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Observations and effects of the January 2022 Hunga Tonga-Hunga Ha'apai tsunami in Tasmania

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Cover: Ash, steam, and gas rising above Hunga Tonga-Hunga Ha'apai volcano on 14th January 2022 photographed by Tonga Geological Services.

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Observations and effects of the January 2022 Hunga Tonga-Hunga Ha'apai tsunami in Tasmania

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1.0 Executive Summary

The eruption of the Hunga Tonga–Hunga Ha'apai submarine volcano on the 15th of January 2022 initiated a tsunami that reached the Tasmanian coastline. The primary focus of this report is to collate and document the physical observations and instrumental records of wave heights, tsunami arrival times and human experiences of tsunami activity. Emergency responses and specific agency actions have been documented in the Tasmanian Response Debrief Report and will not be duplicated here.

The largest waves arrived between 6 and 10 hours after the eruption, with maximum recorded amplitudes of 0.52 m at Southport, 0.35 m at Spring Bay, and 0.3 m at Huonville. The first tsunami waves were generated by a meteotsunami (caused by the eruption's atmospheric shockwave) and arrived earlier than predicted, which complicated the warning and emergency response process.

Management and modelling of future coastal threats could be improved with enhanced coverage and distribution of water level monitoring gauges. Consideration of tidal cycles and weather conditions is also important for predicting tsunami impacts in real-time.

2.0 Definitions

- DART (Deep-ocean Assessment and Reporting of Tsunamis) real-time tsunami monitoring systems.
- Times given in local observed time at the time of the event, Australian Eastern Daylight savings Time (AEDT).
- Relative water level heights given above the Australian Height Datum (AHD Tas83).
- BOM is the Australian Bureau of Meteorology
- Wave amplitude is the height of the wave crest above sea level (Figure 1).

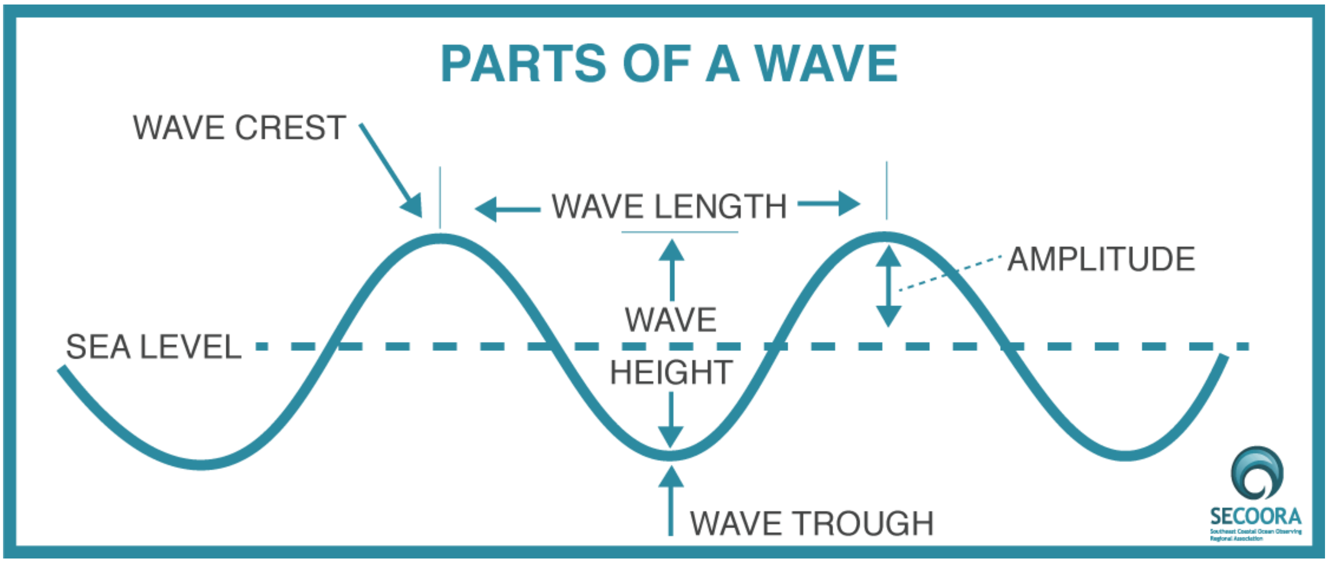

Figure 1. Definition of wave amplitude: the height of the wave crest above sea level. Wave height - often used incorrectly to describe wave amplitude - is defined as the height between wave trough and crest.

3.0 Introduction

A tsunami is a series of waves that results from sudden water displacement, commonly caused by earthquakes, volcanic eruptions, flank collapse, or submarine landslide. Tsunamis are long waves, with periods of minutes to hours, and may cause recurring inundation and unusual currents for several days. Inundation of coastal areas may occur as a steady or rapid rise in water, breaking waves, or a bore travelling up waterways.

Volcano-induced tsunamis occur less frequently and are more difficult to predict in real-time than earthquake-generated tsunamis. Volcanic processes can generate tsunamis in many ways, including underwater eruption, pyroclastic flows, caldera subsidence, shockwave, flank failure, earthquake, and lava processes (Latter, 1981; Paris 2015). The variety and potential combination of these mechanisms makes simulating volcanic tsunamis difficult.

Tsunami warning processes rely on a combination of water level observations (tide gauges and DART buoys) and pre-calculated earthquake-source forecast models (e.g. T2 tsunami database: Greenslade et al., 2009). However, existing tsunami forecast models cannot usually be applied to non-earthquake-generated tsunamis, as the generation mechanisms and propagation patterns vary depending on source type. In particular, the propagation patterns of volcanic tsunamis tend to be more symmetrical and dissipative, whereas earthquake tsunamis have longer wave periods and are more directional.

3.1 Overview of event

On Saturday 15th of January 2022, a trans-Pacific tsunami was generated by a major eruption of the Hunga Tonga-Hunga Ha'apai Volcano, which is located 65 km from the Tongan capital Nuku'alofa on the Tonga-Kermadec Arc (Figure 2). The eruption occurred at 15:10 AEDT and reports of tsunami waves in Tonga were received soon afterwards.

The Bureau of Meteorology initially issued a "No Threat Bulletin" for Australia. Approximately 3 hours after the eruption, a 0.5 m wave was recorded at Norfolk Island and a marine tsunami warning was issued for Norfolk Island and Lord Howe Island. This warning was upgraded to a land threat warning at around 21:00, as recorded waves exceeded 1 m. Tsunami waves were observed in New South Wales and Queensland at 20:10, and marine warnings were then issued for those jurisdictions. Marine warnings were extended to Victoria and Tasmania at 21:00, by which time tsunami waves were arriving at the coast.

Regardless of source, tsunami arrival times can be predicted based on water depth, as shown in Figure 2 for this event. However, the first tsunami waves arrived several hours sooner than predicted in Australia, which complicated the warning process. This pattern was replicated elsewhere around the Pacific. Post-event data analysis showed that the initial waves were the result of a meteotsunami generated by the eruption shockwave, which travelled through the air faster than the primary tsunami waves in the ocean (Somerville et al., 2022).

The volcanic nature of the tsunami meant that existing tsunami forecast models could not be used to predict propagation and distant threat, and warning systems were reliant on observational data to assess potential threat levels. As a consequence of these unusual circumstances, the potential for a far-field tsunami was not recognised until several hours after initial detection. The tsunami was also larger than anticipated, with impacts reaching further than expected for a volcanic-source tsunami. Impacts were widely recorded around the Pacific margin, with fatalities occurring as far away as Peru (Parra, 2022).

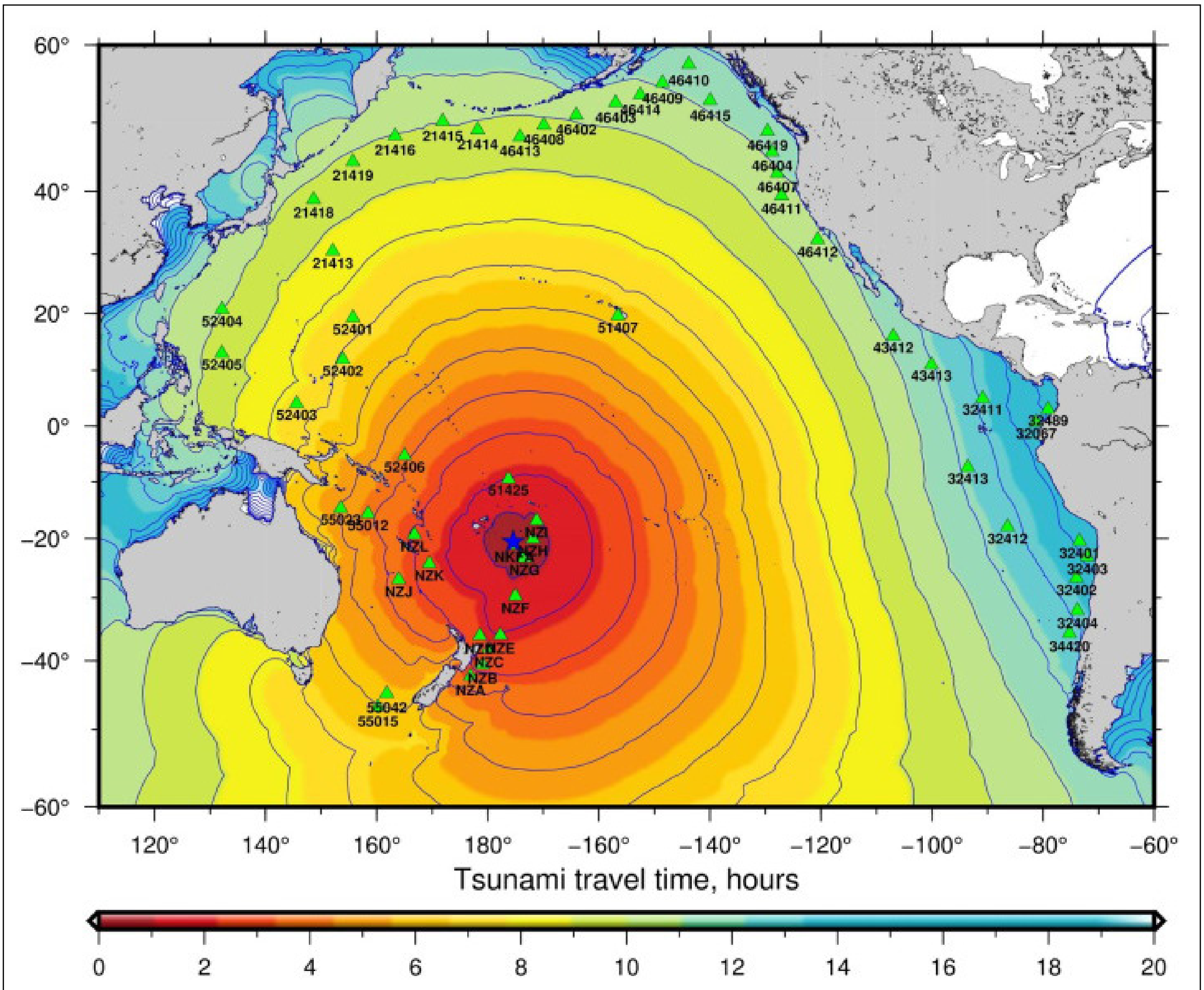

Figure 2. Theoretical Tonga tsunami (long wave) travel time in the Pacific Basin. The contour intervals for the travel time are 1 hour, DART stations represented by green triangles, the blue star shows the location of Hunga Tonga-Hunga Ha'apai volcano. Figure from GNS Science, Gusman & Roger (2022).

