

## Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System



# TSUNAMI NEWSLETTER



## International Tsunami Information Center

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### In Remembrance, Michael Blackford, 1939-2014

Mike Blackford passed away in Magdeburg, Germany while traveling with his wife in Europe, trying to meet their goal of visiting every country in the world. His death, due to pancreatic cancer, was unexpected and occurred while pursuing his favorite pastime, traveling to exotic places and meeting interesting people. Blackford was dearly loved by his family and passed away surrounded by as many as could be there under difficult travel circumstances. He was 74 years old.

Blackford was born in South Bend, Indiana. His family relocated to San Francisco when he was young. He attended Riordan High School and University of California, receiving a degree in Geophysics. Mike moved his family around the country to many states including, California, Alaska, New Jersey, Maryland, and Hawaii. He worked for various government agencies as a Seismologist and Tsunami expert, including being the Director of the NOAA Pacific Tsunami Warning Center and the International Tsunami



*Michael Blackford, former PTWC and ITIC Director, visited the ITIC office in January 2014. Blackford made significant contributions to tsunami science over the years and continued to give back as a volunteer science docent in Northern California. (Left to right): Michael Blackford in his old ITIC Director's office with Brian Yanagi (ITIC Manager). Courtesy of ITIC.*

## SUMMARY OF EARTHQUAKES

1 October - 31 December

Reported by: International Tsunami Warning Centres

Compiled by: International Tsunami Information Center, ITIC

Advisories issued by international tsunami warning centers. As of 01 October 2014, the Pacific Tsunami Warning Center (P) issues: Tsunami Information Statements (TIS) and Tsunami Threat Messages (TTM). Prior to 01 October 2014, the Pacific Tsunami Warning Center (P) issued: Tsunami Information Bulletins (TIB), Fixed and Expanding Regional Warnings (FRW, ERW), and Ocean-wide or Widespread Watch/Warnings (TWW) for the Pacific; Tsunami Information Statements (TIS), Local, Regional, and Ocean-wide Watches (LTW, RTW, TW) for the wider Caribbean (C). The Japan Meteorological Agency (JMA), issues: Tsunami Advisories (NWPTA) for the Northwestern Pacific. The US National Tsunami Warning Center (N), formerly known as West Coast/Alaska Tsunami Warning Center, was renamed on 01 October 2013. The US National Tsunami Warning Center (USNTWC) issues: Tsunami Information Statements (TIS), Tsunami Advisories (TA), Tsunami Watch/Warnings (TWW) for Canada, the US (including Puerto Rico and the US/British Virgin Islands but excluding Hawaii and US-affiliated Pacific Island countries). Depth (from GCMT solution), epicenter and Moment Magnitude ( $M_w$ ) from the USGS (G), and preliminary  $M_w$  from PTWC, USNTWC, 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 USNTWC (N) ACTION	ACTION TIME (UTC)	TSUNAMI? DAMAGING?	MAXIMUM MEASUREMENT & LOCATION
9-Oct	02:15	Southern East Pacific Rise	32.112° S 110.815° W	12	6.8 (P, N) 7.1 (G)	(P) 01 TIS (N) 01 TIS (P) 04 TIS (P) 03 TIS	02:25 02:28 02:54 04:42	YES NO	47 cm amp (g), Easter Island, Chile
14-Oct	03:52	Off the Coast of Central America	12.576° N 88.046° W	42	7.4 (P, N) 7.3 (G)	(P) 01 TIB (N) 01 TIS (P) 01 TTM (P) 02 TTM	04:03 04:05 04:11 04:35	NO NO	
1-Nov	18:57	Fiji Region	19.696° S 177.729° W	450	6.9 (P, N) 7.1 (G)	(P) 01 TIS (N) 01 TIS	19:06 19:07	NO NO	
7-Nov	03:34	New Britain Region Papua New Guinea	6.044° S 148.210° E	43	6.9 (P, N, J) 6.6 (G)	(P) 01 TIS (N) 01 TIS (J) 01 NWPTA	03:42 03:44 04:00	NO NO	
15-Nov	02:32	Halmahera Indonesia	1.928° N 126.547° E	38	7.3 (P, N, J) 7.1 (G)	(P) 01 TTM (N) 01 TIS (J) 01 NWPTA (P) 02 TTM (P) 03 TTM (P) 04 TTM	02:42 02:44 02:58 03:03 04:15 04:31	YES NO	9 cm amp (g), Jailolo, Indonesia
16-Nov	22:33	Off East Coast of the North Island N.Z.	37.682° S 179.685° E	21	6.7 (P, N, G)	(P) 01 TIS (N) 01 TIS	22:39 22:41	NO NO	
21-Nov	10:10	Halmahera Indonesia	2.277° N 127.055° E	31	6.9 (P, N) 6.5 (G)	(P) 01 TIS (N) 01 TIS (J) 01 NWPTA	10:16 10:19 10:34	NO NO	

