



TSUNAMI NEWSLETTER



International Tsunami Information Centre

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SUMMARY OF EARTHQUAKES IN THE PACIFIC

Occurring August-October 2004

With surface wave or moment magnitude (M_w) greater than or equal to 6.5 and a depth no greater than 100 km, or an event for which a Tsunami Information Bulletin (TIB) or Regional Watch Warning (RWW) was issued. Epicenter, M_s , and M_w from USGS National Earthquake Information Center (NEIC, G); M_w and centroid depth from Harvard (H); M_w from PTWC at action time.

DATE	TIME (UTC)	LOCATION	LATITUDE	LONGITUDE	DEPTH (km)	M_w	M_s	PTWC ACTION	ACTION TIME (UTC)	TSUNAMI? DAMAGING?
September 5	10:07	Near S. Coast of Honshu	33.070N	136.618E	14	7.4 (P) 7.2 (G) 7.0 (H)	7.0	TIB	10:19	YES NO
September 5	14:57	Near S. Coast of Honshu	33.184	137.071E	10	7.4 (G,H) 7.2 (P)	7.1	TIB	15:16	YES NO
September 6	23:30	Near S. Coast of Honshu	33.205N	137.227E	10	6.7 (G) 6.6 (P) 6.5 (H)	6.3	TIB	23:44	NO NO
October 8	8:28	Solomon Islands	10.980S	162.141E	36	7.1 (P) 6.8 (G,H)	6.9	TIB	08:45	NO NO
October 8	14:36	Mindoro, Philippines	13.913 N	120.573 E	105	6.6 (P) 6.5 (H) 6.4 (G)	N/A	TIB	14:57	NO NO
October 9	21:27	Near Coast of Nicaragua	11.424 N	86.655 W	35	7.3 (P) 6.9 (G) 6.8 (H)	7.0	TIB	21:38	NO NO
October 15	4:09	Taiwan Region	49.305 N	128.781 W	94	6.7 (H, P) 6.6 (G)	6.4	TIB	10:11	NO NO

OFF HONSHU JAPAN, 5 SEPTEMBER 2004

Compiled from reports by Masahiro Yamamoto (masahiro.yamamoto-a@met.kishou.go.jp) and Tatsuo Kuwayama (kuwayama@met.kishou.go.jp) Japan Meteorological Agency, and the USGS National Earthquake Information Center.

Two major earthquakes occurred on September 5, 2004 southeast off Kii Peninsula, Honshu Island, Japan (Figures 1-3). An earthquake of magnitude $M_W 7.2$ (HRV, JMA 6.9) occurred at 1007 UTC 450 km southwest of Tokyo, and was followed about five hours later at 1457 UTC by the magnitude $M_W 7.4$ (HRV, JMA 7.4) mainshock about 30 km ENE from foreshock. About four people and 40 people were injured in the Kyoto area in the 1007 UTC and 1457 UTC earthquakes,

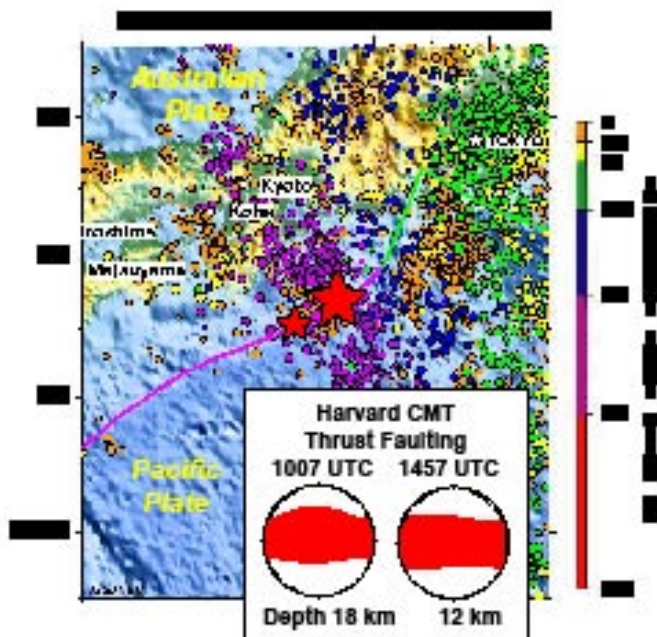


Figure 1. Historical seismicity (1900-present, NEIC) and tsunamis (ITDB, 2004) observed in the region. The events are represented by red stars, with the larger star representing the larger 1457 UTC earthquake. Harvard Centroid Moment Tensor solutions indicate thrust faulting at shallow depths associated with the subduction of the Philippine Sea Plate beneath Japan.

respectively, which were felt in much of southwestern Japan and as far north as Tokyo. A Tsunami Advisory was issued by the Japan Meteorological Agency (JMA) to the coasts along the Pacific within seven minutes for each earthquake. Small local tsunamis were recorded at several tidal stations (Table 1 and Figures 4 and 5). Maximum tsunami heights (above mean sea level) of 63 cm and 93 cm were recorded by each tsunami respectively at Kozushima island located in the Pacific Ocean to the west, with heights of 34 cm and 86 cm, respectively, observed to the east-northeast at Kushimoto in Wakayama Prefecture, south-central Honshu island.

Some reports of overturned fishing boats were made, but no major tsunami damage was reported. Aftershocks were located over an 80-km length along

the Nankai trough and also perpendicular to the trend of the trough (Figure 3). The largest aftershocks were recorded on 6 September with a magnitude $M_W 6.7$ (HRV), and another on 8 September measuring $M_W 6.2$ (HRV). The CMT solutions for the foreshock, mainshock, and largest aftershocks all indicated reverse or thrust faulting.

The epicenter of the 1944 magnitude 7.9 Tonankai Earthquake was located near the September earthquakes. The JMA reports the expected probability of occurrence for at least a magnitude 8.1

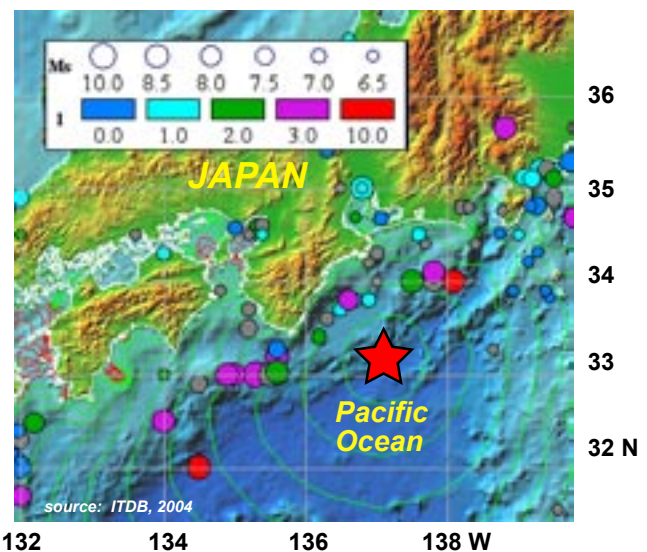


Figure 2. Tsunami times (green lines) are contoured in 5-minute intervals assuming a point source for the 1457 UTC earthquake. Circles show the locations of historical tsunamis with the colors corresponding to tsunami intensity on the Soloviev-Imamura scale.