4.0 Impacts in Tasmania

4.1 Observations and timeline of events

Tasmania and Macquarie Island received a marine threat tsunami warning at 21:00 on the 15th of January, approximately 6 hours after the eruption of Hunga Tonga-Hunga Ha'apai. The first tsunami waves were observed at Spring Bay (Figure 3) at 21:06, and tsunami activity was recorded around the state throughout the 16th of January.

Observations and human experiences of tsunami activity were collated from social media posts, media publications and reports to SES, Tasmania Police and Surf Life Saving Australia. A public information request was also issued, seeking any images, videos or witness reports relating to the event.

Relatively few impacts were reported across Tasmania, although observations of water level oscillations were common along the East Coast. In particular, a surge of about half a metre was observed at Spring Bay by a member of the public, and the Maria Island ferry skipper noted that at 08:00 on the 16th of January the water level was going up and down by half a metre every 15 minutes. Repeated surges (up to 1 m) were also witnessed at Swansea at 07:00 on the 16th of January, with water levels oscillating every 10 minutes or so (Figure 3). Surf Life Saving Tasmania received reports of strong currents and flash rips, and some campers packed up their campsites and moved away from the coast. The location of these reports is not documented. Some inundation of immediate foreshore areas was reported, but the times and locations of these observations were unable to be verified. The tsunami impact around Coles Bay was limited, although locals reported some larger-than-usual swells that drew surfers to the beach (Chounding, 2022).

Figure 3. Tsunami observations at Swansea. Photographs taken 30 seconds apart at 7:00 am on 16 January, courtesy of Paul Myers-Allen.

Flinders Island experienced some impacts, particularly in the southeast of the island. Fishermen reported that large swells made it too dangerous to take boats out on the eastern side of the island and instead chose to fish to the west (Chounding, 2022). Observations of swells up to 7 m and significant damage to beaches was also reported by The Examiner (Chounding, 2022).

Few reports were received of tsunami impacts around Hobart and the Derwent Estuary, possibly because the largest waves arrived overnight (Table 1). However, a 0.5 m surge was witnessed at the Derwent Park Marina at 22:40 on the 15th of January. Tasmania Police stationed one of their emergency response vessels in the Derwent Estuary, but no tsunami impacts were witnessed and no requests for assistance were received.

Further south at Southport and Huonville, the tsunami waves were some of the largest recorded in Tasmania (see measurements in the following section). On the morning of the 16th of January, Marine and Safety Tasmania (MAST) reported that an aquaculture farm had sustained damage from the tsunami, leaving equipment and debris floating in the harbour (MAST, 2022). Local residents of Garden Island in Huonville reported that some children on paddle boards were pulled downstream by strong currents (Karen Palmer, pers. comm).

Tsunami waves were reported as far west as Burnie by The Examiner (Graham, 2022), but no impacts or observations were reported from Launceston or the Tamar Estuary. No impacts were felt on Macquarie Island, with a report of calm seas received at 09:30 on the 16th of January.

Table 1. Timeline of warnings and maximum non-tidal residual heights from Bureau of Meteorology (supplied).

Date	Time	Event
15 January	15:10	Eruption of Hunga Tonga–Hunga Ha'apai Volcano, causing a tsunami
	16:58	BoM issued a "No Threat Bulletin"
	21:00	BoM issued "Marine Threat Warning" for Tasmania and Macquarie Island
	21:06	Largest non-tidal residual for event recorded at Spring Bay (0.44 m)
	22:42	Report of 0.5 m surge in Derwent Park marina
16 January	00:13	Largest non-tidal residual for event recorded at Southport (0.59 m)
	04:40	Largest non-tidal residual for event recorded at Battery Point (0.29 m)
	07:09	Largest non-tidal residual for event recorded at Burnie (0.41 m)
	11:12	BoM cancelled tsunami warning for Macquarie Island
	11:50	BoM cancelled tsunami warning for Tasmania

4.2 Measurements

4.2.1 Water level station locations

Time series for the month of January 2022 were included from 15 water level stations distributed around Tasmania. These records are obtained from various station owners, as shown in Table 3. These represent the known sea level monitoring stations in Tasmania, except for the Devonport tide gauge on the north coast (TasPorts), Strahan tide gauge in Macquarie Harbour on the West Coast (Tassal), and Hobart tide gauge (TasPorts) - instead the nearby Battery Point tide gauge has been included (part of the BOM tsunami monitoring network). Temporary pressure-type water depth sensors deployed for a research collaboration between the University of Tasmania and SES were also included.

Water level observations of high frequency (between 6-15 minute intervals) were adjusted to the local observed time zone at the time of the tsunami event, Australian Eastern Daylight savings Time (AEDT). Water surface heights were offset to height relative to Australian Height Datum (TAS83). Note that all data are supplied in good faith, with permission, and may contain errors and omissions. Observations are stored by Geoscience Australia in the data repository linked with the Australian Scientific Response to the Tonga Tsunami.

4.2.2 Mean sea level pressure

Mean sea level pressure (MSLP) data indicate some of the pre-existing weather conditions influencing sea surface elevation before and after the volcanic explosion and the subsequent pressure shockwave and tsunami duration. The synoptic charts for mean sea level pressure over the Australian region are shown in Figure 5. The inverse barometer effect results in depressed sea surface height where there is higher than standard mean sea level pressure (1013.5 hPa) and elevated sea surface height where the is lower than standard mean sea level pressure. The low pressure barocline of 999-1003 hPa support conditions for elevated sea surface height of approximately 10-15 cm according to the rule of thumb of 1 cm/hPa difference.

Data from BOM weather stations (and a barometric pressure logger deployed by UTAS at Huonville) shown in

Figure 6 shows the distinct arrival of the initial pressure shockwave from the volcanic eruption. The first shockwave arrived at the east coast of Tasmania shortly after 19:00 on Saturday 15th of January. A second, smaller shockwave appears after 07:00 on Sunday 16th of January. The mean sea level pressure is lower than standard before the eruption and until Tuesday 18th of January, with pressure dropping below 1000 hPa by chance coinciding around the time of the eruption.

4.2.3 Coastal tide gauge observations

The arrival of the tsunami at the Tasmanian coast is visible by the increased oscillations in the residual water levels shown in Figure 7. The residual levels are calculated by the difference between the observed sea level and the predicted tide. The predicted tide was reconstructed from tidal analysis of each time series where there was at least 6 months data available. The residual includes all non-tidal anomalies, combining weather effects with tsunami effects. Tsunami wave properties varied noticeably around the Tasmanian coast. In Spring Bay, Battery Point, and Southport, residuals indicate that sea surface was elevated by around 20 cm prior to the tsunami arrival. Spring Bay and Southport tide gauges recorded the most significant tsunami effects at the coast.