**Michael Blackford, 1939-2014, *continued***

Information Center in Hawaii as well as working at the West Coast and Alaska Tsunami Warning Center (now US NTWC) and the Nuclear Regulatory Commission. He was renowned in his field and traveled around the world from Russia to Indonesia and beyond, attending conferences, continuously learning and staying up to date in his field of work, even after retirement.

Blackford's love of travel began with camping trips all over California and Nevada. If there was an unpaved road, Mike found it, accompanied by his wife, children and anyone else he could talk into going.

Blackford volunteered extensively after retirement. He worked with young people at locations all over the Bay Area, sharing his love of science and the environment. He could, and did, go on for hours on the wonders

of the Foucault Pendulum. With his white beard, he was recruited to play Santa at Forest Home Farms for several years. He also enjoyed his service to various Catholic churches, including St. Joan of Arc in San Ramon, the city where he lived with his wife which was close to the homes of his daughters. He helped his children with many duties including pet sitting, driving the float in the Homecoming parade, and just being there when they needed him. He was forever a Cal fan, a Cal Band member until the end. He attended almost every football and basketball game, cheering on his teams, in good times and bad.

Blackford is survived by his wife, Charlotte, his children, Tavie Knapp (Steve), Dana Chavarria (Stan), Jenny Jensen (Dave), Tim Blackford (Juliet) and Cameron Blackford (Evelyn), and 9 grandchildren.

**In Remembrance, Fredric Raichlen, 1932-2014**

Fredric Raichlen, Professor Emeritus of Civil and Mechanical Engineering at Caltech's Division of Engineering and Applied Science, passed away on 13 December 2014. He was 82 years old. Raichlen was an expert in coastal engineering whose pioneering studies of tsunami mechanics have led to standards for designing tsunami-resistant structures to save lives and reduce property damage. For almost a decade, Raichlen was the only professor in the U.S. working on tsunami hydrodynamics.

Upon arriving at Caltech in 1962, Raichlen built a set of wave tanks to analyze how tsunamis originate, how they propagate through the open ocean, and what happens when they run up on shore. The data from these experiments enabled him to develop a comprehensive, three-dimensional computer model of tsunami behavior. He supervised laboratory experiments with numerical models and established benchmark standards. In 1965, Raichlen built a 31 by 15 foot wave tank instrumented to measure wave heights and water velocities anywhere within its walls.

Raichlen earned his bachelor's degree in engineering from the John Hopkins University in 1953 and his master's and doctoral degrees at MIT in 1955 and 1962. He also served in the Air Force as an environmental health officer from 1956 to 1959.

Raichlen was inducted into the National Academy

of Engineering in 1993. In 2003, he was given the American Society of Civil Engineers (ASCE) International Coastal Engineering Award, the most prestigious honor in the international coastal engineering community. In his retirement, he became an avid watercolor painter.

Raichlen is survived by his wife, Judy, two sons and two grandchildren.



