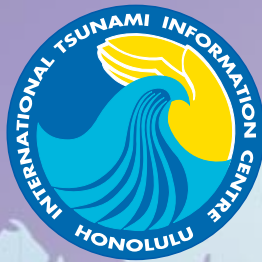


Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System



TSUNAMI NEWSLETTER



International Tsunami Information Centre

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Indian Ocean Regional Workshop on Standard Operating Procedures for Tsunami Warning and Emergency Response, Jakarta, Indonesia, 19 - 23 September 2011

In preparation for the commencement of Indian Ocean Regional Tsunami Service Provider (RTSP) operations on 12 October 2011, a 5 day regional workshop on Standard Operating Procedures (SOPs) for tsunami warning and emergency response was held in Jakarta. The objectives of the workshop were:

1. to understand the roles and products of RTSPs;
2. to understand the impact of RTSP products and services on National Tsunami Warning Centre (NTWC) SOPs;
3. to identify potential gaps and possible challenges for NTWC and National Disaster Management Organisations (NDMO) SOPs;
4. to develop/adapt SOPs to interface with the media; and;
5. to prepare for the Indian Ocean Wave 2011 exercise on 12 October.

The workshop was attended by 40 participants and trainers from 17 countries, with representatives from the RTSPs, NTWCs, NDMOs and media organisations. The participants were introduced to the new RTSP

products and discussed their impact on national level SOPs. RTSP services are being provided by Australia, India, and Indonesia. The role and responsibilities of the media in tsunami warning were also discussed. A tabletop exercise at the end of the workshop tested the participants knowledge of SOPs and provided them



Participants work collaboratively at the Indian Ocean Regional Workshop on Standard Operating Procedures for Tsunami Warning and Emergency Response in Jakarta, Indonesia. Photo courtesy of IOC.

SUMMARY OF EARTHQUAKES

1 JULY - 30 SEPTEMBER 2011

Reported by: International Tsunami Warning Centres

Compiled by: International Tsunami Information Centre, ITIC

Advisories issued by international tsunami warning centres. The Pacific Tsunami Warning Center (P) issues: Tsunami Information Bulletins (TIB), Fixed and Expanding Regional Warnings (FRW, ERW), and Ocean-wide or Widespread Watch/Warnings (TWW) for the Pacific; Tsunami Information Bulletins (TIB), Local, Regional, and Ocean-wide Tsunami Watches (LTW, RTW, TW) for the Indian Ocean (IO); Tsunami Information Statements (TIS), Local, Regional, and Ocean-wide Watches (LTW, RTW, TW) for the wider Caribbean (C). The Japan Meteorological Agency (J), issues: Tsunami Advisories (NWPTA) for the Northwestern Pacific; Tsunami Watch Information (TWI) for the Indian Ocean. The West Coast/Alaska Tsunami Warning Center (A) issues: Tsunami Information Statements (TIS), Tsunami Advisories (TA), Tsunami Watch/Warnings (TWW) for Canada, the US (including Puerto Rico, excluding Hawaii and US-affiliated Pacific Island countries), and the US/British Virgin Islands. Depth (from GCMT solution), epicentre and M_w from the USGS (G), and M_w from PTWC, WC/ATWC, and JMA at action time. Other earthquakes with M_w greater than or equal to 6.5 and a depth no greater than 100 km, as recorded by USGS, have also been included. Wave height and period measurements from sea level gauges (g) reported as amplitude (amp), peak to trough, or greatest value for either flow depth (fd) or runup (r) as indicated.

DATE	TIME (UTC)	LOCATION	EPICENTER	DEPTH (km)	M_w	PTWC (P), JMA (J) or WC/ATWC (A) ACTION	ACTION TIME (UTC)	TSUNAMI? DAMAGING?	MAXIMUM MEASUREMENT and LOCATION
6 Jul	19:03	Kermadec Islands Region	29.312° S 176.204° W	22	7.8 (A, P) 7.6 (G)	(P) 01 FRW (A) 01 TIS (P) 02 FRW (P) 02 FRW	19:12 19:13 19:33 19:59	YES NO	120 cm amplitude
10 Jul	00:57	Off East Coast of Honshu, Japan	38.040° N 143.287° E	24	7.1 (A, J, P) 7.0 (G)	(P) 01 TIB (J) 01 NWPTA (A) 01 TIS (J) 02 NWPTA	01:04 01:05 01:07 02:09	YES NO	9 cm amplitude
11 Jul	20:47	Negros, Philippines	9.504° N 122.211° E	13	6.6 (A, J, P) 6.4 (G)	(P) 01 TIB (A) 01 TIS (J) 01 NWPTA	20:56 20:58 21:08	NO NO	
23 Jul	04:34	Near East Coast of Honshu, Japan	38.932° N 141.907° E	49	6.5 (A, J, P) 6.4 (G)	(J) 01 NWPTA (P) 01 TIB (A) 01 TIS	04:45 04:57 04:59	NO NO	
29 Jul	07:42	South of Fiji Islands	23.651° S 179.822° E	542	6.6 (A, P) 6.7 (G)	(P) 01 TIB (A) 01 TIS	07:49 07:51	NO NO	
31 Jul	23:39	Near the Coast of New Guinea, PNG	3.569° S 144.844° E	12	6.8 (A, G, J, P)	(P) 01 TIB (A) 01 TIS (J) 01 NWPTA	23:45 23:46 23:59	NO NO	
19 Aug	05:36	Near East Coast of Honshu, Japan	37.673° N 141.716° E	46	6.8 (A, J, P) 6.3 (G)	(J) 01 NWPTA (P) 01 TIB (A) 01 TIS	05:43 05:52 05:54	NO NO	
20 Aug	16:55	Vanuatu Islands	18.260° S 168.069° E	32	7.5 (A, P) 7.2 (G)	(P) 01 TIB (A) 01 TIS	17:04 17:05	YES NO	20 cm amplitude
20 Aug	18:19	Vanuatu Islands	18.287° S 168.132° E	35	7.4 (A, P) 7.1 (G)	(P) 01 TIB (A) 01 TIS	18:28 18:29	YES NO	18.2 cm amplitude
24 Aug	17:46	Peru-Brazil Border Region	7.644° S 74.506° W	150	6.9 (A, P) 7.0 (G)	(P) 01 TIB (A) 01 TIS	17:55 17:57	NO NO	
2 Sep	10:56	Fox Islands, Aleutian Islands	52.185° N 171.684° W	40	7.1 (A, P) 6.8 (G)	(P) 01 TIB (A) 01 TWW (A) 02 TWW (A) 03 TWW	11:05 10:59 11:36 11:57	YES NO	6 cm amplitude