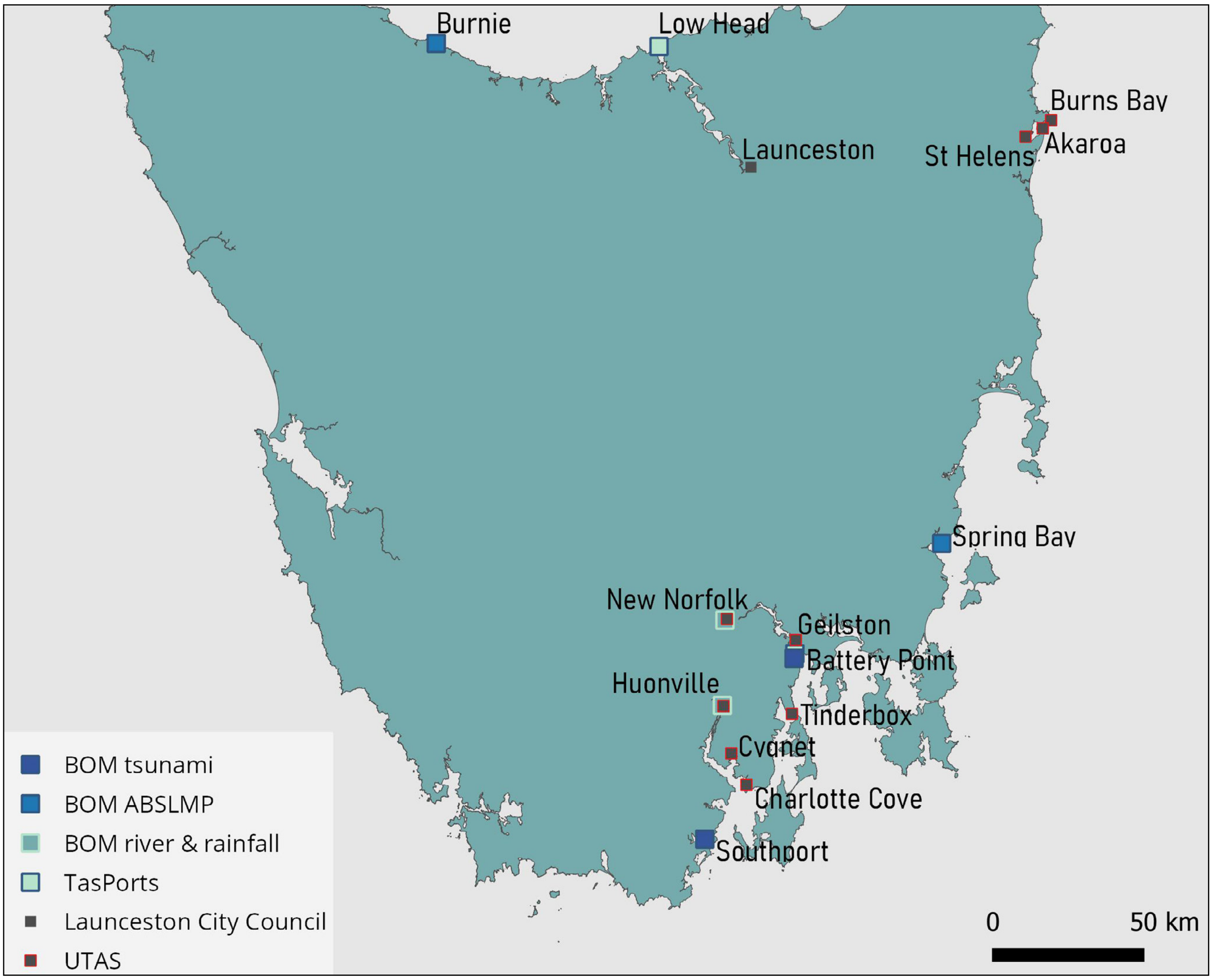

Figure 4. Water level station sites where 2022 tsunami effects in Tasmania have been assessed. The National Tidal Centre at the Bureau of Meteorology (BOM) supplied the data for BOM and TasPorts tide gauges. Launceston City Council supplied data for their monitoring station, and additional data were obtained from temporary research stations deployed for a study at the University of Tasmania (UTAS). Australian Statistical Geography Standard coastline shown (ABS, 2016) and Esri World Imagery ocean bathymetry.

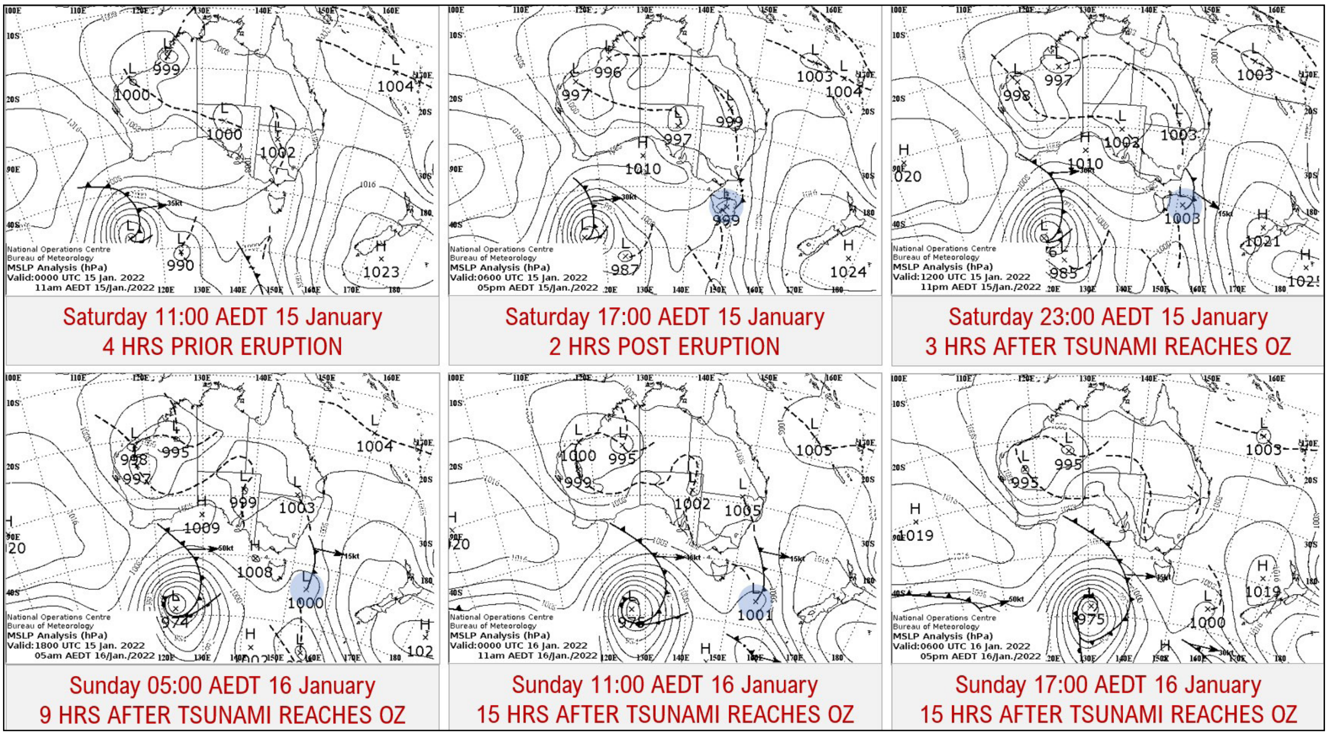

Figure 5. Synoptic charts for the mean sea level pressure conditions before and after the Tonga volcanic eruption on 15th of January 2022. A low pressure system evident (shaded blue) is associated with elevated sea surface heights around Tasmania at the time of tsunami arrival. Data from Bureau of Meteorology MSLP Analysis Chart Archive.

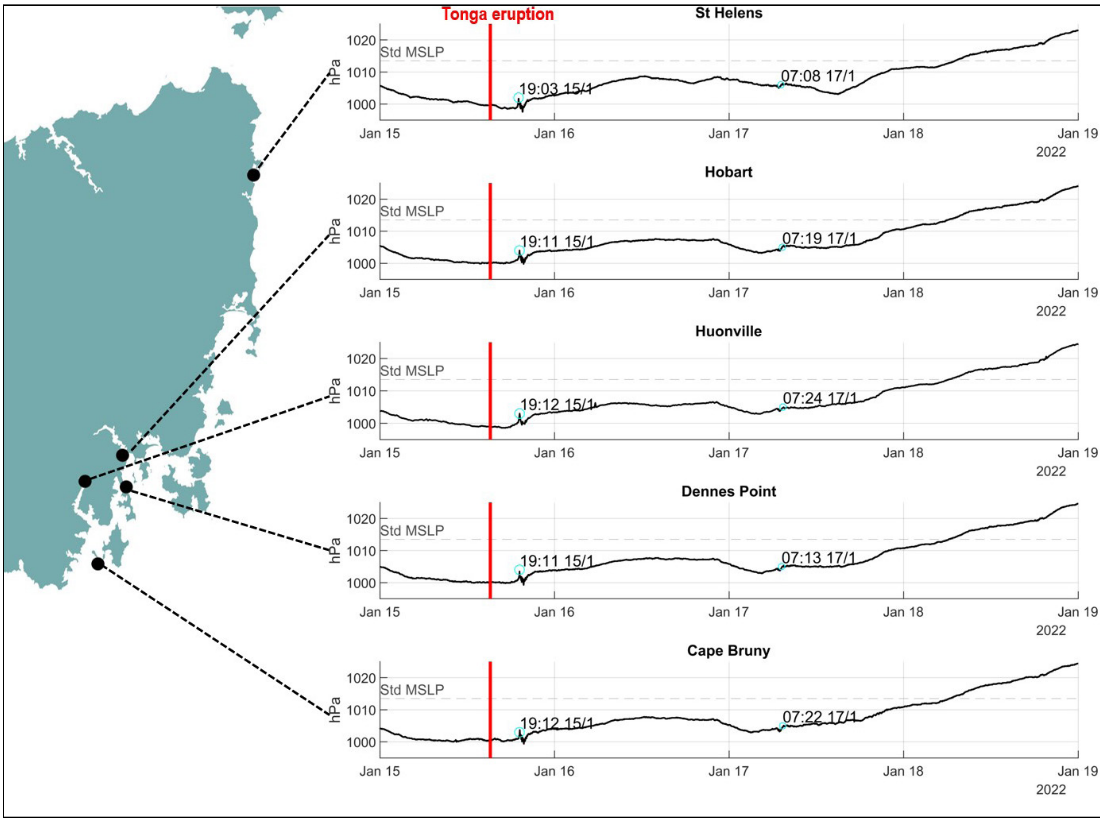

Figure 6. Atmospheric pressure shockwave arrival at the Tasmanian east coast on 15th of January 2022 (cyan circle). All data shown are from the Bureau of Meteorology except for Huonville, which are obtained from a pressure sensor installed for a study by UTAS. Standard International Pressure is shown by the dashed grey line at 1013.5 hPa.