*Fred Raichlen, Professor of Civil and Mechanical Engineering, Emeritus at the California Institute of Technology. Courtesy of Caltech Archives.*



## IOC NEWS

### IOC TOWS-WG Meeting, Tokyo, Japan, 21-22 October 2014

[http://www.ioc-tsunami.org/index.php?option=com\\_oe&task=viewEventRecord&eventID=1566](http://www.ioc-tsunami.org/index.php?option=com_oe&task=viewEventRecord&eventID=1566)

The IOC Working Group on Tsunamis and other Hazards Related to Sea-Level Warning and Mitigation Systems Task Team Meeting (TOWS-WG) on Tsunami Watch Operations (TTTWO) was conducted in Tokyo, Japan from 21-22 October 2014. IOC Resolution XXIV-14 (2007) established the TOWS-WG to advise the IOC Governing Bodies on coordinated development and implementation activities on warning and mitigation systems for tsunamis and other hazards related to sea level as a common priority of all Global Intergovernmental Coordination Groups (ICGs). The chair of the Task Team is Dr. Srinivasa Kumar.

The following is a Summary of Action Items and Recommendations to TOWS-WG:

#### Action Items

Action 1: Dr. McCreery to contact BMKG directly to clarify the backup service required for the Banda/Java Sea regions.

Action 2: The Global Area of Service map should be updated to reflect the agreed service for the Banda/Java Sea regions and should be submitted to the TOWS-WG for approval.

Action 3: IOC Secretariat and ITIC to update the Tsunami Glossary with the definitions of tsunami threat levels, and the new definitions of Tsunami Service Provider (TSP), Tsunami Warning Focal Point (TWFP) and National Tsunami Warning Centre (NTWC) in accordance with the decision of the IOC Executive Council (EC-XLVII/Dec.3.2.1). The definition of the TOWS-WG should also be included in the Glossary.



*TOWS Tsunami Watch Operations Task Team Meeting participants. Front (left to right): Chip McCreery (PTWC, PTWS), Takeshi Koizumi (NWPTAC, PTWS), Laura Kong (ITIC), Victor Huerfano (USA, CARIBE-EWS), Masahiro Yamamoto (IOC Senior Tsunami Advisor, retired). Back (left to right): Yutaka Michida (Japan, TOWS WG Chair), Ocal Necmioglu (Turkey, NEAMTWS), Ken Gledhill (New Zealand, PTWS Chair), Rick Bailey (Australia, IOTWS Chair), Srinivasa Kumar (India, TT Chair, IOTWS Vice-Chair), Tony Elliott (IOTWS Secretariat Head), Tetsuo Ueyama (NWPTAC), and Michael Angove (USA). Courtesy of JMA.*

**Tokyo, continued**

*From left to right: Victor Huerfano (Puerto Rico Seismic Network), Rick Bailey (Australia Bureau of Meteorology), and Ken Gledhill (New Zealand Geologic and Nuclear Sciences) during the TOWS Task Team Meeting. Courtesy of ITIC.*

**Action 4:** ITIC to propose definitions of Tsunami Service Provider (TSP) and TOWS-WG for the consideration of the TOWS-WG at its 8th meeting.

**Action 5:** The chair of the Task Team to write to IMO and JCOMM to request their feedback on the Task Team's proposal for transmitting specialised tsunami bulletins to vessels at sea via GMDSS.

**Action 6:** Dr. Laura Kong to circulate draft post-event assessment survey questionnaire to the Task Team members of the TTTWO and Task Team on Disaster Management and Preparedness (TTDMP).

**Action 7:** IOTWS to finalise its Service Definition Document by early March 2015 and circulate to other ICG Task Team members.

**Action 8:** Dr. Srinivasa Kumar to prepare an outline Global Service Definition Document based on earlier Task Team recommendations and reports and circulate to the other Task Team members before the next TOWS-WG meeting.

## **Recommendations**

**Recommendation 1** to the TOWS-WG on Tsunami Threat Levels:

The Task Team recommends that the following definitions for tsunami threat levels should be adopted and requests the IOC Secretariat and ITIC to update the Tsunami Glossary accordingly:

### **1. Tsunami Threat Levels**

- Describes the types of tsunami threats

according to its potential hazard and impact to people, structures, and ecosystems on land or in near-shore marine environments.

