

TONGA METEOROLOGICAL SERVICES

MULTI-HAZARD EARLY WARNING TIMELINE SUMMARY REPORT ON THE VOLCANIC ERUPTION AND TSUNAMI EVENT, OPERATIONS AND RESPONSE

(14th – 17th January 2021)

Date/Local Time	Response Operations	Remarks
14 th January 2022 10:30 – 10:50am	Received observations from Mango Town officer, Marine and Ports officer and Fono resident about the abnormal tides experienced in their respective shore lines	Updated the Director of TMS and discussion the issuing of the relevant warning
14 th January 2022 11:12am	Issued Tsunami Marine Warning No.1 for Tonga (Tongan and English versions). Tsunami operation continued and direct live on-air briefings were being made from the Tsunami Warning Centre on radio Tonga to the people.	Refer to Annex 1 of this report
14 th January 2022 03:26pm	Tsunami Marine Warning for Tonga No. 2 (Tongan and English versions). Tsunami operation continued and direct live on-air briefings were being made from the Tsunami Warning Centre on radio Tonga to the people.	Refer to Annex 2 of this report
14 th January 2022 06:22pm	Cancelled Tsunami Marine Warning No. 1 for: <ul style="list-style-type: none">• Niuafu'ou• Niuatoputapu• Vava'u• Kuvai Ha'ano District, Ha'apai• Pangai Lifuka District• Ha'apai Lulunga District	Refer to Annex 3 of this report
14 th January 2022 10:00pm	Tsunami Marine Warning for Tonga No. 3 (Tongan and English versions) for: <ul style="list-style-type: none">• 'Otumu'omu'a Group• Tongatapu• 'Atataa• 'Eueiki• 'Eua	Refer to Annex 4 of this report

	Tsunami operation continued and direct live on-air briefings were being made from the Tsunami Warning Centre on radio Tonga to the people.	
15 th January 2022 01:00am	<p>Tsunami Marine Warning for Tonga No. 4 (Tongan and English versions) for:</p> <ul style="list-style-type: none"> • 'Otumu'omu'a Group • Tongatapu • 'Atataa • 'Eueiki • 'Eua <p>Tsunami operation continued and direct live on-air briefings were being made from the Tsunami Warning Centre on Radio Tonga (AM Radio) to the people.</p>	Refer to Annex 5 of this report
15 th January 2022 04:00am	<p>Tsunami Marine Warning for Tonga No. 5 (Tongan and English versions) for:</p> <ul style="list-style-type: none"> • 'Otumu'omu'a Group • Tongatapu • 'Atataa • 'Eueiki • 'Eua <p>Tsunami operation continued and direct live on-air briefings were being made from the Tsunami Warning Centre on Radio A3Z to the people.</p>	Refer to Annex 6 of this report
15 th January 2022 07:00am	<p>Tsunami Marine Warning for Tonga No. 6 (Tongan and English versions) for:</p> <ul style="list-style-type: none"> • 'Otumu'omu'a Group • Tongatapu • 'Atataa • 'Eueiki • 'Eua <p>Tsunami operation continued and direct live on-air briefings were being made from the Tsunami Warning Centre on Radio A3Z to the people.</p>	Refer to Annex 7 of this report

15 th January 2022 10:00am	<p>Cancellation of Tsunami Marine Warning for Tonga (Tongan and English versions) for:</p> <ul style="list-style-type: none"> • 'Otumu'omu'a Group • Tongatapu • 'Atataa • 'Eueiki • 'Eua <p>Due to consistent reductions in the wave amplitude measured from sea level gauges in TBU/Vv/NTT getting lower than 10cm and the reduction in the volcano activity</p>	Refer to Annex 8 of this report
15 th January 2022 5:13pm – 5:16pm	<p>First sighting of the development of volcanic ash mushroom cloud from the Fua'amotu MET Office observation site.</p> <p>Duty officers immediately called the Tonga Geological Services via VHF radio and reported the sighting of this volcanic clouds.</p>	Duty Officers: Selusalema Vite and Sitamipa Paea
15 th January 2022 5:21pm	Extremely loud volcanic blast and acoustic shock wave observe and experienced on the ground.	Director Instructs Officers on Duty via phone call to issue and Urgent Tsunami Warnings advising people to move inland based on the magnitude of the blast and his observations of a mass sea birds coming inland from the NW direction.
15 th January 2022 5:30pm or there about	Duty Officers issue a direct verbal Urgent Tsunami Warning Message on AM Radio after some difficulty in breaking through a congested phoneline to Radio Tonga (A3Z)	This warning was repeated a several times by both the Duty Officers and AM Radio announcer for people to evacuate inland. Director Arrives in Office between 5:35 and 5:40pm.

15 th January 2022 5:45pm to 1:48am on 16 th	Issued 1st Tsunami Warning Bulletin (written) for Tonga (Tongan and English versions) . Tsunami operation continued and direct live on-air briefings were being made from the Tsunami Warning Centre on radio Tonga to the people.	Discussion with Volcanic Ash Advisory Centre (Wellington, NZ) were carried out at every 2 to 3 hours discussing the status of the eruption, ash intensity, coverage and height over the Tonga areas. Refer to Annex 9 of this report
15 th January 2022 6:30pm	Last observation received from the Nuku'alofa tide gauge. Last internet connection received at the Tonga MET Office.	Nuku'alofa tide gauge was online at 2pm, 17 th Jan 2022 as it was confirmed from Jeff (BOM) that they can view tide gauge reading from Australia but cannot access information from Tonga MET due to internet connection failure.
16 th January 2022 1:48am	Downgraded Tsunami Warning for Tonga to Tsunami Marine Warning for Tonga based on direct ocean observations from the Director of Geology and discussion with Tonga Geological Unit. Constant radio briefings on air were carried out via radio to the people of Tonga.	Discussion with Volcanic Ash Advisory Centre (Wellington, NZ) were carried out at every 2 to 3 hours discussing the status of the eruption, ash intensity, coverage and height over the Tonga areas. Refer to annex 10 of this report
16 th January 2022 11:00am	Director of Meteorology briefing to NEMC	Presenter: 'Ofa Fa'anunu
17 th January 2022 10:00am	Cancelled Tsunami Marine Warning for: <ul style="list-style-type: none"> • Niuafo'ou • Niuatoputapu • Vava'u • Kuvai Ha'ano District, Ha'apai • Pangai Lifuka District • Ha'apai Lulunga District Tsunami Marine Warning remained in-force for: <ul style="list-style-type: none"> • 'Otumu'omu'a Group Cancellation template	

	<p>was not send via email to the distribution list because of internet disconnection.</p> <ul style="list-style-type: none"> • Tongatapu • 'Atataa • 'Eueiki • 'Eua 	
17 th January 2022 11:00am	<p>First direct contact from Tonga to Ha'apai in regard to initial damage assessment and reports from Ha'apai based on the volcanic eruption and tsunami wave event.</p> <p>Mode of communication was through channel 5832kHz between Tonga MET Services, Tonga Airport Limited Tower and Tonga Airport Limited Tower (Lifuka)</p>	Deputy Director of TMS made first contact and then reported to Director of TMS and NEMC
17 th January 2022 01:00pm	<p>Cancelled Tsunami Marine Warning for:</p> <ul style="list-style-type: none"> • 'Otumu'omu'a Group • Tongatapu • 'Atataa • 'Eueiki • 'Eua 	Cancellation template was verbal not send via email to the distribution list because of internet disconnection.
17 th January 2022 02:30pm	<p>First direct contact from Tonga to Vava'u in regard to initial damage assessment and reports from Vava'u based on the volcanic eruption and tsunami wave event.</p> <p>Mode of communication was through channel 5832kHz between Tonga MET Services, Tonga Airport Limited Tower and Tonga Airport Limited Tower (Vava'u)</p>	Deputy Director of TMS made first contact and then reported to Director of TMS and NEMC

TONGA TSUNAMI WARNING CENTRE REPORT

"HUNGA TONGA/HUNGA HA'APAI VOLCANIC ERUPTION TRIGGERED TSUNAMI EVENTS ON 14TH and 15TH OF JANUARY 2022"

Introductory Summary

This meteorological report covers the Hunga Tonga/Hunga Ha'apai volcanic eruption activity that generated the tsunami event and all related tsunami warnings during the time period 14th to 17th January 2022.

It was noted and observed that there were two separate events that had resulted in the various tsunami warnings that was issued from the National Tsunami Warning Centre (Tonga MET).

- Event #1: 14th January 2022
- Event #2: 15th January 2022

The National Tsunami Warning Centre (Tonga MET), responded to both the above-mentioned events with key support agencies the Geological Department and the National Emergency Management Office (NEMO) . In addition, to the regional and international collaborations with the Volcanic Ash Advisory Centre (VAAC), Wellington, New Zealand, the Pacific Tsunami Warning Centre (PTWC), Hawaii and discussions via email with experts in the tsunami working group in the region and international platform.

The National Tsunami Warning Centre (Tonga MET), experienced operational challenges during its response, especially event #2 where communications both international and domestic were affected.

In general, despite the set backs encountered during the response to both events the National Tsunami Warning Centre (Tonga MET) managed to successfully provide the warnings to the public.

Meteorological Observations and Discussions.

Event #1: 14th January 2022

On the morning of Friday 14th January 2022, a moderate to strong sulphuric odour was detected by many in the air between 7am and to 8am throughout Tongatapu. This strange odour was confirmed to be originating from the volcano. One of the important factors that this report presents is the contributions of the surface to upper level winds over the Group that had supported the drifting of the sulphur smell to the south over Tongatapu, nearby islands of Nuku'alofa and 'Eua.

Reports from the town officer and locals of Fonoi island that they have experienced rain-like ash falling from the sky this morning from the nearby Hunga Tonga/Hunga Ha'apai eruption.

Direct observations of the volcanic ash clouds were also observed on board the MV. 'Otuanga'ofa Inter-Island Ferry and was reported over facebook messenger from of the assistant forecasters, Mr. Uatahausi at around 8am local time.

At 11:12am, Friday 14th January the National Tsunami Warning Centre issued the first Tsunami Marine Warning (refer to annex 1) after a report of erratic tides coming in and going out at Mango Island by the Town Officer of Mango Island in Ha'apai and subsequent tide gauge data. Based on the tide gauge observation readings shown below, a maximum tsunami wave of 30cm was recorded.

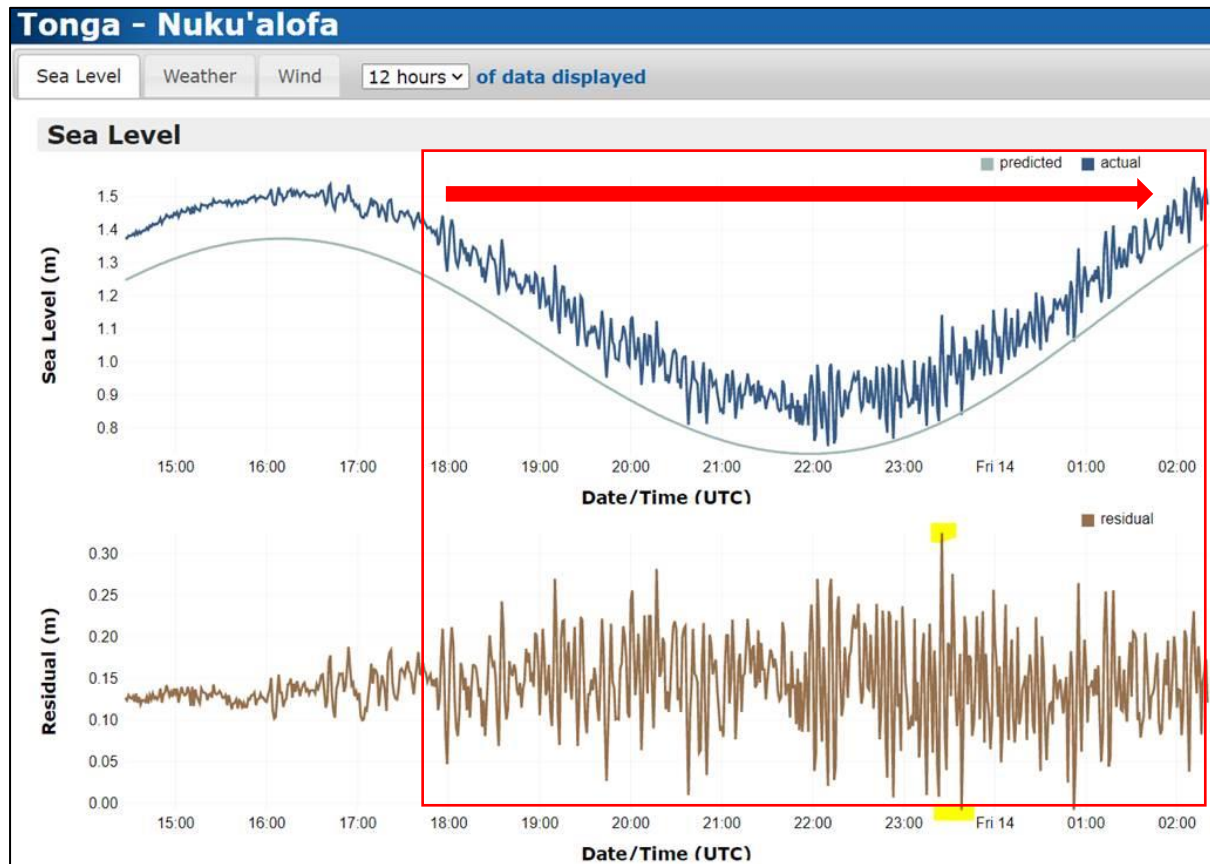


Figure 1: The Nuku'alofa tide gauge readings showing the sea level fluctuations as the result from the eruption of event #1 at Hunga Tonga/Hunga Ha'apai. These fluctuations of the sea level were evident starting at 7am local time (18:00UTC). The highest wave recorded was about 30cm at around 12:30pm local time (23:30UTC). The red arrow above indicates the fluctuations of the sea level being recorded on the tide gauge.

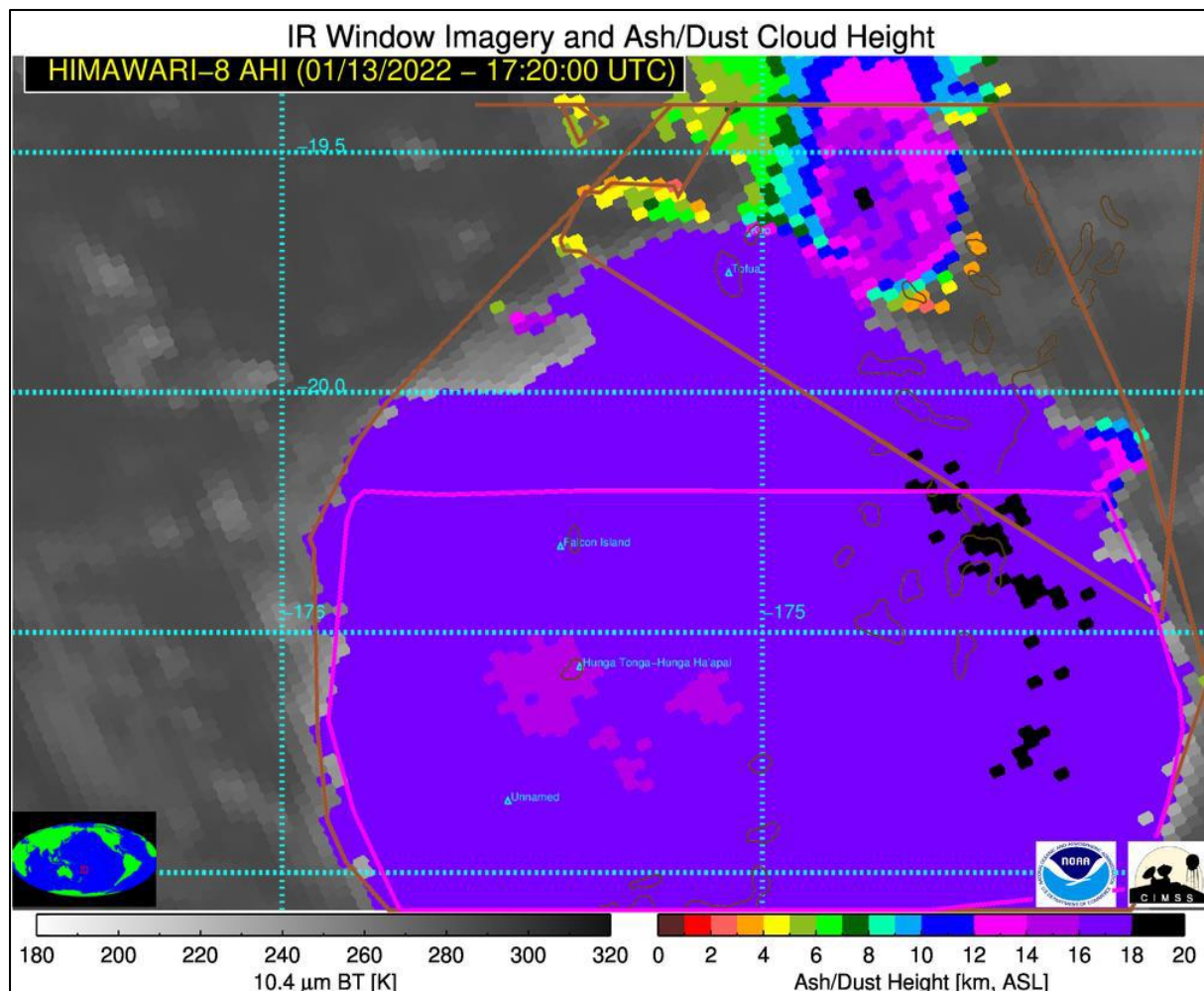


Figure 2: HIMAWARI 8 AHI Satellite Imagery captured at 6:20 AM 14/1/2022 (Local Time) showing volcanic plume over Hunga Tonga/Hunga Ha'apai. The ash/dust cloud height is best estimated to be 12 to 14km above sea level.