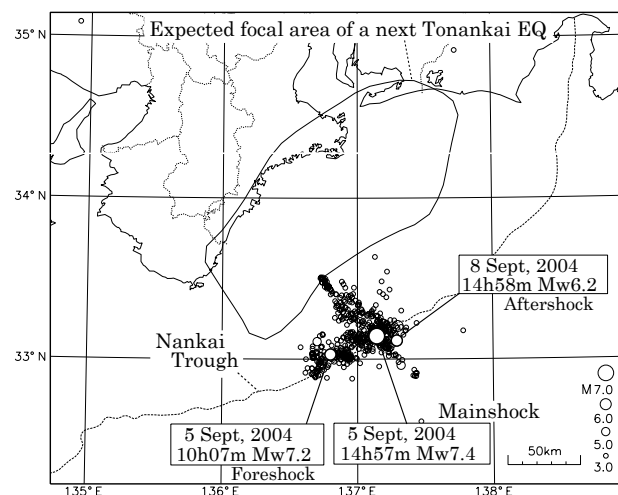


Figure 3. Seismicity associated with the 5 September 2004 earthquakes and aftershocks determined by the JMA.

OFF HONSHU, *continued*

Tonankai earthquake within the next 30 years to be 60% presently. A repeat of the Tonankai earthquake could cause the generation of a teletsunami capable of propagating across the Pacific and seriously damaging distant coastal regions.

TABLE 1. TSUNAMI ARRIVAL TIMES AND HEIGHTS (JAPAN METEOROLOGICAL AGENCY)

Tide station name	Latitude	Longitude	1007 UTC Earthquake			1457 UTC Earthquake		
			Arrival time (JST)	Initial wave height (cm)	Max wave height (cm)	Arrival time (JST)	Initial wave height (cm)	Max wave height (cm)
AYUKAWA	38°18'	141°30'				1:55	-3	7
CHOSHIGYOKO	35°45'	140°51'				1:35	7	15
MERA	34°55'	139°49'	20:27	-16	36	0:53	-18	43
OKADA	34°47'	139°23'				0:47	-12	26
KOZUSHIMA	34°13'	139°08'	19:53	21	63	0:24	11	93
AKO	34°04'	139°29'	19:30	-8	27	0:26	17	49
TSUBOTA	34°03'	139°33'	19:29	-12	21	0:28	-27	37
CHICHIJIMA	27°06'	142°11'	20:34	10	19	1:23	11	39
IROZAKI	34°37'	138°51'	19:57	11	30	0:23	19	58
UCHIURA	35°01'	138°53'				0:32	9	33
OMAEZAKI	34°37'	138°13'				0:29	17	40
MAISAKA	34°41'	137°37'				0:33	23	23
TAKETOYO	34°53'	136°57'				1:17	4	5
YOKKAICHIKOU	34°57'	136°38'				1:40	-5	6
TOBA	34°29'	136°49'				1:16	-24	33
OWASE	34°05'	136°12'	19:27	-4	29	0:22	54	58
KUSHIMOTO	33°29'	135°46'	19:27	27	34	0:20	86	86
URAGAMI	33°33'	135°54'	19:26	-3	28	0:17	61	61
SHIRAHAMA	33°41'	135°23'	20:05	-12	14	0:28	-9	19
WAKAYAMA	34°13'	135°09'				1:09	8	8
TANNOWA	34°20'	135°11'				1:28	-9	5
KOMATSUSHIMA	34°01'	134°35'				1:04	9	13
MUROTOMISAKI	33°16'	134°10'	19:48	-29	29	0:37	32	35
TOSASHIMIZU	32°47'	132°58'	19:33	-6	17	0:54	21	31

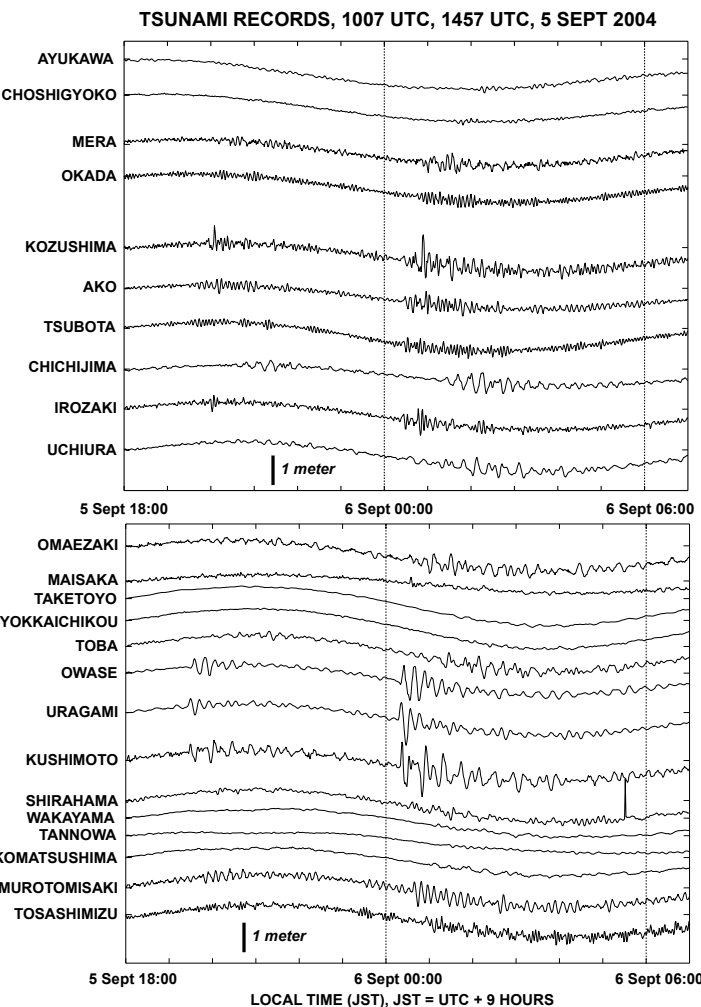


Figure 4. Sea level records showing the tsunamis from the 1007 UTC and 1457 UTC events. Data courtesy JMA.

