Australian Government
Bureau of Meteorology

Australian Government
Geoscience Australia

National Warning Response to the HTHH Tsunami Event – An Australian Example

Yuelong Miao yuelong.miao@bom.gov.au
Joint Australian Tsunami Warning Centre (JATWC)

Satellite Activity for the UN Ocean Decade Safe Ocean Laboratory
Webinar on Further Challenges for Warnings of Tsunamis, 6-7 April 2022

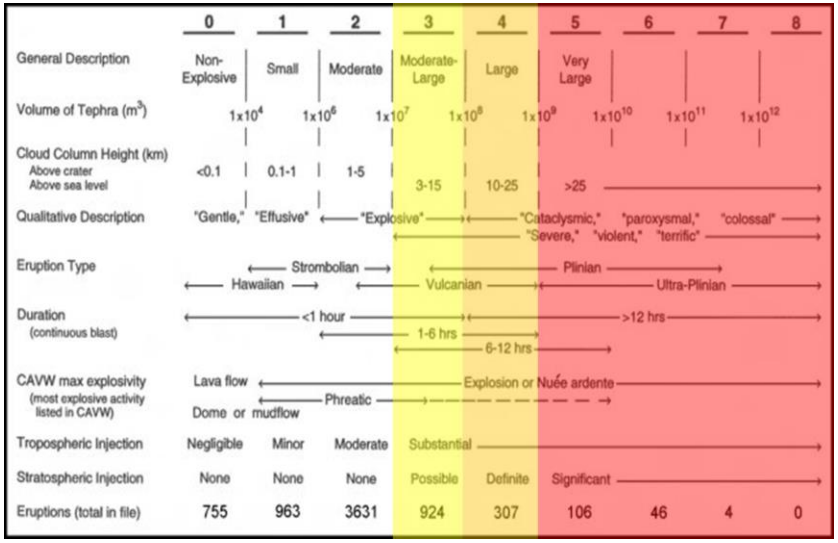
JATWC Standard Operating Procedures for Volcanic Events

1. Assign a Volcanic Explosive Index (VEI),
2. Monitor tsunami observations, then
3. Decide threat areas within a Tsunami Travel Time (TTT) Isochrone,
4. Adjust as needed in warning level and areas of warning

Assign a Volcanic Explosive Index (VEI)

- by Volcanic Ash Advisory Centre (VAAC)
- by assessing Satellite Imageries for stratospheric injection of the volcanic ash plume

VEI < 3 little to no stratospheric injection
VEI 3 or 4 some stratospheric injection
VEI >=5 significant stratospheric injection



Notes:

- The VEI index should not be the only indicator for assessing tsunami threat.
- Tsunami could be generated from smaller eruptions.
- Undersea volcanic eruptions may cause tsunamis but may not be detected by satellite.

JATWC Standard Operating Procedures for Volcanic Events

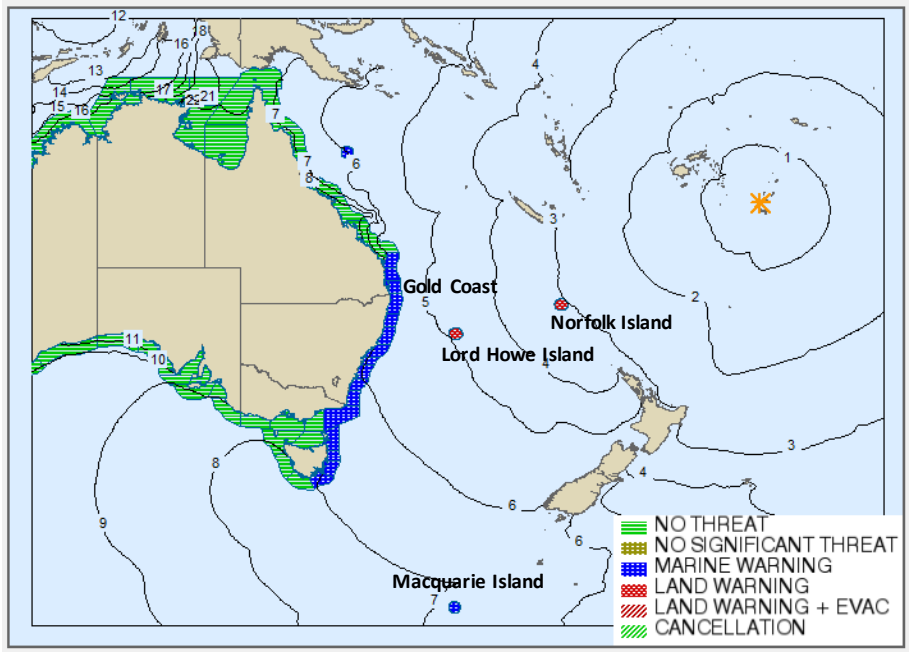
1. Assign a Volcanic Explosive Index (VEI),
2. Monitor tsunami observations, then
3. Decide threat areas within a Tsunami Travel Time (TTT) Isochrone,
4. Adjust as needed in warning level and areas of warning

VEI	Tsunami Observations	Threat Area
VEI <3	No	Nil
	Marine Threat	1 hour travel time isochrone
VEI = 3 or 4	No	3 hour travel time isochrone, early cancellation if still no
	Marine Threat	3 hour travel time isochrone
	Land Threat	Judgement call. Consider expanding to 6 hour isochrone
VEI >=5	No	6 hour travel time isochrone, early cancellation if still no
	Marine Threat	6 hour travel time isochrone, consider expanding
	Land Threat	6 hour travel time isochrone, consider expanding