Satellite imagery of the eruption clearly indicated the presence of the ash/dust clouds and particles in the eruption site and being distribute over to Tongatapu, 'Eua and in the 'Otumu'omu'a group (Southern Haapai). This satellite image is consistent with the direct observations that were reported to the National Tsunami Warning Centre and the smell of sulphur in the air on the morning of Friday 14th January 2022.

In addition to the sighting of the volcanic ash, direct observations were received by telephone reports and over social media of the strange abnormal tides and sea level fluctuations in the water front areas of Nuku'alofa. This fluctuation of the sea level/tides were picked up by the Nuku'alofa tide gauge.

The second Tsunami Marine Warning (refer to annex 2) was issued 3:26pm on the same day. On-air briefings were also carried out to local radio stations as well. The National Tsunami Warning Centre cancelled the Tsunami Marine Warning at around 6:22pm for Niuafo'ou, Niuatoputapu, Vava'u, Kauvai Ha'ano District, Pangai Lifuka district and Ha'apai Lulunga districts (refer to annex 3).

Despite the cancellation for the above-mentioned areas, the Tsunami Marine Warning for the 'Otumu'omu'a group, Tongatapu, 'Atataa, 'Eueiki and 'Eua remained in-force. This warning remained until it was cancelled at 10:00am, 15th January 2022 (refer to annex 4 to annex 8). This cancellation was based on the ceasing of visual volcanic activity and Nuku'alofa tide gauge readings now showing the state of the sea wave fluctuations showing a general reduction in wave fluctuations.

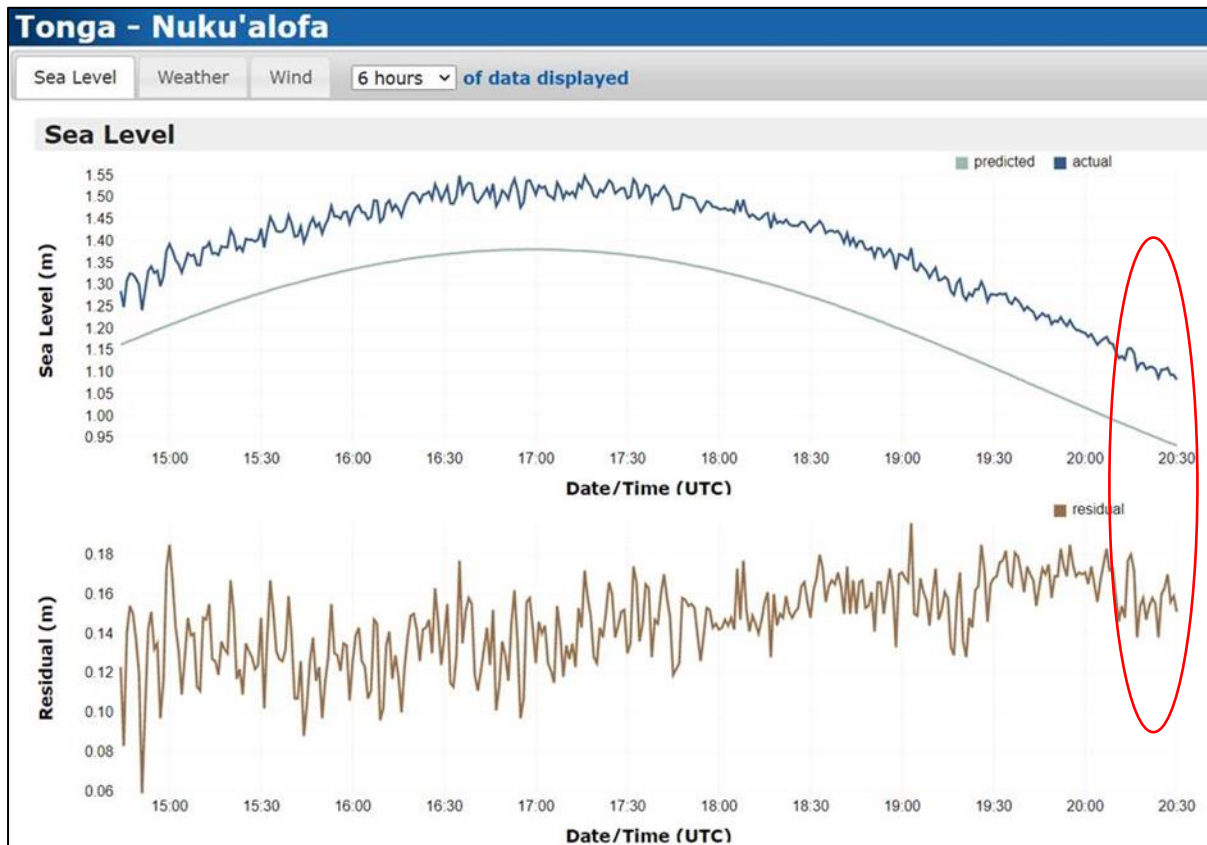


Figure 3: The Nuku'alofa tide gauge readings at around 9:30am local time, 15th January 2022.

Event #2: 15th January 2022

On the evening of Saturday 15th January 2022, a strange sighting of the development of a huge mushroom cloud (volcanic ash cloud) was noted and was being attributed to the Hunga Tonga/Hunga Ha'apai eruption site, it was clearly visible to the main island of Tongatapu. The sighting of this cloud development was followed by loud blast sound that went to the extent of penetrating and hurting the ear-drums for a couple of minutes.

The duty officers at the National Tsunami Warning Centre captured this moment on video recording and photos. The cloud development and the thunder from the eruption site were being seen and heard from the observatory site at the MET Office. The observations being made by these duty officers (Mr. Selusalema Vite and Mr. Sitamipa Paea) were recorded between 5:13pm to 5:21pm on that day.



Figure 4: Sighting of the development of the volcanic ash cloud from the eruption site at the Tonga MET observatory site by the duty officers. This is looking North from the observation site. Image taken at 5:13pm local time, 15th January 2022.

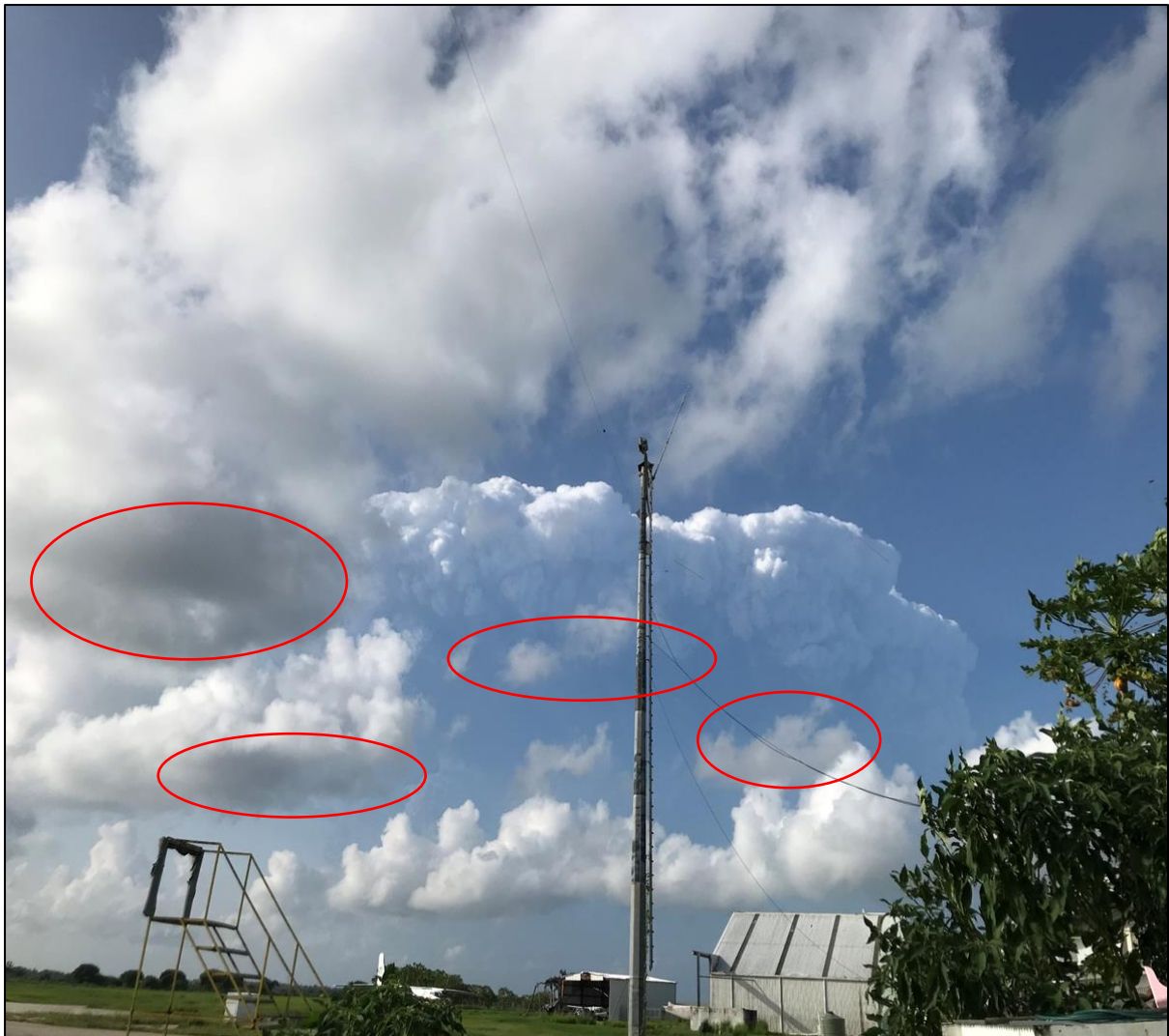


Figure 5: Sighting of the development of the volcanic ash cloud from the eruption site at the Tonga MET observatory site by the duty officers. Ash can be noted in the above picture by the dark grey cloud bases (circled in red). This is looking North from the observation site. Image taken at 5:21pm local time, 15th January 2022. Very loud thunderstorm strikes, and lightning were being heard and observed.

The duty officers of the National Tsunami Warning Centre immediately contacted the Tonga Geological Services via VHF radio to report this occurrence and the sighting of the development of the volcanic ash cloud. This call over the VHF radio was to notify the Tonga Geological Services to raise their alert and response.

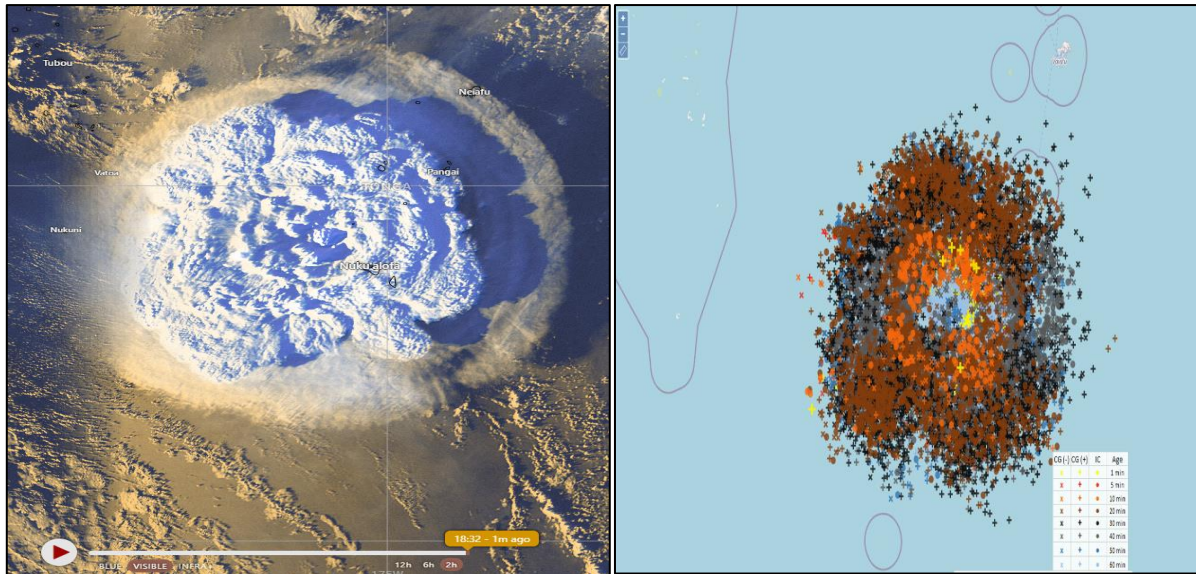


Figure 6 & 7: An aerial visible satellite image (left) captured the explosion of the Hunga Tonga/Hunga Ha'apai volcano site with the outward shock wave energy being pushed east to west from the eruption and the rising cumulonimbus volcanic ash cloud plume. The image to the right, is the lightning and thunder strikes being detected over the eruption site which matched the development of the cloud from the eruption site. This was captured at around 6:32pm local time, 15th January 2022.

The National Tsunami Warning Centre issued repeated verbal Urgent Tsunami Warning and evacuation message for all of Tonga National AM Radio at est. 5:30pm Tonga on national after some difficulty (they had to be raised via VHF to clear the phone lines and call the MET Office) this was followed by the first written Tsunami Warning Bulletin at 5:45pm local time 15th January 2022 (refer to annex 9). This bulletin was immediately issued due to the severity of the eruption and the ground shaking effect that was produced from the shock wave caused by this eruption. Tsunami operations continued and direct live-on air briefings were being made from the Tsunami Warning Centre were carried out on radio by the Director to the people of Tonga until downgraded to Tsunami Marine Warnings at 1:48am on the 16th. Warnings were also posted to the Tonga MET face book page before complete internet blackout.

Simultaneously, discussion with the Volcanic Ash Advisory Centre, Wellington, New Zealand were carried out every 2 to 3 hours via hand held satellite phone. Discussion made were related to the status of the eruption, intensity, coverage and height of the ash clouds over our area of responsibility throughout the duration of the tsunami response operations.



Figure 8: The Director of Tonga MET Services, Mr. 'Ofa Fa'anunu using an Iridium hand held satellite phone to contact the VAAC, Wellington New Zealand for updates and discussion about the eruption. Head cover and protective mask was needed during these calls due to the heavy ashfall.

