

IOC Global Tsunami Warning and Mitigation Systems: HTHH Interim Procedures and PTWS Products

ICG/PTWS Working Group (WG) 2 on Tsunami Detection, Warning and Dissemination
Task Team on Hunga-Tonga Hunga-Ha'apai (HTHH) Volcano Tsunami Hazard Response

Chair : France (François Schindelé)

NDMO : NZ (David Coetzee, Ashleigh Fromont)

NTWC : Chile (SHOA, Carlos Zuñiga), France (TNC, Francois Schindelé)

Tsunami Service Providers: PTWC (Charles McCreery), NWPTAC (Yuji Nishimae)

PICT: Tonga ('Ofa Fa'anunu)

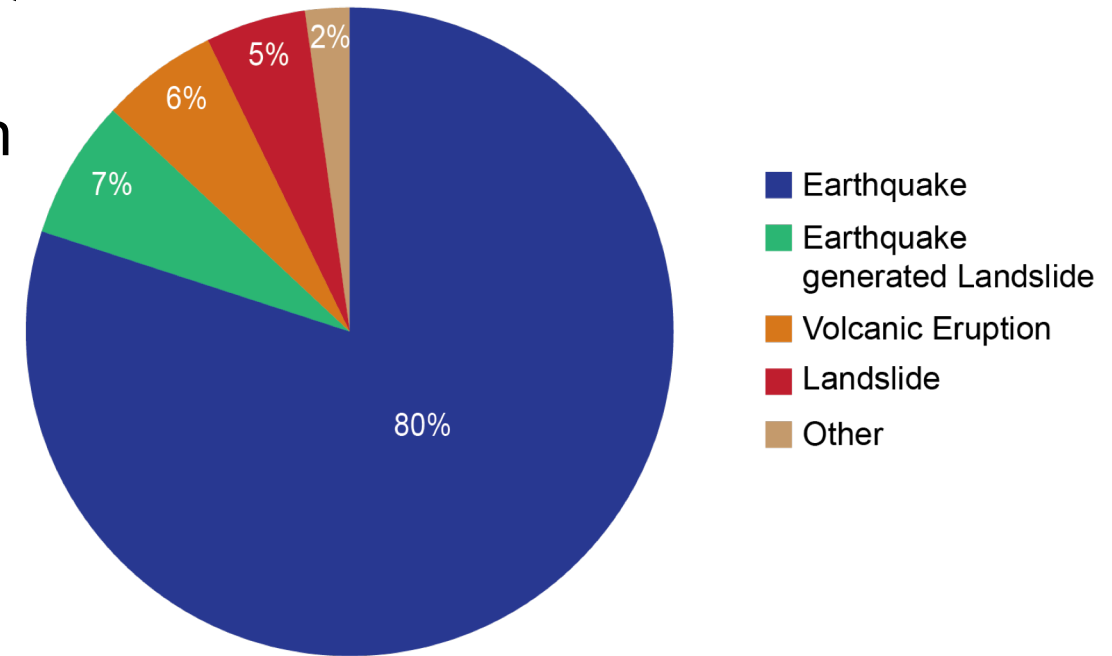
ITIC (Laura Kong)

WG2: Chair (Bill Fry)

General Challenges with Non-Seismic Tsunamis from Volcanoes, Landslides, Meteotsunamis, Bolides / Asteroid, etc.

To date, global TWS focused on earthquake-generated tsunamis

- 87% of deadly tsunamis caused by earthquakes, or EQ-generated landslides
- Early warning possible because seismic waves travel 3-4 times faster than tsunami waves
- Rapid EQ source characterization
 - => Fast tsunami source characterization
 - => Useful Tsunami forecast
 - => Life-saving tsunami warnings



So for Volcanoes

- No rapid alert
- No source location and mechanism
- No Forecast
- No Pre-Scripted Standard Products
- No Warning system