- Depending on the type of threat, a NTWC may issue a corresponding tsunami bulletin or statement.

### **2. Land Inundation Threat**

- Tsunamis that can inundate coastal communities possibly causing significant damage. When there is a land threat, people should evacuate tsunami hazard zones.

### **3. Marine Coastal Waters Threat**

- Tsunamis that are a marine threat may generate strong and unusual currents in coastal waters. When this is a marine threat, people should stay out of the water and away from the immediate foreshore including inlets of water.

### **4. Potential Threat**

- Tsunamis that represent a potential land/marine threat but are still under evaluation.

### **5. No Threat**

- When there is no possibility of a Tsunami or Tsunamis that are generated but are not expected to cause damage or be a danger to people.

**Recommendation 2** to the TOWS-WG on standards for the reporting of tsunami water levels and wave arrival time.

### **1. Tsunami Amplitude**

- Amplitude relative to sea level to be used as the common measure of a tsunami and should be defined in the message. All TSPs to report forecast and observations as amplitude relative to sea level at the time of the forecast or observation.
- Amplitude is measured as 1) the absolute value of the difference between a particular peak or trough of the tsunami and sea level at that time, or 2) half the difference between an adjacent trough and peak and can be corrected for the change of tide between that trough and peak.
- Each TSP will specify the methodology and the parameters used for producing

Tokyo, *continued*

forecast amplitudes in its Service Definition Document.

## 2. Arrival Times

- Estimated time of arrival of first tsunami wave with positive or negative amplitude as calculated by forecast model. Observed time of arrival of first distinguishable tsunami wave with positive or negative amplitude as measured by sea level stations.
- Estimated time of arrival of first tsunami wave amplitude over basin-specific threat threshold with positive or negative amplitude as calculated by forecast model. Observed time of arrival of tsunami wave with positive or negative amplitude over basin-specific threat threshold as measured by sea level stations.
- Estimated time of arrival of maximum tsunami wave with positive amplitude as calculated by forecast model. Observed time of arrival of maximum tsunami wave with positive amplitude as measured by sea level stations. Estimated time of arrival of last tsunami wave with positive amplitude over basin-specific threat threshold as calculated by forecast model. Observed time of arrival of last tsunami wave with positive amplitude over basin-specific threat threshold as measured by sea level stations.

**Recommendation 3** to the TOWS-WG on Key Performance Indicators and targets for TSP Areas of Service and Earthquake Source Zones.

## 1. Earthquake detection

- Elapsed time of 1st (EQ) Bulletin for TSP Area of Service – Target 10 minutes (when no coordination required between TSPs).
- Probability of Detection of EQ with basin-defined minimum magnitude threshold, in comparison with final estimate from USGS after 1 month – Target 100%.
- Accuracy of EQ parameters in comparison with final estimate from USGS after 1 month:
  - Magnitude: Target 0.3
  - Depth: Target 30 km
  - Location: Target 30 km

## 2. Threat Assessment

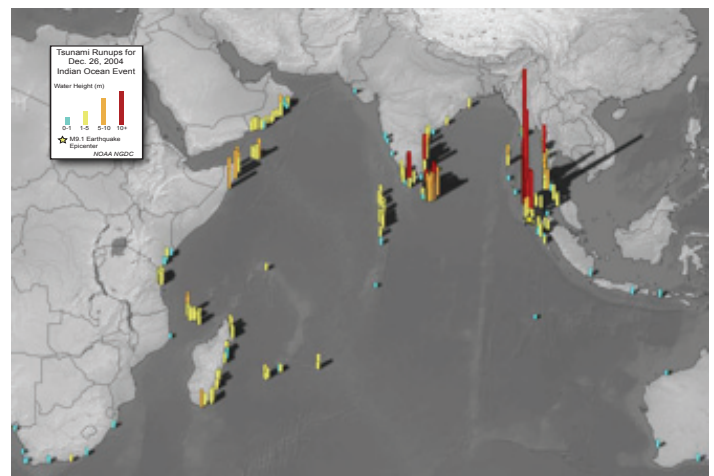
- Elapsed time of issuing first threat assessment bulletin after EQ – Target 20 mins (when no coordination required between TSPs).
- Probability of detection of tsunamis above basin specific threat threshold – Target 100%.
- Accuracy of tsunami amplitude forecasts – Target factor of 2.
- The actual values are to be verified and adjusted by each ICG according to the nature of the tsunami threat in each basin.