At about 6:30pm local time 15th January 2022, the last observation from the Nuku'alofa tide gauge was received before it went offline due to the devastation impacts caused by the tsunami wave. At around the same time the National AM Radio Station failed so warnings from that point on was broadcast on FM90 Radio which only reached Tongatapu, Eua and small surrounding islands. The rest of Tonga was in the dark not receiving any warnings or communications from that point on. The largest residual recorded before this downtime of the Nuku'alofa tide gauge was about 1.2 meters at about 6pm. Approximately around 7:00pm local time, 15th January 2022, all internet connection to the Tonga MET Office was out. Only local phone calls in Tongatapu and to 'Eua was still operational. Connections and phone calls to the outer islands of Niuafu'ou, Niuatoputapu, Vava'u and Ha'apai were disconnected too for several days (up to today 1 February 2022).

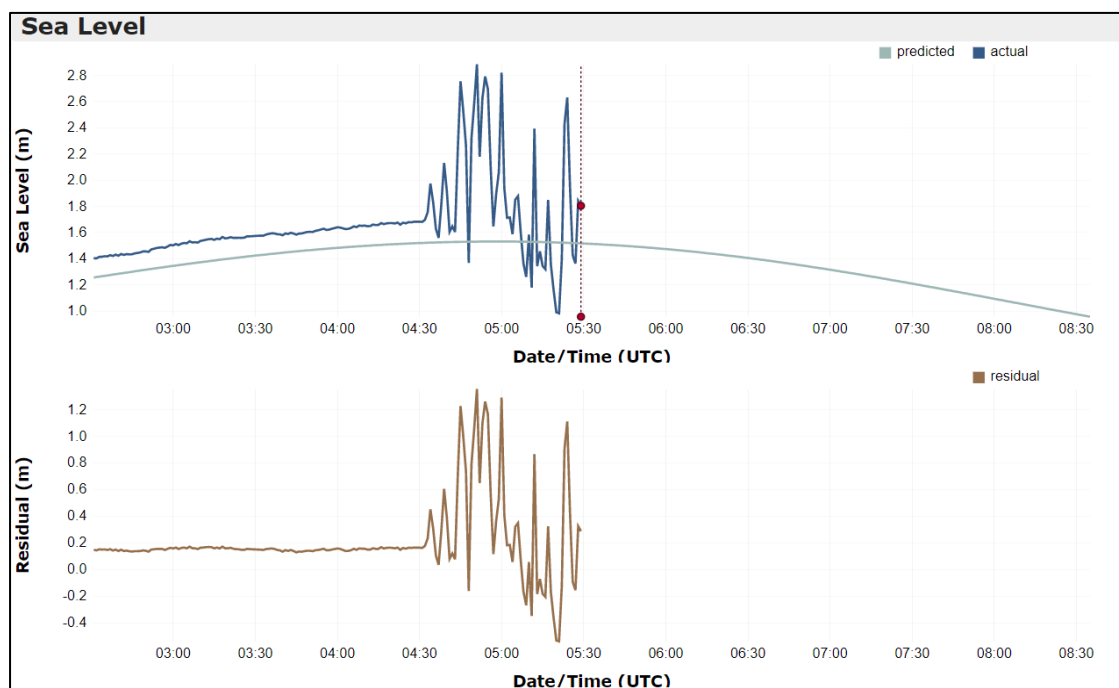


Figure 9: The latest Nuku'alofa tide gauge reading received at 6:30pm local time (05:30UTC), 15th January 2022. It shows that the largest residual of the sea level was about 1.2 meters and the fluctuations of the actual sea level reached 2.8 meters. That is a difference of 1.5 meters between the predicted sea level and the actual sea level fluctuations being recorded.

Photo of the Tsunami First arrival at Nuku'alofa



Figure 9.1: First major tsunami waves arriving at Nuku'alofa. Glimpse of the Palace in the background. Photo taken at 5:47pm

Related Severe Weather Events during the Eruption

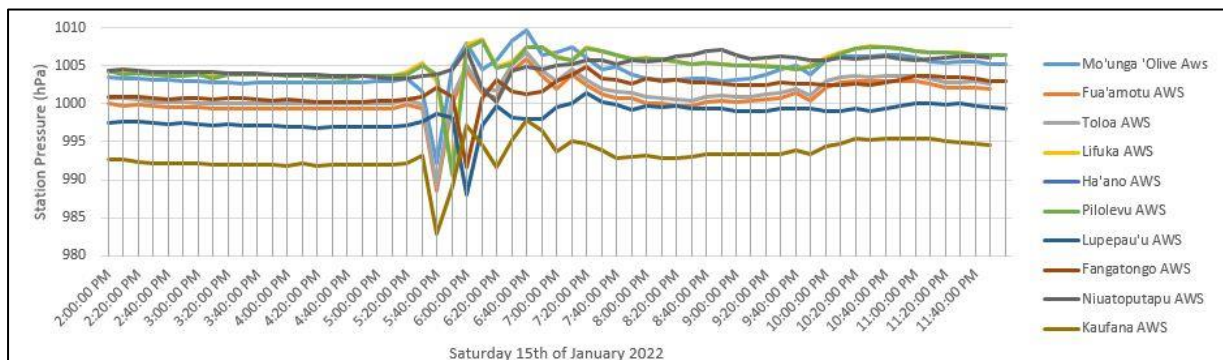


Figure 10: The pressure surge wave recorded over several AWS during the 15th January 2022 event. A remarkable pressure drop in all AWS was noted to have occurred between 5:20pm to 5:40pm local time. Lowest air pressure recorded was approximately 983 hecto-Pascals at the Kaufana AWS, equivalent to a category 2 tropical cyclone.

Preliminary analysis of this atmospheric pressure surge is underpinned directly to the catastrophic eruption of the Hunga Tonga/Hunga Ha'apai on the 15th January 2022. The blast from this eruption was strong enough to jiggle the atmosphere from the surface to the upper layers of our atmosphere. Speculation from this dramatic pressure drop recorded by the Tonga MET AWS network was being attributed to the massive force of the eruption sucking in the surrounding air in its environment leading to this drop in the air pressure being recorded.

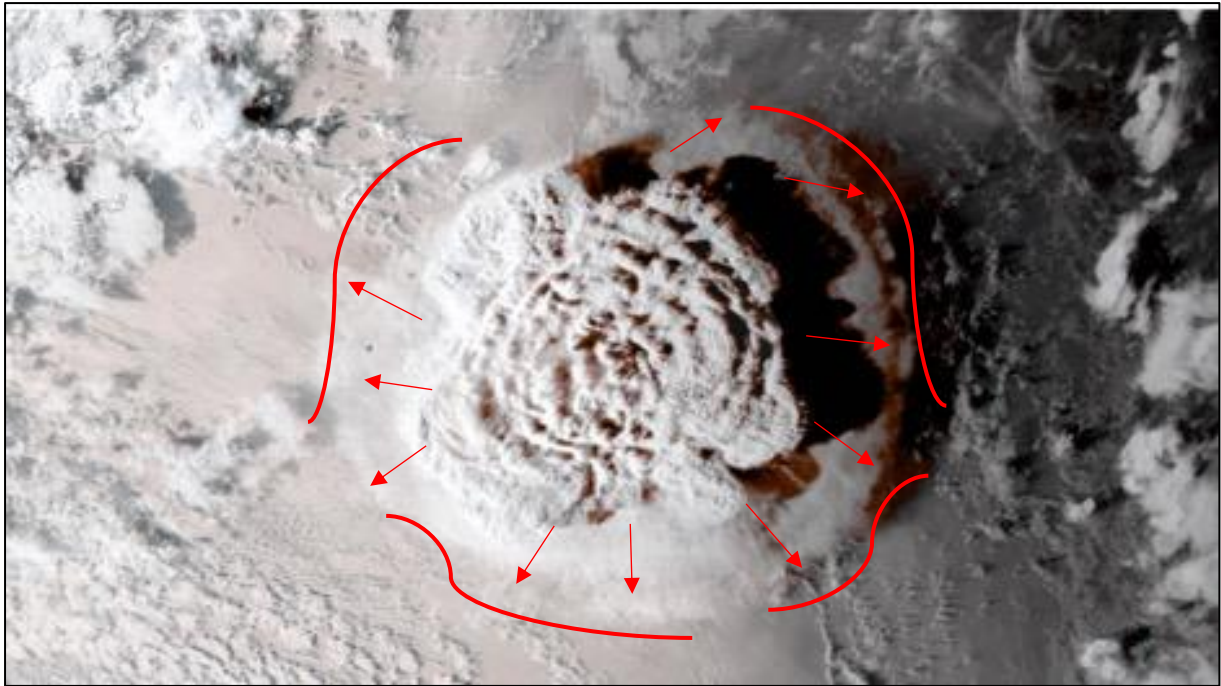


Figure 11: A NASA Satellite caught the Hunga Tonga/Hunga Ha'apai explosive eruption (Source: NASA Worldview/NOAA/NESDIS/STAR). This satellite image also captures very well the shock wave energy spreading at almost 360° (marked in red), expanding from the centre of the eruption which travelled outwards across the globe causing tsunami waves and local generated severe weather.

Scientists describe the volcanic eruptions and also the wave observations (tsunami waves) were observed atmospheric waves from the explosion shot across the globe in less than 24 hours. Gusts of up to damaging gale force winds were also recorded over the AWS network, several minutes to hours after the eruption.

Damages to the Automatic Weather Station (AWS) Network

A quick initial damage assessment was carried out by the Tonga MET Services technical team 24 hours later, after the major eruption on the 15th January 2022. Obviously, the ash coverage on all meteorological instruments in each of the AWS site of Tongatapu was experienced. Similarly, the impacts were also noted in the outer islands AWS sites in the island of 'Eua, Nomuka, Kuvai Ha'ano and Pangai Ha'apai.

To date, one of the AWS sites in the western side of Tongatapu, the Kanokupolu AWS was completely damaged. Kanokupolu village was on the villages that was significantly damaged by the tsunami wave in the western coastal areas of the main island, and our Kanokupolu AWS site was well within range of the tsunami wave run up and inundation coverage.

Immediate clean up of all Tongatapu AWS sites were carried out by the technical team to avoid further damages of the meteorological instrument(s) by the ash that has covered these AWS sites. A quick system check was also carried to see that the AWS network was still operational after the event. Difficulties experienced with this AWS system check was the internet being disconnected. However, several attempts were carried and with the result that the AWS system and networks seems to be functional.

The Nomuka AWS was also cleaned up and maintained by the technical team that was on-board in one of the military vessels that distributed emergency relief supplies to the 'Otumu'omu'a group.



Figure 12 & 13: The remains of the Kanokupolu AWS site, to the left is wind mast cemented foundations and to the right is the AWS fence which has been completely damaged by the tsunami waves and covered by ash.



Figure 14: A full view of the Kanokupolu AWS site, all that remains is the concrete foundations of site completely covered by ash.



Figure 15 & 16: The Stevenson screen at the Mo'unga 'olive AWS site in the eastern side of Tongatapu, which was completely covered by ash both the exterior and the interior equipment(s).



Figure 16 & 17: The solar panel and the automatic tide gauge at the Mo'unga 'olive AWS site in the eastern side of Tongatapu, which was completely covered by as.

Collaboration with the Tonga Geological Services Unit

Event 1: 14th January 2022

Regular volcanic eruption reports were received from the Tonga Geological Services Unit and discussions were being made over the VHF radio. The information from these volcanic eruptions reports were used by the Tonga MET Services to send the Volcano Observation Notice for Aviation (VONA) to the Volcanic Ash Advisory Centre (VAAC) in New Zealand. This also included the recommended changes as appropriate of the Alert Colour Code (AAC) from the Geological Services and was conveyed to the VAAC.

Event 2: 15th January 2022

Throughout the entire tsunami response operations of the 15th January 2022 event, the Tonga Geological Services was not operational. Relevant geological feedbacks and/or discussions during the event was not received or in any way a back up contingency plan from the Tonga Geological Services was advised to provide the necessary technical support needed for the National Tsunami Warning Centre.

Despite this, contact with the Director of the Tonga Geological Services was able to be established through the mobile. Site observations were being reported by Mr. Kula that supported the downgrading of the Urgent Tsunami Warning into a Tsunami Marine Warning for Tonga. At 1:48am local time, 16th January 2022, the National Tsunami Warning Centre downgraded the Urgent Tsunami Warning for Tonga to a Tsunami Marine Warning for Tonga (refer to annex 10).

The Director of the Tonga MET Services, provided a meteorological briefing of the event to the National Emergency Management Committee at around 11:00am local time, 16th January 2022 and updates on the tsunami operation response that was being done by the National Tsunami Warning Centre.

At around 10:00am local time, 17th January 2022, the National Tsunami Warning Centre cancelled the Tsunami Marine Warning that was in force for Niuafo'ou, Niuatoputapu, Vava'u, Kauvai Ha'ano District, Pangai Lifuka District and the Lulunga District of the Ha'apai Group of Islands. Meanwhile, the Tsunami Marine Warning remained in force for the 'Otumu'omu'a Group (Nomuka, Mango, Fonoi), Tongatapu, 'Atataa, 'Eueiki and the nearby islands of Nuku'alofa and the island of 'Eua.

The cancellation of the Tsunami Marine Warning for the above-mentioned island groups were based on the tide gauge readings of Niuatoputapu and Vava'u also site observations from Ha'apai. That the state of the sea had returned to normal.

At 11:00am local time, 17th January 2022, the Deputy Director of the Tonga MET Services had managed to break through and made first contact from the Tonga MET Services to Ha'apai. This contact was being made thru the High Frequency (HF) radio at frequency 5832 KHz. Initial contact was being made from the MET office but due to technical problems of not clearly receiving the message from the Ha'apai Tower. Radio HF calls were then being done from the Tonga Airport Limited Tower at Fua'amotu to the duty officer at Ha'apai Tower.

An urgent message was being relayed from the Deputy Director of Tonga MET Services to the Ha'apai Tower operator to quickly contact the MEIDECC Ha'apai Acting Officer in Charge, Mr. Samiu Vaitaki to report on the current status of the Ha'apai group after the event. Mr. Vaitaki provided a detailed initial damage assessment report and it was immediately conveyed to the Director of the Tonga MET Services and the NEMC.

At 1:00pm local time, 17th January 2022, the National Tsunami Warning Centre cancelled the Tsunami Marine Warning that was in force for the 'Otumu'omu'a Group (Nomuka, Mango, Fonoi), Tongatapu, 'Atataa, 'Eueiki and the nearby islands of Nuku'alofa and the island of 'Eua. The cancellation of the Tsunami Marine Warning for the above-mentioned island groups were based direct site observations at various locations in Tongatapu. That the state of the sea had returned to normal.

At 2:30pm local time, 17th January 2022, the Deputy Director of the Tonga MET Services had managed to break through and made first contact from the Tonga MET Services to Vava'u.

This contact was being made thru the High Frequency (HF) radio at frequency 5832 KHz. Radio HF calls were then being done from the Tonga Airport Limited Tower at Fua'amotu to the duty officer at the Vava'u Tower

Mr. Mafi Penisoni from NEMO (MEIDECC Vava'u) provided a detailed initial damage assessment report and it was immediately conveyed to the Director of the Tonga MET Services and the NEMC.

Continuous Weather Watch and Volcano Monitoring

The operational staff of the Tonga MET Services continued its usual weather watch during each daily shift and also kept a sharp eye out to the Hunga Tonga/Hunga Ha'apai eruption site for any new signs of development.

Starting on Monday 17th January 2022 one of the senior officers from the Tonga Geological Services Unit, Mr. Vaiomo'unga, came into the MET Office regularly throughout this week for a few hours to monitor the Hunga Tonga/Hunga Ha'apai eruption site for any signs of possible new eruptions from the site.

Recommendations:

This report highlights key recommendations that is needed to be addressed to improve and to strengthen our early warning systems based on the experiences encountered before, during and after the event and also the response operations to the two events discussed in this report. The following recommendations are:

Standard Operation Procedures (SOP):

- To establish a tsunami standard operation procedure based on Volcanic eruptions
- To improve and amend the current tsunami standard operation procedures
- To establish tsunami SOPs in all Tonga MET Stations
- Development of interim SOPs to support the National Tsunami Warning Centre during this internet down-time.

