

Building Tsunami Resiliency in the Pacific: Exercise Pacific Wave 2006-2020

By Laura Kong (UNESCO/IOC – NOAA International Tsunami Information Center (ITIC), USA), Jo Guard (National Emergency Management Agency, New Zealand), Bernardo Aliaga (UNESCO/IOC Tsunami Unit, France), and Jiuta Korovulavula (UNESCO/IOC Tsunami Unit, Fiji)

All coastlines are vulnerable to tsunamis, especially those proximal to subduction zones where great earthquakes can generate local tsunamis. In 2011, the M9.0 Great East Japan earthquake generated huge tsunami waves that quickly devastated coastal towns – and in many places stranded cars and boats atop buildings Credit: Y. Fujii



| Tsunami Hazard Zone Sign NTHMP-ITIC



Tsunamis are no-notice, fast onset natural hazards that can cause catastrophic impacts. We don't know when or where the next tsunami will hit, but we do know that when communities are prepared, lives are saved. People must evacuate before the tsunami hits, or thousands may die and massive economic loss incurred that together will have long lasting negative humanitarian, social and economic effects. Lessons learned from past local and trans-Pacific tsunamis from Chile in 1960 and 2010, in Indonesia in 2004 (Sumatra), 2006 (Java), and 2018 (Palu), in Samoa, American Samoa, and Tonga in 2009, in Japan in 2011, and in the Solomon Islands in 2013, attest to the importance of readiness: when a tsunami

arrives and communities are ready to respond, lives are saved.

Nearly all of the world's earthquakes and most of the tsunamis occur in the Pacific Ocean and its marginal seas in the zone known as the "Ring of Fire" – in fact, 76 percent of the fatal tsunamis have been in the Pacific, and on average, there have been 1-2 each year since 1900. We also know that 99 percent of all tsunami casualties are from local or regional sources that hit within a few minutes or hours. Between 1980 and 2020, there were 26 local or regional deadly or damaging tsunamis in the Pacific.

Tsunami exercises and drills are effective tools to increase community readiness. They enable everyone to practice what they will do during a real tsunami. Tsunami Warning Centers practice their tsunami analyses so they can rapidly issue accurate warnings and forecasts, emergency management agencies practice their evacuation decision-making and first responder actions, critical facilities practice their shutdown procedures that will prevent catastrophic damage, and schools practice their procedures to keep schoolkids safe and parents informed. In each exercise or drill, people are practicing the right actions to take so they know what to do, and if there is a tsunami warning, every person will know where to evacuate to

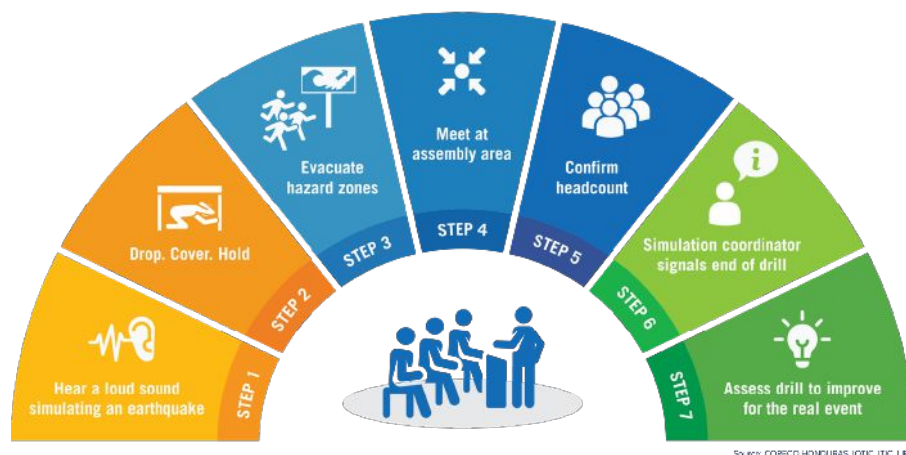
to be safe from the dangerous tsunami waves, or strong and unusual currents.

The first Pacific-wide exercise "Exercise Pacific Wave 2006" was conducted on 16 and 17 May 2006 using Philippines and Chile tsunami sources, under the auspices of the UNESCO Intergovernmental Oceanographic Commission (IOC Tsunami Programme and its Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS). The ICG/PTWS encompasses 46 Member States in and bordering the Pacific Ocean and its marginal seas. Subsequent exercises have been conducted bi-annually since 2006 (also 2008, 2011, 2013, 2015, 2016, 2017, 2018, 2020, <http://www.pacwave.info>). In addition to testing the international communication pathways, each country conducted its own national and local exercises. These have ranged from orientation workshops and straightforward communications tests to full-scale alerting and evacuations of people from tsunami hazard zones.