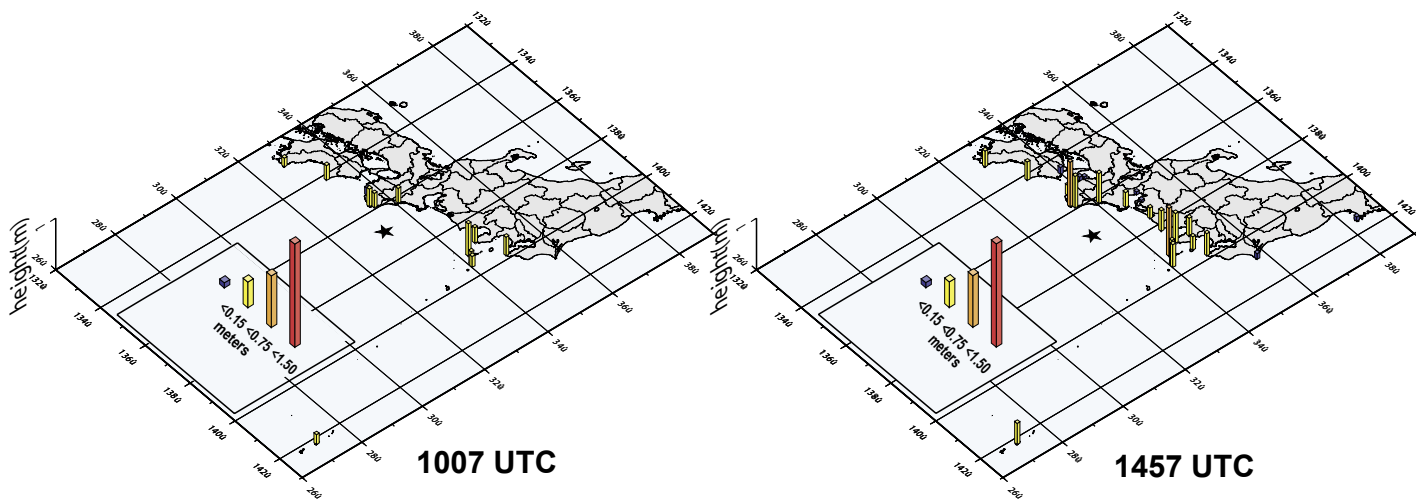


Figure 5. Observed tsunami heights from the two earthquakes as reported by the JMA. Heights are values above mean sea level. Star indicates earthquake epicenter.

ITSU NEWS

JMA-PTWC-ITIC MEETING ON NORTHWEST PACIFIC TSUNAMI INFORMATION CENTER, 19-21 OCTOBER 2004

In preparation for the beginning of operations of the Northwest Pacific Tsunami Information Center in March, 2005 (see *related story, next page*) the Japan Meteorological Agency (JMA) hosted a technical planning meeting with the Richard H. Hagemeyer Pacific Tsunami Warning Center (PTWC) and the International Tsunami Information Center (ITIC) October 19-21, 2004. PTWC Director Dr. Chip McCreery and ITIC Director Dr. Laura Kong met with the JMA's Earthquake and Tsunami Observations (ETO) Division Director and ITSU National Contact Masahiro Yamamoto and his staff to discuss and coordinate the warning operation activities between PTWC and JMA's Northwest Pacific Tsunami Information Center (NWPTIC). McCreery and Kong also met with Kunio Sakurai, Director General of the Seismological and Volcanological Department, and Noritake Nishide, Director of the Administrative Division of the Seismological and Volcanological Department and former ITSU National Contact. During the technical meeting, the procedures of both Centers were reviewed, and a number of action items identified to effect a smooth coordination of operations including the dissemination of products.

In discussions, the JMA and PTWC agreed to cooperate on a more comprehensive exchange of sea level and seismic data to aid their respective. PTWC hopes to receive both more frequently-transmitted (every 15 minutes) sea level data and additional sea level data from other Japanese coastal stations, as well as data from three JMA cabled deep ocean pressure sensors. JMA wants to receive additional Pacific seismic and sea level data. Discussions included the need for a multi-national request to the Comprehensive Nuclear Test Ban Treaty Organization (CTBTO) to enable the



Dr. McCreery and Dr. Kong met with Tsunami and Earthquake Observations Division Director Yamamoto and his Staff. From left to right: Naoyuki Yamada, Shuichi Katsuki, Kiyoshi Sakuma, Deputy Director Akira Nagai, McCreery, Kong, Yamamoto, Tatsuo Kuwayama, Musashi Kiyomoto, and Yuji Nishimae.

use of real time seismic data from auxiliary seismic stations of the CTBTO network, and real-time access to stations of the South Pacific Sea Level and Climate Monitoring Project Network that is currently managed by Dr. Chalapan Kaluwin of Australian Marine Science & Technology Ltd (AMSAT) and Bill Mitchell of the Australia Bureau of Meteorology's National Tidal Center. On the last day in Japan, the Dr. McCreery traveled to Yokohama to the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) Institute for Earth Science. He met with Dr. Kiyoshi Suyehiro, Executive Director of Research, to discuss possible PTWC access to data from JAMSTEC's deep ocean pressure sensors. At the same time, Dr. Kong and Yuji Nishimae (JMA ETO Division) met with the Japanese television network NHK International (Japan Broadcasting Corporation) to review their archive tsunami footage and discuss its availability for use by ITIC for educational purposes.

NORTHWEST PACIFIC TSUNAMI INFORMATION CENTER PLANNED

Masahiro Yamamoto, Director, Earthquake and Tsunami Observations Division, Japan Meteorological Agency, masahiro.yamamoto-a@met.kishou.go.jp

The Japan Meteorological Agency (JMA) plans to begin operation of the Northwest Pacific Tsunami Information Center (NWPTIC) in March 2005. The NWPTIC was developed by JMA in response to the request by ITSU member states to provide tsunami information for the Northwest Pacific region. In January 2001, JMA began operations in the Japan sea region, where it currently provides tsunami information to the bordering countries. The NWPTIC, with support and recommendations from the PTWC and the ITIC, will expand its service area in 2005 to include the countries of Russia, the Republic of Korea, China, the

Philippines, Indonesia, Papua New Guinea, and island states in the north Pacific including the Commonwealth of the Northern Mariana Islands, Guam, the Republic of Palau and the Federated States of Micronesia.

