclone & main data source	Year	Deaths	Maximal rainfall in one locality (mm)	Top wind speed recorded (km/h)	Lowest pressure in hectopascals (hPa)
Giselle [11]	1968	59*	355 (Otago over 4 days)	275 (Cook Strait). Roofs were ripped off 98 houses.	970
Cyclone in February 1936 [12] (unnamed)	1936	12 [13]	406 (Dawson Falls, Taranaki)	145 (Henderson, Auckland)	974 (Auckland)

*There were 53 deaths associated with the Wahine sinking (including 2 delayed deaths) and another 6 deaths around the country from the storm.[14]

The path of the cyclone could have been worse: The damage from Gabrielle could have been much worse if Auckland had been hit directly. Indeed, the cyclone was heading towards the Auckland Region but undertook a sharp deviation out to sea near Great Barrier Island (see Figure).

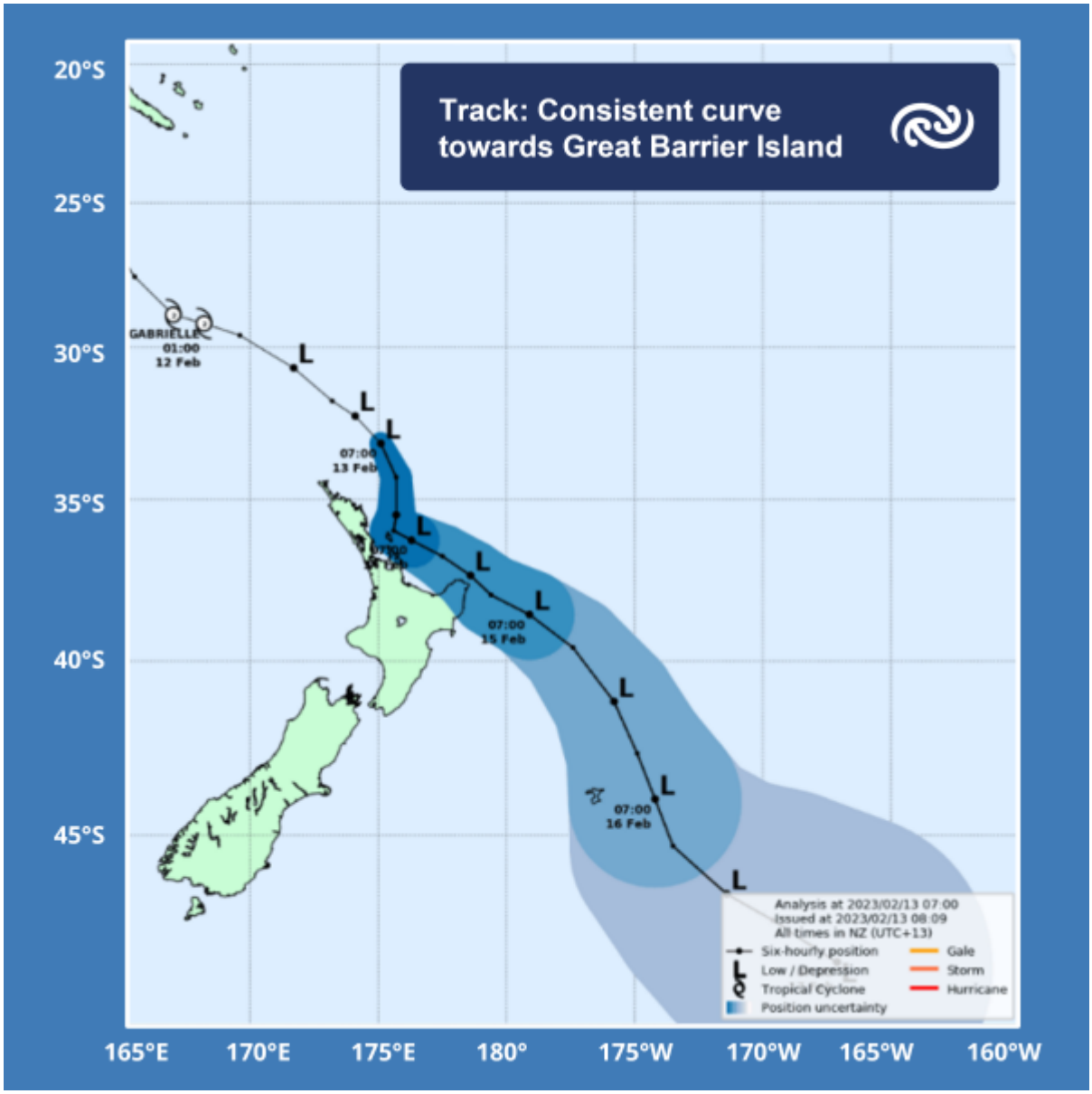

Figure: How Cyclone Gabrielle deviated away from Auckland (MetService image used with permission).

The timing could have been worse: The timing could have been worse if Gabrielle had arrived closer in time to the preceding Cyclone Hale – meaning that the ground could have already been even more water saturated in impacted areas. It also could have occurred at a peak summer holiday time – causing more disruption to road transport and potentially causing more loss of life (eg, if campgrounds were suddenly flooded).

The response by the public could have been worse: The public response to Gabrielle appeared very good with people rescuing neighbours, helping with clean-up efforts, and local marae providing food and accommodation for evacuees etc. These favourable public responses could have been less functional if dis/misinformation had been more widely circulated. Indeed, some Auckland-based radio hosts "played down the danger it posed and complained about a day of school closures".[15] Also, if social capital in NZ was generally more eroded with lower overall trust in the news and in government agencies, then public responses such as helping others and working with authorities, could also have been less forthcoming.

The response by the authorities could have been worse: Some of the emergency authorities in the hardest hit regions of the country responded well to Gabrielle (at least in the view of one emergency management expert: Jon Mitchell[16]). But these authorities may have acted less effectively – as per the Auckland authorities in response to the Auckland floods in January, as assessed in an independent review.[17] Also, had more defence staff been needed to assist, then the response could have been poorer. As it was, the NZ Defence Force have said that their response to this cyclone was constrained by their recent reductions in workforce – including the capacity to operate various naval vessels.[18]

Discussion of these downward counterfactuals

It seems clear from the above list that the impact of Gabrielle could have been worse for NZ in a number of different ways. Combined with climate change making such weather events more extreme,[19] (including Cyclone Gabrielle specifically involving more rainfall), these issues highlight the need for greater investments in reducing the number of people living in flood-prone areas. It also suggests the need for both central and local government to invest in improving disaster resiliency.

There is also a case for NZ authorities to repeat this "downward counterfactual" exercise for Gabrielle using a wider range of disaster experts and for a wide range of disaster events. For example, the latter could cover how the Covid pandemic could have been worse (eg, no vaccine developed) or how the supply chain impact of the war in Ukraine could have been worse for NZ (eg, if Russia had destroyed all Ukraine's ports).

What is new in this Briefing

- We outline five plausible scenarios in which the impact from Cyclone Gabrielle could have been worse for Aotearoa NZ – a “downward counterfactual” analysis.

Implications for public health policy

- This type of analysis could be repeated for Cyclone Gabrielle by a wider range of disaster experts.
- It could also be conducted for a range of other disasters – including the impact of the Covid-19 pandemic.
- In general, there is a need for central and local government to reduce the numbers of people living in flood-prone areas and to upgrade resiliency, especially in the most vulnerable areas. Such adaptations should go hand-in-hand with enhanced climate change mitigation.

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