Early Warning System

- To ensure a dedicated back-up internet connection for the National Tsunami Warning Centre
- The need for high tech volcano monitoring capability of the National Tsunami Warning Centre
- Satellite phones to be allocated to all MET stations
- HF radio instalment and or upgrades to be implemented at all MET stations
- The need for a quieter media briefing room
- The need for complete hazard gears for the operational MET staff
- To establish operational seismic stations
- The establish of radar tide gauge at critical locations over Tongatapu, 'Otumu'omu'a group, Ha'apai, Vava'u and Niua
- Replacement of the Kanokupolu AWS
- The need for a new international telephone set for calling international agencies

- The need for a drone to be used by the National Tsunami Warning Centre for quick and immediate event surveys

Training and awareness Programs

- The need for a complete tsunami siren control system training for all MET staff
- Community tsunami awareness programs and trainings
- Staff training is very much needed based on this event so that required level of understanding and competency skills is kept at a high level.
- SOP training for operational staff

Media

- The need to establish a dedicated platform for all live on-air media radio briefings to be done once new warnings or cancellation warnings are issued from the National Tsunami Warning Centre
- A post-event press conference should be implemented for all media personnel and the technical warning agencies

Surveys

- A complete post-event survey should be implemented with the participation of staff from the National Tsunami Warning Centre

ICT & Technical

- Dedicated V-SAT connection for Tonga MET
- To ensure the functionality of chatty beetles and spare units
- To establish HF radios in all stations
- The need to localize data from AWS and tide gauges in the MET office for easy access in times of internet breakdown
- The need for quick procurement of seismometers and telemetry accessories
- The need for a back-up data channel for the seiscamp work station data ingestion

ANNEXES

ANNEX 1

Fakatokanga Peau Kula ki he matāfanga ‘o Tonga
Fika: 01
Taimi tuku atu: 11:12am ‘aho 14 Sanuali 2022
Ne mapuna ha mo’unga afi pea ko hono fua eni: Taimi ne hoko ai: - Latitute: 20.54 faka-Tonga, Longitute: 175.38 Faka-Hihifo Loloto: 0km Malohi: - Feitu’u: Hunga-Tonga Hunga-Ha’apai
Fakatokanga ki ha Peau Kula ki he ngaahi Matafanga (Ko e Fakatokanga kotoa pe ‘oku tuku atu mei he Va’a Vakai Matangi ‘a Tonga ko e totonu ia ‘o e Fakatokanga ki Tonga) KO E SENITA FAKAFONUA KI HE FAKATOKANGA PEAU KULA ENI ‘OKU FAKAHOHA’A. Tupu mei he fetoo’aki ‘a e tahi ‘i hono lipooti mei he ‘ofisa kolo ‘o Mango pea mo e poate taulanga ‘I Nuku’alofa pea mo ‘ene felave’i ki he mo’unga afi ‘oku lolotonga mapuna ‘I he ‘elia ‘o Hunga-Tonga Hunga-Ha’apai ‘OKU TUKU ATU HENI HA FAKATOKANGA PEAU KULA KI HE KOTOA NGAahi MATAFANGA E ‘OTU TONGA NI Ko e fale’I ki he kakai e fonua ke mavahe mei he ngaahi mataafanga pea mo e ngaahi matatahi. Ki he kau folau tahi ‘oku ‘i tahi, ‘oku fale’i ke mou nga’unu ki he loloto ‘o mama’o mei he hakau mo e ngaahi matātahi. Ko e fakamatala peau kula hoko ‘e tuku atu ia ‘i he vave taha ‘i ha’amau ma’u ha fakamatala fo’ou fekau’aki mo e anga e tu’u e tahi mo e mapuna ‘a e mo’unga afi. Fakafanogo ki he letio Tonga.

Tsunami Marine Warning for Tonga

No: 01

Issued at 11:12am on 14 January 2022

A volcanic eruption has occurred with these parameters:

Origin time: -

Coordinates: Lat: 20.54 Lon: 175.38W

Depth: 0km

Magnitude: NIL

Tsunami Marine Warning Summary

(Only Warnings issued by the Tonga Meteorological Service represent the official warning status for Tonga)

THIS IS THE NATIONAL TSUNAMI WARNING CENTRE.

Based on the abnormal tide observation reported from the town officer of Mango island and the Nuku'alofa marine and ports and its relevant to the ongoing volcanic eruption in the Hunga-Tonga Hunga-Ha'apai area, A TSUNAMI MARINE WARNING IS NOW INFORCE FOR TONGA.

Public are advised to keep away from low lying coastal areas, reefs and beaches. Mariners out at sea are advised to prepare to move to deep water.

The next bulletin will be issued as soon as new information is received. Listen to Radio Tonga.

NEOC Status:

The National Emergency Operation Centre (NEOC) is activated and remains on standby.

Normal NEOC contact details apply:

General Enquiries: (676) 26340

Issued by:

Message authorized by the Tonga Meteorological Service

General Enquiries: (676) 74 00062 or (676) 35 009

Duty Officer: LF/GV/VF/NH/SIV/ST

End of message

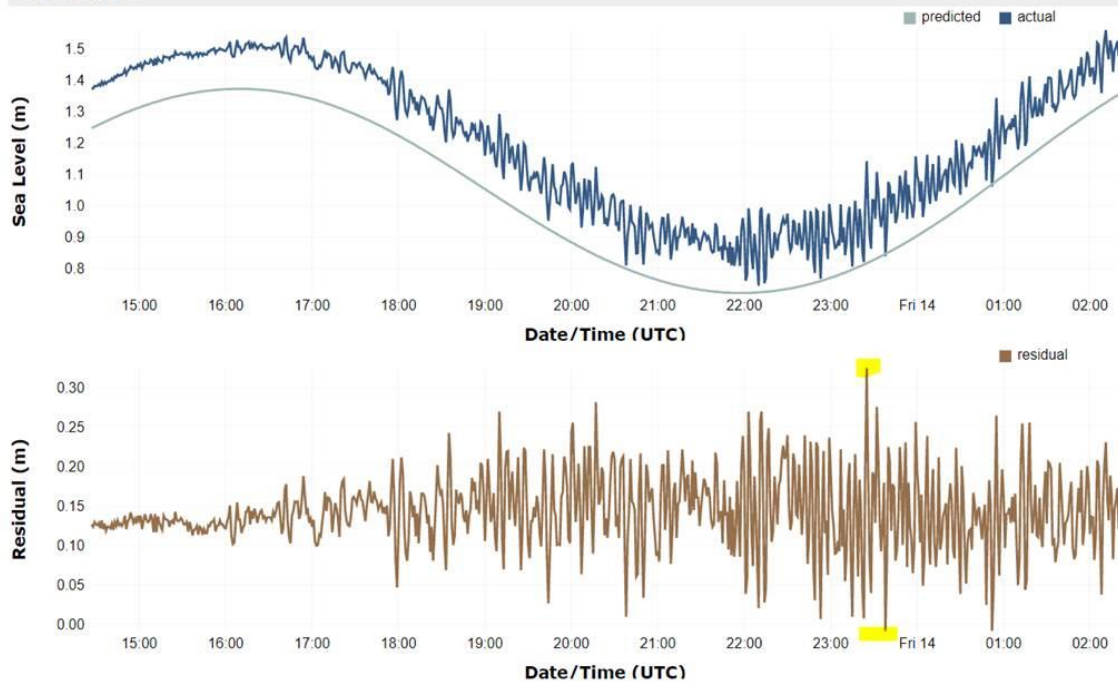
ANNEX 2

Fakatokanga Peau Kula ki he matāfanga ‘o Tonga
Fika: 02
Taimi tuku atu: 3:26pm ‘aho 14 Sanuali 2022
Ne mapuna ha mo’unga afi pea ko hono fua eni: Taimi ne hoko ai: - Latitude: 20.54 faka-Tonga, Longitute: 175.38 Faka-Hihifo Feitu’u: Hunga-Tonga Hunga-Ha’apai
Fakatokanga ki ha Peau Kula ki he ngaahi Matafanga (Ko e Fakatokanga kotoa pe ‘oku tuku atu mei he Va’a Vakai Matangi ‘a Tonga ko e totonu ia ‘o e Fakatokanga ki Tonga) KO E SENITA FAKAFONUA KI HE FAKATOKANGA PEAU KULA ENI ‘OKU FAKAHOHA’A. Tupu mei he fetoo’aki ‘a e tahi ‘i hono lipooti mei he ‘ofisa kolo ‘o Mango pea mo e poate taulanga ‘I Nuku’alofa pea mo ‘ene felave’i ki he mo’unga afi ‘oku lolotonga mapuna ‘I he ‘elia ‘o Hunga-Tonga Hunga-Ha’apai ‘OKU TUKU ATU HENI HA FAKATOKANGA PEAU KULA KI HE KOTOA NGAahi MATAFANGA E ‘OTU TONGA NI Ko e ma’olunga ‘o e peau kula ne fua ‘I he me’afua peau ‘I Nuku’alofa ne a’u pe hono ma’olunga ki he senitimita ‘e 30 (fute ‘e 1) fakafuofua ki he taimi 12:30pm pea ‘oku hokohoko atu ‘a e fetoo’aki ko eni ‘o a’u mai pe ki he lolotonga ni. Ko e ngaahi fetoo’aki ko eni ‘a e tahi ‘e malava pe ke a’u ki he houa ‘e 24 (ki ‘apongipongi).

Tonga - Nuku'alofa

Sea Level Weather Wind 12 hours of data displayed

Sea Level



Ko e fale'i ki he kakai e fonua ke fakamama'o mei he ngaahi mataatahi mo e ngaahi mataafanga ma'ulalo. Fale'l atu ke ta'ofi 'a e kaukau tahi, toutai 'l he ngaahi mataafanga mo e ngaahi ngaue ki tahi, ka e 'oleva kuo kaniseli atu 'a e fakatokanga ni. Ki he kau folau tahi 'oku 'i tahi, 'oku fale'i ke mou nga'unu ki he loloto 'o mama'o mei he hakau mo e ngaahi matatahi.

Ko e fakamatala peau kula ki he ngaahi mataafanga 'e tuku atu ia 'i he vave taha 'i ha'amaui ma'u ha fakamatala fo'ou fekau'aki mo e anga e tu'u e tahi mo e mapuna 'a e mo'unga afi. Fakafanogo ki he letio Tonga.

Tsunami Marine Warning for Tonga

No: 02

Issued at 3:26pm on 14 January 2022

A volcanic eruption has occurred with these parameters:

Origin time: -

Coordinates: Lat: 20.54S Lon: 175.38W

Location: Hunga-Tonga Hunga-Ha'apai

Tsunami Marine Warning Summary

(Only Warnings issued by the Tonga Meteorological Service represent the official warning status for Tonga)

THIS IS THE NATIONAL TSUNAMI WARNING CENTRE.

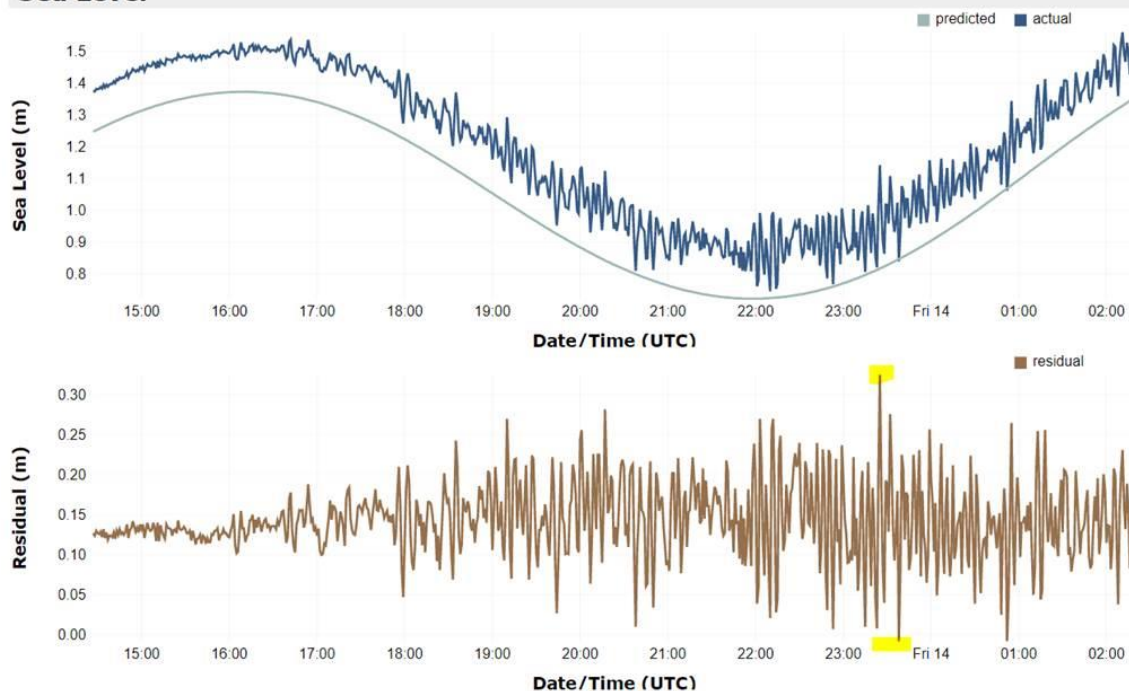
Based on the abnormal tide observation reported from the town officer of Mango island and the Nuku'alofa marine and ports and its relevant to the ongoing volcanic eruption in the Hunga-Tonga Hunga-Ha'apai area, A TSUNAMI MARINE WARNING IS NOW INFORCE FOR TONGA.

The maximum tsunami wave recorded in Nuku'alofa tide gauge at 12:30pm was about 30cm (1 feet) and the fluctuation of the sea level is currently observed. This fluctuation of the sea level is expected to continue for the next 24 hours (tomorrow).

Tonga - Nuku'alofa

Sea Level Weather Wind 12 hours of data displayed

Sea Level



Public are advised to keep away from low lying coastal areas, beaches and harbor areas. Public are also advised to avoid swimming and any related activities out at until this warning is cancelled. Mariners out at sea are advised to move to deep water.

The next bulletin will be issued as soon as new information is received. Listen to Radio Tonga.

NEOC Status:

The National Emergency Operation Centre (NEOC) is activated and remains on standby.

Normal NEOC contact details apply:

General Enquiries: (676) 26340

Issued by:

Message authorized by the Tonga Meteorological Service

General Enquiries: (676) 74 00062 or (676) 35 009

Duty Officer: OF/LF/GV/VF/NH/SIV/ST

End of message

ANNEX 3:

Kaniseli 'o e Fakatokanga Peau Kula ki he ngaahi matāfanga 'o e ongo Niua, Vava'u, Vahe Kauvai Ha'ano, Vahe Pangai Lifuka mo e Vahe Ha'apai Lulunga

Fika: 01

Taimi tuku atu: 6:22pm 'aho 14 Sanuali 2022

Ne mapuna ha mo'unga afi pea ko hono fua eni:

Taimi ne hoko ai: -

Latitude: 20.54 faka-Tonga, Longitute: 175.38 Faka-Hihifo

Feitu'u: Hunga-Tonga Hunga-Ha'apai

Kaniseli 'o e Fakatokanga Peau Kula ki he ngaahi matāfanga 'o e ongo Niua, Vava'u, Vahe Kauvai Ha'ano, Vahe Pangai Lifuka mo e Vahe Ha'apai Lulunga

(Ko e Fakatokanga kotoa pe 'oku tuku atu mei he Va'a Vakai Matangi 'a Tonga ko e totonu ia 'o e Fakatokanga ki Tonga)

'Oku kaniseli atu 'a e fakatokanga peaukula ki he ngaahi matafanga 'o e ongo Niua, Vava'u, Vahe Kauvai Ha'ano, Vahe Pangai Lifuka mo e Vahe Ha'apai Lulunga

Ka 'oku kei tu'u pe 'a e fakatokanga peau kula ki he ngaahi matafanga 'o e 'otu Mu'omu'a 'i Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua.