Earthquakes, *continued*

DATE	TIME (UTC)	LOCATION	EPICENTER	DEPTH (km)	M _w	PTWC (P), JMA (J) or WC/ATWC (A) ACTION	ACTION TIME (UTC)	TSUNAMI? DAMAGING?	MAXIMUM MEASUREMENT and LOCATION
3 Sep	22:56	Vanuatu Islands	20.585° S	151	7.0 (A, G, P)	(P) 01 TIB	23:02	NO	
			169.696° E			(A) 01 TIS	23:04	NO	
5 Sep	17:55	Northern Sumatra, Indonesia	2.958° N	94	6.5 (J, P)	(P) 01 TIB	18:01	NO	
			97.916° E		6.6 (G)	(J) 01 NWPTA	18:15	NO	
9 Sep	19:42	Vancouver Island, Canada Region	49.493° N	22	6.7 (A, P)	(A) 01 TIS	19:43	NO	
			126.967° W		6.4 (G)	(P) 01 TIB	19:46	NO	
15 Sep	19:31	Fiji Islands Region	21.559° S	630	7.4 (A, P)	(P) 01 TIB	19:38	NO	
			179.369° W		7.3 (G)	(A) 01 TIS	19:40	NO	
16 Sep	19:27	Off East Coast of Honshu, Japan	40.303° N	20	6.6 (A, P)	(P) 01 TIB	19:39	NO	
			142.801° E		6.7 (G)	(A) 01 TIS	19:40	NO	
18 Sep	12:41	Sikkim, India	27.723° N	47	6.8 (J, P)	(P) 01 TIB	12:50	NO	
			88.064° E		6.9 (G)	(J) 01 NWPTA	13:08	NO	
22 Sep	23:07	Samoa Islands Region	15.449° S	12.0	6.8 (A, P)	(P) 01 TIB	23:14	NO	
			175.293° W		6.4 (G)	(A) 01 TIS	23:18	NO	

IO Regional Workshop, *continued*

with an insight into the practical applications of the new RTSP products.

This workshop was decided at the 8th Session of the Intergovernmental Coordinating Group for Indian Ocean Tsunami Warning System (ICG/IOTWS) in Melbourne in May 2011 co-sponsored with United Nations Development Programme (UNDP) Asia Pacific Regional Centre, and was hosted by the Indonesia Agency for Meteorology, Climatology and Geophysics (BMKG). Its primary purpose is to bring the Indian Ocean Regional Tsunami Service Providers (RTSPs), NTWCs, NDMOs and regional media groups together to help prepare the IOTWS for the implementation of the new Regional Tsunami Service Provider (RTSP), which will become operational on 12 October, following the IOWave11 exercise.

The launch of the RTSP service in the Indian Ocean marks a significant milestone for the IOTWS and represents the culmination of six years of development and preparation, since the ICG decided to develop its own regional tsunami warning capability in December 2005.

Since the Indian Ocean tsunami on 26 December 2004, UNESCO through its Intergovernmental Oceanographic Committee (IOC) has played a major role in overseeing the development of the Indian Ocean Tsunami Warning System. The ICG/IOTWS Secretariat has assumed a crucial role in facilitating the implementation of the Indian Ocean Tsunami

Warning System by arranging meetings of the ICG and its working groups, by ensuring the flow of information and reports between the Member States, and by continuously monitoring and updating work and implementation plans.

The importance of Standard Operating Procedures in tsunami warning and emergency response at National Tsunami Warning Centres and at Disaster Management Organisations was recognised and identified as a weakness during capacity assessment missions to Indian Ocean Member States undertaken between 2005 and 2007. Recognising this need, UNESCO IOC in collaboration with the International Tsunami Information Centre has since 2008 been conducting a programme of training workshops with the support of the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) Multi Donor Trust Fund to develop the necessary capacity in the Indian Ocean and Southeast Asia region.

At the national level, UNESCO/IOC and the UNESCO Regional Science Bureau for Asia and the Pacific established the Jakarta Tsunami Information Centre in 2006 to support the coordination of tsunami information and to promote preparedness and awareness in Indonesia. From early 2010, with the support of the UNESCAP Multi Donor Trust Fund, the JTIC expanded its role to support the development of awareness and education materials in Thailand, the Philippines, Timor Leste and Indonesia. At its last session in Melbourne,

IO Regional Workshop, *continued*

the ICG/IOTWS decided to support the expansion of JTIC's role to become an information centre for the wider Indian Ocean region.

With the RTSP service scheduled to commence on 12 October, this workshop was both timely and

important. The IOWave11 exercise will provide the countries of the region with an opportunity to evaluate their readiness for this new service. It is essential that they are prepared for the new warning products they will receive from the RTSPs and that their Standard Operating Procedures have been adapted accordingly.

ITIC-PTWC NEWS**ITIC Training Programme-International (ITP-Intl), Vanuatu Workshop, Port Vila, Vanuatu, 12-16 September 2011**

by Dr. Laura Kong, Director, ITIC

The following summarizes the ITP-Intl: Tsunami Early Warning and Mitigation Systems Workshop in Vanuatu. There were 39 total participants from various Vanuatu stakeholder agencies (Meteorology, Geology, NDMO, media, other government and non-government agencies) and an international team from IOC, ITIC, PTWC, World Bank and SOPAC. This training was a continuation of recently conducted ITP-Intl: Pacific Island Country tsunami capacity building workshops in Tonga (2009); Samoa (2009, 2010); and Fiji (2010). The ITIC carries out its international tsunami information resource and capacity building activities per NOAA-UNESCO Intergovernmental Oceanographic Commission (IOC) arrangements. The Pacific Tsunami Warning Center (PTWC) provides warning services for the Pacific Ocean.

Training topics covered through plenary lectures were on tsunami warning and emergency response including:

- Vanuatu Tsunami Plan development
- Lessons Learned from Past Tsunamis, and Tsunami Case Studies
- Tsunami Science, Hazards, and Warning Centers, including PTWC services
- Tsunami Warning Center (TWC) Operations, Roles and Responsibilities, and Standard Operating Procedures for centers
- TWC Decision Support Tools
- Tsunami Emergency Response by National Disaster Management Organizations, including Roles and Responsibilities and Standard Operating Procedures for alerting and evacuation
- Tsunami Information Dissemination, including technologies and the role of media
- Preparedness, Education and Awareness
- Exercises and Drills – preparation for Exercise Pacific Wave 2011

A Course Manual was compiled and distributed comprised of reference materials used in the training.

Outcomes of the Training included:

- By the end of the workshop, Vanuatu agencies drafted a customized Vanuatu Tsunami Plan.
- Sharing of best practices amongst international experts and Vanuatu participants.
- Plenary sessions were held covering tsunami science, hazards and warning centre operations, and emergency response and preparedness. The trainers included many examples from their working experience in their lectures, which helped the trainees relate to their own operational experience. Sessions were also



Participants of the Vanuatu Tsunami Early Warning and Mitigation Systems Workshop breakout into a working group to review their Standard Operating Procedures. Photo courtesy of L.Kong.

ITP-Intl, Vanuatu, *continued*

devoted to briefings from the attending Vanuatu agencies, providing a local context to the current status of tsunami plans. Vanuatu groups broke out for more detailed training on their specialist topics before coming back together to draft a Vanuatu - PacWave 11 Exercise Plan.

- Vanuatu agencies also developed a “Strategy for the Way Forward” on the next steps (short term and long term) that need to be taken to fully develop a Vanuatu “end to end” Tsunami Early Warning and Mitigation System.