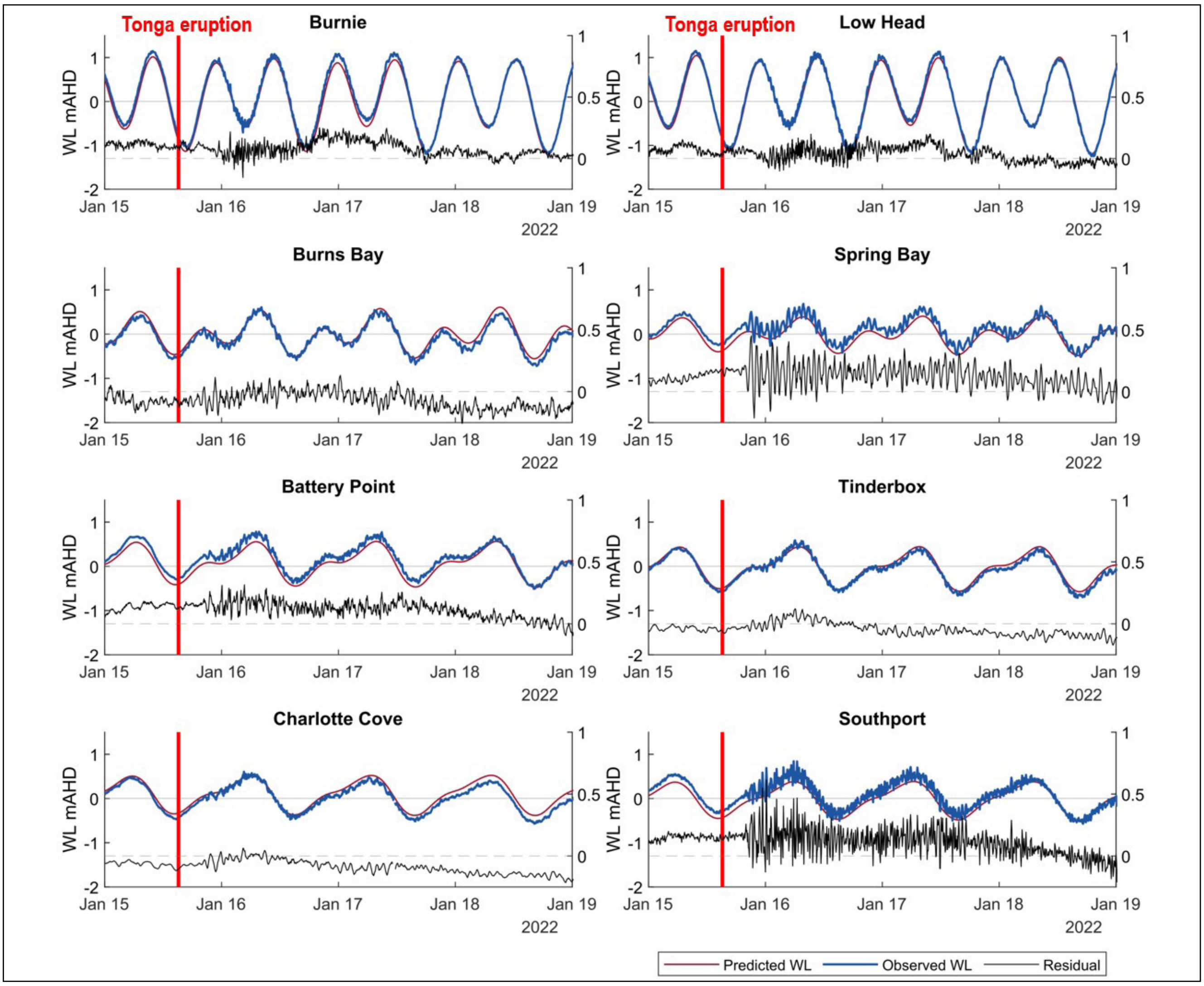

Figure 7. Coastal observed and residual sea level following the Tonga volcanic eruption at 15:10 on Saturday 15th of January 2022. Observed water levels (blue) appeared elevated above the predicted water level (red) prior to the tsunami arrival. The right y-axis shows the magnitude of residual levels (observed – predicted level).

The inverse barometer effect (mean sea level pressure anomaly) was removed from the residual levels to estimate the wave amplitude and period of the tsunami oscillations independent of weather conditions. This adjusted tsunami residual at the Tasmanian east coast is shown in Figure 8. The tsunami effects observed were largest at Spring Bay and Southport, with tsunami oscillations continuing for several days. The approximate timing of the tsunami arrival and the maximum height of the adjusted residual is highlighted, showing differences between the timing of the strongest effects and the maximum adjusted residual in some cases. Note that the adjusted tsunami residual maximums are smaller than the heights given by the Bureau of Meteorology (Table 1) due to the removal of the MSLP anomaly.

4.2.4 Propagation into estuaries

As waves propagate into estuaries they interact with shallow bathymetry and coastal landforms. The tidal propagation in four major Tasmanian estuaries is shown in Figure 9. The tsunami effects are reduced along the Tamar Estuary from Low Head to Launceston, and into Georges Bay from Burns Bay to St Helens. The Launceston record was too short to allow accurate tidal reconstruction, the apparent effects are minimal relative to the small effects at the Low Head tide gauge. Burns Bay adjusted residuals show some slight increase in wave amplitude, however no effects are seen in the St Helens adjusted residual.

In contrast to the Tamar and Georges Bay estuaries, tsunami effects were amplified in the Derwent and Huon Estuaries. The Derwent Estuary has its mouth near Tinderbox, north of Bruny Island (see Figure 4 for station locations). Minimal effects are noticeable in the Tinderbox record, oscillations are minor for the central Hobart mid-estuary zone, with the largest effects recorded some 56 km upstream at New Norfolk. Similarly, for the Huon Estuary minor effects are noticeable at the Charlotte Cove site near the mouth, with increased effects in the bay near Cygnet, and largest effects recorded 37 km upstream at Huonville.

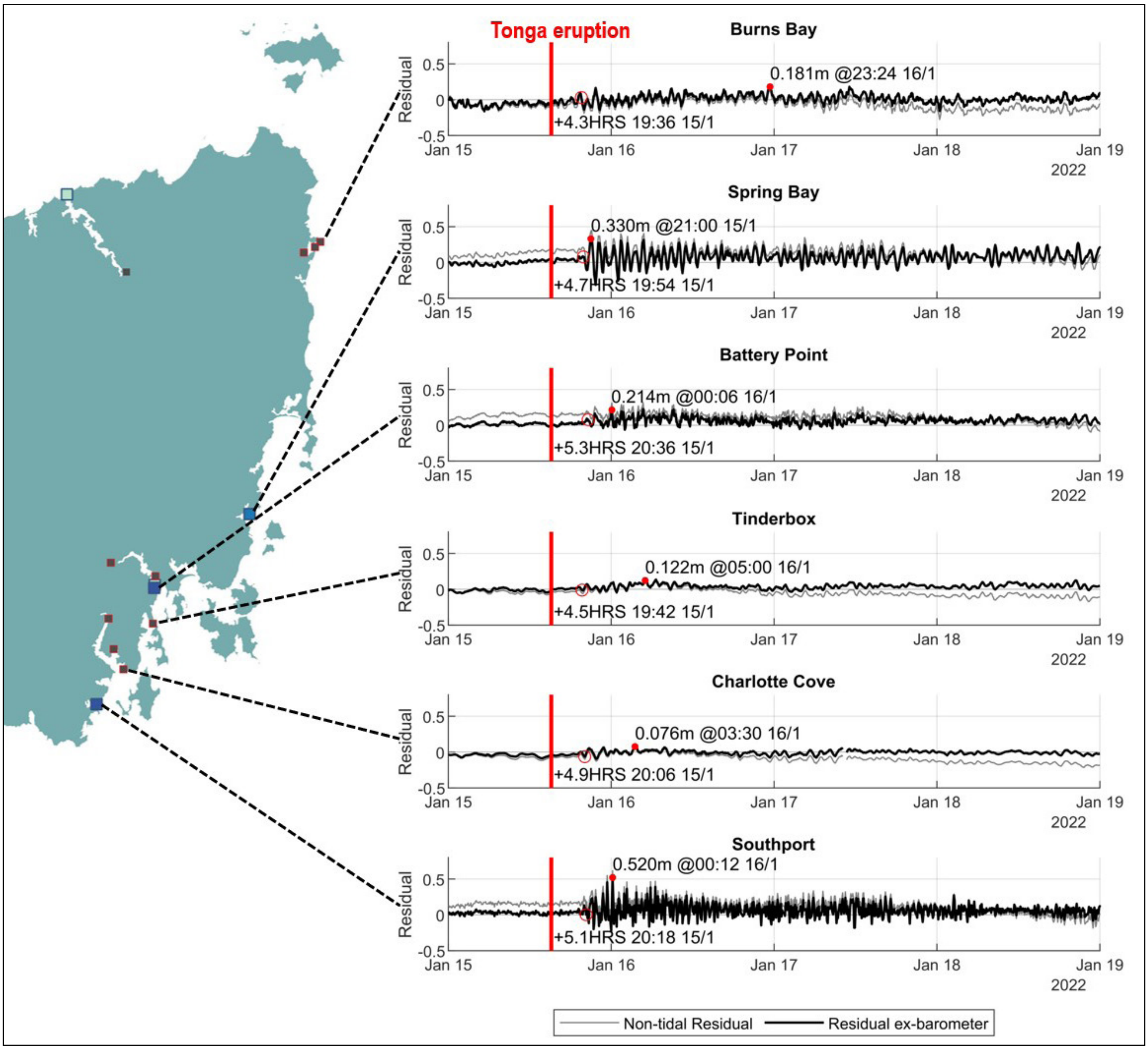

Figure 8. Tsunami effects at the Tasmanian east coast. The de-tided water level (non-tidal residual in grey) is shown compared to the adjusted tsunami residual (black) where the mean sea level pressure anomaly is removed.