II. ICG/PTWS Post-Event Briefs (3), IOC CL 2882 (16 Mar)


1. Post-Event Briefs (20 Jan, 3 Feb, 10 Feb)

- Sharing Information, Lessons Learned
- What to do if HTHH erupts again?
- => TT HTHH Volcano Tsunami Hazard Response (TWC, DMO, PICT, PTWS WG 2, PTWC, ITIC)
 - Review, Finalize Implementation Plan
 - Provide feedback interim PTWC procedures and products
 - User's Guide, Training

2. IOC CL 2882 (16 Mar)

- Implementation Plan with Interim SOPs
- Effective March 15, 2022

PEB-I (20 Jan): <https://oceanexpert.org/event/3380>
PEB-II (3 Feb): <https://oceanexpert.org/event/3387>
PEB-III (10 Feb): <https://oceanexpert.org/event/3401>
<https://vimeo.com/showcase/9211015> pw 15jan22



INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION
COMMISSION Océanographique Intergouvernementale
COMISIÓN OCEANOGRÁFICA INTERGUBERNAMENTAL
МЕЖПРАВИТЕЛЬСТВЕННАЯ ОКЕАНОГРАФИЧЕСКАЯ КОМИССИЯ
اللجنة الدولية للحكومات لعلوم المحيطات
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IOC Circular Letter No 2882
(Available in English only)

IOC/VR/BA/ah
16 March 2022

To : Tsunami National Contacts (TNCs),
National Tsunami Warning Centres (NTWCs), and
Tsunami Warning Focal Points (TWFs) of the Intergovernmental Coordination Group of
the Pacific Tsunami Warning and Mitigation System (ICG/PTWS)

cc : Official National Coordinating Bodies for liaison with the IOC,
Permanent Delegates/Observer Missions to UNESCO, and
National Commissions for UNESCO of IOC ICG/PTWS Member States
Directors of UNESCO and IOC Regional Offices in the Asia/Pacific Region
Permanent Observers to ICG/PTWS
Director Pacific Tsunami Warning Center (PTWC)
Director, Northwest Pacific Tsunami Advisory Center (NWPTAC)
Director, South China Sea Tsunami Advisory Center (SCSTAC)
Director, International Tsunami Information Center (ITIC)
ICG/PTWS Officers

Subject: Interim Volcano-generated Tsunami
of the Pacific Tsunami Warning

The massive explosion on the volcanic island of Hunga 1
(19 m) south-southeast of Fonuafo'ou island in Tonga
generated a tsunami that caused damages locally, regionally.

This was the first time that the Pacific Tsunami Warning
event since its system is primarily focused on earthquakes
90% of the past cases of tsunami in the world.

Following this event and with reference to the information
regarding the launch of an IOC Post-Event Assessment I
several responses have been received. I am pleased to
will be published by 1 April 2022.

In response to the HTHH volcanic explosion and tsunami
(ICG) for the Pacific Tsunami Warning and Mitigation System
Tsunami Hazard Response and requested it to prepare
Procedures Implementation Plan. By way of this letter

ICG/PTWS HTHH Interim Procedures Implementation Plan, V1.1

**Hunga Tonga – Hunga Ha'apai
Volcanic Tsunami Hazard Response**

PTWS Interim Procedures Implementation Plan
Version 1.1, 1 March 2022

Due to the potential for another Hunga Tonga–Hunga Ha'apai volcanic
eruption and tsunami, immediate implementation of this Plan was begun
following the proposal presentation to Member States, their feedback, and
agreed upon 'Actions Forward' concluded from the PTWS Post-Event
Brief I: 15 January 2022; Hunga Tonga–Hunga Ha'apai Volcanic Eruption
and Tsunami held on 20 January 2022. Further Member State feedback
was provided during PTWS Post-Event Brief II on 3 February 2022 and
PTWS Post-Event Brief III on 10 February 2022.

This document presents the ICG/PTWS Interim Procedures
Implementation Plan for the Hunga Tonga–Hunga Ha'apai Volcanic
Tsunami Hazard Response for urgent consideration and adoption by the
ICG/PTWS Steering Committee.