ITIC Training Programme-Hawaii (ITP-Hawaii), Honolulu, Hawaii, USA 21 August - 2 September, 2011

The International Tsunami Information Center (ITIC) in conjunction with the Pacific Tsunami Warning Center (PTWC) performs an annual training course for different countries, located in the Pacific Basin, in

order to train, develop and standardize procedures and actions to mitigate the effects of tsunamis. This course was conducted between August 21 and September 2, in Honolulu, USA, and it consisted in two weeks of classroom and professional visits to PTWC and relevant tsunami agencies. The main purpose of this course was to request participating countries to expound on the Standard Operating Procedures (SOPs) which consist on pre-planned actions for the receipt, analysis, dissemination and monitoring of seismic and oceanographic parameters used for watches, warnings and cancellations of tsunamis. It also considered the projection of SOPs according to what participants learned in the course. Similarly at this time, the course considered the preparedness and planning of the exercise Pacwave 11 to be held between 9-10 November 2011.

The participating countries were the following: Hong Kong, South Korea, Haiti, Niue, Kiribati, Fiji, Antigua and Barbuda, Tonga, Peru, Ecuador and Chile.



Participants of the 2011 ITIC Training Programme-Hawaii. Front row (l to r): Edward Young (US NWS Pacific Region Headquarters), Dr. Wenxi Zhu (Technical Secretary, IOC WESTPAC); Dr. Laura Kong (ITIC), Lorena Ismodes (Peru Directorate of Hydrography and Navigation), Rennie Vaiomounga (Tonga Geological Services Unit). 2nd row (l to r): Noor Matalatta (Malaysia Met Dept); Sean Tukutama (Niue Met Service); Ueneta Toorua (Kiribati Met Service), Edwin Uscocovich (Ecuador Naval Oceanographic Institute), Gerard Metayer (Haiti Maritime Navigation Service); Dick Lau (Hong Kong Observatory); Hwang Chang-Su (Korea Hydrographic and Oceanographic Administration), Nicolas Guzman (Chile Naval Hydrographic and Oceanographic Service). Back row (l to r): Sefanaia Seru (Fiji Mineral Resources Dept), Brian Yanagi (ITIC), Keithley Meade (Antigua & Barbados Met Services), Sergio Pardo (Peru Hydrography and Navigation), Alvaro Carrasco (Chile Naval Hydrographic and Oceanographic Service), An Jang Hyun (Korea Hydrographic and Oceanographic Administration). Photo courtesy of B. Yanagi.

ITP-Hawaii, *continued***Country Trip Reports**
ITP-Hawaii 2010**Antigua***by Keithley Meade, Antigua & Barbados Met Services*

This visit took us to the 'big' Hawaiian island of Hawaii, to the Pacific Tsunami Museum, the affected areas of downtown Hilo, which has suffered devastating effects in 1946 and again in 1960, the Volcanoes of Kilauea and the mitigations measures taken by the community of Laupahoehoe after it was affected on April 1 1946. About twenty students and three teachers were killed as a result of the tsunami generated by an earthquake that occurred in Aleutian Islands. There was also a comprehensive tour of the Hawaii County Civil Defense Agency.

At the Pacific Tsunami Museum, dedicated to the memory of those who lost their lives tragically in Hilo Bay tsunami(s), the group got a more than rousing presentation, with the staff presenter rehashing the scene just before the tsunami and stressing the importance of public education in order to save lives. The group was afterwards allowed to view information and photos about the tsunamis that have devastated the Hawaiian Islands in the past, photos and graphics that describe how plate tectonics work and how they cause tsunami and learn about seismographs and tsunami warning systems.

After Pacific Tsunami Museum we visited the Hawaii Volcano Observatory at Kilauea for a presentation and tour of the facility. There we learned that the Kilauea is the youngest volcano on Hilo. For many years Kilauea was thought to be a satellite of the Mauna Loa volcano. However, research has shown that Kilauea has its own magma-plumbing system, extending to the surface from more than 60 km deep in the earth.

Afterwards, we visited the Laupahoehoe Community to observe the monuments dedicated to those who lost their lives when a tsunami struck the community on April Fools day tsunami on April 1, 1946. On that day the old school building at Laupahoehoe was inundated, and twenty students and four teachers drowned. We also saw the great strides that have taken place since that fateful day to put early warning measures in place and to educate the community. Signs indicating evacuation zones, sirens and other public educational mechanisms.

Our tour of Hilo culminated with a visit to Hawaii County Civil Defense Agency headquarters where their methods and practices were explained of how

the agency handles events like a tsunami or any other type of hazard. They keenly explained also the value of working effectively with other agencies such as the police and the media.



ITP participants visit the Pacific Tsunami Warning Center. Photo courtesy of B. Yanagi.

Presentations of Country PacWave11 plans Participants were asked to develop their plans for the PTWS Pacific-wide Tsunami Exercise "PacWave 11" from November 9th to 10th, using the knowledge and tools gained during the course. From the lively presentations it was clear that quite a bit was learnt by the participants on developing SOPs, using the PTWC decision support tools and the best practices taught. Not being from the Pacific region, I sought to concentrate on the SOPs and the problems that being a meteorological office and the Tsunami Warning Focal Point (TWFP) can present, since the staff is not really geared towards tsunami but rather weather events. My approach was to bring an Information Technology solution to the problem by developing a software program that will easily allow for the staff to follow the SOPs in a quick and efficient way. The motivation for this solution was the problems we faced following the Joint CARIBE Wave 2011 and LANTEX 2011 exercise on March 23rd 2011, when it became obvious that as the TWFP, only a few members of staff were familiar with the existing SOPs. The idea is, not that the staff is not to be made familiar with the SOPs but the need to strengthening the TWFP process as a first point of contact.

The workshop was indeed timely and clearly showed the need for islands states, including the Caribbean and in particular Antigua and Barbuda, to continue to educate the public and to establish methods and approaches to ensure a proper End-to-end Warning System. It also demonstrated the need to continue to train staff, develop and revise SOPs and to organize

Country Trip Reports, *continued*

national drills in order to minimize loss of life in the event of a visit by a tsunami.

Chile

by Nicolas Guzman and Alvaro Carrasco, Chile Naval Hydrographic and Oceanographic Service

The National Tsunami Warning System (SNAM) of the Hydrographic and Oceanographic Service of the Chilean Navy (SHOA) is continuously enhancing its operational procedures, so that the participation in this course will allow to propose and suggest various modifications to improve the procedures, equipment and staff that currently is operating the SNAM, in order to SHOA has an efficient, modern and updated tsunami warning center to give security to the public and country.

Considering the above points learned in the course, a much better view about different aspects related to Tsunami Warning Centers, lessons learned, new technologies, procedures, examples of other countries, among others could be obtained. All of these will allow identifying clearly several gaps of National Tsunami Warning System (SNAM). Among the SNAM weaknesses, some could be modified without major difficulties, but others require political will, time and money to be conducted.

There is a key proposal that gives the solution to the current system corresponding to the following number one. However, it requires a suitable decision that considers equipment and trained staff that is efficient and diligent in delivering information, supported by precise and well-structured SOPs, and no doubt to users.