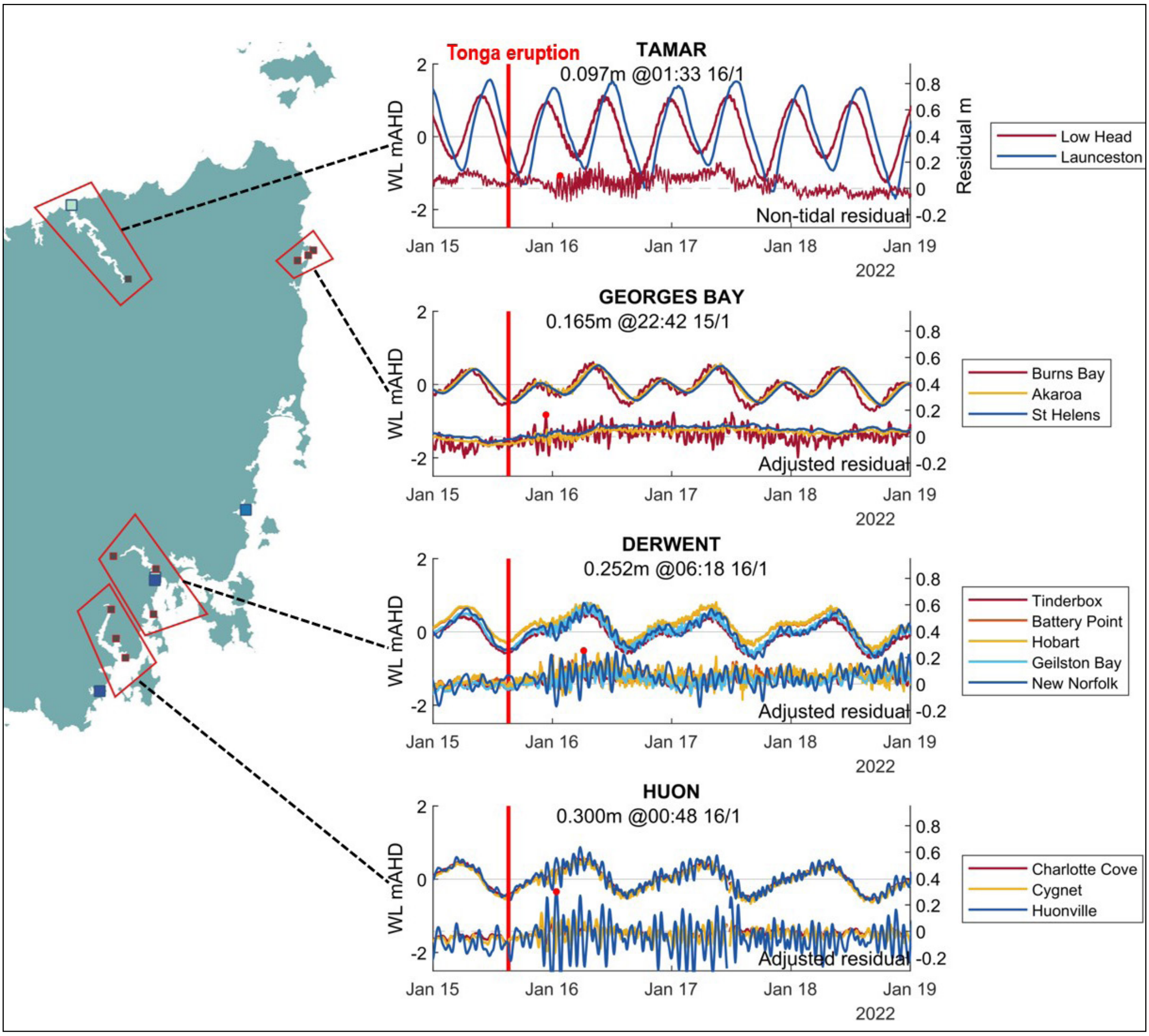

Figure 9. Tsunami effects in four major Tasmanian estuaries: Tamar, Georges Bay, Derwent, and Huon. Water levels (WL) in metres above Australian Height Datum (Tas1983), residual levels = height observed above the predicted tide level (right y-axis), with the maximum residual level shown by red circle.

4.2.5 Tsunami wave period and amplitude

To characterise the peak magnitude of the tsunami effects in Tasmania, continuous wavelet transforms of the adjusted residuals were undertaken. Scalograms illustrating these results are provided in the Appendix. The resulting tsunami wave properties for the most affected Tasmanian tide gauges are summarised in Table 2. The timing, wave amplitude, and wave period were determined from the maximum wavelet magnitude identified in the transformed adjusted residual. The period analysed was 72 hours beginning at 15:00 15th of January, the approximate eruption time.

The strongest tsunami effects were felt at the Southport site, with wave amplitude peaking at 52.0 cm. Wave period varied, with the first sites to record the effects showing wave periods of 68-73 minutes. Wave period slowed with distance along the Derwent Estuary but was constant for the three sites in the Huon Estuary. Wave period was much shorter (24 minutes) at Southport. Individual site characteristics such as water depth, refraction, and reflection at complex coasts and embayments, may have significant effects and so wave periods do not necessarily reflect tsunami properties beyond the immediate location of each monitoring site. Resonance within embayments and estuaries is indicated to have produced increased tsunami amplitudes.

Table 2. Tsunami wave properties around Tasmania, with Derwent Estuary (green) and Huon Estuary (blue) sites grouped.

Site	Time	Amplitude	Period (minutes)
Burns bay Spring Bay	15-Jan-2022 21:42 15-Jan-2022 21:06	16.5 34.8	73 68
Tinderbox Battery Point Geilston Bay New Norfolk	16-Jan-2022 00:18 16-Jan-2022 09:12 16-Jan-2022 09:12 15-Jan-2022 23:48	9.7 21.9 13.9 22.2	78 90 90 110
Charlotte Cove Cygnet Huonville	15-Jan-2022 22:54 15-Jan-2022 21:48 16-Jan-2022 00:48	6.4 13.9 30.0	103 103 103
Southport	16-Jan-2022 00:12	52.0	24

5.0 Emergency response

The emergency response was focused on monitoring tsunami observations and coastal conditions and providing beach and marine warnings where necessary. No large-scale response was required for a tsunami of this magnitude. However, the nature of the tsunami complicated predictions of magnitude and timing and meant that the response was observation-driven rather than based on tsunami model forecasts.

Tasmania Police and the State Emergency Service were monitoring the situation in conjunction with the Bureau of Meteorology, with coastal police and marine rescue units on standby to respond if necessary. Coastal police checked marinas for damage and a Tasmania Police vessel was stationed in the Derwent Estuary, but no calls for assistance were received. Surf Life Saving Tasmania (SLST) cancelled nippers for east coast clubs, and Bicheno SLC erected signs at beach entrances to warn beachgoers of potential tsunami waves, flash rips and strong currents.

The emergency response process ran smoothly, despite the earlier-than-predicted arrival of the first wave (generated by the atmospheric shockwave). A review of the response and specific agency actions have been documented in the Tasmanian Response Debrief Report (DPFEM, 2022).

6.0 Comparison with previous tsunamis

The tsunami was comparable in size to several other tsunamis that have affected Tasmania in recent decades (Table 3), including the 2007 and 2009 Puysegur Trench tsunamis at Spring Bay and Southport, respectively. Comparisons with published reports of the 2012 Puysegur tsunami and the 2004 Macquarie Island tsunami suggest that these events were smaller, but it is difficult to determine based on the amplitude at a single location.

The 2004 Sunda and 1960 Chile-Peru tsunamis were significantly larger than the Hunga Tonga-Hunga Ha'apai event at the locations evaluated, although this is not unexpected as these two events were very large by global standards. Interestingly, the 2011 Tōhoku-Oki tsunami showed a comparatively small signature in tide gauge records around Tasmania despite being an extremely large event. This is most likely due to the distance and direction of propagation, with Tasmania somewhat protected by mainland Australia and Indonesia.

Table 3. Comparison of wave amplitudes for historical tsunamis and the Hunga Tonga-Hunga Ha'apai tsunami.

Date	Source	Amplitude and location(s)	Comparable guage record(s) Jan 2022
Jan 2012	Puysegur Trench, Mw 6.2 earthquake	0.17 m, Southport	0.52 m, Southport
Mar 2011	Tōhoku-Oki, Mw 9.0 earthquake	0.23 m Spring Bay	0.33 m Spring Bay
		0.20 m Southport	0.52 m Southport
		0.10 m Battery Point	0.21 m Battery Point
Jul 2009	Puysegur Trench, Mw 7.9 earthquake	0.12 m Spring Bay	0.33 m, Spring Bay
		0.55 m Southport	0.52 m, Southport
Sep 2007	Puysegur Trench, Mw 6.4 earthquake	0.35 m Spring Bay	0.33 m Spring Bay
Dec 2004	Sunda Trench, Mw 9.0 earthquake	0.6 m Spring Bay	0.33 m Spring Bay
Dec 2004	Macquarie Island, Mw 8.1 earthquake	0.15 m Spring Bay	0.33 m Spring Bay
May 1960	Chile-Peru Trench, Mw 9.5 earthquake	0.46 m, Hobart	0.21 m Battery Point

7.0 Conclusions

The Hunga Tonga-Hunga Ha'apai tsunami was widely recorded around Tasmania on the 15th and 16th of January 2022. The largest wave amplitudes, isolated from the tide and weather conditions, were felt at Southport (0.52 m), Spring Bay (0.35 m), and Huonville (0.3 m). Reported impacts included visible water level oscillations, strong currents, and damage to fish farming equipment. No significant inundation of coastal areas was observed, with impacts limited to marina and beach settings. The tsunami was larger than expected and was comparable in size to the 2007 and 2009 Puysegur tsunamis.

The tsunami waves were largest between 6-10 hours following the volcanic eruption, with maximum magnitude occurring between 21:00 on the 15th and 01:00 on the 16th of January. The highest tsunami wave amplitudes coincided with an ebbing or incoming tide rather than a high tide peak, such that tide timing reduced the potential for water level exceedances. The tsunami also coincided with lower than average barometric pressure conditions which elevated sea surface levels, providing meteorological conditions which increased the potential for water level exceedances. These external influences (tides and meteorological conditions) together with mean sea level, which has risen since past tsunami events, are all influential factors for tsunami threat. Considering and monitoring these factors is therefore valuable for predicting tsunami threats and managing coastal risk.

The volcanic mechanism of this tsunami and meteotsunami generated by the atmospheric shockwave made predictions difficult, with the first waves arriving at Tasmanian shores as the marine warning was issued. Only four tide gauges were capable of providing real-time monitoring of water levels and in many coastal locations there are no instrumental observations. The locations of real-time monitoring gauges at the coast provided information about the tsunami arrival, but some significant effects, such as hazardous currents and amplification of tsunami waves in some estuaries, are only observable by post-event analysis and eyewitness accounts. Much of the instrumental observations – nine gauges – were obtained from temporary tide research installations.

The authors recommend that improvements in the distribution and coverage of permanent water level monitoring gauges would greatly assist with the management and modelling of future coastal threats, including tsunamis, and post-event analysis. Additionally, increasing the accessibility of real-time observational data would help with tsunami detection and operational emergency processes. The inclusion of tidal predictions and weather conditions with expected tsunami arrival time and magnitude would also be valuable, together with clear definitions of measurements and terminology.