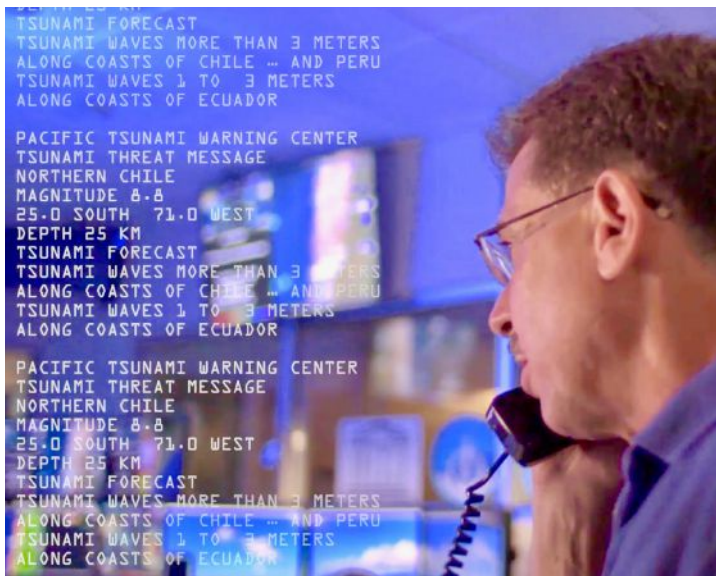
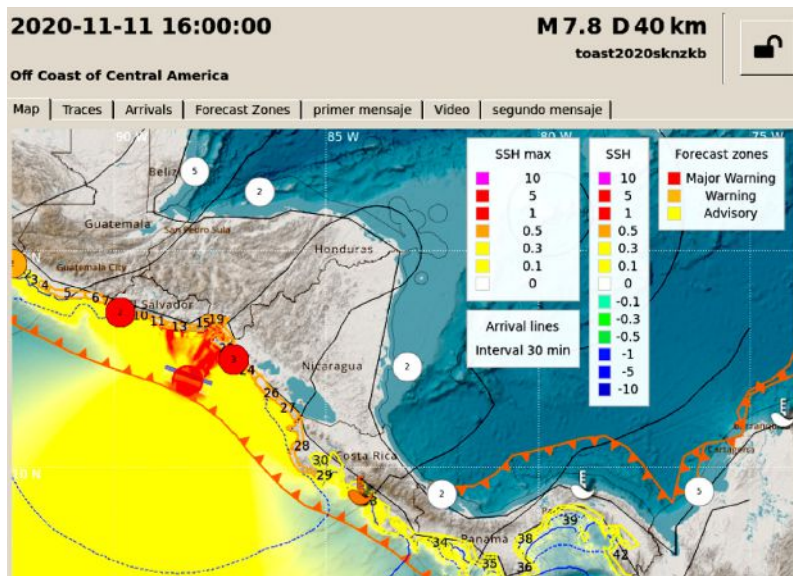
To support the tsunami exercises, the IOC has made available guidelines on exercises (How to Plan, Conduct and Evaluate UNESCO.IOC Tsunami Wave Exercises, IOC MG 58, 2012), warning and emergency management procedures (Plans and Procedures for Tsunami Warning and Emergency Management, IOC MG 76, 2017), and evacuation (Pre-



TSUNAMI EVACUATION DRILL



A Tsunami Evacuation Drill for a local tsunami starts with responding to strong shaking from a nearby earthquake, followed by evacuation for the tsunami, and afterward, a debrief or 'hotwash' to evaluate the exercise and improve the warning and evacuation process. Exercises not only strengthen community readiness, but also underpin response planning through continuous and regular review, assessment, and improvement.



| PacWave20 CATAC regional exercise scenario. Credit S. Chacón-Barrantes.

paring for Community Tsunami Evacuations: From Inundation to Evacuation Maps, Response Plans, and Exercises, IOC MG 82, 2020), as well as scenario development tools such as TsuCAT (Tsunami Coastal Assessment Tool, NOAA, ITIC, 2017), to assist countries in planning, conducting and evaluating their tsunami exercises.

For 2020, "Exercise Pacific Wave 2020" (PacWave20) took place during the period from September through to November, and consisted of varying international, national, and regional activities. On 5 November 2020 (World Tsunami Awareness Day), 46 countries around the Pacific Rim participated in a live international communications test from the IOC's Tsunami Service Providers (TSP) to every country's official tsunami warning authority. TSPs provide timely alerts to country National Tsunami Warning Centres who then assess their own tsunami threat and issue tsunami warnings to coastal communities accordingly. The TSPs in the Pacific are the Pacific Tsunami Warning Center (PTWC) in Hawaii, USA, the Northwest Pacific Tsunami Advisory Center (NWPTAC) in Japan, the South China Sea Tsunami Advisory Center (SCSTAC) in China, and the developing Central America Tsunami Advisory Center (CATAC) in Nicaragua.