III. IOC CL 2902 (17 Aug), HTHH Information webinar (6 Sep)

<https://www.oceanexpert.org/event/3613>

<https://vimeo.com/showcase/9211015> pw 15jan22

PTWC Interim Procedures and PTWS Products User's Guide

SPECIFIC TEXT MESSAGES



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IOC Circular Letter No 2902
(Available in English only)

IOC/VR/BA/ah/RB
17 August 2022

To : Tsunami National Contacts (TNCs),
National Tsunami Warning Centres (NTWCs), and
Tsunami Warning Focal Points (TWFPs) of the Intergovernmental Coordination Group of
the Pacific Tsunami Warning and Mitigation System (ICG/PTWS)

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Director, International Tsunami Information Center (ITIC)
ICG/PTWS Officers
ICG/PTWS Steering Committee

Subject: PTWC Interim Procedures and PTWS products for Tsunamis developed
after the Hunga Tonga Hunga Ha'apai Volcano event (User's Guide and
informational webinar on 6 September 2022)

The massive explosion on the volcanic island of Hunga Tonga-Hunga Ha'apai (HTHH), about 30 km
(19 mi) south-southeast of Fonuafo'ou island in Tonga, on 15 January 2022 at about 4:14 UTC,
generated a tsunami that caused damages locally, regionally, and across the Pacific.

This was the first time that the Pacific Tsunami Warning Center (PTWC) had to respond to such an
event, since its system is primarily focused on earthquake-generated tsunamis representing nearly
90% of the past cases of tsunami in the world.

Following this event and with reference to the information provided in the IOC [Circular Letter 2877](#)
regarding the launch of an IOC Post-Event Assessment for the HTHH volcanic eruption and tsunami,
we are pleased to confirm that nearly all Member States of the ICG/PTWS did respond to the online
survey. The results of this assessment will be published by 30 September 2022.

In response to the HTHH volcanic explosion and tsunami, the Intergovernmental Coordination Group
(ICG) for the Pacific Tsunami Warning and Mitigation System (PTWS) established a Task Team on
Tsunami Hazard Response and requested it to prepare a PTWS Interim Volcanic Tsunami Alert

HTHH Volcanic Tsunami Hazard Response:
ICG/PTWS PTWC Interim Procedures and PTWS Products User's Guide, V1.3

Hunga Tonga – Hunga Ha'apai Volcanic Tsunami Hazard Response

Intergovernmental Coordination Group for Pacific Tsunami Warning and Mitigation System (ICG/PTWS) PTWC Interim Procedures and PTWS Products User's Guide Version 1.3, 25 July 2022

Due to the potential for another Hunga Tonga–Hunga Ha'apai volcanic
eruption and tsunami, immediate development of an Intergovernmental
Coordination Group for Pacific Tsunami Warning and Mitigation System
(ICG/PTWS) Interim Procedures Implementation Plan for the
Hunga Tonga–Hunga Ha'apai Volcanic Tsunami Hazard Response was
initiated. This followed the proposal presented to Member States, their
feedback, and agreed upon 'Actions Forward' concluded from the PTWS
Post-Event Brief I: 15 January 2022: Hunga Tonga–Hunga Ha'apai
Volcanic Eruption and Tsunami held on 20 January 2022. Further
Member State feedback was provided during PTWS Post-Event Brief II
on 3 February 2022 and PTWS Post-Event Brief III on 10 February 2022.

To facilitate implementation of the PTWS Interim Volcano Tsunami Alert
Products and Procedures, the ICG/PTWS established a Task Team on
the HTHH Volcanic Tsunami Hazard Response. The Task Team finalised
the Implementation Plan and it was endorsed by the ICG/PTWS Steering
Committee on 1 March 2022 (v1.1).