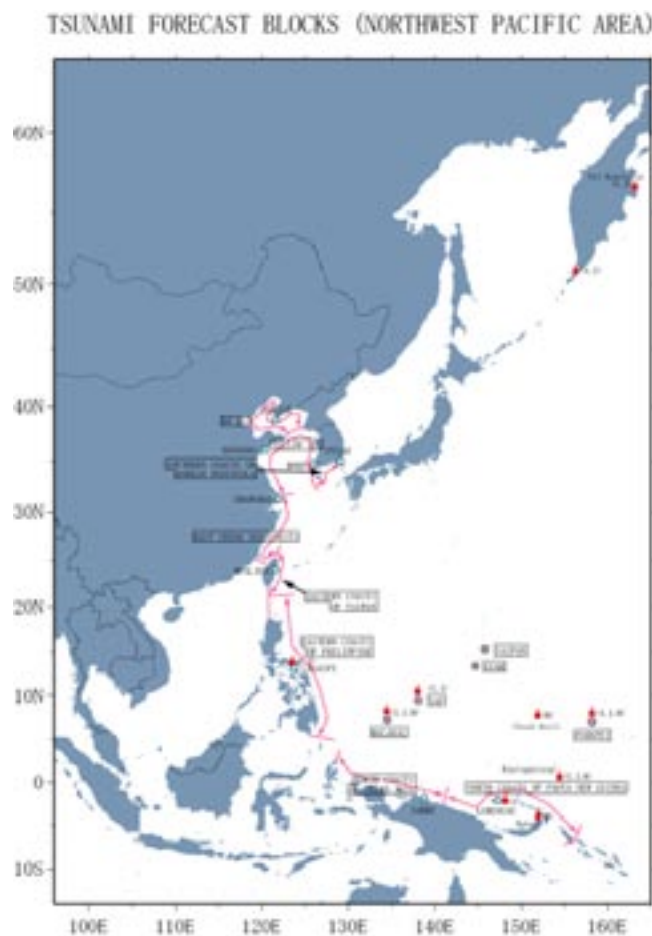
When an earthquake greater than Magnitude 7 takes place in the Northwest Pacific area, the NWPTIC will initially provide earthquake location and magnitude. The NWPTIC will also provide information for each coastal area on an expected tsunami arrival time and an expected potential tsunami wave height extracted from a pre-calculated tsunami database. As data are

NWPTIC, continued

received, the Center will also provide information on the observed and reported tsunami wave height (Figure 1). The first information is expected to be provided within about 20 minutes of the earthquake's occurrence.

All information disseminated from the NWPTIC shall be delivered to the relevant authorities as specified in the ITSU Communication Plan and be utilized for the mitigation of tsunami disasters. The Center plans to send the information over the Global Telecommunication System (GTS/WMO), and by e-mail and Fax. The establishment of reliable, easy, and quick communication procedures and protocols between the NWPTIC and each country will be essential for the timely communication of tsunami information. The acquisition of additional seismological and sea level data in the region in real or near-real time will be critical for improving the quality and timeliness of the earthquake characterization and the evaluation of its tsunamigenic potential. Cooperation and collaboration between the JMA, PTWC, ITIC and all Pacific countries in the timely and open sharing of data and communication of information messages will be essential for a successful implementation of the NWPTIC.

Figure 1. Tsunami Forecast Blocks (red) where the JMA plans to provide tsunami information during the Phase 1 implementation of the NWPTIC.



SAKHALIN TSUNAMI WARNING CENTER HOSTS JAPANESE SCIENTISTS OCTOBER, 2004

Tatiana Ivelskaya Director, Sakhalin Tsunami Warning Centre, 78, Zapadnaya St., Yuzhno-Sakhalinsk, Russia 693000, ivelskaya@mail.ru

The Sakhalin Tsunami Warning Center (STWC) in Yuzhno-Sakhalin, Russia, hosted two visiting scientists from Japan during October, 2004. Dr. Kenji Hirata from the Deep Sea Research Department of the Japan Agency for Marine-Earth Science and Technology (JAMSTEC/DSRD) visited for two weeks from October 14, 2004, and Dr. Hiroyuki Matsumoto, also of JAMSTEC/DSRD, visited for a week from October 21. Tatiana Ivelskaya, STWC Chief, and Hirata discussed the possibility of obtaining tsunami mareogram records from South Kuril Island sea level stations for use in conducting tsunami simulations from strong Japan Trough and South Kuril Island regional earthquakes. Ivelskaya indicated that she will send mareograms and some digital tsunami records to Hirata to aid in his research, and both look forward to further cooperation in the future. The simulation results that Hirata will provide to the STWC will be a very important contribution that improves the operations of the Russian Tsunami Warning Service.

During his visit, Hirata also met with Dr. Boris Levin, Director of the Institute of Marine Geology and Geophysics (IMGG), Dr. Viktor Kaistrenko, Chief of



From left to right: Dr. Kenji Hirata, (JAMSTEC), Tatiana Ivelskaya (STWC Chief), and Dr. Hiroyuki Matsumoto (JAMSTEC).

Sakhalin Institute of Fisheries and Oceanographic Research (SIFOR) Tsunami Laboratory (IMGG), and Dr. George Shevchenko, Chief of SIFOR Oceanography Laboratory. Kaistrenko indicated that an atlas of tsunami mareograms for Sakhalin and Kuril Island tide

SAKHALIN, *continued*

stations from 1952 to 1968 is available and will send it to Hirata.

During his visit, Dr. Matsumoto was briefed on the operations of STWC in evaluating tsunami threats from local and distant earthquakes, on the responsibilities of engineers on duty, and on the methods whereby tsunami warnings are transmitted to Russian coastal

populations.

Both scientists also visited the library of Sakhalin Hydromet and the regional museum of Yuzhno-Sakhalinsk. The media reported on the visits of the Japanese scientists through the web site of the ITAR-TASS News Agency of Russia and on the local television news.

NORTHERN CHILE CITY PREPARES TSUNAMI PLANS AND INSTALLS EARLY WARNING SIRENS

Emilio Lorca, Head, Marine Geophysics, Department of Oceanography, Servicio Hidrografico y Oceanografico de la Armada de Chile (SHOA), Errazuriz 232 Playa Ancha, Valparaíso, Chile, elorca@shoa.cl

The first Tsunami Inundation Map for Arica, a port city in the northern part of Chile, was completed during 1996 by SHOA. Arica, located at 18° 30' S, 70° 19' W near a "seismic gap" zone, has been frequently affected by tsunamigenic earthquakes generated in the Pacific, including the catastrophic near-field events of 1868 generated in southern Peru, and 1877, which was generated in northern Chile and overwhelmed the Arica coast. Using the tsunami inundation map, the Arica Local Emergency Office designed a Hazard and Resources Map for each tsunami risk zone. Two areas were distinguished: the tsunami inundation zone along the Arica coast and a security zone that marks the whole area that would not be exposed to tsunamis.

Arica's Tsunami Emergency and Evacuation Plan prepares and educates the population about the tsunami alert, the coordination that occurs, and the evaluation, resolution and integrated decision-making actions taken by government and local emergency agencies, and depending on where they live, informs the population on what to do when a tsunami alert occurs. To assure the effectiveness of the plan, the Local Emergency Office of Arica has also implemented a tsunami alarm system with early alert sirens to guide the actions of the population when there is a tsunami event.