ITP participants listen to a panel discussion by ITIC Director, Dr. Laura Kong (lower right); PTWC Deputy Director, Dr. Stuart Weinstein; and PTWC Director, Dr. Charles McCreery. Photo courtesy of B. Yanagi.

Actually, within the proposals that do not require great efforts to fruition, but which are fundamental for the operation of a Tsunami Warning Center, are the assessment and modification of the SOPs which must be reviewed and modified periodically. In relation to these procedures, a series of measures and changes will be proposed to implement or evaluate their implementation in the short and medium term.

Finally, in accordance to the exercise PacWave, a proposal for its staging will be considered, as coordinated with PTWC.

Complex and simple proposals to be evaluated and implemented and according to what we have learned through this training course are:

1. Integration of Agencies

The current organizational structure related to SNAM, is divided into three institutions. In the flow of information between the organizations and population is illogical (information travels from Santiago to Valparaiso and it returns to Santiago again). Consequently, considering the current positions of the Centers Tsunami Warning, where the time between the earthquake and warning dissemination to the public should be kept to a minimum, where communications suffer serious damage and where responsibility should be centralized to avoid aberrations such as occurred on 27 February 2010, when the tsunami warning was not released to the public, it is recommended that a single institution carries out all this work, or at least, the seismological institution with the organization responsible for evaluation of the earthquake should join in two institutions.

The main proposal is based on merging the three agencies and creating a single organization that receives, analyzes and disseminates the information to the population, as does the PTWC, the Japan Meteorological Agency (JMA), Malaysia and Korea among other countries.

2. Making Decision Support System

The SNAM operational system has a number of weaknesses in the making decision support system that can be improved in the short and medium term. The following are the failures and suggestions.

- a. SNAM depends directly on the PTWC, ATWC, USGS and SSN to obtain the seismic parameters, which allow assessing a potential tsunami or non-occurrence of it.

Country Trip Reports, *continued*

Proposal: to elaborate a project to integrate the seismic sensors of the SSN into SNAM (current study), or the integration of software such as Seiscom P3 or Antelope for displaying the magnitude, location and depth of earthquakes in the shortest time, using information from the Global Seismic Network (GSN).

- b. SNAM deliveries, for near-field earthquakes, tsunami watches and warnings for the whole country, but it cannot identify the areas to be affected by the tsunami and those which will not. Also, it cannot identify the areas that could be affected by destructive tsunamis (e.g. in Talcahuano February 27, 2010) or tsunamis with lower hazards. (Valparaiso March 11, 2011).

Proposal: to report two tsunami warning levels based on wave height on the coast, using numerical tsunami



ITP participants visit Hawaii County Civil Defense Agency facilities in Hilo. Photo courtesy of B. Yanagi.

forecast model that simulates the behavior of a tsunami wave after an earthquake. To repeat this procedure a thousand times in order to store thousands of pre-modeled scenarios in a database. Simultaneously, to design a computer application that allows displaying an image in seconds with different tsunami warning levels (colors) on the coast of Chile, based on earthquake parameters which should be entered into the application. (All this is currently running and must be completed in December 2012).

As proposed to the PTWC and ITIC in this course, the real-time modeling is not a solution to Chile; taking into account different scenarios and very high magnitudes (to avoid underestimates as happened to Japan in March this year), the purpose of informing safely and quickly is completed. For far-field events, the real-time modeling may be considered in a medium-term future, since it has several hours of response actions. As

additional information, PTWC will deliver the modeled wave heights in real time from the year 2013.

- c. SNAM must manually enter data into an application for each earthquake to send warnings by e-mail, fax and SHOA web page. It must also manually enter earthquake location details for the Tsunami Travel Time program (TTT).

Proposal: To develop programs that receive information from emails, or CISN display and introduce and process the data automatically, providing a proposed response (which must be approved by the Chief Service Officer). In short, all the possible systems must be automated to prevent human error and increase response actions.

3. Standard Operating Procedures (SOP)

The following are a series of proposals based on lessons learned and recommendations of the ITIC and PTWC:

- a. To review and modify earthquake magnitude thresholds, tsunami watches and warnings.
 1. Each country has a different reality and must make its own analysis based on historical data (such as SHOA does). There is non-destructive tsunami record from 7.0 on the Richter scale, which does not match with the actual 7.5 threshold. If a 7.4 earthquake in shallow waters occurs, it could generate a destructive tsunami. In addition, PTWC will do exactly the same thing; Peru transmits warnings for earthquake of magnitude over 7.0 and Ecuador over 7.3.
 2. To conduct a study to separate by sector (north of Puerto Montt and south, following the geological line that divides Chile in two main areas of seismic activity) and have 2 different procedures, depending on location of the epicenter.
 3. Medium intensity earthquakes are reporting. This role should be responsibility of in-country seismological services. In the case of countries that have Tsunami Warning Center in conjunction with the seismic division is justified, but not in the case of Chile. It is suggested to report the earthquakes greater than or equal to 6.0 on the Richter scale.
 4. Far-field earthquakes are reported in accordance with magnitude over 6.5 and

Country Trip Reports, *continued*

less than 100 km depth. It is suggested to change to 7.0 or higher for all the earthquakes, regardless of the depth and only those within the Pacific Basin.

- b. To check positions of the current staff covering SNAM guard and responsibilities in time of crisis (during an earthquake) and in normal times for near and far field, since it has not been specified in such manner. For example, it has been found that in seismic events in the middle of the night, SNAM takes 5 to 10 minutes to disseminate warnings after receiving the seismic data, because the Chief Service Officer should dress himself quickly and go down from the wardroom to validate the information.

This can be avoided if the responsibility is given to the oceanographer between 1 and 8 am, who is at the SNAM and is an expert in the area.

It is also recommended to propose times for all the activities; for example, the information should be disseminated simultaneously by VHF and within 3 minutes per fax, e-mail and website, at the moment it is received.

It is generally suggested to review all the procedures, positions and responsibilities to rewrite the current SOPs, with all the associated documentation (such as Permanent Task Order, Internal Permanent Order, Internal Task Order OPT/OPI/ OTI). Note that the SOPs must be designed so that each event has the same quality in the result, no matter who is on duty or who serves in particular.

4. Instructions And Transfer Of Information To The National Emergency Office Of The Ministry Of Interior (ONEMI from its abbreviation of Spanish)

In the course various topics related to the emergency were covered, which could be useful for ONEMI and SHOA. Some of these are as follows:

- a. To widen the tsunami warnings, including television and radio which will receive and broadcast automatically on all channels available. A radio frequency destined only for emergencies can also be assigned. It could allow hearing reports on the emergency regulations.
- b. To consider the use of sirens with voice message machine on all the coastal communities, for tsunami warnings.
- c. To include tsunami inundation charts in

telephone directories for locations that have such a tool.

- d. To consider police roadblock for flood areas in case of tsunami warning.
- e. Exercise in schools, as these institutions are available to receive any instruction or extracurricular activity that is helpful.
- f. To implement a month called "a tsunami month", for mass dissemination of tsunami information to the population. Exhibitions, books, pamphlets, or any printed information must be considered. An example, it may be February, in commemoration of 27F.