Fakatatau ki he ngaahi lipooti kuo ma'u mei he vahefonua 'o e ongo Niua, Vava'u, Vahe Kauvai Ha'ano, Vahe Pangai Lifuka mo e Vahe Ha'apai Lulunga pea mo e ngaahi me'afua tahi 'I he ngaahi vahe fonua ni, kuo 'ikai ke to e fetoo'aki 'a e tahi 'i he ngaahi mataafanga 'o e ngaahi vahe fonua ni.

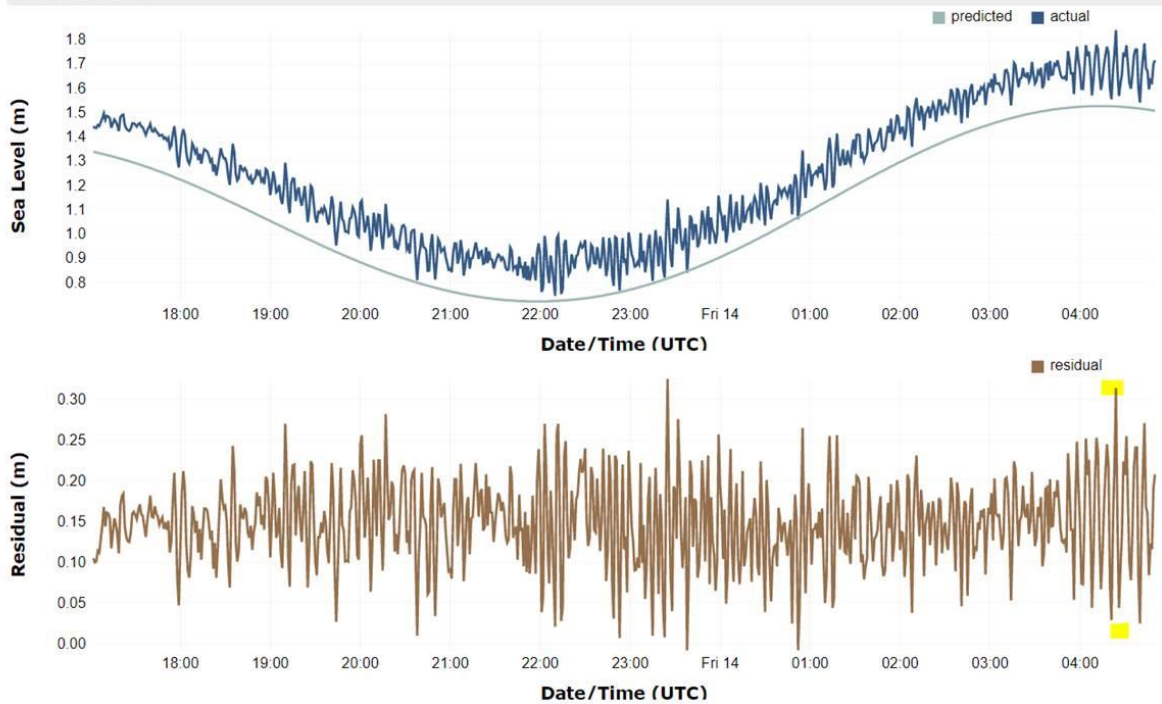
Tupu mei he kei fetoo'aki 'a e tahi 'i hono lipooti mai 'e he me'afua tahi 'o Nuku'alofa ni, 'oku kei tu'u ai 'a e fakatokanga peau kula ki he ngaahi matafanga 'o e 'otu Mu'omu'a 'i Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua.

Ko e ma'olunga 'o e fetoo'aki 'o e tahi 'i he me'afua peau 'I Nuku'alofa ne a'u pe hono ma'olunga ki he senitimita 'e 30 (fute 'e 1) fakafuofua ki he taimi 6pm 'o e efiafi ni pea 'oku malava ke hokohoko atu 'a e fetoo'aki ko eni 'I he houa 'e 6 ki he 12 ka hoko mai.

Tonga - Nuku'alofa

Sea Level Weather Wind 12 hours of data displayed

Sea Level



Ko e fale'i ki he kakai e fonua ke fakamama'o mei he ngaahi mataatahi mo e ngaahi mataafanga ma'ulalo. Fale'l atu ke ta'ofi 'a e kaukau tahi, toutai 'l he ngaahi mataafanga mo e ngaahi ngaue ki tahi, ka e 'oleva kuo kaniseli atu 'a e fakatokanga ni. Ki he kau folau tahi 'oku 'i tahi, 'oku fale'i ke mou nga'unu ki he loloto 'o mama'o mei he hakau mo e ngaahi matatahi.

Ko e fakamatala peau kula ki he ngaahi mataafanga 'e tuku atu ia 'i he vave taha 'i ha'amau ma'u ha fakamatala fo'ou fekau'aki mo e anga e tu'u e tahi mo e mapuna 'a e mo'unga afi. Fakafanogo ki he letio Tonga.

Cancellation of Tsunami Marine Warning for the Niuas, Vava'u, Kauvai Ha'ano, Pangai Lifuka and Ha'apai Lulunga coastal areas and waters

No: 01

Issued at 6:22pm on 14 January 2022

A volcanic eruption has occurred with these parameters:

Origin time: -

Coordinates: Lat: 20.54S Lon: 175.38W

Location: Hunga-Tonga Hunga-Ha'apai

Cancellation of Tsunami Marine Warning for the Niuas, Vava'u, Kauvai Ha'ano, Pangai Lifuka and Ha'apai Lulunga coastal areas and waters

(Only Warnings issued by the Tonga Meteorological Service represent the official warning status for Tonga)

The tsunami marine warning previously enforced for the Niuas, Vava'u, Kauvai Ha'ano, Pangai Lifuka and Ha'apai Lulunga coastal areas and waters are now CANCELLED.

A tsunami marine warning remains in force for the 'otu Mu'omu'a in Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua coastal areas and waters.

Based on observation reports from the Niuas, Vava'u, Kauvai Ha'ano, Pangai Lifuka and Ha'apai Lulunga and the tide gauge report from these island groups, the fluctuation of the sea level are no longer observed in these coastal waters and returns to normal.

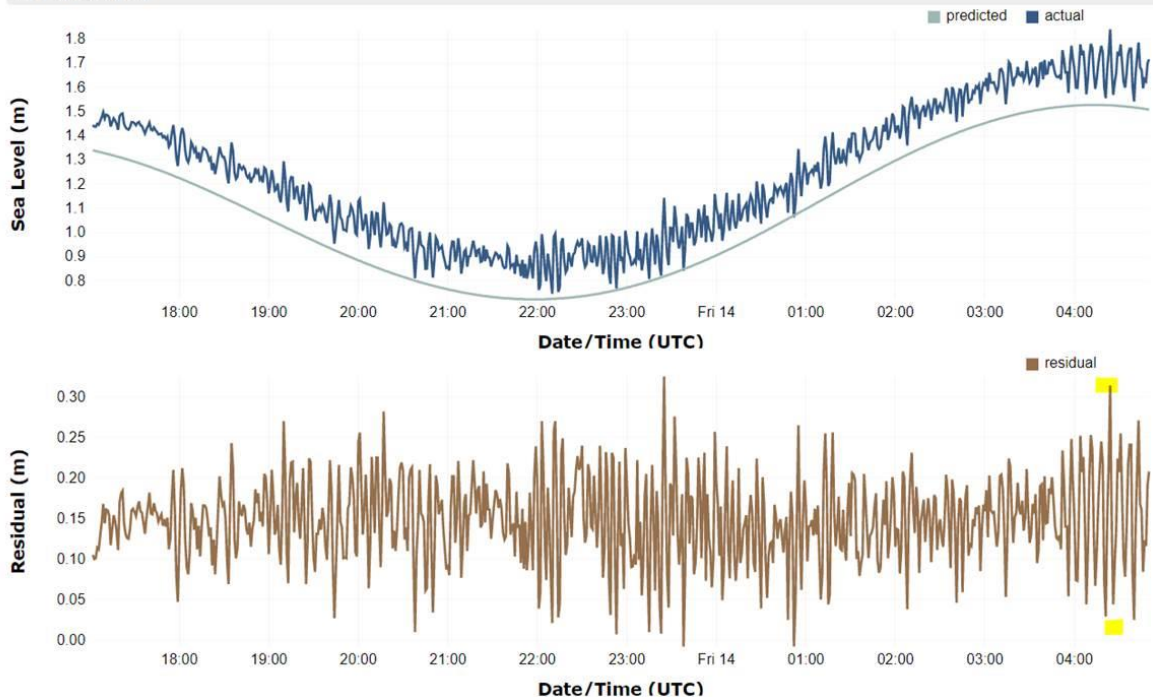
The fluctuation of the sea level is currently observed and recorded in the tide gauge at Nuku'alofa, therefore, the **tsunami marine warning** remains in force for the 'otu Mu'omu'a in Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua coastal areas and waters.

The highest tsunami wave recorded in the past 3 hours in Nuku'alofa tide gauge was at 6pm this evening of about 30cm (1 foot). This fluctuation of the sea level is expected to continue for the next 6 to 12 hours.

Tonga - Nuku'alofa

Sea Level Weather Wind 12 hours of data displayed

Sea Level



Public are advised to keep away from low lying coastal areas, beaches and harbor areas. Public are also advised to avoid swimming and any related activities out at until this warning is cancelled. Mariners out at sea are advised to move to deep water.

The next bulletin will be issued as soon as new information is received. Listen to Radio Tonga.

NEOC Status:

The National Emergency Operation Centre (NEOC) is activated and remains on standby.

Normal NEOC contact details apply:

General Enquiries: (676) 26340

Issued by:

Message authorized by the Tonga Meteorological Service

General Enquiries: (676) 74 00062 or (676) 35 009

Duty Officer: LF/GV/VF/AA/FL

End of message

Annex 3

Fakatokanga ki ha Peau Kula ki he ngaahi matafanga 'o e 'otu Mu'omu'a 'i Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua.

Fika: 03

Taimi tuku atu: 10:00pm 'aho 14 Sanuali 2022

Ne mapuna ha mo'unga afi pea ko hono fua eni:

Taimi ne hoko ai: -

Latitude: 20.54 faka-Tonga, Longitute: 175.38 Faka-Hihifo

Feitu'u: Hunga-Tonga Hunga-Ha'apai

Fakatokanga ki ha Peau Kula ki he ngaahi matafanga 'o e 'otu Mu'omu'a 'i Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua.

(Ko e Fakatokanga kotoa pe 'oku tuku atu mei he Va'a Vakai Matangi 'a Tonga ko e totonu ia 'o e Fakatokanga ki Tonga)

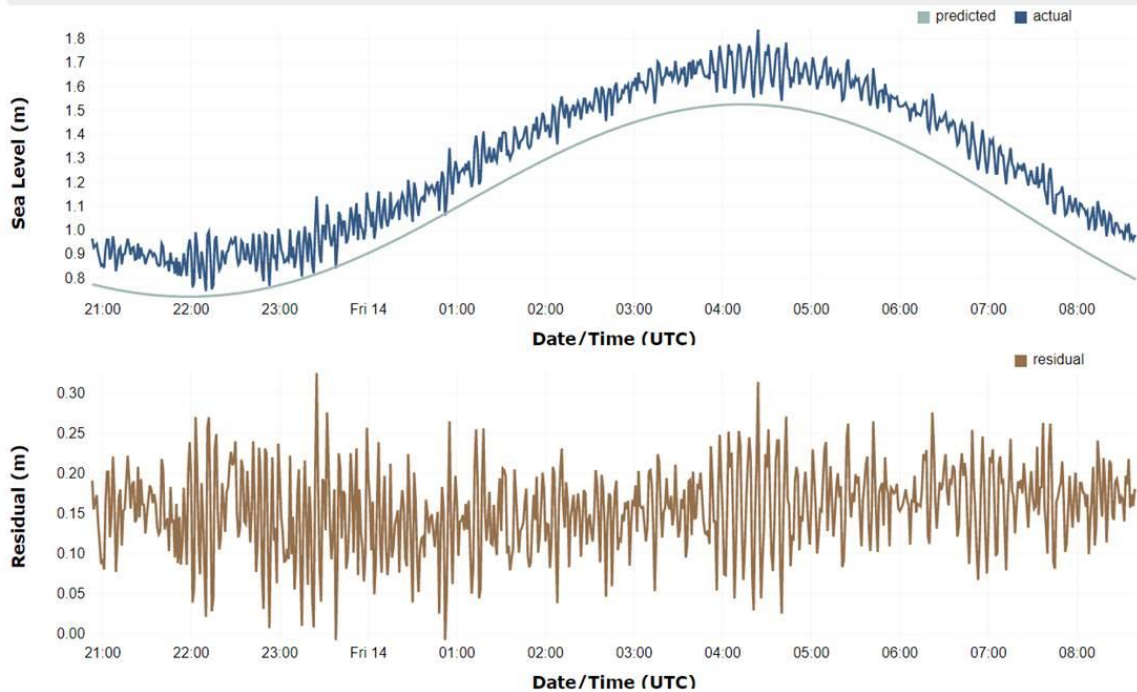
Tupu mei he kei fetoo'aki 'a e tahi 'i hono lipooti mei he me'afua tahi 'i Nuku'alofa ni, 'oku kei tu'u ai 'a e fakatokanga peau kula ki he ngaahi matafanga 'o e 'otu Mu'omu'a 'i Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua.

Ko e ma'olunga 'o e fetoo'aki 'o e tahi 'i he me'afua peau 'i Nuku'alofa ne a'u pe hono ma'olunga ki he senitimita 'e 20 fakafuofua ki he taimi 10pm 'o e pooni pea 'oku malava ke hokohoko atu 'a e fetoo'aki ko eni 'i he houa 'e 12 ki he 24 ka hoko mai.

Tonga - Nuku'alofa

Sea Level Weather Wind 12 hours of data displayed

Sea Level



Ko e fale'i ki he kakai e fonua ke fakamama'o mei he ngaahi mataatahi mo e ngaahi mataafanga ma'ulalo. Fale'i atu ke ta'ofi 'a e kaukau tahi, toutai 'l he ngaahi mataafanga mo e ngaahi ngaue ki tahi, ka e 'oleva kuo kaniseli atu 'a e fakatokanga ni. Ki he kau folau tahi 'oku 'i tahi, 'oku fale'i ke mou nga'unu ki he loloto 'o mama'o mei he hakau mo e ngaahi matatahi.

Ko e fakamatala peau kula ki he ngaahi mataafanga 'e tuku atu ia 'i he taimi 1am 'ahengihengi (15 Sanuali 2022) pe 'i ha'amau ma'u ha fakamatala fo'ou fekau'aki mo e anga e tu'u 'a e tahi felave'i mo e mapuna 'a e mo'unga afi. Fakafanogo ki he letio Tonga.

Tsunami Marine Warning for the 'otu Mu'omu'a in Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua coastal areas and waters.