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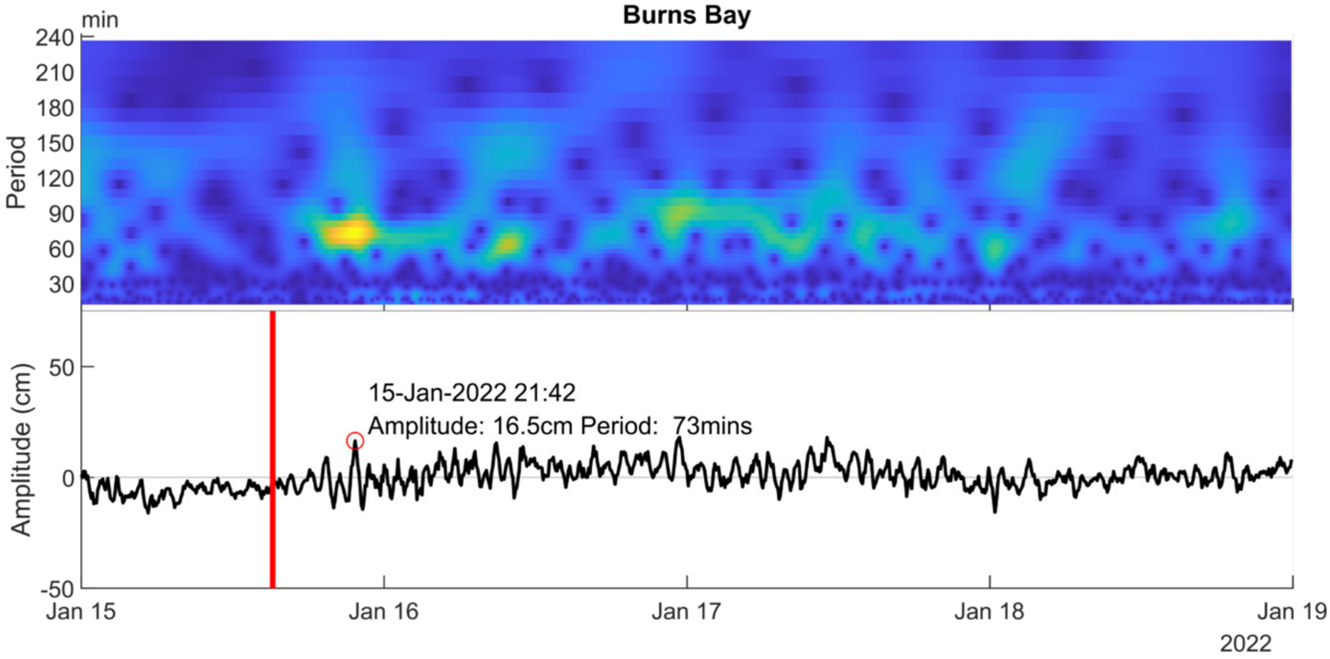
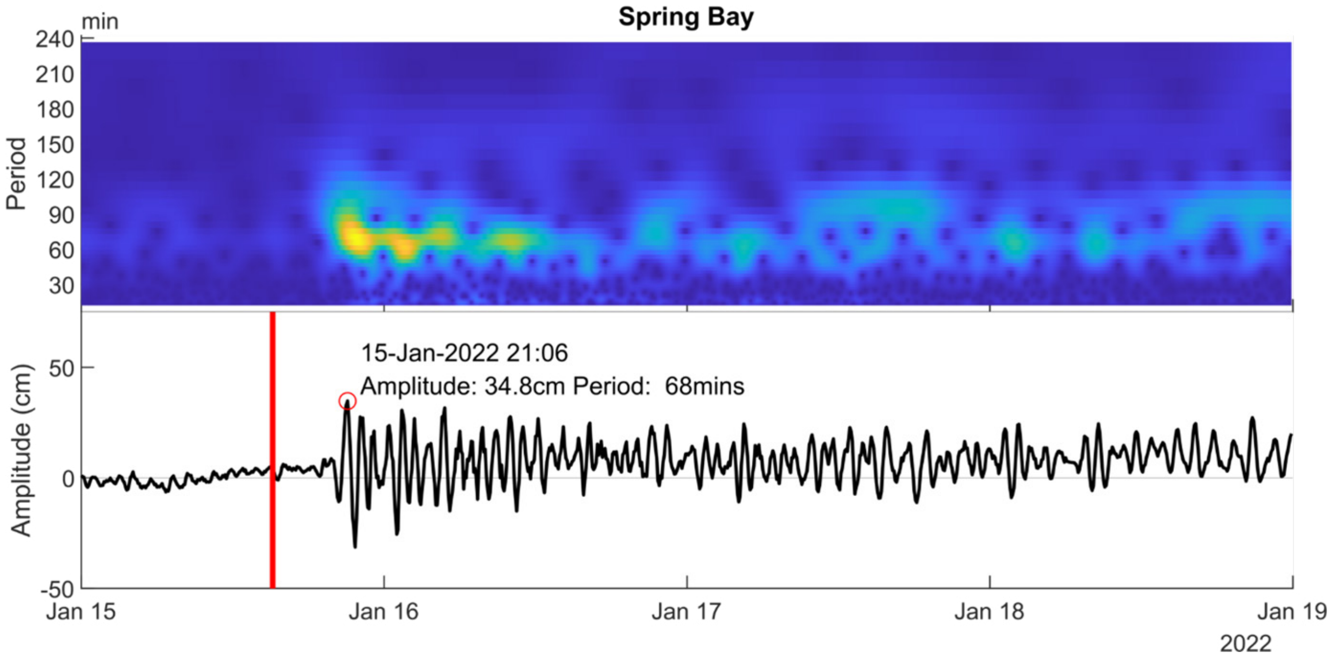
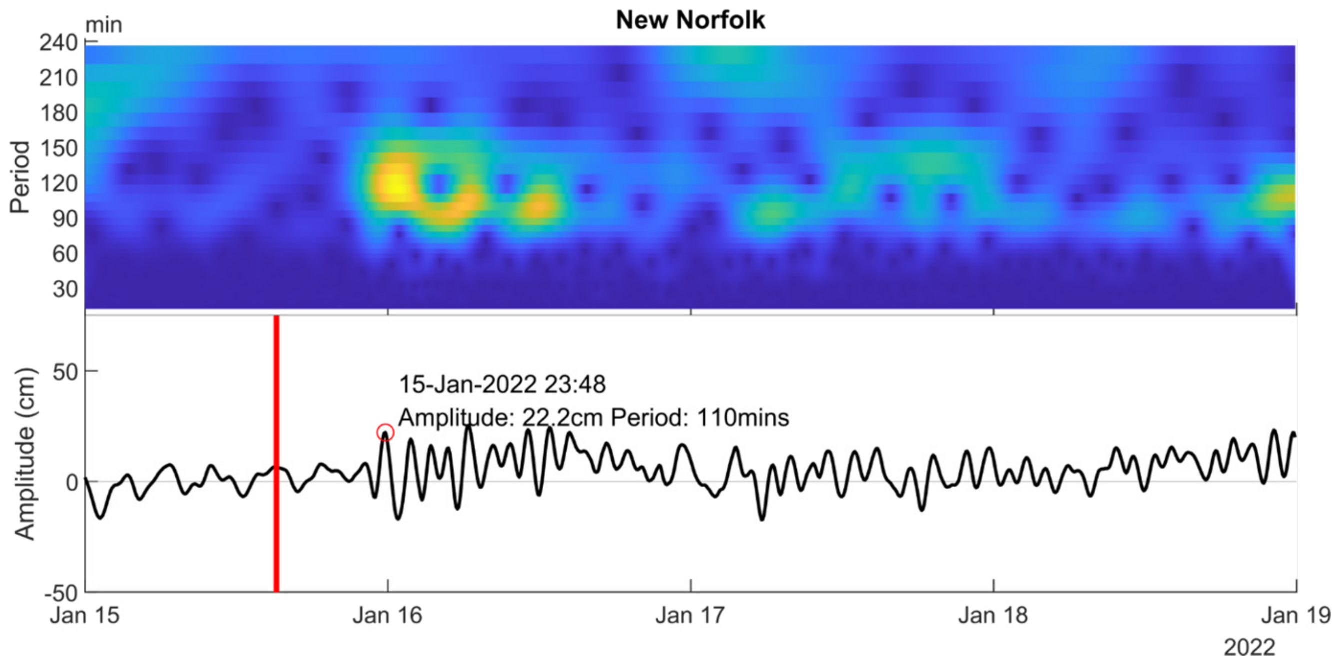
Appendix

Continuous wavelet transform analyses

Continuous 1-D wavelet transforms are plotted in the time-period domain, the colour ramp is shaded from blue (low) to yellow (high) on a normalised spectrum indicating wave magnitude (similar to wave amplitude but not equivalent). Thus, scalograms are not directly comparable but are shaded according to the range of values calculated at each site. Under each scalogram is the time series for the adjusted residual wavelet analysed, which is the de-tided signal with the mean sea level pressure anomaly subtracted. This adjusted residual is proxy for the isolated tsunami residual, however other non-tidal effects are likely to remain, including seiches and meteorological influences.