5. Exercise Pacwave 2011

During the course, planning PacWave 2011 to be held



Hawaii County Civil Defense Agency Administrator, Quince Mento, describe tsunami emergency response operations to ITP participants. Photo courtesy of B. Yanagi.

on 9 and November 10 this year was asked to elaborate. For its staging, two PTWC dummy bulletins will be disseminated (these will be posted on the website of the year), corresponding to a tsunami warning in the Valparaíso Region. SHOA and ONEMI will carry out a large scale exercise in the region. Accordingly, the details are below:

- a. Planning: A month before a meeting will be held with all participating agencies to instruct on the general objectives and actions to be implemented by institutions for the year. A week before an instruction will detail the participating staff in the SNAM. The same day, an hour before, a review will be undertaken to check that everyone knows exactly what to do. Evaluators and Exercise Controller will be appointed.

Country Trip Reports, *continued*

- b. Staging: participating agencies will simulate 7 minutes before receiving the PTWC bulletin, the occurrence of a major earthquake in the region of Valparaíso, considering use of Datamar2 (Gobmar and capuertos) and VHF (ONEMI). Then, a tsunami warning dissemination, considering all channels, will clearly indicate "exercise," with the exception of the website.
- c. Review: On the same day, a hot debriefing with the participating staff, will inform the results of the evaluators, and suggestions and comments will be made.

6. Continuation of Course

It is recommended to continue participating in this course, because its high international level and due to it allows evaluating SNAM performance, identifying weaknesses and strengths, updating knowledge and obtaining experience of various warning centers. Within two vacancies that can be used by Chile, it is suggested that attendance at such course be assigned to at least one of the members of SNAM, either technical or managerial person.

Haiti

by Gerard Metayer, Haiti Maritime Navigation Service

PTWS is the first Tsunami Warning System developed across countries in Pacific Ocean because the majority of tsunamis have been in Pacific Ocean. With its structure and organization, Pacific Tsunami Warning and Mitigation System designs a Global Tsunami and Mitigation System. It works in End-to-End Risk Reduction by hazard risk assessment, warning guidance, and mitigation/awareness.

These tools like CISN, TsuDig, Tide Tool, Tsunami Travel Time (TTT) and others will be widely used in my country. Service Maritime et de Navigation d'Haiti (SEMANAH) expects to establish a monitoring center and will use these different softwares. We also think that many haitian institutions in the tsunami warning in Haiti will be able to use them for monitoring earthquake in real time, sea level changes, use TsuDig as database and calculate the travel time of a simulated tsunami.

With materials given we are going to work to produce some materials adapted to the Haitian reality. In Haiti awareness is very important and the materials from ITIC provide good information which will be inserted across awareness campaign and let have a great orientation to teach tsunami in Haiti at three levels: schools, media, public and private sectors.

Haiti is under the area of responsibility of PTWC and receive from it Watch messages and Tsunami Information Bulletin (TIB). We take advantage to thank Charles McCreery and staff for the hard job they do. Visiting PTWC lets us materialize different information read across books, texts and abstracts, and understand its Standard Operation Procedures (SOPs) to send different messages in case of tsunami to coastal areas under its responsibility. At PTWC we realized the utility of Information and Communication Technology serving different people in order to save lives.

Hong Kong

by Dick Lau, Hong Kong Observatory



Tsunami wave tank display at the Pacific Tsunami Museum in Hilo, Hawaii. Photo courtesy of N. Guzmán.

The training was conducted in the Pacific Guardian Centre Conference Room. The training consisted of country report presentations, lectures, discussion sessions and assignments on review of country SOP, sessions on planning for the PacWave11 and a two-day off-island field trip to Big Island. The first week of the training was mainly on background information of seismology and tsunami and the operation of tsunami warning centre. In the second week of the training, the focus was placed on Tsunami Emergency Response (TER), SOP and PacWave11. The followings are highlights of the training:

- Dr. Laura Kong, the Director of ITIC, kicked off the training by delivering a presentation on the requirements and implementation of the Pacific Tsunami Warning and Mitigation System (PTWS). She briefed on the history for establishing PTWS. She highlighted that 80% of tsunami which caused casualty was local

Country Trip Reports, *continued*

and regional tsunamis. She also emphasized that more effort would be put for educating the public to have self-evacuation capability and build more strong buildings. An effective system meant that all people in vulnerable coastal communities were prepared to respond appropriately, and in a timely manner upon recognition that a potentially destructive tsunami might be approaching. She also talked about the lessons learned from past tsunami events that provided a basis for improvement of the PTWS.

- Dr. McCreery, the Director of the Warning Centre (PTWC) and Dr. Weinstein, the Deputy Director of PTWC were invited to deliver talks on the operations in the PTWC, including the operating procedures for issuing warning bulletins for distant, regional and local tsunami, on seismic monitoring and generation and use of experimental products etc. Dr. Weinstein introduced the warning thresholds for different types of bulletins issued by PTWC for the Pacific Ocean. The requirement and scope of SOPs were also explained. He said that SOP was a set of written instructions for routine repetitive organization activities and was detail work processes to be followed within organization. SOP documents could be divided into different types for use in different occasions such as crisis and non-crisis management. A half day visit to PTWC was arranged in the first week to give every participant a good chance to look at the instrumentations used by the centre and have better understanding of the operations of PTWC.
- Dr. Wang from PTWC talked about the need for real-time tsunami forecasting. A tsunami forecast could be refined or updated using real-time parameters when earthquake location and focal mechanisms became available, which might or might not agree with the pre-defined sources in the database models. He also emphasized on the sensitivity of the earthquake depth to the tsunami height in the database models. There were three tsunami forecast models used in PTWC. Two of them were pre-computed databases (PMEL's SIFT and WCATWC's ATFM) and the other one was computed in real time (PTWC's RIFT).
- Professor Kwok Fai Cheung from Ocean and

Resources Engineering of University of Hawaii delivered a talk about tsunami modeling science and Hawaii tsunami inundation mapping. He said that that for modeling purpose, the tsunami height could be approximated by simple 2D mathematical functions and there would be no need to model a 3D solution. It was a simple approach to make assumption that the flow of water was uniform over water column, i.e. velocity at the water surface was the same as that at the bottom. Furthermore, he emphasized that the two key features, namely the development of tsunami bore and the effect of the size of tsunami wave to the propagation speed of the tsunami wave, had to be incorporated into a tsunami model for better estimation of tsunami height hitting the coast, especially for tsunami generated by intense earthquakes. As most of the tsunami models did not have these two features, the tsunami height hitting the coast might be underestimated.

- Mr. Brian Yanagi, emergency manager of ITIC, delivered a number of talks on Tsunami Emergency Response (TER). He suggested 10 steps to enable a successful TER. They were (a) know and understand the hazards of tsunami and a country's tsunami risk, (b) develop an "end to end" Tsunami Early Warning and Mitigation System (TEWS) implementation strategy, (c) set up stakeholder coordination committees at all levels of government, (d) develop multi-hazard disaster response plans, (e) enable a country to receive 24x7 Tsunami Warning Center messages through



April 1, 1946 Tsunami Memorial at Laupahoehoe, Hawaii with Tonga participant, Rennie Vaiomounga. Photo courtesy of K. Meade.