**Recommendation 4** to the TOWS-WG on the tenure of the Task Team: To extend the term of the Task Team on Tsunami Watch Operations for a further intercessional period with the same Terms of Reference to allow it to continue its work.

### International Conference to Commemorate the 10th Anniversary of the Indian Ocean Tsunami, Jakarta, Indonesia, 24-25 November 2014

[http://www.ioc-unesco.org/index.php?option=com\\_oetask&view=DocumentRecord&docID=14662](http://www.ioc-unesco.org/index.php?option=com_oetask&view=DocumentRecord&docID=14662)

The IOC convened a high-level policy conference called, “The IOTWS 10 years after the Indian Ocean Tsunami: Achievements, Challenges, Remaining



*Tsunami runups in the Indian Ocean produced by the 26 December 2004 Sumatra, Indonesia Tsunami. Data from eyewitness accounts, field surveys, and tide gauges. Courtesy of the National Geophysical Data Center/World Data Service for Geophysics.*



**Jakarta, continued**

Gaps and Policy Perspectives.” The conference was hosted by the Government of Indonesia from 24-25 November in Jakarta, and brought together countries, donors, and experts to recognise the achievements of the last 10 years, to highlight work that still needs to be done, and to seek re-commitment to continued investment in the IOTWS.

The 26 December 2004 magnitude 9.1 northern Sumatra, Indonesia earthquake (depth 30 km) generated a gigantic tsunami that was observed worldwide and caused tremendous devastation and deaths throughout the Indian Ocean region. The earthquake, the third largest since 1900, caused severe damage and casualties in northern Sumatra, Indonesia, and in the Nicobar Islands, India. No separate death toll is available for the earthquake as the tsunami followed within 20 minutes. The death toll was probably no worse than for the earthquake of 28 March 2005—that is, fewer than 1,000.

However, the tsunami that followed killed more people than any other tsunami in recorded history, with 227,898 dead or missing in 14 countries across the Indian Ocean. The worst hit country was Indonesia with 167,540 listed as dead or missing and damages of \$4,451.6 million. The remaining fatalities occurred

in Sri Lanka (35,322), India (16,269), Thailand (8,212), Somalia (289), Maldives (108), Malaysia (75), Myanmar (61), Tanzania (13), Bangladesh (2), Seychelles (2), South Africa (2), Yemen (2), and Kenya (1). The total estimated material losses in the Indian Ocean region were \$10 billion and insured losses were \$2 billion.

According to the NOAA National Geophysical Data Center / World Data Service for Geophysics Global Historical Tsunami Event database 2,229 tsunamis have occurred in the world since 2000 B.C. Of these tsunamis, 1,212 are considered confirmed tsunamis. In the Indian Ocean region, 69 confirmed tsunamis have been observed since the beginning of the 18th Century, and 22 (32%) of these events caused deaths. Three of these deadly tsunamis occurred after the 26 December 2004 event. The majority of Indian Ocean tsunamis were generated by earthquakes (88%), the remainder resulted from volcanic eruptions (6%), landslides (1%), and unknown causes (4%).