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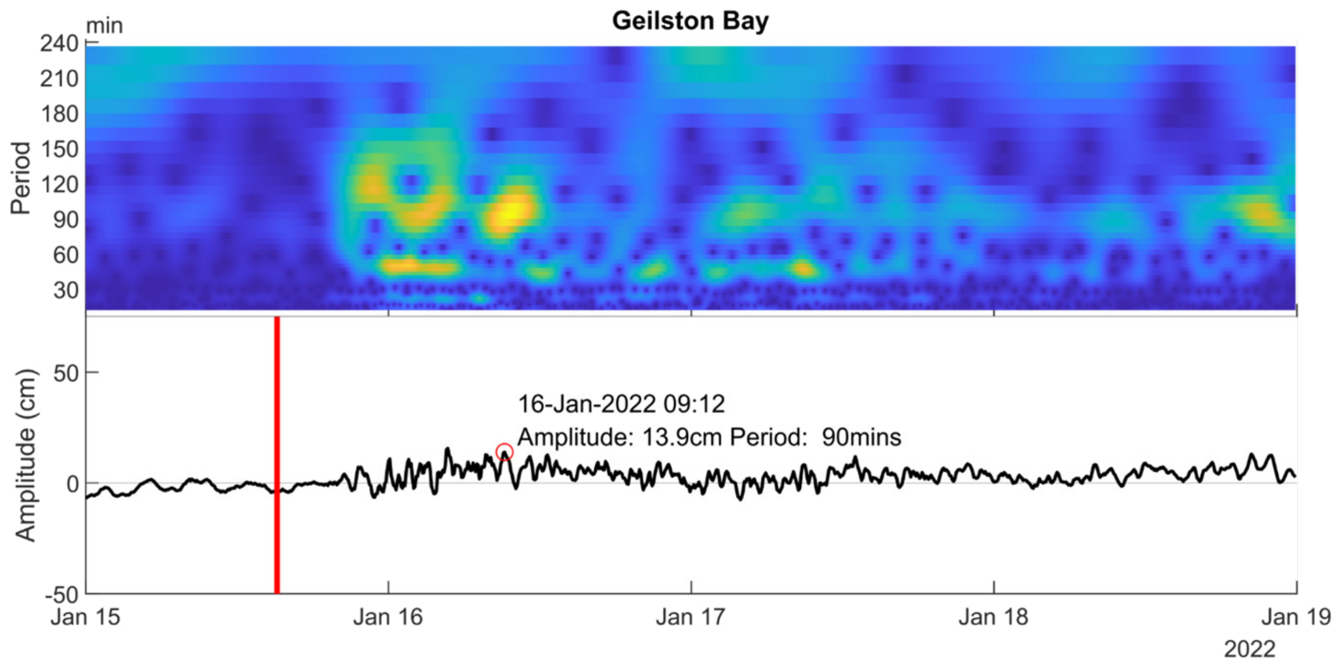
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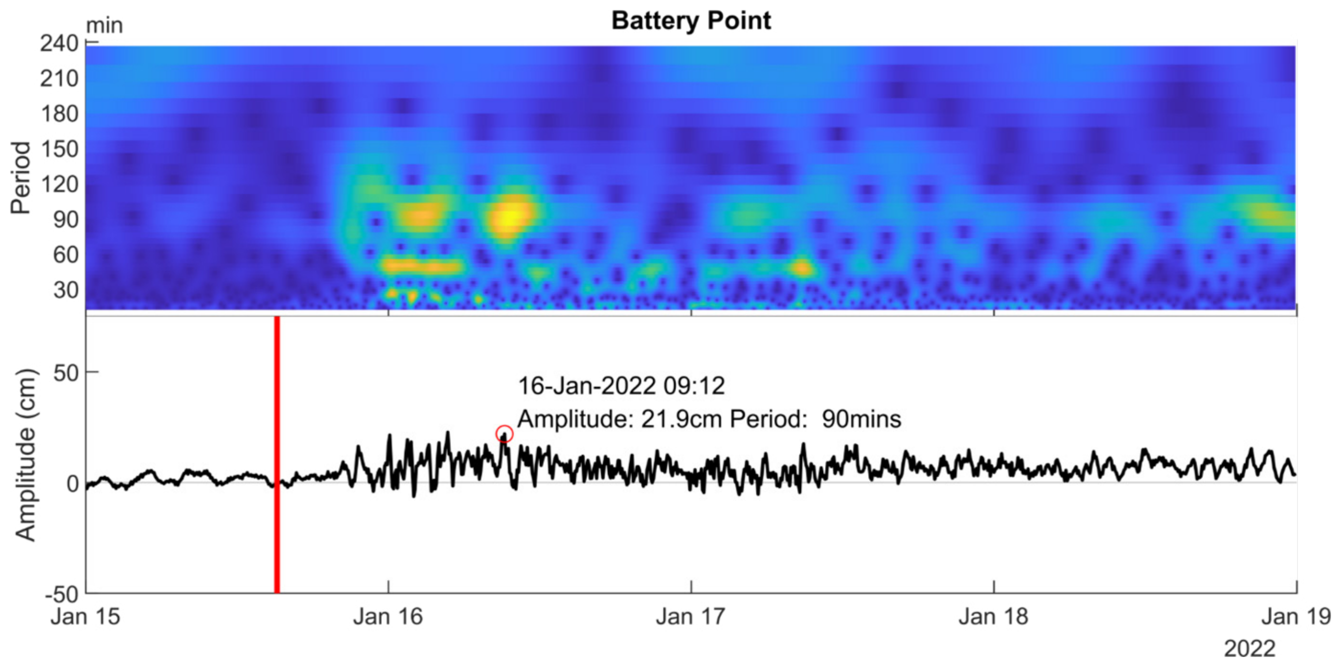
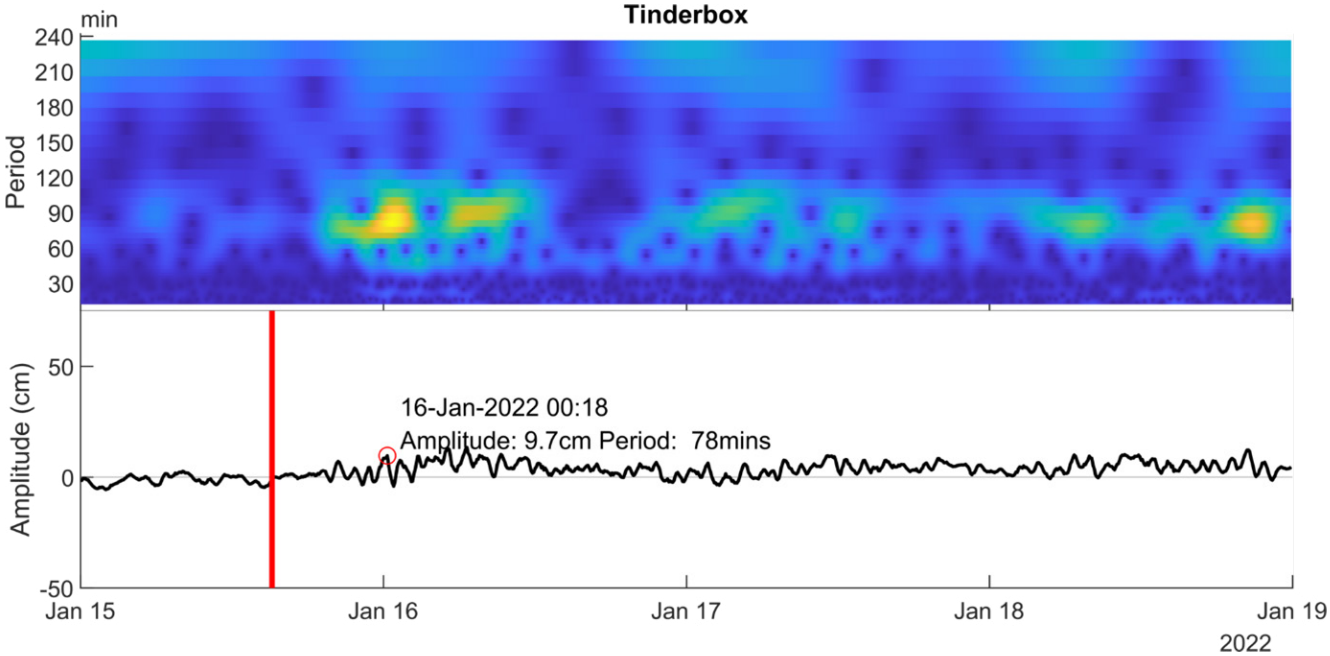
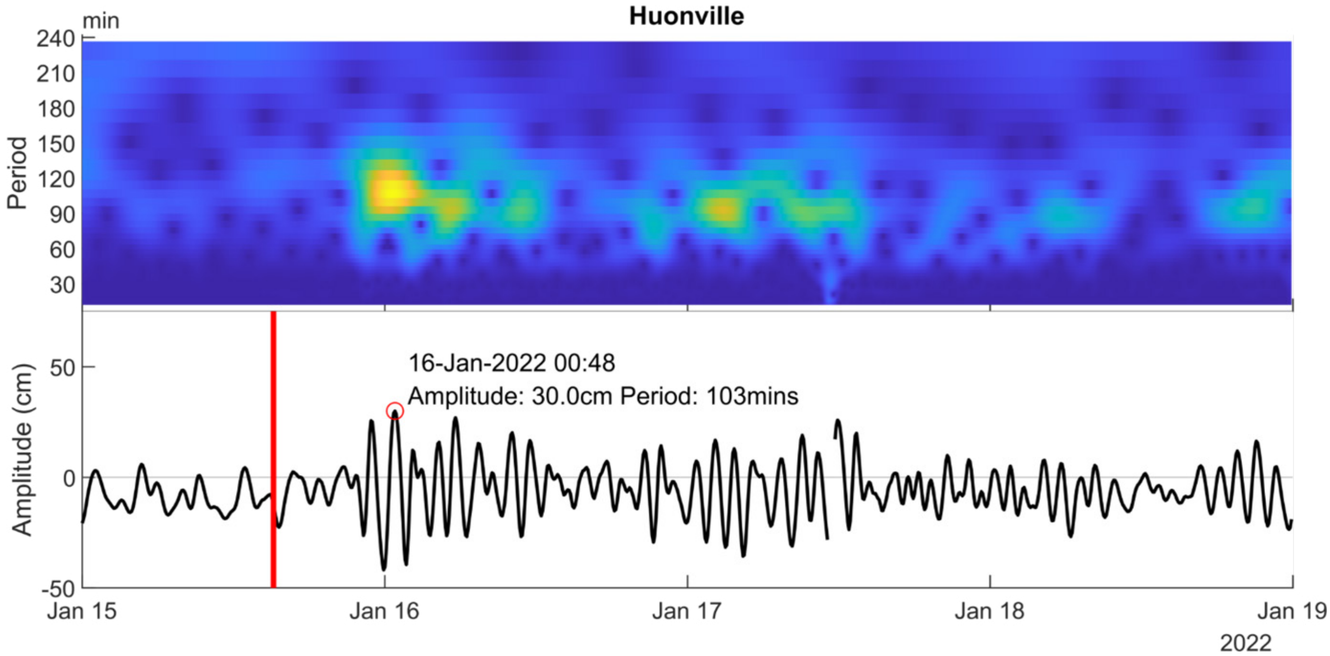
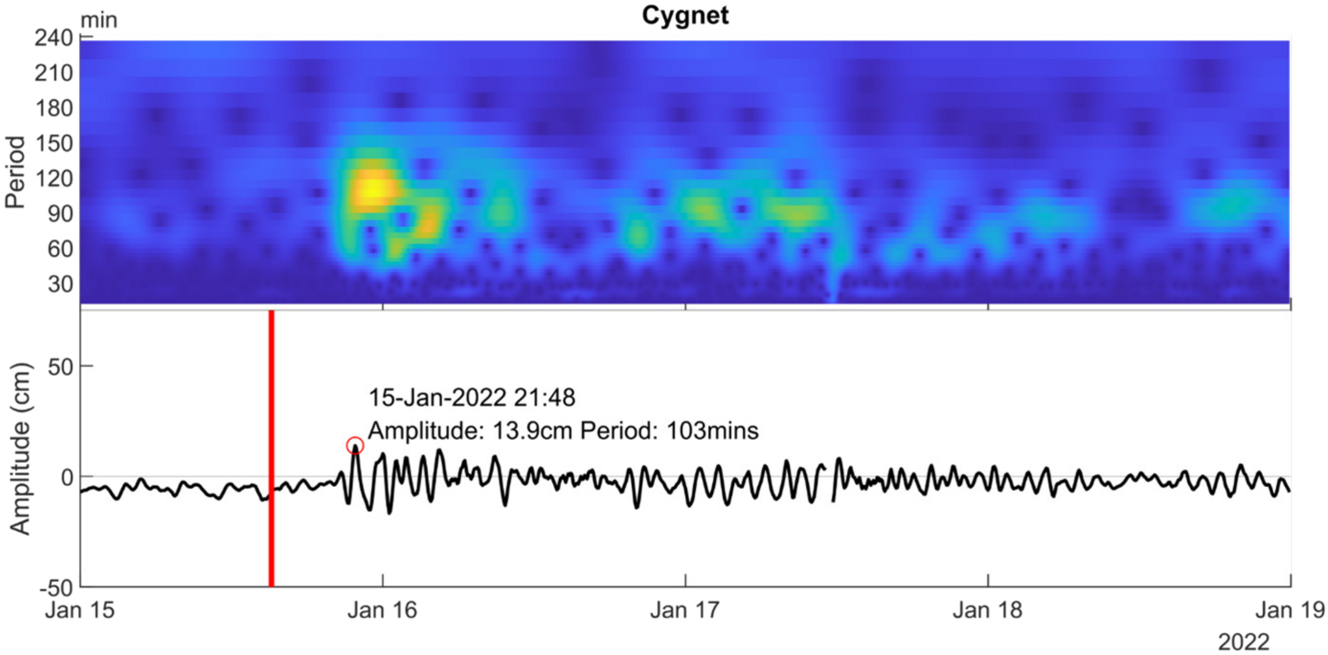
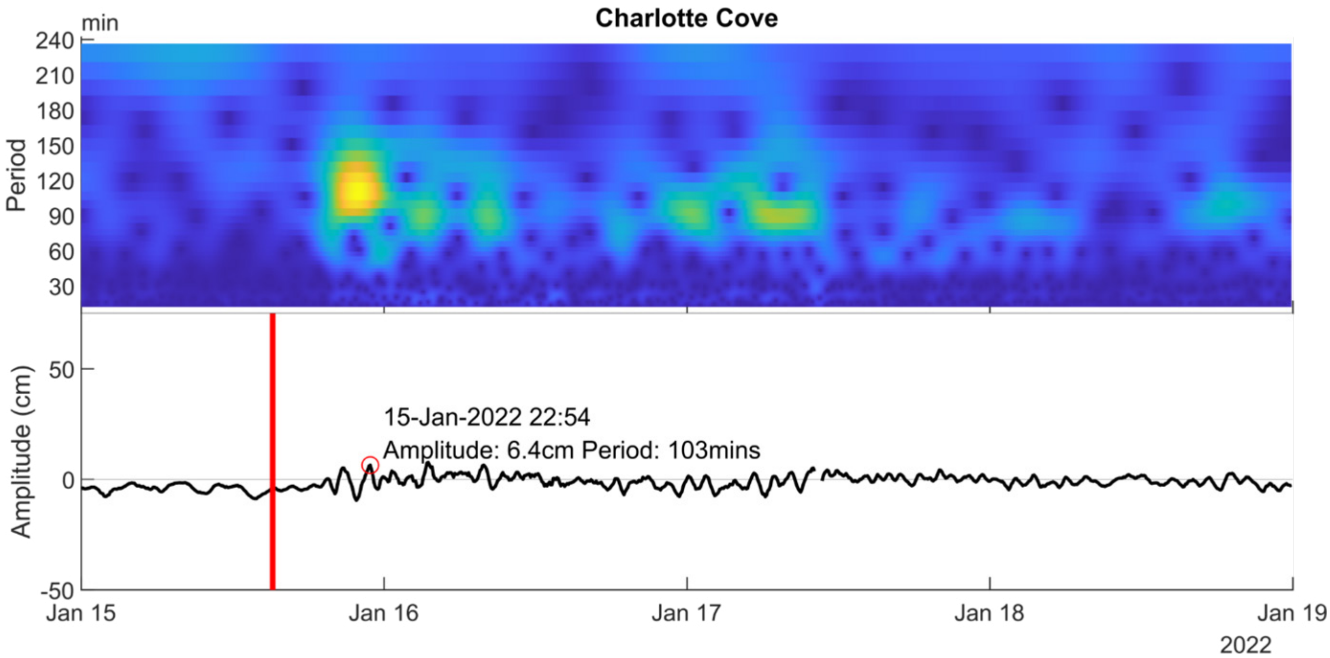
Jan 19
2022