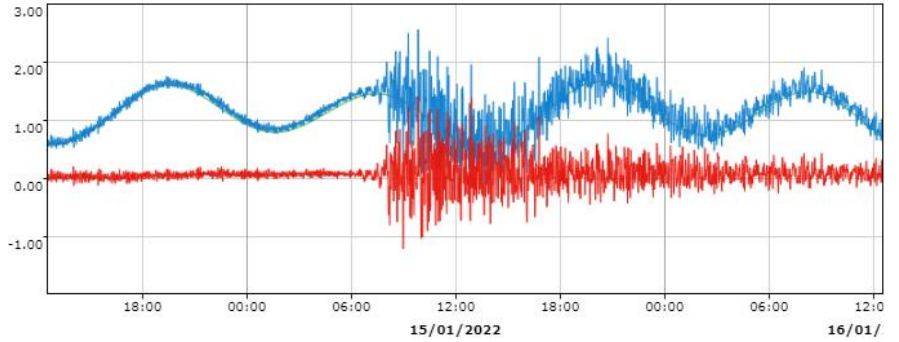
JATWC in the HUNGA TONGA-HUNGA HA'APAI (HTHH) Volcanic Tsunami Event

UTC	AEDT	Elapsed Time hh:mm	15-16 January 2022 JATWC key actions
04:10	15:10	00:00	Explosive volcanic eruption of the Hunga Tonga-Hunga Ha'apai volcano (Tonga)
04:30	15:30	00:20	1.2m tsunami waves observed at a Nuku Alofa tide gauge station (but JATWC was unaware of it till later)
05:48	16:58	01:48	No Threat Bulletin issued. Based on 3 hours travel time (TTT) with Norfolk just outside the 3hr isochrone, VEI assessed as 3 or 4
08:26	19:36	04:26	Marine Warning for Norfolk Island issued after 50 cm wave observed at the tide gauge. Reactively revised.
09:00	20:00	04:50	Marine Warning issued for Lord Howe Island (in 5hr TTT).
09:37	20:37	05:27	Significant observations in NSW and QLD: (40cm at Twofold Bay, NSW at 20:10 AEDT; 25 cm at Gold Coast, QLD at 19:40 AEDT) prompts the issuing of Marine Warnings to south QLD & entire NSW. Also revised VEI >=5, expanding areas covered by 6hr TTT
09:58	20:58	05:48	Norfolk Island Marine Warning upgraded to Land Threat Warning after wave observations exceed 1.0 m at the tide gauge.
10:00	21:00	05:50	Marine Warnings extended to Victoria, Tasmania and Macquarie Island covered by 7hr TTT.
10:18	21:18	06:08	Lord Howe Island Marine Warning upgraded to Land Threat Warning with evacuation order issued by NSWSES at 20:12 AEDT.
		06 – 18	Each warning updated on hourly basis during the 12 hr period
23:09	10:09 +1 day	18:59	Land Threat Warnings for Norfolk Island and Lord Howe Island downgraded to Marine Warnings.
23:30 – 00:50 +1 day	10:30-11:50 +1 day	19:20 to 20:40	Cancelled QLD, Macquarie Island, Victoria and Tasmanian Marine Warnings.
08:56 – 10:59 +1 day	19:56 - 21:59 +1 day	28:46 to 30:49	Cancelled Lord Howe Island, Norfolk Island and NSW Warnings.

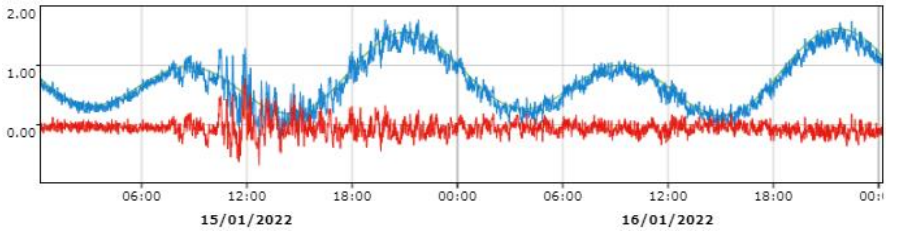
JATWC Tsunami Threat Assessment – Within 7 Hours Travel Time



Norfolk Island – 1.27 m



Gold Coast – 0.82 m



Learnings

What went well?

- The JATWC had specific SOPs and decision support system to handle volcanic tsunami sources before the event
- The JATWC has direct access to VAAC advices.
- Experts who originally developed those SOPs were activated and then led the long and complex JATWC operation, which helped navigate changing and challenging situations.

What could be improved?

- Close sea level monitoring occurred throughout and helped with key warning decisions including when to cancel. Running an auto sea level alerting algorithm would have eased workload, and enabled the detection of the first tsunami waves. This algorithm is now being developed.
- The initial small tsunami due to the shockwaves have caused some confusion, which contributed to the No Threat assessment initially.
- The valued real-time NZ DART data were not directly ingested in the decision support system, but this is now close to be resolved.
- We should develop modelling specific to this type of events, which will be a difficult task thus requiring national and international collaboration.

Thanks!