When SHOA issues a Tsunami Watch, the Local



Tsunami inundation area signs at Chinchorro Beach, Arica.

Emergency Office of Arica and the Local Committee of Civil Defense notify various government response agencies, including the Arica Navy Office, local police, and the fire department. Conference bridge discussions take place with these groups and volunteer tsunami scientific advisors to determine whether the Tsunami Watch should be upgraded to a warning or cancelled. When SHOA issues a Tsunami Warning, the Committee of Civil Defense initiates evacuation of the coastlines. The Local Emergency Office Administrator and fire department then activate sirens announcing the evacuation. When SHOA issues an Urgent (local) Tsunami Warning, designated firemen immediately activate the sirens and the Local Emergency Office of Arica broadcasts a Tsunami Warning message to immediately evacuate the coastlines, or evacuate vertically to the 3rd floor and above in steel/reinforced concrete buildings. The sound of Arica sirens is the local standard alert signal (a two minute steady signal) that prompts people to turn on their radios, where they will hear the evacuation notice and information on the evacuation routes. This plan has been tested several times with in-the-field exercises and has had great response from the public.



The boilers of Wateree Ship (Tsunami 1868). Tsunami inundation area in the northern part of Arica.

ITIC – PTWC NEWS

ICG/ITSU TRAINING PROGRAMME (ITP-HAWAII), AUGUST 2004

The 2004 UNESCO/IOC ICG/ITSU Training Programme was held August 9 to 27, 2004 in Honolulu, Hawaii. This year, the program expanded in length from two to three weeks in order to allow more time for discussions on topics, and received a very large number of applicants; a total of 16 nominees were received from ITSU Member States, and three were selected and a total of five participated. For the ITP-Hawaii 2004, the five participants were from Colombia (Camilo Botero, Secretario Técnico, Comité Nacional de Alerta de Tsunami. Comisión Colombiana del Océano), El Salvador (Carlos Pullinger, Director, Servicio Geológico, Servicio Nacional de Estudios Territoriales, SNET, the Philippines (Ishmael C. Narag, Supervising Science Research Specialist, Philippine Institute of Volcanology and Seismology, PHIVOLCS), and the Netherlands (Steve Kuils, Dean Safety Management, and Cees Kersten, NIBRA, the Dutch Institute for Crisis & Disaster Management).

Funding support was provided by the UNESCO/IOC, by the RANET Project, and individually by the NIBRA. Selections were based on the participants' potential to actively promote and initiate tsunami mitigation programmes upon return to their country, representation from regions or countries that had not had participants in recent years, participation of neighboring countries who after attending would be encouraged to coordinate regionally, and that each participant had a good command of English to ensure the fullest understanding of the information presented.

The ITP-Hawaii provides an overview of the history and operation of the Tsunami Warning System in the Pacific, with specific focus given to the important role of regional and national tsunami warning centers in monitoring and evaluating the tsunamigenic potential



Memorial to the 1960 Chile tsunami in Hilo, Hawaii. The clock shown stopped working when the tsunami struck. Shown from left to right are Pullinger, Botero, Kersten, Narag, Kuils, and Yuichi Nichimura of Hokkaido University.

of earthquakes, and in issuing timely tsunami warning messages to government emergency officials. The Programme provides training and familiarization with the Tsunami Warning System in the Pacific and regional warning systems, and how these are integrated into the response procedures of the Civil Defense agencies as carried out by the United States federal, state, and local governments. Tsunami mitigation and outreach programmes are discussed through examples, and an introduction to numerical modeling as it is used in the calculation of wave heights, inundation, and runup is provided. This year, the participants were also able to attend tsunami and related research sessions at the American Geophysical Union's Western Pacific Geophysics Meeting held August 16-20, in Honolulu.

ITP PARTICIPANT REPORTS

COLOMBIA

Ing. Camilo Botero S., Secretario Técnico, Comité Nacional de Alerta de Tsunami Comisión Colombiana del Océano, sinoc@cco.gov.co



Camilo Botero reviews a earthquake analysis on a PTWC workstation. Shown from left to right are Pullinger, Botero, Narag, Kersten, and Dr. Chip McCreery (PTWC Director).

My duties as a Technical Secretary of National Tsunami Warning Committee include the coordination of the different national entities that have responsibilities in the field of tsunamis. Because of this, the ITP training was good because it was general and I learned about all kinds of subjects that I must now apply to each responsible entity. My particular interests were in planning design and education campaigns, and as an environmental engineer, also the different scientific fields such as numerical modeling and recent knowledge advances in understanding the tsunami phenomenon.

ITP-HAWAII, *continued*

Through visits to different places, and direct contact with the people responsible for each emergency center and the PTWC, I gained an understanding of the magnitude of work required for a successful tsunami warning system and the possible emergency attentions that are required. With the knowledge I gained of the procedures, I am now able to better analyze and improve Colombia's warning system.

In Colombia, the National Committee on Tsunami Warning is the catalyst for improving the warning system. Areas in which we will focus include the improvement of the warning procedures, the disclosing that evacuation maps exist, and the inclusion of Colombia in regional warning system initiatives. We will also expand and improve on the information currently in the National Tsunami Risk Management Plan.



Makapuu Sea Level Station, Oahu. PTWC Senior Electronics Technician Rich Nygard (left) provided information on the sea level instrumentation used.



John Cummings III of the Oahu County Civil Defense describes the siren system used to alert the population to evacuate. Shown from left to right are Cummings, Linda Sjogren (ITIC), Narag, Kersten, Phil Cummins (Geoscience Australia), Tammy Kaitoku (ITIC), Botero, Kuils, and Pullinger.



George Curtis (standing), Hawaii island Tsunami Advisor to Hawaii County Civil Defense (HCDA), briefed the ITP participants at the HCDA Emergency Operations Center.

EL SALVADOR

Carlos Pullinger, Director Servicio Geologizo, SNET, El Salvador, cpullinger@snet.gob.sv

The 2004 International Training Programme took place during August 9-27th, at the International Tsunami Information Center (ITIC) in Honolulu, Hawaii. The purpose of the training was to give the participants a general overview of how tsunami warning in the Pacific ocean is done, including information on what and how tsunamis are generated, warning centers and how they work, ongoing research on tsunamis and emergency preparedness, so that once the training is done, the participants can contribute to generating tsunami awareness in their countries.

The first three days of the training was spent attending presentations given by the Programme Director, Dr. Laura Kong, about science of earthquakes and tsunamis as well as on the responsibilities of different international and national actors in tsunamis such as IOC, ITSU, ITIC and PTWC. Two days were spent at the PTWC in order to get familiarized with the Center's procedures, monitoring and warning capabilities. We were fortunate enough to experience an event that triggered the system's alarms and caused PTWC's personnel to respond to it, but fortunately it was not a large one so no watches or warnings were issued.