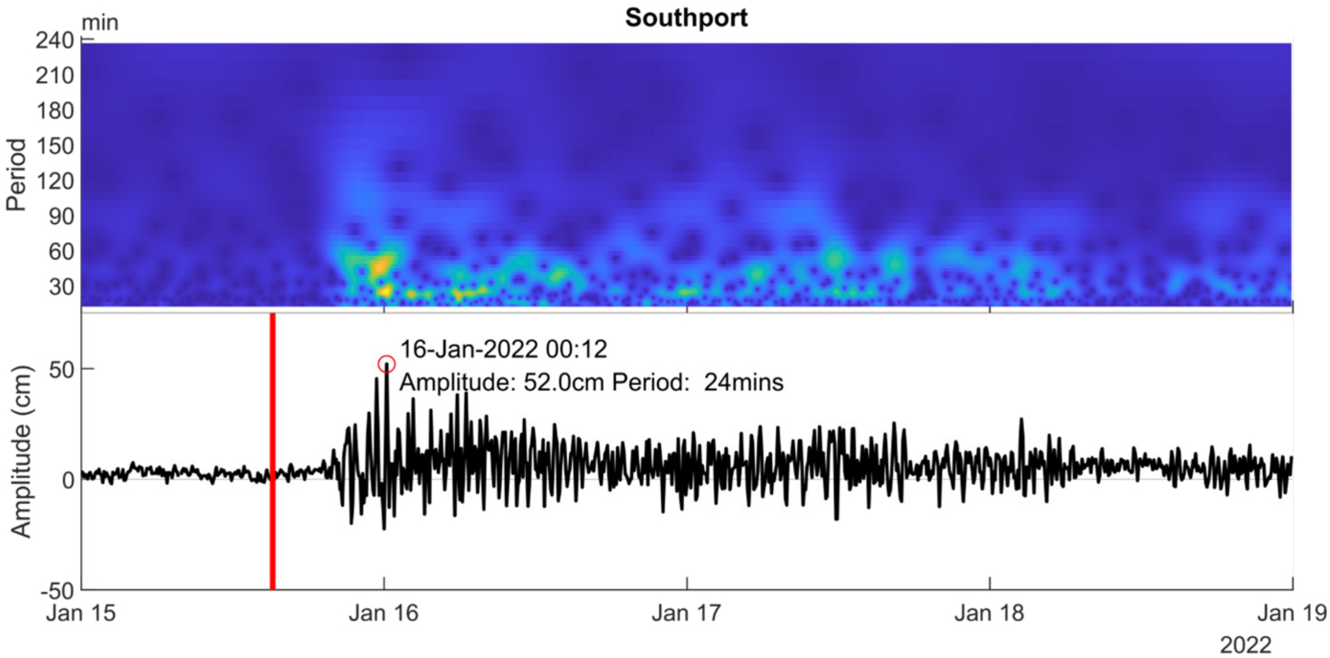

Battery Point
min
Period
Amplitude (cm)
16-Jan-2022 09:12
Amplitude: 21.9cm Period: 90mins
Jan 15
Jan 16
Jan 17
Jan 18
Jan 19
2022


Tinderbox
min
240
210
180
150
120
90
60
30
Period
Amplitude (cm)
50
0
-50
16-Jan-2022 00:18
Amplitude: 9.7cm Period: 78mins
Jan 15
Jan 16
Jan 17
Jan 18
Jan 19
2022


Huonville
min
240
210
180
150
120
90
60
30
Period
Amplitude (cm)
50
0
-50
16-Jan-2022 00:48
Amplitude: 30.0cm Period: 103mins
Jan 15
Jan 16
Jan 17
Jan 18
Jan 19
2022


Cygnet
min
240
210
180
150
120
90
60
30
Period
Amplitude (cm)
50
0
-50
15-Jan-2022 21:48
Amplitude: 13.9cm Period: 103mins
Jan 15
Jan 16
Jan 17
Jan 18
Jan 19
2022


Charlotte Cove
min
Period
Amplitude (cm)
15-Jan-2022 22:54
Amplitude: 6.4cm Period: 103mins
Jan 15
Jan 16
Jan 17
Jan 18
Jan 19
2022


Southport
min
Period
Amplitude (cm)
16-Jan-2022 00:12
Amplitude: 52.0cm Period: 24mins
Jan 15
Jan 16
Jan 17
Jan 18
Jan 19
2022

Tasmanian
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