This document now details the ICG/PTWS PTWC Interim Procedures and
PTWS Products User's Guide, which was developed by the Task Team,
reviewed in consensus by the ICG/PTWS Steering Committee and
subsequently approved by the Chair of ICG/PTWS on 25 July 2022 (v1.3)

HTHH Volcanic Tsunami Hazard Response:
ICG/PTWS PTWC Interim Procedures and PTWS Products User's Guide, V1.3

B) INITIAL TSUNAMI THREAT MESSAGE

The following is a sample initial Tsunami Threat Message that might be issued following the
detection of potentially hazardous tsunami waves on the nearest sea level gauge(s) to HTHH.
In this example, based upon the tsunami amplitude observed at Nuku'alofa, the forecast is for
gauge amplitudes that are 0.5 times the size of the amplitudes observed on January 15, 2022.
The initial areal extent of the threat has been limited to three hours of tsunami travel time from
HTHH. Note that the "TEST" language sprinkled throughout the message would be absent in
an actual product.

ZCZC WEP40 PHEB 041555
TSUPAC

TEST...TSUNAMI MESSAGE NUMBER 1...TEST
NWS PACIFIC TSUNAMI WARNING CENTER HONOLULU HI
1555 UTC FRI MAR 4 2022

...THIS MESSAGE IS FOR TEST PURPOSES ONLY...
...TEST PTWC TSUNAMI THREAT MESSAGE TEST...

**** NOTICE **** NOTICE **** NOTICE **** NOTICE **** NOTICE ****

THIS IS A TEST MESSAGE. THIS MESSAGE IS ISSUED FOR INFORMATION
ONLY IN SUPPORT OF THE UNESCO/IOC PACIFIC TSUNAMI WARNING AND
MITIGATION SYSTEM AND IS MEANT FOR NATIONAL AUTHORITIES IN EACH
COUNTRY OF THAT SYSTEM.

THIS IS A TEST MESSAGE. NATIONAL AUTHORITIES WILL DETERMINE THE
APPROPRIATE LEVEL OF ALERT FOR EACH COUNTRY AND MAY ISSUE
ADDITIONAL OR MORE REFINED INFORMATION.

**** NOTICE **** NOTICE **** NOTICE **** NOTICE **** NOTICE ****

TEST... VOLCANIC ACTIVITY IN TONGA GENERATED A TSUNAMI ...TEST

TEST... PRELIMINARY VOLCANO PARAMETERS ...TEST

* ACTIVITY TIME 1530 UTC MAR 4 2022
* COORDINATES 20.5 SOUTH 175.4 WEST
* LOCATION TONGA

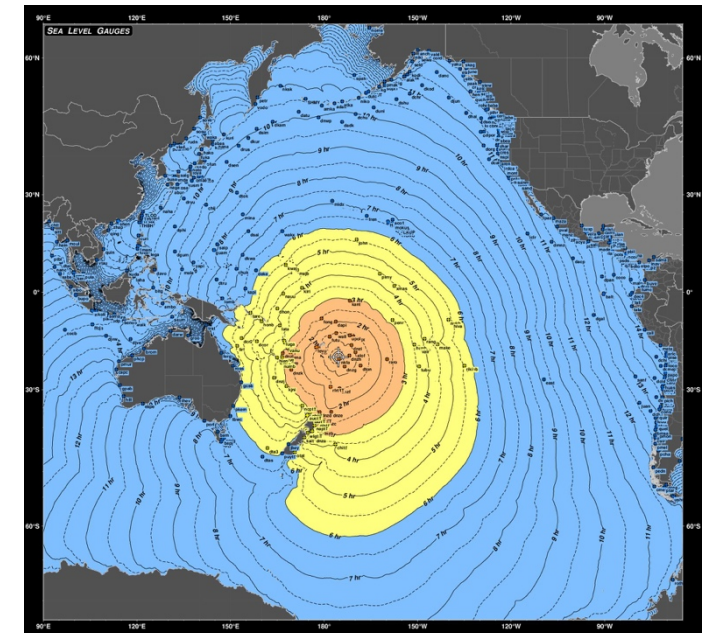
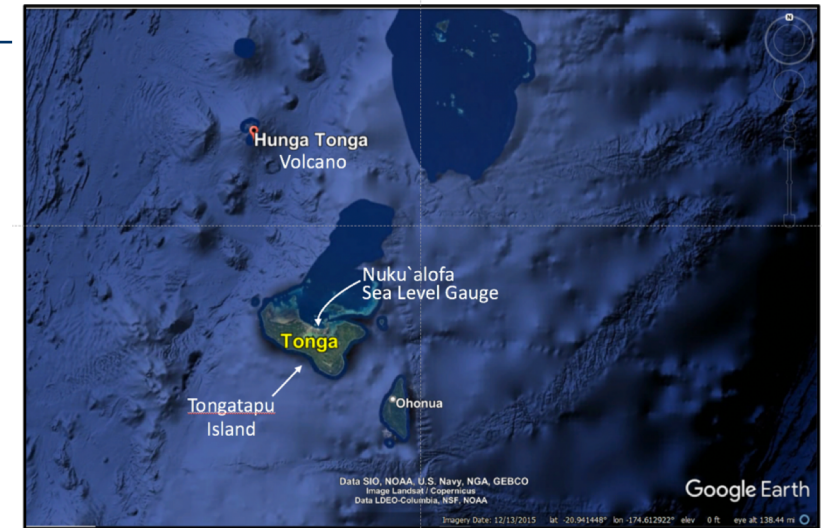
TEST... EVALUATION ...TEST