During the second week of training we attended presentations on tsunamis and volcanoes of the 2004 Western Pacific Geophysics Meeting (WPGM), held in Honolulu from August 16-20th. This was a very good experience because we were able to see some of the most recent research on volcanoes and tsunamis. In addition to attending WPGM, we visited State and County Civil Defense, which gave us an insight into how emergency personnel react to a message issued by PTWC.

On August 19-20th, we traveled to the island of Hawaii "The Big Island", where we first visited Hawaii County's Civil Defense to look at how the island that is most

ITP-HAWAII, *continued*

affected by natural hazards reacts to them. Following this, we visited the Pacific Tsunami Museum to learn about outreach programs that the island has and find out about damage caused by the 1946 and 1960 tsunamis in Hilo and towns around the island. We visited the memorials and affected areas around Hilo and Laupahoehoe. The following day was spent at the Kilauea National Park, where we looked at the active caldera and some other landforms in its surroundings. Dr. Paul Okubo, seismologist of the Hawaii Volcano Observatory, showed us around and explained all the different techniques used at the observatory to monitor Kilauea and Mauna Loa volcanoes.

The final week of training was dedicated to learning about tsunami modeling, instrumentation, outreach and mitigation of tsunamis. Once again we visited PTWC to look at instrumentation used by the center, including sea level stations and seismic equipment. Richard Nygard, senior electronics engineer at the center took us to a site where a sea level station is installed. Dr. Kwok Fai Cheung and some of his graduate students at the Department of Ocean & Resources Engineering of the University of Hawaii at Manoa, showed presentations on their research on modeling of tsunamis, which they hope to apply in the revision of the inundation maps for the state of Hawaii. On the last couple of days in Honolulu, we prepared



Hawaii State Civil Defense Earthquake and Tsunami Programme Manager Brian Yanagi briefed ITP participants on the response procedures of SCD during tsunami warnings. Shown from left to right are Pullinger, Botero, Narag, Masato Iguchi (Sakurajima Volcano Research Center), Kersten, Kaitoku (ITIC), Kurils and Yanagi.

presentations on our countries' efforts in tsunami mitigation. These were given to PTWC and ITIC personnel on August 26th at the PTWC installation.

Overall, the Programme was very complete and it gave us a general overview of the different components of tsunami mitigation in the Pacific Ocean that enables us to continue efforts in our home countries. The most valuable knowledge that I gained were the personal and institutional accounts and experiences (positive and negative) that were shared with us during

extended discussions in each particular presentation. Being able to see how PTWC, State and County Civil Defense work and interact was also a valuable lesson and more gratifying than just reading about it.

The lesson that I take back to El Salvador is the need to start an awareness program, first at an institutional and governmental level, followed by a national level. In order for El Salvador to be able to make strides on tsunami mitigation a lot of people need to be involved and a "snowball effect" has to occur so that tsunami preparedness and mitigation is incorporated into the national development plans and strategies.

Considering that tsunami hazards in the Pacific Ocean affect many countries and within each of these, several institutions are involved in mitigating their effects, I think there is still a need for future ITP sessions similar to the one we attended. However, a long term plan should be developed, so as to also permit focused training on specific topics of tsunami mitigation for key personnel of participating countries.

PACIFIC ISLAND DISASTER RISK REDUCTION FOR SUSTAINABLE ISLAND DEVELOPMENT, HAWAII, USA, 18–29 OCTOBER 2004

Pacific Tsunami Warning Center Geophysicist-in-Charge, Dr. Chip McCreery, and International Tsunami Information Center Director, Dr. Laura Kong, participated in a tsunami response planning session at the East-West Center's Leadership Seminar for Pacific Island Disaster Managers on Disaster Risk Reduction for Sustainable Island Development on October 27, 2004 in Honolulu, Hawaii. The session on tsunamis was organized by the Pacific Disaster Center and featured a table-top facilitated discussion in which the participants identified the highest priority actions that they needed to take when a tsunami warning is issued by the PTWC. Prior to the tsunami scenario exercise, McCreery gave a presentation outlining the activities of the PTWC and Kong summarized the Work Programme for tsunami risk reduction developed in July 2004 at the South Pacific Tsunami Awareness Workshop (SPTAW, attended by American Samoa, Cook Islands, Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, and Vanuatu, see *Tsunami Newsletter*, April-July, 2004 issue), that was presented at the SOPAC STAR Meeting and adopted by the SOPAC Governing Council in September, 2004 (see *SOPAC article in this issue*).

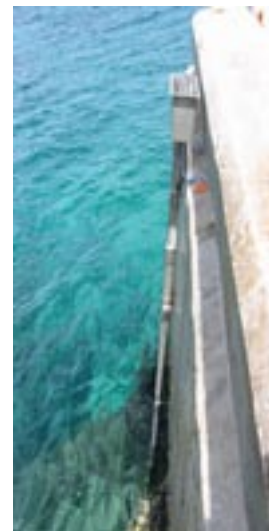
PTWC NEWS – NIUE SEA LEVEL STATION REPAIRED

The PTWC re-established the Niue tsunami/tide system in October, 2004, after it sustained major damage and lost its Data Collection Platform (DCP) when Cyclone Heta devastated the island in January. The site consists of a Vaisala DCP, GOES antenna, GPS clock, battery, and solar panel and a Druck pressure sensor. Due to travel time constraints, rainy weather, and so as to reduce the time needed for repair, Graham Marsh, a private contractor who had assisted in the initial installation, carried out much of the installation prior to the visit of PTWC Senior Electronics Technician, Rich Nygard.



Nygard also visited the tsunami/tide system in American Samoa that had not been working for a number of months. Upon evaluation, it was determined that the CPU of the DCP had ceased working and that it needed to be shipped back to the PTWC for repair.

Alofi Wharf and coastline, Niue Island. Arrow shows the location of the pressure sensor.



Sensor package installed off side of wharf. Shown are the pressure sensors, stilling well, and enclosure.

WORKSHOP AND MEETING SUMMARIES

SOPAC GOVERNING COUNCIL, 17–24 SEPTEMBER 2004, FIJI

The 33rd Annual Session of the South Pacific Applied Geoscience Commission (SOPAC, hosted by Papua New Guinea (PNG), was held 17-24 September 2004 at the Warwick International Resort, Coral Coast, Fiji. The Session included papers presented at the Science, Technology, and Resources Network meeting (STAR, 17-20 September), a joint plenary of the Governing Council and its Technical Advisory Group (TAG, 21-22 September), and the formal deliberations of the Governing Council (23-24 September). The sessions were attended by a total of 150 participants representing the 22 SOPAC countries, policy makers and other government officials, scientists and researchers.