No: 03

Issued at 10:00pm on 14 January 2022

A volcanic eruption has occurred with these parameters:

Origin time: -

Coordinates: Lat: 20.54S Lon: 175.38W

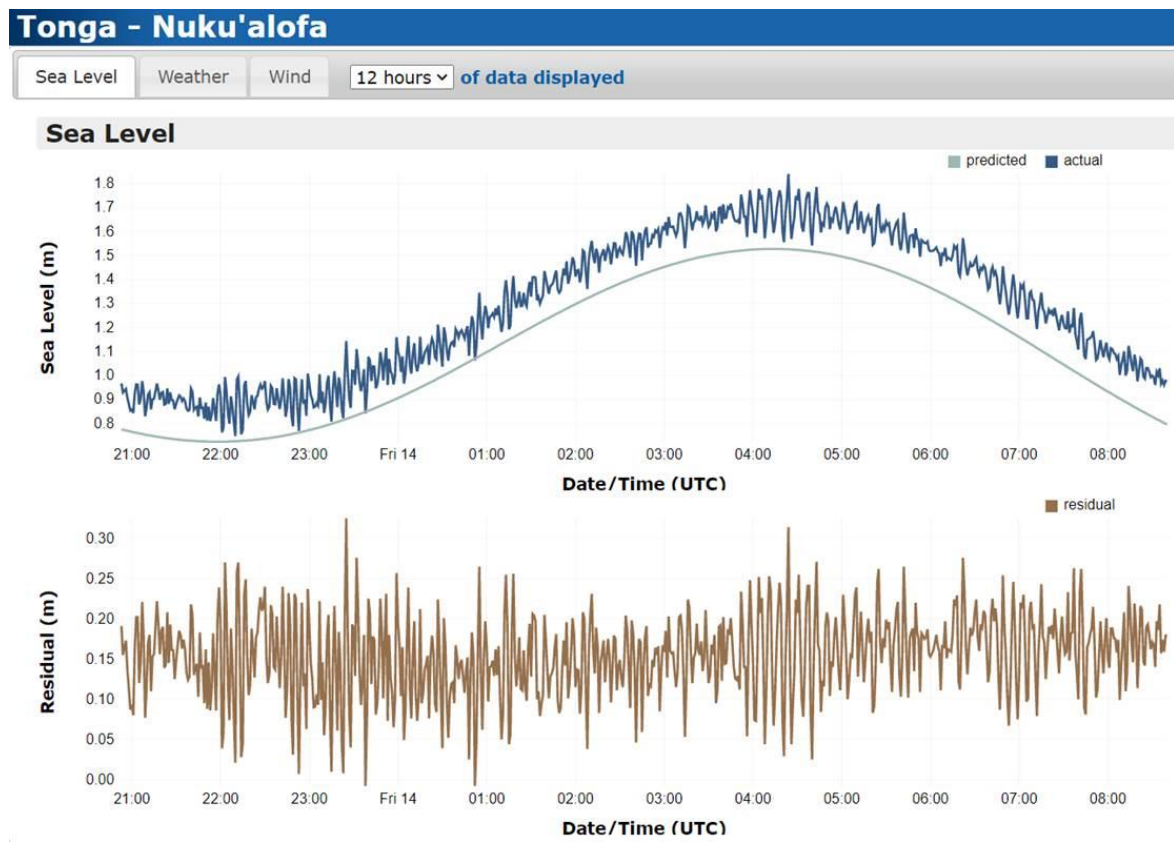
Location: Hunga-Tonga Hunga-Ha'apai

Tsunami Marine Warning for the 'otu Mu'omu'a in Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua coastal areas and waters.

(Only Warnings issued by the Tonga Meteorological Service represent the official warning status for Tonga)

The fluctuation of the sea level is currently observed and recorded in the tide gauge at Nuku'alofa, therefore, the **tsunami marine warning** remains inforce for the 'otu Mu'omu'a in Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua coastal areas and waters.

The height of the tsunami wave recorded in Nuku'alofa tide gauge was 20cm at 10pm tonight. This fluctuation of the sea level is expected to continue for the next 12 to 24 hours.



Public are advised to keep away from low lying coastal areas, beaches and harbor areas. Public are also advised to avoid swimming and any related activities out at until this warning is cancelled. Mariners out at sea are advised to move to deep water.

The next bulletin will be issued at 1am early tomorrow morning (15th January 2022) or as soon as new information is received. Listen to Radio Tonga.

NEOC Status:

The National Emergency Operation Centre (NEOC) is activated and remains on standby.

Normal NEOC contact details apply:

General Enquiries: (676) 26340

Issued by:

Message authorized by the Tonga Meteorological Service

General Enquiries: (676) 74 00062 or (676) 35 009

Duty Officer: LF/GV/VF/STP/AA/FL

End of message

Annex 4

Fakatokanga ki ha Peau Kula ki he ngaahi matafanga 'o e 'otu Mu'omu'a 'i Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua.

Fika: 04

Taimi tuku atu: 01:00am 'aho 15 Sanuali 2022

Ne mapuna ha mo'unga afi pea ko hono fua eni:

Taimi ne hoko ai: -

Latitude: 20.54 faka-Tonga, Longitute: 175.38 Faka-Hihifo

Feitu'u: Hunga-Tonga Hunga-Ha'apai

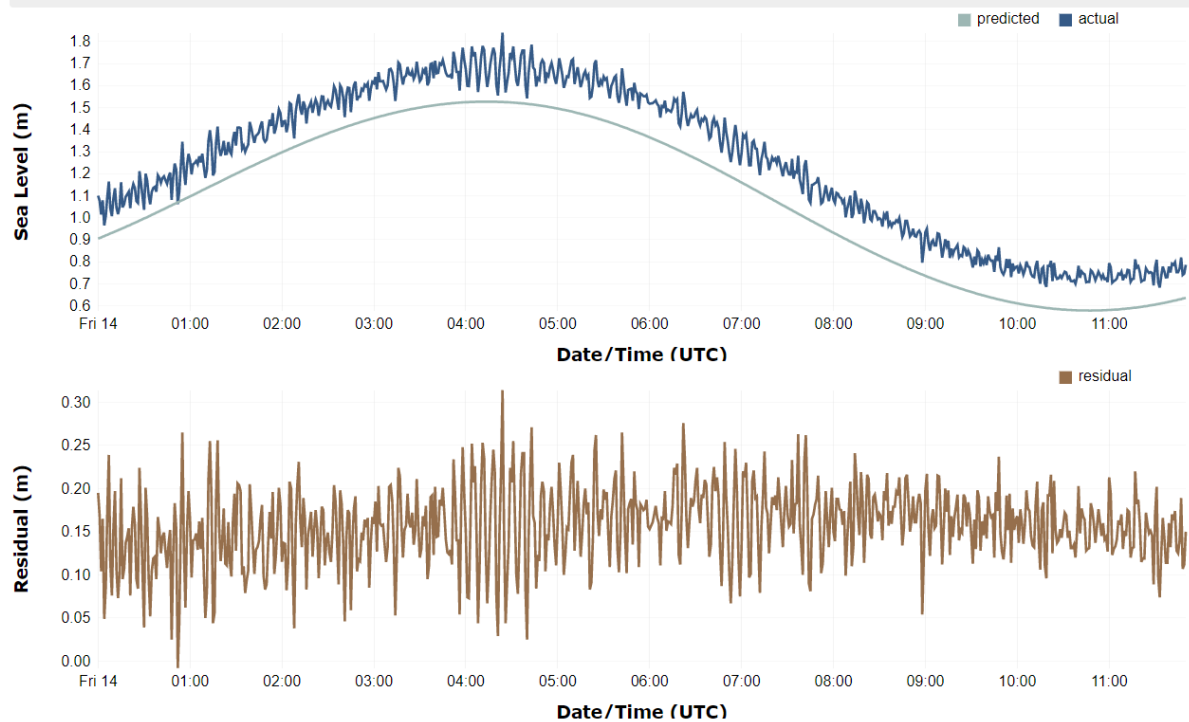
Fakatokanga ki ha Peau Kula ki he ngaahi matafanga 'o e 'otu Mu'omu'a 'i Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua.

(Ko e Fakatokanga kotoa pe 'oku tuku atu mei he Va'a Vakai Matangi 'a Tonga ko e totonu ia 'o e Fakatokanga ki Tonga)

Tupu mei he kei fetoo'aki 'a e tahi 'i hono lipooti mei he me'afua tahi 'i Nuku'alofa ni, 'oku kei tu'u ai 'a e fakatokanga peau kula ki he ngaahi matafanga 'o e 'otu Mu'omu'a 'i Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua.

Ko e ma'olunga 'o e fetoo'aki 'o e tahi 'i he me'afua peau 'i Nuku'alofa ne a'u pe hono ma'olunga ki he senitimita 'e 25 fakafuofua ki he taimi 12am 'o e pooni pea 'oku malava ke hokohoko atu 'a e fetoo'aki ko eni 'i he houa 'e 12 ka hoko mai.

Sea Level



Ko e fale'i ki he kakai e fonua ke fakamama'o mei he ngaahi mataatahi mo e ngaahi mataafanga ma'ulalo. Fale'i atu ke ta'ofi 'a e kaukau tahi, toutai 'I he ngaahi mataafanga mo e ngaahi ngaue ki tahi, ka e 'oleva kuo kaniseli atu 'a e fakatokanga ni. Ki he kau folau tahi 'oku 'i tahi, 'oku fale'i ke mou nga'unu ki he loloto 'o mama'o mei he hakau mo e ngaahi matātahi.

Ko e fakamatala peau kula ki he ngaahi mataafanga 'e tuku atu ia 'i he taimi 4am 'ahengihengi (15 Sanuali 2022) pe 'i ha'amaui ma'u ha fakamatala fo'ou fekau'aki mo e anga e tu'u 'a e tahi felave'i mo e mapuna 'a e mo'unga afi. Fakafanogo ki he letio Tonga.

Tsunami Marine Warning for the 'otu Mu'omu'a in Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua coastal areas and waters.

No: 04

Issued at 01:00am on 15 January 2022

A volcanic eruption has occurred with these parameters:

Origin time: -

Coordinates: Lat: 20.54S Lon: 175.38W

Location: Hunga-Tonga Hunga-Ha'apai

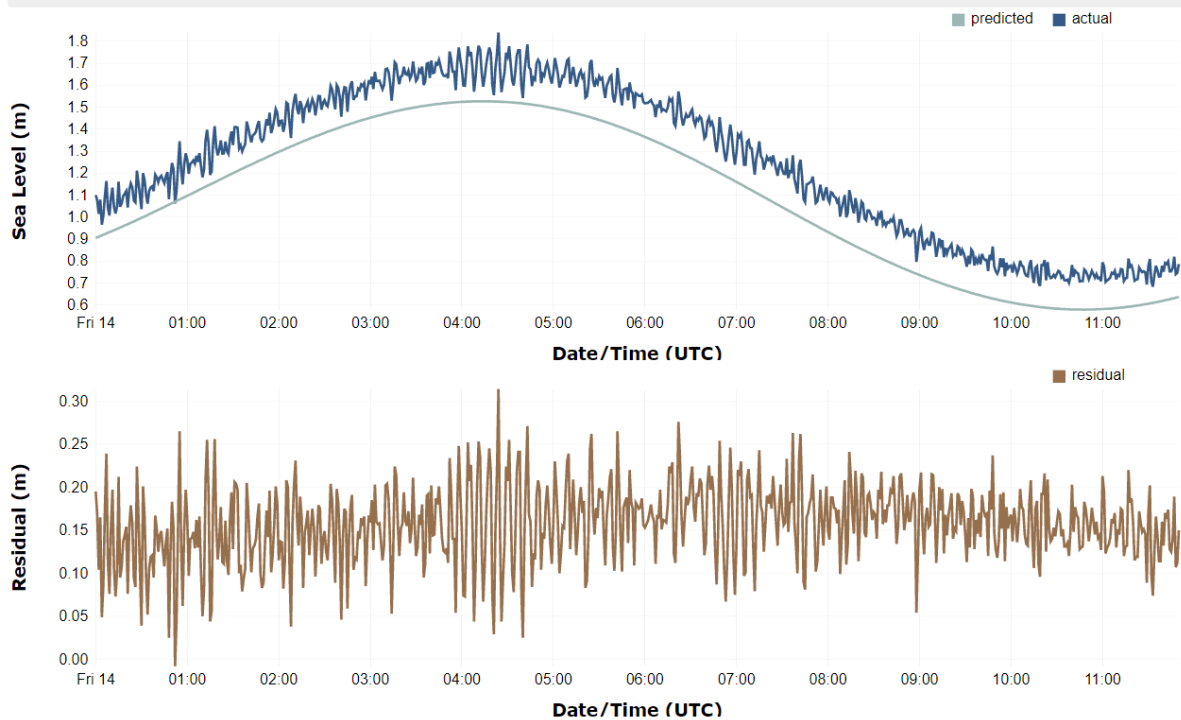
Tsunami Marine Warning for the 'otu Mu'omu'a in Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua coastal areas and waters.

(Only Warnings issued by the Tonga Meteorological Service represent the official warning status for Tonga)

The fluctuation of the sea level is currently observed and recorded in the tide gauge at Nuku'alofa, therefore, the **tsunami marine warning** remains inforce for the 'otu Mu'omu'a in Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua coastal areas and waters.

The height of the tsunami wave recorded in Nuku'alofa tide gauge was 25cm at 12am mid-night. This fluctuation of the sea level is expected to continue for the next 12 hours.

Sea Level



Public are advised to keep away from low lying coastal areas, beaches and harbor areas. Public are also advised to avoid swimming and any related activities out at until this warning is cancelled. Mariners out at sea are advised to move to deep water.

The next bulletin will be issued at 4am early morning (15th January 2022) or as soon as new information is received. Listen to Radio Tonga.

NEOC Status:

The National Emergency Operation Centre (NEOC) is activated and remains on standby.

Normal NEOC contact details apply:

General Enquiries: (676) 26340

Issued by:

Message authorized by the Tonga Meteorological Service

General Enquiries: (676) 74 00062 or (676) 35 009

Duty Officer: TTK/PT/UV/

End of message

Annex 5

Fakatokanga ki ha Peau Kula ki he ngaahi matafanga 'o e 'otu Mu'omu'a 'i Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua.

Fika: 05

Taimi tuku atu: 04:00am 'aho 15 Sanuali 2022

Ne mapuna ha mo'unga afi pea ko hono fua eni:

Taimi ne hoko ai: -

Latitude: 20.54 faka-Tonga, Longitute: 175.38 Faka-Hihifo

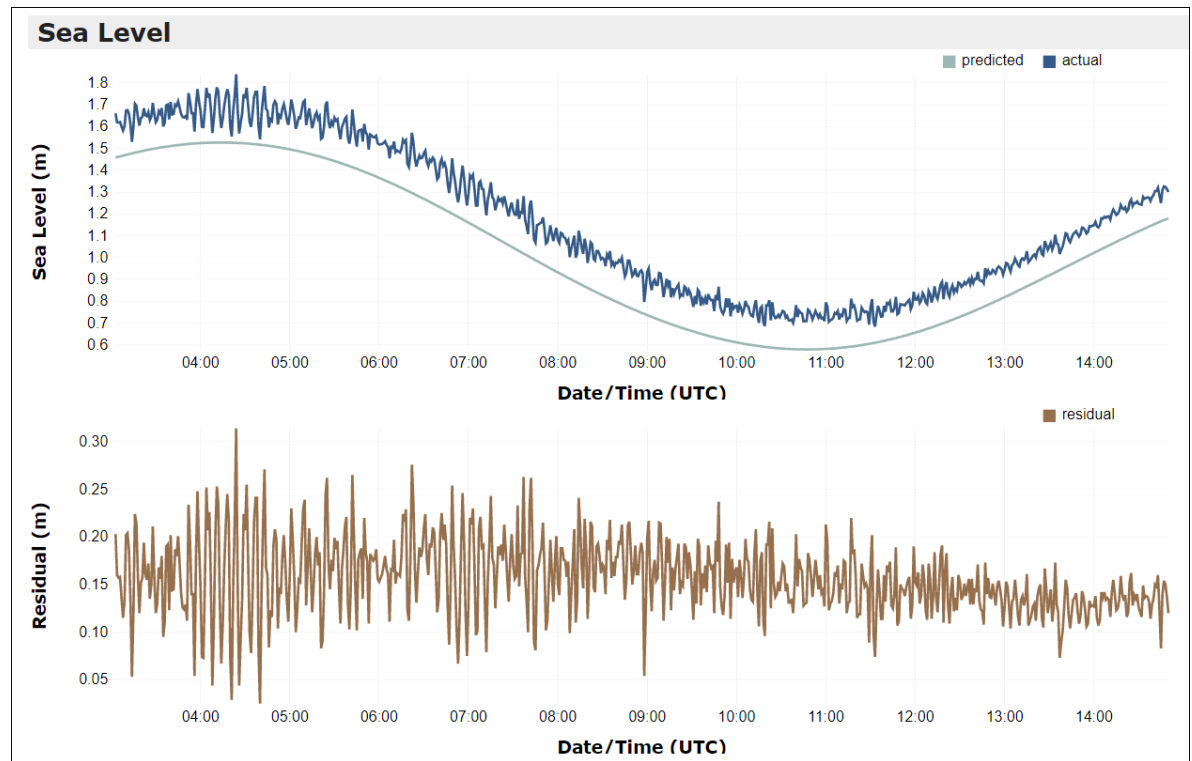
Feitu'u: Hunga-Tonga Hunga-Ha'apai

Fakatokanga ki ha Peau Kula ki he ngaahi matafanga 'o e 'otu Mu'omu'a 'i Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua.