* THIS IS A TEST MESSAGE. VOLCANIC ACTIVITY OCCURRED IN THE
TONGA ISLANDS AT 1530 UTC ON FRIDAY MARCH 4 2022.

HTHH Event Response by PTWC

1. PTWC wave **alarm trigger** (Nuku`alofa or nearby gauge (NZ DART) ~15 min after eruption)
2. PTWC **alert call** to Tonga NTWC (Met Office)
3. PTWC **measure arrival time & wave amplitude** at Nuku`alofa gauge
4. PTWC issues **Threat Message** (countries within **3 hours** tsunami travel time):
 - ETAs based on Nuku`alofa arrival time
 - Amplitude forecast at tide gauges based on scaling from Nuku`alofa amplitude

HTHH is about 70 km north of Tongatapu Island



Additional Information – Alerting and Forecasting for Future HTHH Tsunamis

- **Messages use same PTWC Product IDs as PTWC uses for earthquake - generated tsunamis**
- **Message content similar but modified for HTHH source**
- **Amplitude forecast based on scaling 1/15/2022 observations to match current event observations**
- **“Best Effort” forecasting approach with caveats**
 - Generation mechanism may not be same as 1/15/22
 - Atmospheric pressure wave generation may or may not be present
 - Scaling may not be linear (e.g., if half as big on one gauge then half as big everywhere)
 - Amplitude forecasts only for gauge locations, not entire coasts
 - Estimated arrival times based on normal tsunami travel time calculation from volcano – not on atmospheric disturbance generation.

IV. Ongoing Global TOWS WG – non-seismic (non-typical) tsunamis

1. Motivated from 2018 non-seismic tsunamis – Palu, Anak Krakatau
2. TOWS-WG-XV (Feb 2022) formed **Ad-Hoc Team on Tsunamis Generated by Volcanoes**. Provide written **report to TOWS-WG-XVI (Feb 2023)**
 - **List tsunami sources related to volcanoes / eruptions, and potential threat**
 - **Identify methodologies to monitor and detect** volcanic sources of tsunami,
 - Review relationship required between TSPs/NTWCs and Volcanic Ash Advisory Centres (VAACs) and other relevant agencies to monitor / warn for volcano generated tsunamis,
 - **Develop guidelines on SOPs to monitor, detect and warn** for induced tsunami waves.

Members:

Dr François Schindel , Chair, (past Head of CPPT (French Polynesia), CENALT (France))

[Dr Laura Kong \(Director International Tsunami Information Center - USA\)](#)

Dr Rapha l Paris (Volcanologist, University of Clermont Ferrand - France)

Dr Maurizio Ripepe (Seismologist, University of Florence - Italy) – Stromboli EWS

[Dr Vasily Titov \(Tsunami Modeler, NOAA-PMEL – USA\)](#)

Thank You

ICG/PTWS Working Group (WG) 2 on Tsunami Detection, Warning and Dissemination
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