Platform 2 – Geological Processes and Hazards

Immediate expert advice and long-term social science inform tsunami risk communication for Aotearoa New Zealand

A series of tsunamigenic earthquakes on 5th March along the Hikurangi - Kermadec margin prompted a significant GNS Science response. Early on 5th March 2021, three large earthquakes occurred offshore New Zealand, beginning with a M7.3 East Cape earthquake felt widely across the country. This was followed a few hours later by M7.4 and M8.1 earthquakes in the Kermadecs. Seismology research and expertise, funded by the Strategic Science Investment Fund (SSIF) contributed to the tsunami response through analysis of seismological data, earthquake models and aftershock patterns, as well as the development of "Future Scenarios" to answer and inform the public and key stakeholders (e.g. National Emergency Management Agency (NEMA)) about what might happen next in the earthquake sequence. Our response to these events and the supporting research aligns with the our SSIF Geological Processes and Hazards Platform's strategic intent to support the management of increased risk from geological hazards. Through the provision of better real-time forecasts communities can better respond to and recover from events.

GNS expert advice and forecasting

The earthquakes, and subsequent tsunamis and landslides led to an organisation wide GNS Science response. The NZ Tsunami Experts Panel was activated in the early hours of the morning to provide critical advice and updates to NEMA and the Minister of Emergency Management via the National Geohazards Monitoring Centre, and directly later in the day at the National Crisis Management Centre. NEMA issued tsunami alerts to the public following these events and tsunami arrivals were recorded as around 35-40 cm at East Cape and 15-20 cm at Great Barrier Island.

This sequence of earthquakes tested a new GNS Science event response structure, and successfully trialled systems and processes. GeoNet used the outputs of SSIF funded research in its communication of aftershock and scenario forecasts following the earthquakes.

Software that has been developed as part of the SSIF Hazard and Risk Management programme to fetch, analyse and visualize New Zealand tsunami gauge data and NZ DART buoy data for research studies and event responses, was used to assist the Tsunami Experts Panel (TEP) with decision making in the tsunami responses. Information provided to the TEP also included outputs from the COMCOT tsunami simulation package, the "Rapid Characterisation of Earthquakes and Tsunami: Fewer deaths and faster recovery" Endeavour funded programme and research undertaken as part of the Hazards and Risk Management SSIF programme, SSIF Enhanced Geohazards Monitoring and our SSIF Data Science programme. The tsunami forecasts developed led to a better understanding of the hazard from these tsunamis to New Zealand and underpinned a more rapid cancellation of response by NEMA than would have been otherwise scientifically supported. Multiple tsunami threat maps were produced by the TEP and delivered to NEMA to help inform them on the appropriate response to the tsunamis, such as whether or not to evacuate a particular coastal zone. Provision of data from the new DART buoy monitoring network and resulting tsunami forecasts for the Americas also contributed to the global tsunami response.

Earthquake and landslide forecasts were also calculated as part of the response which, along with other hazard information provided to our main stakeholders, were well received. Social Science SSIF funded research on the Canterbury Earthquakes, Cook Strait and Lake Grassmere, Edgecumbe, and Kaikōura earthquakes, particularly relating to community information needs and uses, was also applied during the recent events.

Ongoing research and response

A significant body of research is continuing to fully understand the mechanisms for these earthquakes and tsunami and the community response. Through SSIF funding, further improvements have been made in estimating the tsunami wave heights of Distant-source and Regional-source tsunamis in the National Tsunami Hazard Model (NTHM) and an innovative advance was made in in our widely recognized tsunami simulation model (COMCOT), improving accuracy and computational speed. Since the 5th March tsunamis, there have been ongoing collaborative workshops and meetings with other relevant organisations such as Australian emergency and science agencies, the Pacific Tsunami Warning Centre, the Australian Tsunami Advisory Group and the Tsunami Researchers Group. We are also planning surveys to understand public tsunami warning and evacuation responses from the event in collaboration with NZ tsunami scientists, CDEM Groups and NEMA.

Our collaborators and funding

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