Country Trip Reports, *continued*

international/regional and/or national tsunami warning systems, (f) develop a rapid 24 x 7 communications dissemination infrastructure “down to the last kilometer,” (g) emphasize sustainable local community education, preparedness, and mitigation programs, (h) conduct annual tsunami exercises and drills at various levels of government, and in particular, with coastal schools, (i) obtain commitment from public authorities to enact multi-hazard and/or tsunami specific disaster risk reduction policies at all levels of government, and (j) develop emergency management policies and legislation that address multi-hazards including tsunami specific events. Other topics delivered by him were SOP of TER, Tsunami Stakeholder coordination concept, roles of government jurisdictions, non-government organizations and private sectors, and roles of individual agencies in emergency response. He gave some tsunami response guidelines for boaters, fishing ports and harbors in Japan and Hawaii.

- Field Trip to Big Island:
 - a. Visit to Pacific Tsunami Museum where a talk was given by the director of the museum on the damage caused by the 1946 and 1960 tsunamis in Hilo and towns around the island.
 - b. Visit to Hawaii County Civil Defense where their operations and emergency procedures were explained. It gave us an insight on how emergency personnel reacted to a message issued by PTWC.
 - c. Visit to Hilo and Laupahoehoe tsunami memorials.
 - d. Visit to USGS Hawaii Volcano Observatory where volcanic and seismic activities of volcano Kilauea were monitored.
- Each country presented its Tsunami Warning system and Mitigation measures in the first week of the training. Having learned about the scope and guidelines of how to design or review SOP, an assignment was given to each participant to review his/her country SOP and give another presentation about SOP as part of the planning for PacWave11 at the end of the training.

What I learned



Alvaro Carrasco, Chile (left) and Gerard Metayer, Haiti (right) tour the PTWC Operations Center. Photo courtesy of N. Guzmán.

- In the country presentation, I learned that every country had their own criteria for tsunami warning system, standard operating procedures for emergency response, mitigation plan, evacuation plan, communication mechanism, preparedness and awareness of the people. It was found that there were techniques useful in one place but not in another. Every country wanted to have a fast early warning system but resources and specialists were limited. Some Pacific Islands that lacked of resources could only rely on the warning messages from PTWC. On the other hand, in some tsunami high risk countries, they had completed evacuation plan and SOPs for tsunami and emergency response. They also had their tsunami models for calculating tsunami height and establishing mitigation measures with the help of inundation and evacuation maps. They would also conduct drill and exercise for tsunami in their countries regularly to enhance public awareness. The public should be educated for self-evacuation not waiting for warning when ground shaking was felt. For some Pacific Islands of flat topography with no high ground for people to evacuate, coconut tree might be one of the good choices for people to climb up to withstand the current of tsunami.
- DART was good but it just provided a signal in deep ocean. A modeling system was required to make use of the sea level measured by DART to adjust the predicted tsunami height hitting a coast. For local tsunami, the usefulness of DARTs was limited as the tsunami might have

Country Trip Reports, *continued*

already hit the coast before it was detected by DART.

- Tsunamis were not common. Each Tsunami was unique. The past events provided a basis for improvement of existing procedures for future events. When a tsunami arrived with below predicted level, called it a non-destructive tsunami instead of a "False Alert." A tsunami was a series of wave. It should be aware that the first wave might not be the largest. Hazard could continue for many hours.
- It was noticed that there were different kinds of tsunami warning decision support tools such as CISN, TTT, TsuDig and TideTool.
- SOP documents could be divided into different types for use in different occasions such as crisis and non-crisis conditions. The SOP for crisis cases should be in quick reference and checklist format while SOP for non-crisis cases should contain detailed procedures and background information. Tsunami emergency response procedures with drills to ensure good preparedness and public education to enhance public's awareness were also important other than a well established tsunami warning system. A perfect warning would be useless if people did not know what to do in case of emergency.
- During the visit to PTWC, it was a good opportunity for me to talk with watchstanders that made me better understand their daily routine duties, operational procedures, instrumentations for earthquake and tsunami monitoring and analysis. It also allowed me to

know the latest developments and technology on their new products

- PTWC's real-time tsunami forecasting model was of limited use for local warning as their model relied on "Green's Law." The law was accurate for the situation of a uniformly decreasing ocean depth and a straight coastline. It was less accurate for complex near-shore bathymetry and/or irregular coastline.
- Warning based on magnitude alone might not be adequate if the earthquake location is very close to the coast. Self-evacuation might be the only way to avoid the loss of lives. There were uncertainties in earthquake parameters that might also cause challenge in real-time tsunami forecast.

How the training will improve tsunami warning / awareness in Hong Kong

- To review SOP for tsunami and emergency response - The information in the training was very useful for evaluation and enhancement of our Tsunami Warning System. It also drew attention to the need of inundation and evacuation maps for emergency planning.
- To keep abreast of the latest development and products in PTWC - The latest tsunami decision supporting tools such as CISN, tide tool, TsuDig and TTT were useful for monitoring earthquake and sea level changes. Feasibility study could be carried out to enhance our tsunami model to a real-time forecasting model but a more powerful computer might be required.
- To strengthen public awareness - More education resources to public would be required, e.g. long duration ground shaking would be a natural warning and people should know how to response it (self-evacuation before actual warning come).
- To bring out the importance of preparedness for natural disaster - More regular drill and exercise were required.
- To give more advice on precautionary measures to public and boat owners - For the fishing boat off-shore, people should take action to immediate evacuate to a pre-decided designated sea area where sea depth is more than 50m in advance of the arrival of the first tsunami wave. If a larger tsunami is confirmed,



Ueneta Toorua of Kiribati Met Service describes his country's tsunami warning system. Photo courtesy of N. Guzmán.

Country Trip Reports, *continued*

people should move to deeper-depth sea area. Ships evacuated to the offshore should not approach to the coast until tsunami warning is cleared, and stay there for at least 6 hours. For fishing boat in harbour, if there is enough time, fishing boats can evacuate to the designated sea area. If no time, people should leave the boats immediately to evacuate to the safe place on land.

Evaluation and Other Observation



Siren pole on the grounds of PTWC. Photo courtesy of N. Guzmán.

The training course was very comprehensive and well organized. It provided an opportunity to the participants to know about the history and operation of the Pacific Tsunami Warning and Mitigation system. It also covered the background knowledge and basic principles for establishing the Standard Operating Procedures (SOP) for tsunami and emergency response. The training program also provided a good connection platform for participants from different background and different countries and specialists in PTWC and ITIC to share experiences and skills.

Conclusion

It was a rewarding experience to participate in this training. It not only enriched my knowledge in seismology and tsunami, in particular to better understand the operation in PTWC, but also gave me an insight to emergency response, public awareness, preparedness and education for such natural disaster. They were all

definitely useful in my work. I would highly recommend this training program to those who need to perform emergency response, evacuation planning duties related to seismology and tsunami.