(Ko e Fakatokanga kotoa pe 'oku tuku atu mei he Va'a Vakai Matangi 'a Tonga ko e totonu ia 'o e Fakatokanga ki Tonga)

Tupu mei he kei fetoo'aki 'a e tahi 'i hono lipooti mei he me'afua tahi 'i Nuku'alofa ni, 'oku kei tu'u ai 'a e fakatokanga peau kula ki he ngaahi matafanga 'o e 'otu Mu'omu'a 'i Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua.

Ko e ma'olunga 'o e fetoo'aki 'o e tahi 'i he me'afua peau 'i Nuku'alofa ne a'u pe hono ma'olunga ki he senitimita 'e 20 fakafuofua ki he taimi 4am 'o e pongipongi ni pea 'oku malava ke hokohoko atu 'a e fetoo'aki ko eni 'i he houa 'e 6 ki he 12 ka hoko mai.



Ko e fale'i ki he kakai e fonua ke fakamama'o mei he ngaahi mataatahi mo e ngaahi mataafanga ma'ulalo. Fale'i atu ke ta'ofi 'a e kaukau tahi, toutai 'I he ngaahi mataafanga mo e ngaahi ngaue ki tahi, ka e 'oleva kuo kaniseli atu 'a e fakatokanga ni. Ki he kau folau tahi 'oku 'i tahi, 'oku fale'i ke mou nga'unu ki he loloto 'o mama'o mei he hakau mo e ngaahi matātahi.

Ko e fakamatala peau kula ki he ngaahi mataafanga hook 'e tuku atu ia 'i he taimi 7am 'ahengihengi (15 Sanuali 2022) pe 'i ha'ama'u ma'u ha fakamatala fo'ou fekau'aki mo e anga e tu'u 'a e tahi felave'i mo e mapuna 'a e mo'unga afi. Fakafanogo ki he letio Tonga.

Tsunami Marine Warning for the 'otu Mu'omu'a in Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua coastal areas and waters.

No: 05

Issued at 04:00am on 15 January 2022

A volcanic eruption has occurred with these parameters:

Origin time: -

Coordinates: Lat: 20.54S Lon: 175.38W

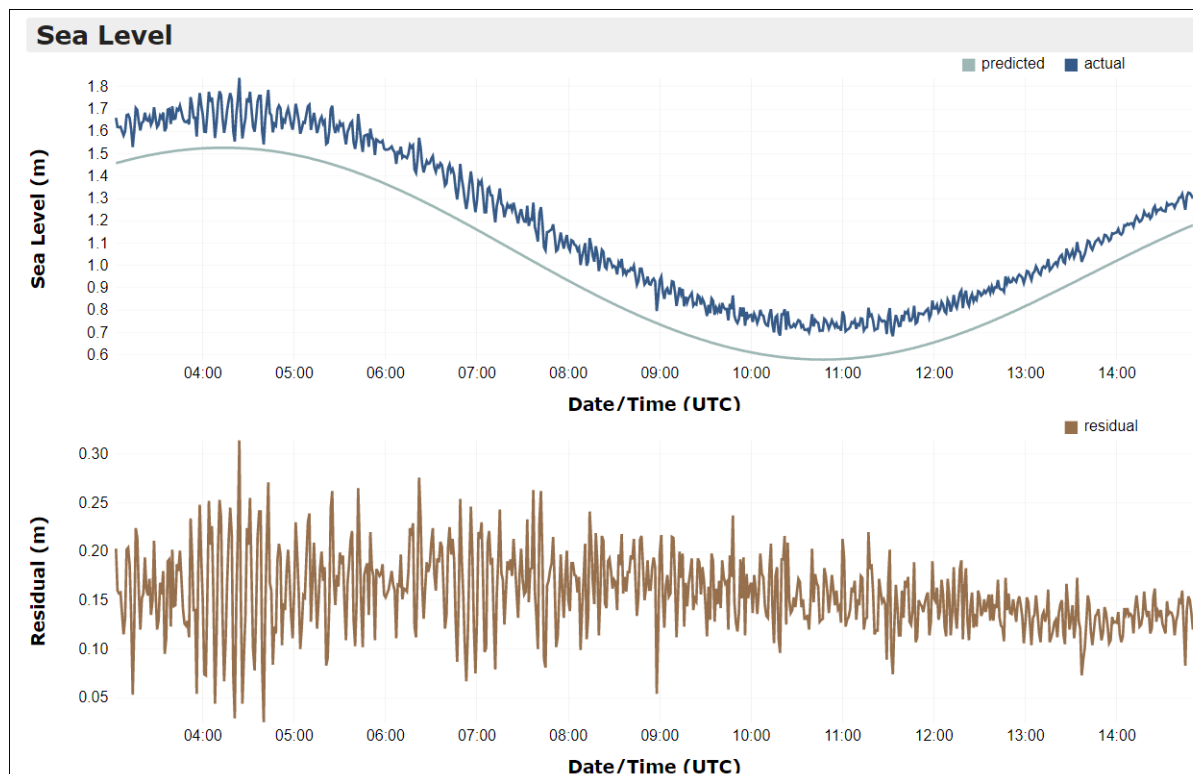
Location: Hunga-Tonga Hunga-Ha'apai

Tsunami Marine Warning for the 'otu Mu'omu'a in Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua coastal areas and waters.

(Only Warnings issued by the Tonga Meteorological Service represent the official warning status for Tonga)

The fluctuation of the sea level is currently observed and recorded in the tide gauge at Nuku'alofa, therefore, the **tsunami marine warning** remains inforce for the 'otu Mu'omu'a in Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua coastal areas and waters.

The height of the tsunami wave recorded in Nuku'alofa tide gauge was 20cm at 4am this morning. This fluctuation of the sea level is expected to continue for the next 6 to 12 hours.



Public are advised to keep away from low lying coastal areas, beaches and harbor areas. Public are also advised to avoid swimming and any related activities out at until this warning is cancelled. Mariners out at sea are advised to move to deep water.

The next bulletin will be issued at 7am early morning (15th January 2022) or as soon as new information is received. Listen to Radio Tonga.

NEOC Status:

The National Emergency Operation Centre (NEOC) is activated and remains on standby.

Normal NEOC contact details apply:

General Enquiries: (676) 26340

Issued by:

Message authorized by the Tonga Meteorological Service

General Enquiries: (676) 74 00062 or (676) 35 009

Duty Officer: TTK/PT/UV/

End of message

Annex 6

Fakatokanga ki ha Peau Kula ki he ngaahi matafanga 'o e 'otu Mu'omu'a 'i Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua.

Fika: 06

Taimi tuku atu: 07:00am 'aho 15 Sanuali 2022

Ne mapuna ha mo'unga afi pea ko hono fua eni:

Taimi ne hoko ai: -

Latitude: 20.54 faka-Tonga, Longitute: 175.38 Faka-Hihifo

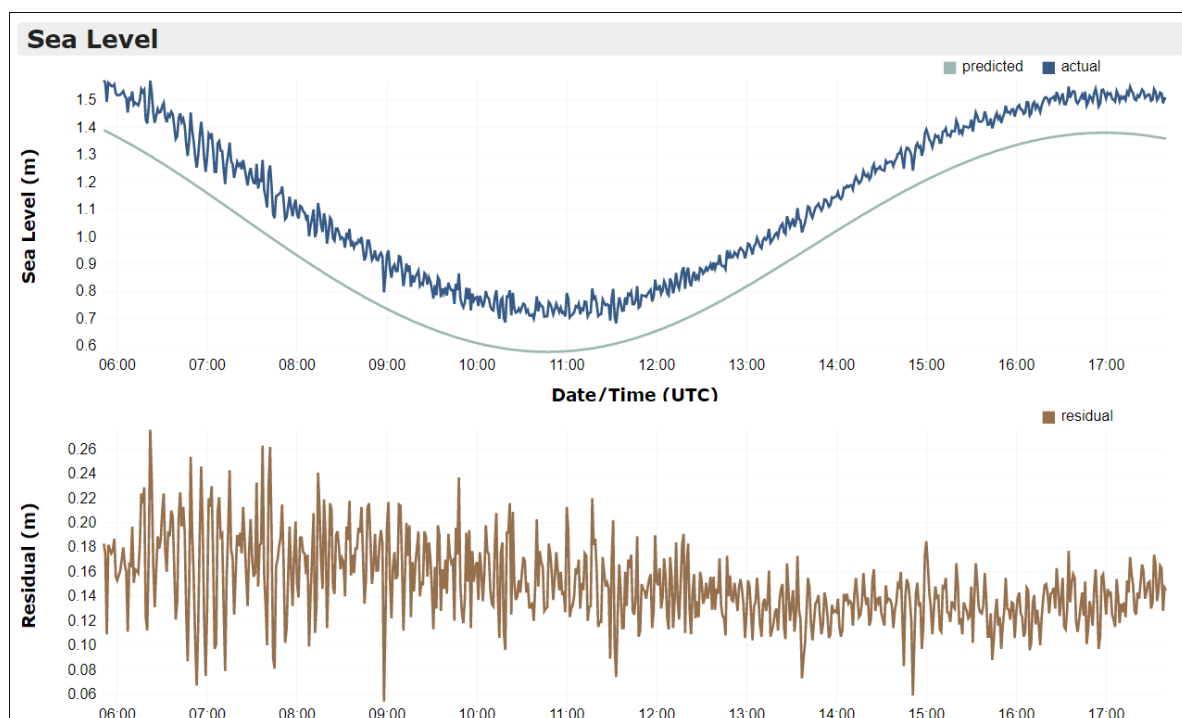
Feitu'u: Hunga-Tonga Hunga-Ha'apai

Fakatokanga ki ha Peau Kula ki he ngaahi matafanga 'o e 'otu Mu'omu'a 'i Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua.

(Ko e Fakatokanga kotoa pe 'oku tuku atu mei he Va'a Vakai Matangi 'a Tonga ko e totonu ia 'o e Fakatokanga ki Tonga)

Tupu mei he kei fetoo'aki 'a e tahi 'i hono lipooti mei he me'afua tahi 'i Nuku'alofa ni, 'oku kei tu'u ai 'a e fakatokanga peau kula ki he ngaahi matafanga 'o e 'otu Mu'omu'a 'i Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua.

Ko e ma'olunga 'o e fetoo'aki 'o e tahi 'i he me'afua peau 'i Nuku'alofa ne a'u pe hono ma'olunga ki he senitimita 'e 13 fakafuofua ki he taimi 7am 'o e pongipongi ni pea 'oku malava ke hokohoko atu 'a e fetoo'aki ko eni 'i he houa 'e 6 ki he 12 ka hoko mai.



Ko e fale'i ki he kakai e fonua ke fakamama'o mei he ngaahi mataatahi mo e ngaahi mataafanga ma'ulalo. Fale'i atu ke ta'ofi 'a e kaukau tahi, toutai 'I he ngaahi mataafanga mo e ngaahi ngaue ki tahi, ka e 'oleva kuo kaniseli atu 'a e fakatokanga ni. Ki he kau folau tahi 'oku 'i tahi, 'oku fale'i ke mou nga'unu ki he loloto 'o mama'o mei he hakau mo e ngaahi matātahi.

Ko e fakamatala peau kula ki he ngaahi mataafanga hoko 'e tuku atu ia 'i he taimi 10am 'ahengihengi (15 Sanuali 2022) pe 'i ha'amau ma'u ha fakamatala fo'ou fekau'aki mo e anga e tu'u 'a e tahi felave'i mo e mapuna 'a e mo'unga afi. Fakafanogo ki he letio Tonga.

Tsunami Marine Warning for the 'otu Mu'omu'a in Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua coastal areas and waters.

No: 06

Issued at 04:00am on 15 January 2022

A volcanic eruption has occurred with these parameters:

Origin time: -

Coordinates: Lat: 20.54S Lon: 175.38W

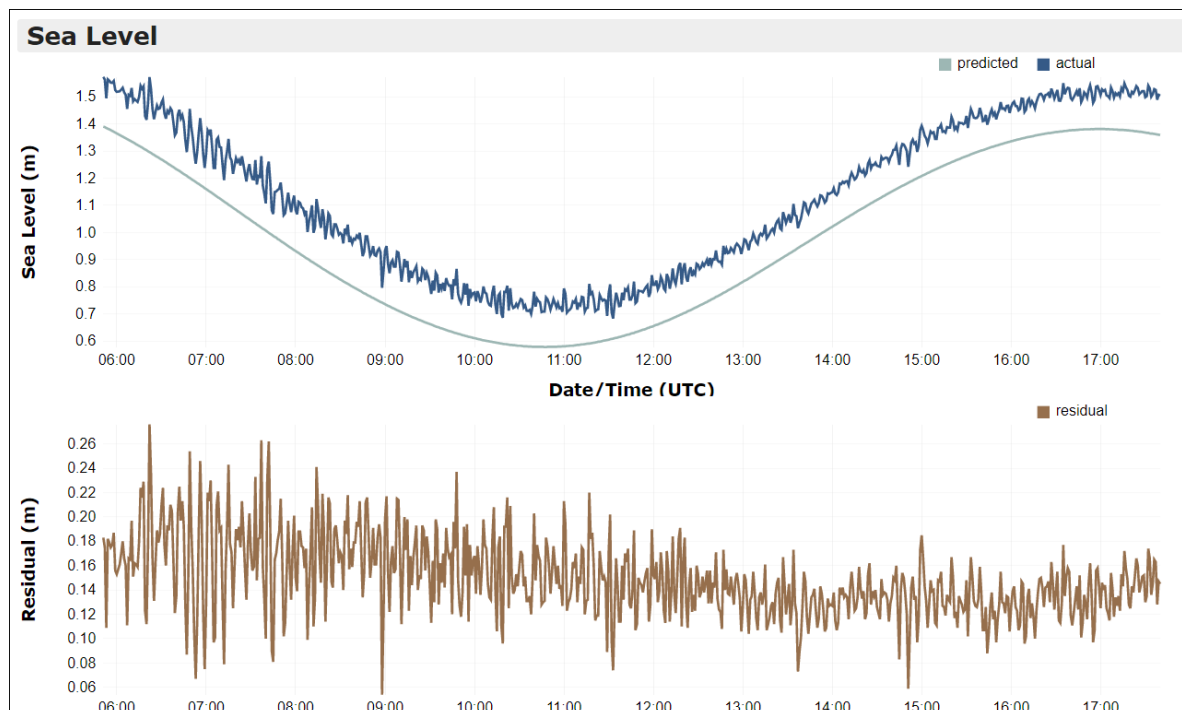
Location: Hunga-Tonga Hunga-Ha'apai

Tsunami Marine Warning for the 'otu Mu'omu'a in Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua coastal areas and waters.

(Only Warnings issued by the Tonga Meteorological Service represent the official warning status for Tonga)

The fluctuation of the sea level is currently observed and recorded in the tide gauge at Nuku'alofa, therefore, the **tsunami marine warning** remains inforce for the 'otu Mu'omu'a in Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua coastal areas and waters.

The height of the tsunami wave recorded in Nuku'alofa tide gauge was 13cm at 7am this morning. This fluctuation of the sea level is expected to continue for the next 6 to 12 hours.



Public are advised to keep away from low lying coastal areas, beaches and harbor areas. Public are also advised to avoid swimming and any related activities out at until this warning is cancelled. Mariners out at sea are advised to move to deep water.

The next bulletin will be issued at 10am early morning (15th January 2022) or as soon as new information is received. Listen to Radio Tonga.

NEOC Status:

The National Emergency Operation Centre (NEOC) is activated and remains on standby.

Normal NEOC contact details apply:

General Enquiries: (676) 26340

Issued by:

Message authorized by the Tonga Meteorological Service

General Enquiries: (676) 74 00062 or (676) 35 009

Duty Officer: TTK/PT/UV/

End of message

Annex 7

Kaniseli 'o e Fakatokanga Peau Kula ki he ngaahi matāfanga 'o e 'otu Mu'omu'a 'i Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua.