During the STAR session, twelve papers on tsunamis were presented during a 20 September 2004 morning session. These included presentations on the outcomes and action proposals from the July South Pacific Tsunami Awareness Workshop (Atu Kaloumaira (SOPAC), Dr. Laura Kong (ITIC), Dr. Phil Cummins (Geoscience Australia) and Dr. Chalapan Kaluwin (AUSMAT)), tsunami visualization tools (Stan Goosby, Pacific Disaster Center), Pacific



SOPAC Director Cristelle Pratt welcomes delegations and participants at the opening of the SOPAC 33rd Annual Session of its Governing Council.

Tsunami Warning Center (Dr. Chip McCreery, PTWC), historical tsunami data collection (Gaye Downes and Dr. Hugh Cowan, New Zealand), South Pacific Sea Level Network (Kaluwin), Papua New Guinea tsunami hazards (Lawrence Anton, PNG, and Dr. David Tappin, England), and Hawaiian landslide tsunami deposits (Tappin).

A Tsunami Working Group was convened after the session to make recommendations to the STAR Chair for presentation at the TAG Session with the Governing Council. The recommendations (printed at end of this

SOPAC, *continued*

article) asked the Council to adopt the SPTAW work programme in its entirety, establish a SOPAC Tsunami Working Group, seek funds for the Feasibility Study, and to consider the SPTAW process and outcomes as an integral part of the ISDR Regional Strategy to be presented at the 2nd World Conference on Disaster Reduction.

After the STAR Chair's Report, Anton of Papua New Guinea, as Chair of the Tsunami Working Group, asked the TAG/Council to recognize the need for regional tsunami warning services. McCreery, Vice-Chair of the IOC Tsunami Programme (ITSU) and PTWC Geophysicist-in-Charge, then reiterated the need for a regional tsunami warning system in the SOPAC area and expressed that this has long been a goal of ITSU to complement the teletsunami warning services provided by PTWC.

During the TAG session, Job Esau, Vanuatu National Disaster Management Office Director, and Joe Buleka, Papua New Guinea Geological Survey Director, voiced support for the tsunami warning



From left to right in front, Steven Nions, Lawrence Anton, Joe Buleka, and Dr. Chalapan Kaluwin listen to papers during the STAR session on tsunamis.

initiative and encouraged Council to place tsunamis as a high priority natural hazard to mitigate against. ITIC Director, Kong, on behalf of the IOC Tsunami Programme, welcomed their interest and offered the ICG/ITSU's experience in assisting in the development of tsunami early warning capabilities in the region. Kaluwin, Sea Level and Climate Monitoring Project Director, noted that the current deployment of sea level stations throughout the South Pacific are an important asset for tsunami wave confirmation. SOPAC Director Cristelle Pratt further brought to the Council's attention the recommendations of the STAR working group on tsunami warnings and the need for a regional tsunami warning centre and indicated that the strong Council support for this recommendation was noted. The SOPAC Secretariat also recognized the STAR comments and recommendations and indicated

that these will be factored into future Community Risk Programme planning.

Upon finalization of the SOPAC Summary Report, the ITIC and SOPAC Community Risk Programme will discuss in detail the 2005-2006 tsunami mitigation activities that will be undertaken, and how SOPAC and ICG/ITSU can most effectively work together to make good progress in the Region.

Further discussions with Dr. Wally Johnson of Geoscience Australia indicated that AusAID may be a source of funding for the Tsunami Feasibility Study. The AusAID funding is available to Australian government agencies for technology assistance carried out in the region. Further, Geoscience Australia has indicated a willingness to take the lead in the pursuit of external funding for the Feasibility Study, and in coordinating and conducting the Study in cooperation and collaboration with SOPAC member countries and the region. Johnson will be communicating the results of the SOPAC STAR, TAG, and General Council meeting to Cummins for further action. Additionally, Geoscience Australia coordinates the activities of the Comprehensive Test Ban Treaty Organization's (CTBTO) for the region, and has within its mission components risk management coordination. New Zealand Institute of Geological and Nuclear Sciences (IGNS) has also indicated its interest in supporting the regional efforts, specifically through the seismic network expertise and incorporation of data streams accessible through GeoNET (Cowan) and their experience in documenting historical seismicity and tsunami records (Downes).

At the same time, Kong, Cummins, and McCreery have been in communication with the RANET Project (Kelly Sponberg, Ed Young), which has a goal of providing communication pathways for multi-disciplinary information, including weather, to local communities using satellites and FM radio technologies. The tsunami team discussed with RANET the planned Regional Tsunami Warning Service, stressing the time-critical nature of its information and indicating that a successful implementation will require real-time, on-demand communications for warning message dissemination and data acquisition. Presently, the RANET project has received AusAID funding through the Bureau of Meteorology (Byron Hodges) to conduct a Communications Feasibility Study that will document the communications infrastructure in the South Pacific in general, with detailed specifications gathered at several potential downlink sites. As the goals of the RANET Feasibility study are very similar to the communication infrastructure goals of the Tsunami Feasibility Study, the Cummins and Kong will be contacting with the RANET Study team to coordinate the efforts.

SOPAC, continued

The ITIC and The Asia Foundation (TAF, Kathryn Hawley) have had preliminary discussions on the inclusion of tsunami awareness and safety information in the regionalized materials that TAF will develop for the SOPAC Community Risk Programme on disaster preparedness. Materials discussed to date were a



From left to right, Dr. Chip McCreery (PTWC) and Dr. Laura Kong (ITIC) with longtime STAR attendees Dr. David Tappin (British Geological Survey) and Dr. Loren Kroenke (University of Hawaii).

children's disaster preparedness handbook and the update of a hazard preparedness video to include tsunamis. Additionally, as a result of suggestions made by recent ITP-Hawaii participants (from El Salvador, Colombia, and the Philippines), the ITIC is also exploring the viability of producing a tsunami hazard video for dissemination to the international community to assist disaster managers in educating their communities.

The ITIC has asked the IOC Executive Secretary or Tsunami Programme Technical Secretary to send information to SOPAC member countries on the procedures, requirements, and benefits in joining the International Coordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU). Currently, there are 26 Member States, but there are a number of SOPAC countries that are not yet members. These include Papua New Guinea, the Solomon Islands, Tonga, and Vanuatu, all of who attended the SPTAW in July 2004, and additionally, the Federated States of Micronesia (FSM), Commonwealth of the Northern Mariana Islands, the Republic of Palau, Kiribati, Marshall Islands, Nauru, Niue, Palau, and Tuvalu.