Lastly, I would like to express my gratitude and heartfelt thanks to Dr. Laura Kong, Brian Yanagi, Dr. McCreery, Dr. Weinstein and all other ITIC and PTWC colleagues who gave me a splendid and successful training in Hawaii.

Fiji

by Sefanaia Seru, Fiji Mineral Resources Dept

Early Warning Systems will save lives. An effective tsunami early warning system is achieved when all persons in vulnerable coastal communities are prepared and respond in a timely manner upon recognition that a potential destructive tsunami may be approaching. For this, tsunami hazards and risks must be known, and preparedness activities must be carried out beforehand so that when a warning is issued, it will motivate ordinary citizens to quickly move out of harm's way before the tsunami attacks. While implementation of the Indian Ocean tsunami warning and mitigation system is being pursued with highest urgency, the tsunami hazard exists in all oceans where tsunamis can attack in minutes as local tsunamis take up to 24 hours to traverse an ocean basin as a distant tsunami. Because of this, international cooperation and data sharing are essential. Early detection by monitoring network will trigger early warnings that must immediately trigger appropriate emergency responses. At the same time, awareness and preparedness activities that educate and inform citizens about tsunamis and what to do when warnings are issued have to take place. Planning activities creating evacuation maps, drills and exercises, and hard and soft countermeasures are pre-disaster mitigations to reduce tsunami impact. Indigenous knowledge, gender, and social science perspectives on warning response have to be factored in. Teaching natural hazards and disaster preparedness subjects in schools will carry awareness to the next generations. Stakeholder coordination, with clear designation of the responsible authorities to minimize confusion during emergencies, is essential for carrying out rapid and effective warning and response. For this, disaster management organizations can play a key leadership role in natural hazard disaster risk reduction. Finally, high-level advocacy is critical to ensure a sustained commitment to prepare for infrequent, high-fatality natural disasters such as tsunami.

Country Trip Reports, *continued*

Keywords: tsunami; early warning; disaster risk reduction, mitigation response and information dissemination during a real scenario case. On the same note, all the media and communication channels is to be tested to ensure that earthquake and tsunami information's are imparted in an effective manner.

Preparation and procedures to be conducted before this PacWave11 Exercise and after the exercise has been drawn as shown below.

Recommendation

Based upon the purpose of this study, the following recommendations are put forward.

- To strengthen and introduce the Tsunami Operational Procedure produced in the training report.
- The need for every key stakeholders to understand the Tsunami SOP and to know Who? What? When? Where? How? for tsunami early warning.
- To strengthen the coordination between key stakeholders and ensure their involvement and participation for the PacWave11 Exercise.

Acknowledgement

I would like to take this great opportunity to express my deepest gratitude to all the staff of PTWC, ITIC and all professors from various institutions for the wonderful lectures and scientific information's conducted during the two weeks of training.

Overall, my great appreciation goes to Director PTWC, Director ITIC, Mr. Yanagi and his team for kindly coordinating the whole programme. At last not forgetting all our co-participants from our various developing countries for their support and encouragement especially the sharing of ideas and discussions in understanding each nation's history and background knowledge in the field of earthquake and tsunami monitoring network and systems.

Last but not the least, my many thanks to the UNESCO-IOC for the funding assistance provided during the two weeks of training. Without this opportunity, I am sure that I could not be able to understand the roles, the systems and functions in place at the Pacific Tsunami Warning Center.

WORKSHOP AND MEETING SUMMARIES**Regional Workshop on Tsunami Awareness and Education Materials,
19-21 July 2011, Jakarta, Indonesia**

Participants of the Regional Workshop on Tsunami Awareness and Education Materials in Jakarta, Indonesia. Photo courtesy of ITIC.

Regional Workshop, *continued*

A UNESCAP sponsored regional workshop on tsunami awareness and education materials was attended by participants from Indian Ocean and Southeast Asia countries.

Topics of discussion and country presentations included:

- Depositories of materials
- Lessons learned in materials development and adaption
- Material needs and gaps
- Lessons learned from recent tsunami events (Feb 2010 Chile, Oct 2010 Mentawai, March 2011 Tohoku)
- From science to material development
- Changes to materials
- Tsunami exercises as a way of educating and building awareness
- Expectations for future Indian Ocean tsunami information services from the Jakarta Tsunami Information Center (JTIC)

The JTIC addressed the need for a depository of tsunami awareness materials, hazard information, preparedness materials (i.e., assessment tools, public awareness tools, training materials, best practice information and other relevant information). The objective was to optimize the use of available materials in Indonesia, Philippines, and Thailand for wider public awareness and education. The project assessed and tested the available information, tools and awareness materials within the context of each country to ensure that all materials and tools were used. The project organized public education, capacity building workshops, awareness activities in coastal areas in each country for trainers, school students, the media, the authorities and relevant industries.

Key workshop findings:

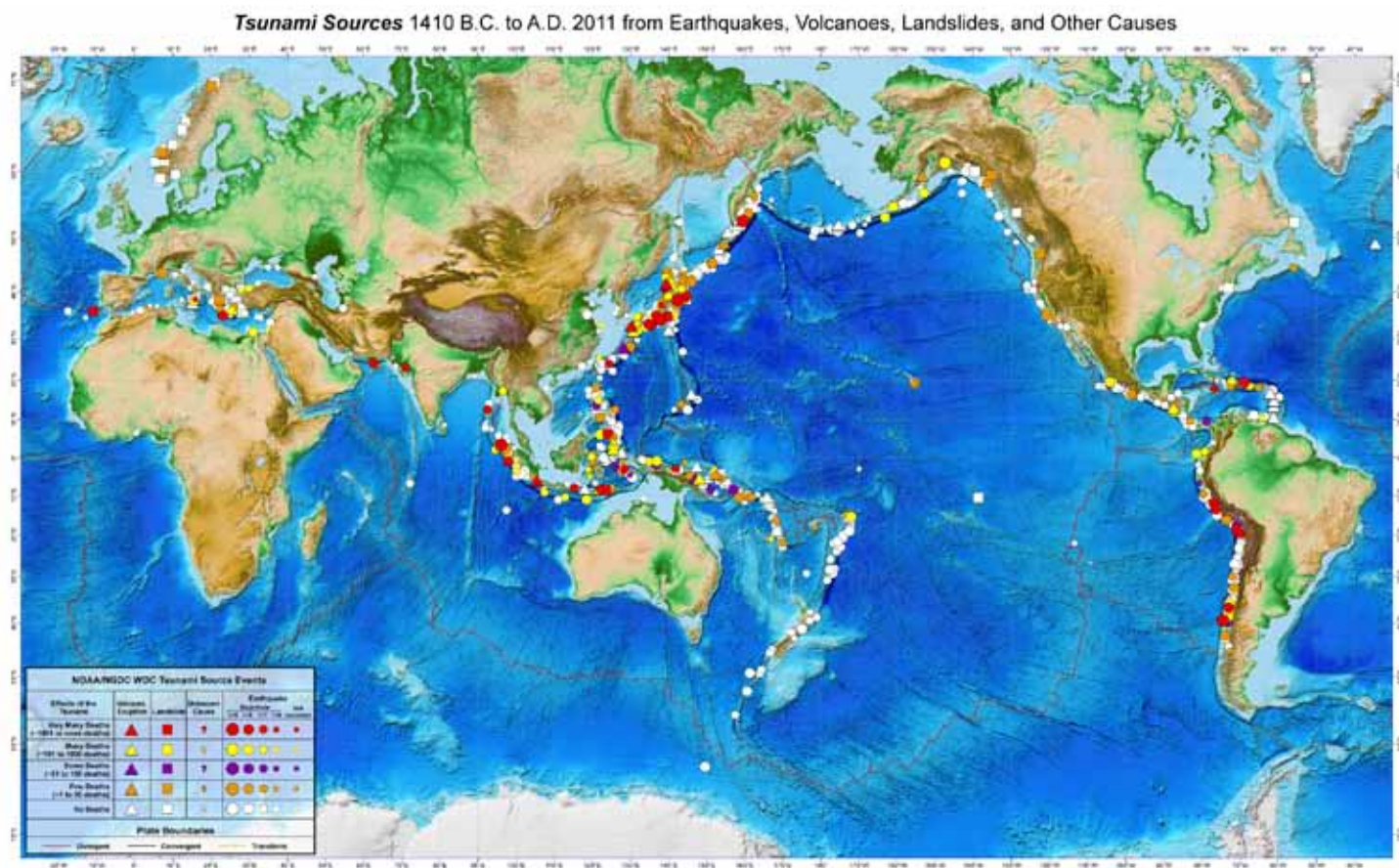


Display table of country awareness materials.

- Most depository materials for the Philippines, Indonesia and Timor-Leste are now available in prints. All printed depository materials will be available and displayed at the Regional workshop in July 2011.
- The translation of TsunamiTeacher DVD ROM into four languages was completed in February 2011.
- JTIC website is now available in four different languages and continues coordination for data input in different languages (<http://www.jtic.org/>).
- Two teacher training workshops and one training workshop for daycare workers of Navotas were conducted in Philippines in February 2011.
- Promotion and socialization of education and awareness training workshops were conducted in Krabi, Phang-Nga and Ranong provinces in Thailand.
- Two material testing were conducted in Indonesia in Daerah, Istimewa, and Yogyakarta provinces.

Examples of Indonesian Tsunami Awareness posters in Bahasa language.





ITIC Updated Tsunami Awareness Materials

In the aftermath of the 26 December 2004 Indian Ocean Tsunami, many excellent tsunami awareness materials were developed, especially at the country level, to inform the public and decision-makers on tsunami hazards, risks, preparedness, and mitigation. On this DVD, the ITIC offers a small compilation of general and basic tsunami awareness materials that can be used to support the needs of government agencies, emergency managers and educators. Many of the included materials were originally developed to support countries of the Pacific Tsunami Warning & Mitigation System (PTWS) during the 1990s and early 2000s, and were then revised and updated after the 2004 catastrophe to emphasize tsunamis as a global hazard requiring a global early warning system.

For ITIC-authored materials, the files are provided in differing print resolutions and formats. Tsunami, the Great Waves, Tsunami Warning!, and the Tsunami Awareness Safety posters and flyers are provided in formats to allow them to be customized in order to meet the needs, cultures, and languages of countries and local communities. These formats, including the text and figures, are provided for your

copying and free use. Please retain the logos and attributes to the UNESCO IOC ITIC, and the credits to the individual authors and/or agencies, but you may also add your agency information and print and distribute the revised materials free-of-charge. Upon modification, we ask that you provide the ITIC with electronic and print copies of your revision. Your sharing will enable us to share your work with others.

The .pdf files, in both low and high resolution (created in Adobe Acrobat 7.0), were created from the originals for both online and print distribution. The .doc files (created in Microsoft Word 2003) are intended for easy translation into other languages, or to allow easy insertion of local information. The .ai files (created in Adobe Illustrator CS) are the original files used to create the product and can be modified to include local images and content. The ITIC would be happy to work with you to finalize and make your materials publication-ready with the same design layout as in the originals.

In general, our goal is to have all basic materials available in at least English, French, and Spanish. Selected materials are also available in other languages. These have been contributed by Member States, and ITIC has received copies of their translated materials.

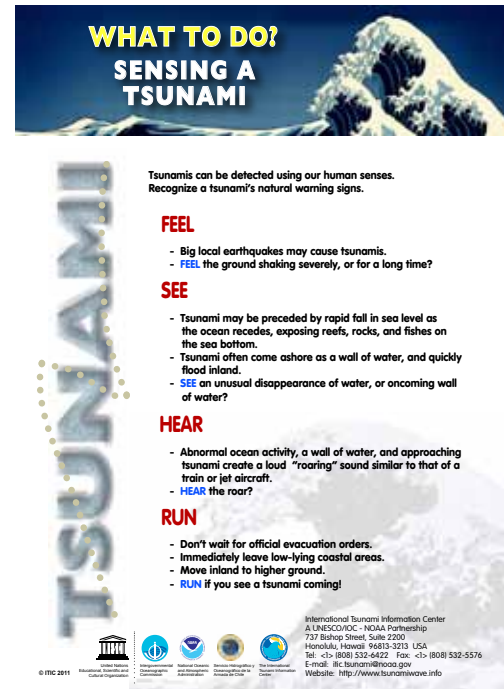
ITIC Updated, *continued*

Sample of ITIC Tsunami Warning Cartoon book translated in various languages.

All files are available by DVD from ITIC on request, or available for download from the ITIC web site at http://itic.ioc-unesco.org/index.php?option=com_content&view=article&id=1349&Itemid=1075&lang=en.

Hard Copies of posters are also available. Please provide ITIC with a FedEx or UPS account number.

We regret that we are unable to offer the full range and breadth of the materials that are available in this 1-DVD compilation. Please do contact us if you have other requests or need further information or examples. We very much welcome your additional contributions to our library collection!



Located in Honolulu, the International Tsunami Information Centre (ITIC) was established on 12 November 1965 by the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific, and Cultural Organization (UNESCO). In 1968, the IOC first convened the International Coordination Group for the Tsunami Warning System in the Pacific (ITSU). In 2005, ITSU became the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS) so as to better convey the comprehensive approach required to reduce tsunami risks.

The 35 Member States with Tsunami National Contacts and Tsunami Warning Focal Points are: Australia, Canada, Chile, China, Colombia, Cook Islands, Costa Rica, Democratic People's Republic of Korea, Ecuador, El Salvador, Fiji, France, Guatemala, Indonesia, Japan, Malaysia, Mexico, New Zealand, Nicaragua, Niue, Panama, Papua New Guinea, Peru, Republic of the Philippines, Republic of Korea, Russian Federation, Samoa, Singapore, Solomons, Thailand, Tonga, Tuvalu, U.S.A., Vanuatu and Vietnam.

International Tsunami Information Centre
A UNESCO/IOC - NOAA Partnership
737 Bishop Street, Suite 2200
Honolulu, Hawai'i 96813 USA
Phone: 1-808-532-6422
Fax: 1-808-532-5576
E-mail: itic.tsunami@noaa.gov
Web: www.tsunamiwave.info