Two additional sub-regional tsunami exercises also took place as part of PacWave20. One was in South

America on 22 October 2020 between National Tsunami Warning Centres (NTWC) of Colombia, Ecuador, Peru, and Chile, and the other was in Central America on 11 November 2020 involving Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica and Panama. These exercises were conducted to improve and encourage regional communication and cooperation between countries during a real tsunami event. In South America, NTWC drills testing their Standard Operating Procedures (SOPs) have been conducted at least twice a year, each with increasing difficulty.

For the 2020 6-hour exercise, Peru

PTWC Staff, on duty 24 hours a day seven days a week, issue international threat information within seven minutes. Tsunami Warning! exercises assist in improving tsunami response. The video documents the international and national tsunami warning and emergency response chain after a hypothetical M9.5 earthquake off northern Chile that strikes locally and also travels across the Pacific to hit Japan and Indonesia. Credit: ITIC, NOAA, 2015. VIDEO: <https://vimeo.com/124650777>

played the role of the PTWC by sending bulletins to each NTWC for a Magnitude 8.8 earthquake north of Nukualofa, Tonga that impacted all countries. The TsuCAT tool, which enables countries to choose from more than 5,000 sce-



PacWave20 tabletop exercise conducted at the Sakhalin Tsunami Warning Center (STWC), Russia used the 2011 Japan tsunami as the scenario. Dr. Tatiana Ivelskaya, STWC Chief (left), led discussions on the data analysis and warning procedures with staff from the STWC and Yuzhno-Sakhalinsk seismic station, and specialists from the Regional Ministry of Emergency Situations (right). Credit: T. Ivelskaya.



In 2017, the town of Cedeño, Honduras became the 1st community in the Pacific to be recognized as Tsunami Ready. To meet the guidelines, the community conducted a full-scale tsunami exercise involving schools and the community on 16 February as part of "Exercise Pacific Wave 2017". At the Safe Assembly area, Tsunami Warning! comics (ITIC and IOC-UNESCO, IOC/INF-1223, 1993, rev. 2020) were distributed for the kids to learn more about warnings. Credits: ITIC, IOC Tsunami Unit.

VIDEO: <https://vimeo.com/542305973>

narios, was used to select the scenario and generate PTWC's messages. In Colombia, the city of Tumaco conducted an evacuation exercise as part of PacWave20.

In Central America, the Central America Tsunami Advisory Center (CATAC) conducted its second regional exercise with the NTWCs. The exercise simulated a "slow" earthquake off the Gulf of Fonseca in the Pacific Ocean that impacted El Salvador, Nicaragua,

and Costa Rica, as well as Mexico and Ecuador. The scenario was similar to the deadly tsunami of 1 September 1992 on the Pacific coast of Nicaragua, and the dangerous tsunami of 26 August 2012 in El Salvador and Nicaragua. In both cases, the lack of strong shaking led people living in coastal areas to mistakenly believe that the risk of tsunamis was low. During the simulation, Costa Rica issued a warning to the beachside community of Bahia at Osa, Puntarenas,

who followed their tsunami preparedness and response plan and evacuated.

Countries also conducted national exercises to further test national communication, cooperation and local readiness.

A tsunami warning will only be successful if every person who lives, works, and plays along the coast is ready to respond and knows how to save their lives by moving out of harm's way before the big tsunami hits. Tsunami exercises are one of the most important activities for increasing community resilience and being a UNESCO IOC Tsunami Ready community (<http://tsunamiready.org>).

IOC-coordinated exercises have also been conducted in regions of the world, in the Caribbean annually since 2011 (also 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020), in the Indian Ocean regularly since 2009 (also 2011, 2014, 2016, 2018, 2020), and in the northeastern Atlantic and Mediterranean since 2012 (also 2014, 2017, 2021)



Discover more:

IOC Tsunami Programme: www.ioc-tsunami.org

WDS Geophysics - NOAA Global Historical Database: www.ngdc.noaa.gov/hazard/tsu.shtml

UN News Report on 2011 Japan Tsunami: www.news.un.org/en/story/2021/03/1086922

For PacWave20, Tuvalu conducted its Fetuvalu Secondary School Tsunami Evacuation drill (bottom right) on 19 November 2020 to test its National Response and the School Tsunami Response Plans. The scenario was a M8.8 earthquake in the Northern Tonga Trench. A total of 125 students (top) and 44 stakeholders participated. Agencies included the Department of Disaster Management as lead organizer, Tuvalu Met Services which tested its warning dissemination procedures. Department of Education, Red Cross, Police, Health Department, Tuvalu Broadcasting Corporation, Kaupule of Funafuti, Australian High Commission, and Lofeagai Community Disaster Committee.