Fika: 02

Taimi tuku atu: 10:00am 'aho 15 Sanuali 2022

Ne mapuna ha mo'unga afi pea ko hono fua eni:

Taimi ne hoko ai: -

Latitude: 20.54 faka-Tonga, Longitute: 175.38 Faka-Hihifo

Feitu'u: Hunga-Tonga Hunga-Ha'apai

Kaniseli 'o e Fakatokanga Peau Kula ki he ngaahi matāfanga 'o e 'otu Mu'omu'a 'i Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua.

(Ko e Fakatokanga kotoa pe 'oku tuku atu mei he Va'a Vakai Matangi 'a Tonga ko e totonu ia 'o e Fakatokanga ki Tonga)

'Oku kaniseli atu heni 'a e fakatokanga peau kula ki he ngaahi matafanga 'o e 'otu Mu'omu'a 'i Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua.

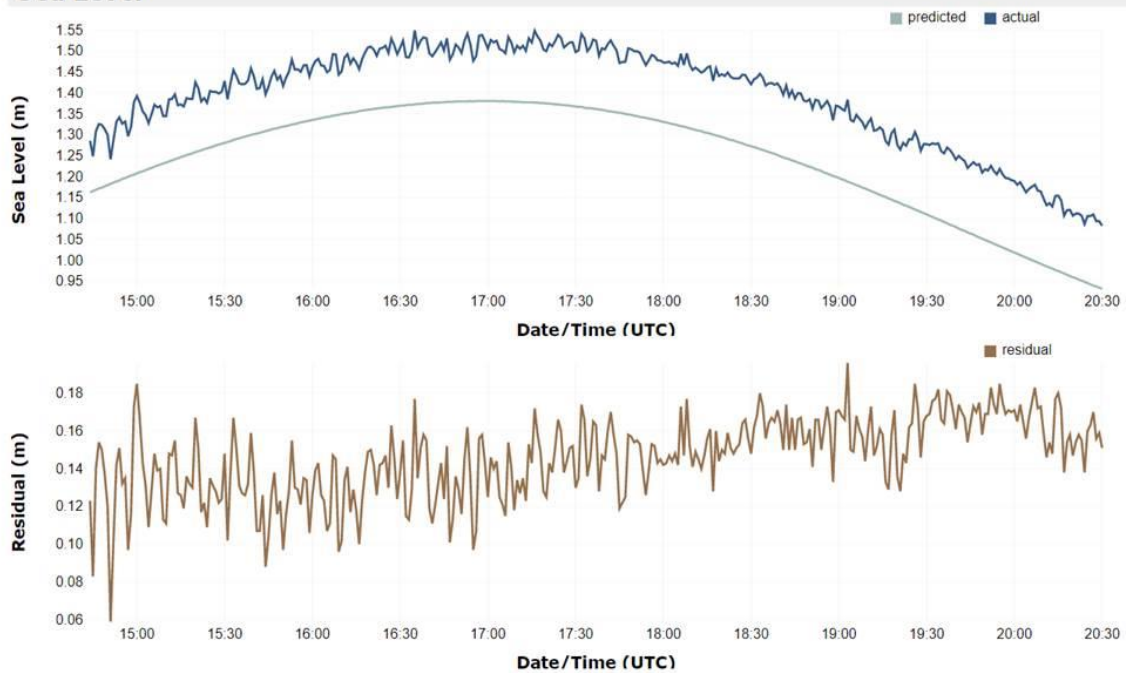
Fakatatau ki he ngaahi lipooti kuo ma'u mei he me'afua tahi 'i Nuku'alofa, 'oku ha mahino mai 'a e holo e ma'olunga 'o e fetoo'aki 'a e tahi ki he'ene anga maheni. Ko e ma'olunga 'o e fetoo'aki 'o e tahi 'i he me'afua tahi 'i Nuku'alofa ne a'u pe hono ma'olunga 'o 'i lalo pe 'i he senitimita 'e 10 'i he houa 'e 6 ne toki 'osi.

Koia ai, 'oku makatu'unga mei ai 'a hono kaniseli atu 'a e fakatokanga peau kula ki he ngaahi matafanga 'o e 'otu Mu'omu'a 'i Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua.

Tonga - Nuku'alofa

Sea Level Weather Wind 6 hours of data displayed

Sea Level



Fakatokanga'i ange pe tetau kei hokohoko atu pe mo e fetaafeaki 'a e 'au 'i he ngaahi hakau 'i he houa 'e 24 ki he 48 ka hoko mai ki he ngaahi matafanga ni.

Ko e fakamatala faka'osi eni ki he fakatokanga peau kula ki he ngaahi mataafanga 'o e 'otu Mu'omu'a 'i Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua.

Cancellation of Tsunami Marine Warning for the 'otu Mu'omu'a in Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua coastal areas and waters.

No: 02

Issued at 10:00am on 15 January 2022

A volcanic eruption has occurred with these parameters:

Origin time: -

Coordinates: Lat: 20.54S Lon: 175.38W

Location: Hunga-Tonga Hunga-Ha'apai

Cancellation of Tsunami Marine Warning for the 'otu Mu'omu'a in Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua coastal areas and waters.

(Only Warnings issued by the Tonga Meteorological Service represent the official warning status for Tonga)

The tsunami marine warning previously inforced for the 'otu Mu'omu'a in Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua coastal areas and waters are now CANCELLED.

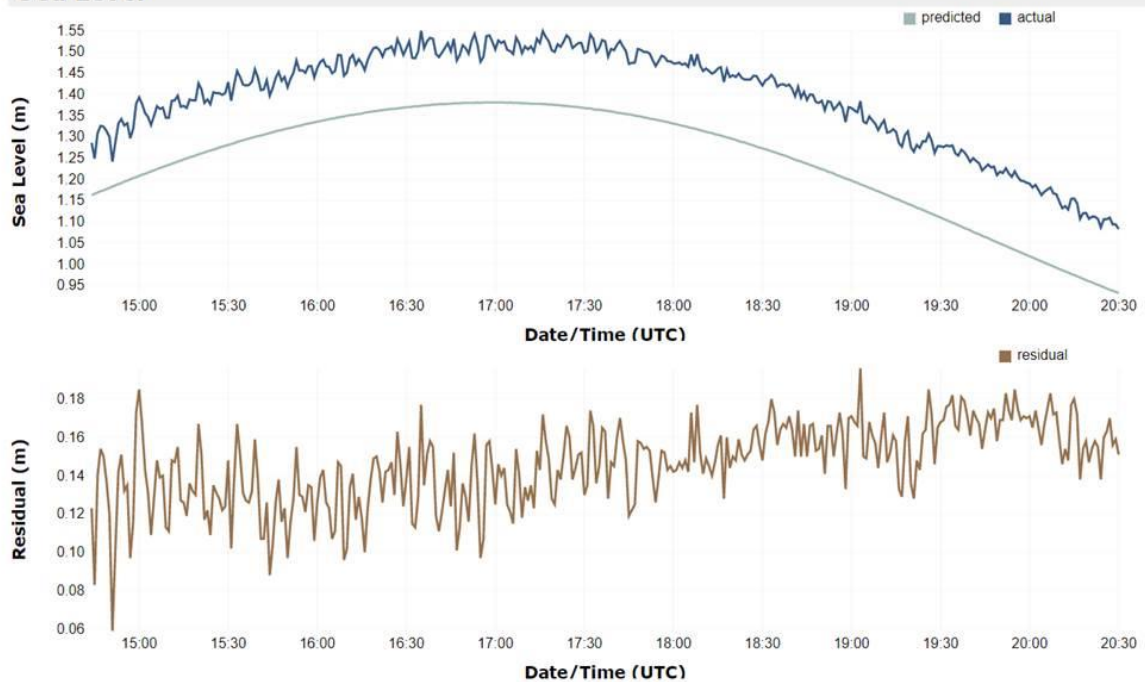
Based on the observation data recorded from the tide gauge at Nuku'alofa, it indicated that the state of the sea level is back to normal. The fluctuation of the sea level recorded in the tide gauge at Nuku'alofa was below 10cm over the past 6 hours.

Therefore, the tsunami marine warning previously inforced for the 'otu Mu'omu'a in Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua coastal areas and waters are now cancelled.

Tonga - Nuku'alofa

Sea Level Weather Wind 6 hours of data displayed

Sea Level



However, ocean currents around these reefs may be strong and erratic in the next 24 to 48 hours and special caution should be exercised

This will be the last bulletin issued from Fua'amotu Tsunami Warning Center for the 'otu Mu'omu'a in Ha'apai (Nomuka, Mango, Fonoifua), 'Atataa, 'Eueiki, Tongatapu mo 'Eua

Issued by:

Message authorized by the Tonga Meteorological Service

General Enquiries: (676) 74 00062 or (676) 35 009

Duty Officer: GV/VF/NH/TT

End of message

Annex 8

Fakatokanga Peau Kula ki Tonga
Fika: 01
Taimi tuku atu: 5:45pm ('aho 15 Sanuali, 2022)
Ne mapuna ha mo'unga afi pea ko hono fua eni: Taimi ne hoko ai: Latitude: 20.54 faka-Tonga, Longitute: 175.38 Faka-Hihifo Loloto: 0km Malohi: - Feitu'u: Hunga-Tonga Hunga-Ha'apai
Ko e malohi 'o e mofuike 'I he'ene ha atu 'i 'olunga 'e ala fetoo'aki 'o fakatatau ki he lahi 'o e ngaahi me'afua 'oku ne lekooki.
Fakatokanga Peau Kula (Ko e Fakatokanga kotoa pe 'oku tuku atu mei he Va'a Vakai Matangi 'a Tonga ko e totonu ia 'o e Fakatokanga ki Tonga) KO E SENITA FAKAFONUA KI HE FAKATOKANGA PEAU KULA ENI 'OKU FAKAHOHA'A. Tupu mei he toe mapuna hake koia 'a e mo'ungaafi Hunga-Tonga Hunga-Ha'apai pea moe lipooti mai kuo 'osi hake 'a e tahi 'i he ngaahi matafanga 'i Sopa mo Ha'atafu, koia 'OKU TUKU ATU HENI HA FAKATOKANGA PEAU KULA KI HE 'OTU TONGA NI. Ko e fale'i ki he kakai e fonua ke mavahe mei he ngaahi mataafanga pea mo e ngaahi matatahi ki lotofonua. Ki he kau folau tahi 'oku 'i tahi, 'oku fale'i ke mou nga'unu ki he loloto 'o mama'o mei he hakau mo e ngaahi matātahi. Ko e fakamatala peau kula hoko 'e tuku atu ia 'i he vave taha 'i ha'amau ma'u ha fakamatala fo'ou fekau'aki mo e anga e tu'u e tahi mo e mapuna 'a e mo'unga afi. Fakafanogo ki he letio Tonga.

Tsunami Warning for Tonga

No: 01

Issued at 5:45pm on 15 January 2022

A volcanic eruption has occurred with these parameters:

Origin time: -

Coordinates: Lat: 20.54 Lon: 175.38W

Depth: 0km

Magnitude: NIL

The above magnitude is provisional and may be increased or decreased as more seismic data becomes available.

Tsunami Warning

(Only Warnings issued by the Tonga Meteorological Service represent the official warning status for Tonga)

THIS IS THE NATIONAL TSUNAMI WARNING CENTRE.

Based on the ongoing volcanic eruption in the Hunga-Tonga Hunga-Ha'apai area and the observation reported that the sea waves already strike on the shore of Sopo and Ha'atafu, therefore , A TSUNAMI WARNING IS NOW INFORCE FOR TONGA.

Public are advised to keep away from low lying coastal areas, reefs and beaches. Mariners out at sea are advised to prepare to move to deep water.

The next bulletin will be issued as soon as new information is received. Listen to Radio Tonga.

NEOC Status:

The National Emergency Operation Centre (NEOC) is activated.

Normal NEOC contact details apply:

General Enquiries: (676) 26340

Issued by:

Message authorized by the Tonga Meteorological Service

General Enquiries: (676) 74 00062 or (676) 35 009

Duty Officer:

End of message

Annex9

Fakatokanga Peau Kula ki he ngaahi Mataafanga
Fika: 02
Taimi tuku atu: 01:48am ('aho 16 Sanuali, 2022)
Ne mapuna ha mo'unga afi pea ko hono fua eni:
Fakafuofua ki he Taimi ne hoko ai: 5:30pm
Latitude: 20.54 faka-Tonga, Longitute: 175.38 Faka-Hihifo
Loloto: -
Malohi: -
Feitu'u: Hunga-Tonga Hunga-Ha'apai
Ko e malohi 'o e mofuike 'I he'ene ha atu 'i 'olunga 'e ala fetoo'aki 'o fakatatau ki he lahi 'o e ngaahi me'afua 'oku ne lekooki.
Ko e Fakatokanga Peau Kula na'e tuku atu ki mu'a ki he 'otu Tonga ni, 'oku tukuhifo ia ki he fakatokanga peaukula ki he ngaahi matafanga kotoa 'o e 'otu Tonga ni.
(Ko e Fakatokanga kotoa pe 'oku tuku atu mei he Va'a Vakai Matangi 'a Tonga ko e totonu ia 'o e Fakatokanga ki Tonga)
KO E SENITA FAKAFONUA KI HE FAKATOKANGA PEAU KULA ENI 'OKU FAKAHOHA'A.
Tupu mei he holo 'a e tu'unga 'o e tahi kuo lekooti 'o si'i hifo 'i he mita 'e 1, pea moe ngaahi lipooti mei he va'a Sioloki 'a Tonga ki he holo 'a e tu'unga 'o e fetoo'aki 'a e tahi, 'oku tukuhifo ai 'a e Fakatokanga Peau Kula na'e tuku atu ki mu'a ki he 'otu Tonga ni, ki he fakatokanga peaukula ki he matafanga ki he kotoa 'o e 'otu Tonga ni.
Ko e fale'i ki he kakai e fonua ke mavahe 'aupito mei he ngaahi mataafanga, matatahi pea mo e ngaahi 'elia ma'ulalo ofi ki tahi. Ki he kau folau tahi 'oku 'i tahi, 'oku fale'i ke mou nga'unu ki he loloto 'o mama'o mei he hakau mo e ngaahi matātahi.
Ko e fakamatala peau kula hoko 'e tuku atu ia 'i he vave taha 'i ha'amaui ma'u ha fakamatala fo'ou fekau'aki mo e anga e tu'u e tahi mo ha toe mapuna 'a e mo'unga afi. Fakafanogo ki he letio Tonga.

Tsunami Marine Warning for Tonga

No: 02

Issued at 01:48am on 16 January 2022

A volcanic eruption has occurred with these parameters:

Estimated Origin time: 5:30pm local time

Coordinates: Lat: 20.54 Lon: 175.38W

Depth: NIL

Magnitude: NIL

Area: Hunga-Tonga Hunga-Ha'apai

The above magnitude is provisional and may be increased or decreased as more seismic data becomes available.

The Tsunami Warning previously inforce for all of Tonga is now downgraded to a Tsunami Marine Warning for all of Tonga.

(Only Warnings issued by the Tonga Meteorological Service represent the official warning status for Tonga)

THIS IS THE NATIONAL TSUNAMI WARNING CENTRE.

Based on direct sea level observation which recorded a wave height of less than 1 meter and reports from the Tonga Geological Services indicating steadily decreasing of the sea level fluctuations. The Tsunami Warning previously inforce for all of Tonga is now downgraded to a Tsunami Marine Warning for all of Tonga.

Public are advised to keep away from low lying coastline, coastal areas, and beaches. Mariners out at sea are advised to move to deep water.

The next bulletin will be issued as soon as new information is received. Listen to Radio Tonga.

NEOC Status:

The National Emergency Operation Centre (NEOC) is activated.

Normal NEOC contact details apply:

General Enquiries: (676) 26340

Issued by:

Message authorized by the Tonga Meteorological Service

General Enquiries: (676) 74 00062 or (676) 35 009

Duty Officer:OF/LF/STP/SV/ST

End of message