STAR Tsunami Working Group Recommendations

Members of Group: Lawrence Anton [Chair], Atu Kaloumaira, Michael Bonte-Grapentin, Noud Leenders, Job Esau, Dr. Laura Kong, Dr. Loren Kroenke, Dr. Wally Johnson, Dr. David Tappin, Doug Ramsay, Dr. Chalapan Kaluwin, Dr. Chip McCreery, Dr. Bernard Pelletier, Dr. Kazuhara Kitazawa, and Kata Duaibe

Recommendation to Council

Upon considering the recommendations of the South Pacific Tsunami Awareness Workshop July 1 – 3, 2004, the presentations of the STAR session and the discussions of the STAR Tsunami Working Group; and

Recognizing the long experiences of the UNESCO/IOC International Coordination Group for the Tsunami Warning System in the Pacific (ITSU) and its efforts to promote the development of regional tsunami warning systems in the Pacific for more effective tsunami mitigation; and

Noting the Draft Pacific Regional Position Paper for the 2nd World Conference on Disaster Reduction;

We present the following recommendations for Council endorsement:

1. Support the South Pacific Tsunami Awareness Workshop's proposed work programme for 2 years as agreed in July 2004 and specifically to:
 - Finalise the Terms of Reference and establish a SOPAC Tsunami Working Group, which is to produce a work schedule within two months;
 - Coordinate the investigation and development of a Regional Tsunami Information and Warning System within the SOPAC region;
 - Finalise the Terms of Reference for the recommended Feasibility Study;
 - Seek resources to conduct the Feasibility Study for the Regional Tsunami Information and Warning System.
2. Consider the inclusion of the South Pacific Tsunami Awareness Workshop's proposed work programme in the Draft Pacific Regional Position Paper for the 2nd World Conference on Disaster Reduction.

TSUNAMI EMPHASIS IN DISASTER REDUCTION COURSE AT UNIVERSITY OF PAPUA NEW GUINEA, 25 OCTOBER – 8 NOVEMBER 2004

Hugh Davies (hdavies@upng.ac.pg) and Wilfred Lus (wlus@upng.ac.pg), Earth Sciences, University of Papua New Guinea, Box 414, University Post Office NCD, Papua New Guinea.

A course on disaster reduction held at the University of Papua New Guinea, 25 October to 8 November, attracted five participants from the Pacific Islands and 16 from within PNG (*Figure 1*). The course was coordinated by Professor Hugh Davies and featured presentations by Professor Fumihiko Imamura (Tohoku University), Yuichi Nishimura (Hokkaido University), Steve Saunders (Rabaul Volcanological Observatory), Chris McKee and Lawrence Anton (Port Moresby Geophysical Observatory), Gabriel Kuna (Geological Survey), and representatives of the National Disaster Centre, Red Cross, World Vision and Caritas.

Although the course topics ranged across all major types of hazard, there was a strong emphasis on tsunamis, given the presence of Professor Imamura, who has maintained close ties with PNG since his involvement in the aftermath of the Aitape tsunami, and Mr Nishimura, who has studied the tsunami sediments in Hokkaido and those deposited during

the 1994 Rabaul eruption. Others with vital tsunami experience were Dickson Dalle, who, as a government office based in Aitape, led the response to the disaster for the first 48 hours, and Jack Siroi, Alexia Tomur and Steve Gary, all of whom were involved in the response and recovery.

Participants were guided through the standard disaster management course materials on prevention, preparedness, response and recovery (PPRR) and then used this framework to analyse a series of case histories, beginning with the explosive eruption of Mount Lamington in 1951, the Rabaul seismic emergency of 1984 and eruption of 1994, the Manam eruption of 1996, the Aitape tsunami of 1998, and the Finisterre Range landslides of 1993 and 2002.

The group split into teams to conduct an Emergency Risk Management exercise based on possible slope failure and cliff failure in the Rouna Valley, which is the source of much of the power and water supply for Port



Figure 1. Disaster Reduction course participants. Back row, from left to right: Nilesh Kumar Jit (Fiji), Malaefatu Leavasa (Samoa), Lt-Col. Peter Barkie, Jonathan Kuduon (RVO), Sen Hugo (PNG Waterboard), Arnold Lakamanga (SOPAC Liaison), Cathy Bolinga (Caritas), Ronald Rambu (Southern Highlands Provincial Government), Charley Douglas (Vanuatu), and Yuichi Nishimura. Front row, from left to right: Prof. Fumihiko Imamura, Prof. Hugh Davies, Thomas Toba (Solomon Islands), Steve Garry (Diocese of Aitape), Bernadette Sariki (Madang Provincial DO), Jack Siroi (Caritas DM), Dickson Dalle (Sandaun Province DM), Oala Moi (National Disaster Centre Liaison), Norman Philemon (Madang Province DM), Alexia Tomur (Counsellor, Aitape), Harrison Gedikile and Manuel David (UPNG Earth Sciences) and Amelia Sili (Tonga DO). Not pictured: Quinton Wibeawa (West New Britain Planning Office), Harry Gubalah (World Vision), Major Paul Kaliop (West New Britain PDM).

PNG TRAINING, *continued*

Moresby. The exercise followed the format promoted by Emergency Management Australia which provides a procedure for risk management at any level from village or community to district, province or nation-wide.

Other highlights were an introduction to the preparation of hazard maps, with emphasis on the importance of involving the local community; a presentation on the implications of global warming for the Pacific region; and presentations by the participants from the Pacific Islands on the hazards facing Tonga, Samoa, Fiji, Vanuatu and the Solomon Islands.



Figure 2. Professor Imamura (right), Lt-Col. Peter Barkie (middle), and Mr. Nishimura (left) listen to presentations from course participants. Imamura and Nishimura contributed greatly to the success of the course. Their presentations focused on tsunami and volcanic hazards, and compared those in Japan with examples from PNG and the Pacific.

The course included two written tests and the completion of an essay, and earns credit points in the University's degree programs (Figure 3). Plans are in place for the development of more disaster-related courses with the goal of being able to offer a Diploma in Disaster Management. The overseas participants were sponsored by NZAID and SOPAC, and four of the participants from PNG were sponsored by UNICEF and SOPAC.



Figure 3. Sir Peter Barter, Minister for Intergovernment Relations and responsible for disaster matters, presents a certificate of course completion to Malaefatu Leavasa of Samoa, as Professors Hugh Davies and Mathias Sapuri (Acting Vice Chancellor) look on.

Located in Honolulu, the International Tsunami Information Centre (ITIC) was established on November 12, 1965, by the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific, and Cultural Organization (UNESCO). In 1968, the IOC formed the International Coordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU).

The present 26 Member States are: Australia, Canada, Chile, China, Colombia, the Cook Islands, Costa Rica, the Democratic People's Republic of Korea, Ecuador, El Salvador, Fiji, France, Guatemala, Indonesia, Japan, Mexico, New Zealand, Nicaragua, Peru, Philippines, the Republic of Korea, Samoa, Singapore, Thailand, the Russian Federation, and the United States of America.

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