In the 10 years since, much has been done by the region to ensure this catastrophe never happens again. Countries now know what a tsunami is and have prepared communities. National Tsunami Warning Centers now exist in every country, and they are working with National Disaster Management



*IOTWS 10th Anniversary Conference key speakers from left to right: Laura Kong (ITIC Director), Sugeng Pribadi (BMKG), Charles McCreery (PTWC Director), Thorkild Aarup (IOC Tsunami Unit Head), Tony Elliott (IOTWS Secretariat Head), Rick Bailey (IOTWS Chair, Australia), Fadly Yusuf (Indonesia RISTEK Minister), Srinivas Kumar (IOTWS Vice-Chair, India), Nora Gale (IOTWS Secretariat), Ardito Kodijat (IOTIC Head), Takeshi Koizumi (JMA Senior International Tsunami Information Coordinator), and Mochammad Riyadi (BMKG Tsunami Warning Center Head). Courtesy of ITIC.*

**Jakarta, continued**

Offices and local government officials to warn their citizens on impending dangerous regional and distant tsunamis. A regional international warning system is now in place under the framework of the UNESCO IOC Indian Ocean Tsunami Warning and Mitigation System, with Australia, India, and Indonesia working together as Tsunami Service Providers (TSP) for the region. The TSPs officially took over in April 2013, replacing the Pacific Tsunami Warning Center and Japan Meteorological Agency who had provided interim advisory services starting immediately afterward in March 2005.

ITIC Director Dr. Laura Kong, PTWC Director Dr. Charles McCreery, and JMA Senior Coordinator for the International Earthquake and Tsunami Information, Takeshi Koizumi were invited PTWS speakers. ITIC, working with the IOC, conducted 30 trainings on tsunami warning and emergency response standard operating procedures to assist countries in building their warning systems. PTWC and JMA provided Interim Tsunami Advisory Services to the IOTWS through 2013.



The session "Development of the IOTWS since 2004. What has been achieved? What is different? Is the Indian Ocean region safer than it was in 2004?" included (left to right): Takeshi Koizumi, Senior Coordinator for International Earthquake and Tsunami Information, Japan Meteorological Agency; Dr Srinivasa Kumar, Head, ASG & In-Charge National Tsunami Warning Centre, Indian National Centre for Ocean Information Services (INCOIS), India and Vice-Chair of ICG/IOTWS; Rick Bailey, Head, Tsunami Warning & Ocean Forecast Services, Australian Bureau of Meteorology and Chair of ICG/IOTWS; Dr Charles McCreery, Director of Pacific Tsunami Warning Center; Dr Harkunti P. Rahayu, Institute of Technology Bandung and Chair of ICG/IOTWS Working Group 3; and Prof Samantha Hettiarachchi, University of Moratuwa and Chair of ICG/IOTWS Working Group 1. Courtesy of ITIC.

### ITIC - PTWC NEWS

#### Asian Seismological Commission, Makati, Philippines, 17-20 November 2014

<http://asc2014ph.phivolcs.dost.gov.ph>



ASC President Gary Gibson (Australia) welcoming delegates to the 10th General Assembly. Courtesy of ITIC.

The IUGG IASPEI 10th General Assembly of the Asian Seismological Commission (ASC) took place 17-20 November 2014. ITIC Director Laura Kong was a guest convener with Philippine Institute of



Leo Bautista (PHIVOLCS) presented a paper on calculating tsunami exposure and vulnerability. Courtesy of ITIC.



Philippines, *continued*

*ITIC Director Laura Kong and PHIVOLCS Tsunami Warning Center Staff, November 2014.*

Volcanology and Seismology (PHIVOLCS) Geologic Disaster Awareness and Preparedness Division Chief Mylene Martinez-Villegas to the session “Education, Outreach, and Cooperation.”

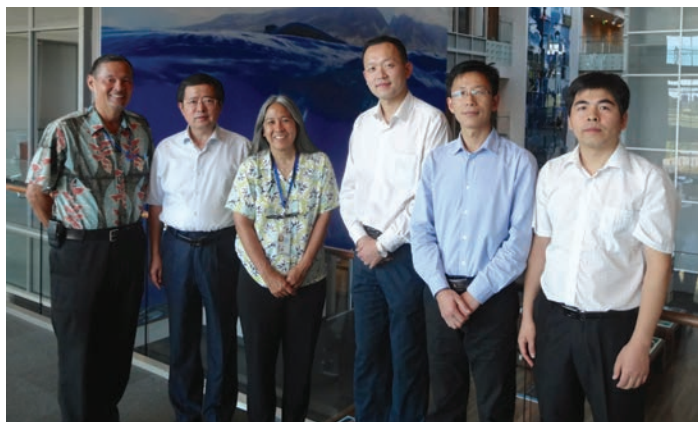
The ITIC has published many well-respected tsunami education and awareness materials, and conducted extensive international outreach and capacity building over its 50-year history. The event was co-sponsored

by the ASC, Philippine Institute of Volcanology and Seismology (PHIVOLCS), Geological Society of the Philippines and the City of Makati. Also, Kong visited PHIVOLCS on 21 November, and briefed their staff on the PTWC Enhanced Products.

### **China Visitation to PTWC and ITIC, Honolulu, Hawaii, USA, 28-29 October 2014**

A China National Marine Environmental Forecasting Center (NMEFC) delegation visited ITIC and PTWC from 28-29 October 2014 to discuss continued collaborative development of a NMEFC hosted South China Sea Tsunami Advisory Center under the IOC (ICG/PTWS-XXV.3, 2013), and potential formalization of an agreement for future collaborations. China participants included:

- Dr. Hui Wang, Director General, NMEFC, State Oceanic Administration
- Dr. Ye Yuan, Acting Director, NMEFC Marine Disaster Forecasting and Warning Division
- Mr. Peitao Wang, Scientist, NMEFC Marine Disaster Forecasting and Warning Division
- Dr. Dakui Wang, NMEFC International Cooperation Office



*Scientists from the National Marine Environmental Forecasting Center (NMEFC) of State Oceanic Administration (SOA) of China met with ITIC and PTWC at the NOAA Inouye Regional Center in Honolulu, Hawaii from 28-29 October 2014. Left to right: Brian Yanagi (ITIC), Dr. Hui Wang (SOA), Dr. Laura Kong (ITIC), Dr. Ye Yuan (SOA), Dr. Dakui Wang (SOA), and Peitao Wang (SOA). Courtesy of ITIC.*

## Workshop and Meeting Summaries

### ICG/PTWS Regional Working Group, Central America, 29-30 September 2014

[http://www.ioc-tsunami.org/index.php?option=com\\_oe&task=viewEventRecord&eventID=1571](http://www.ioc-tsunami.org/index.php?option=com_oe&task=viewEventRecord&eventID=1571)

The ICG/PTWS Regional Working Group for Central America held its Third Session on 29-30 September 2014 in Managua, Nicaragua. The Meeting was presided over by Angelica Muñoz (Chair, INETER, Nicaragua) and supported by Bernardo Aliaga (Technical Secretary of ICG/PTWS), and attended by 36 delegates and observers of the six Central American countries (Costa Rica, El Salvador, Honduras, Guatemala, Nicaragua, Panamá). Observers included Jorge Meléndez (President of CEPREDENAC), Yadira Meza (Nicaragua's CEPREDENAC representative), Praxy Pineda (Co-Director of SINAPRED), and representatives from JICA, USAID, NOAA/ITIC and NOAA/PMEL.

The meeting recognized and thanked JICA's contribution to the future establishment of a regional Central American Tsunami Advisory Center (CATAC), as well as technical training to the region. The Working Group decided to support Nicaragua's continued advancements towards the creation of CATAC,



*Third Meeting of the Regional Working Group for Central America. Courtesy of ITIC.*

specifically supporting their efforts at the upcoming ICG/PTWC and ICG/CARIBE-EWS meetings.

The Working Group also endorsed the proposal by ITIC to pilot its new training course on the tsunami evacuation plans in Central America. The Course focuses on the development of community tsunami evacuation maps. The Course will link and build upon existing trainings on tsunami inundation modeling, standard operating procedures, and exercises to



*During the 2014 Fall AGU meeting, the ITIC and NGDC met with scientists to gather materials for the upcoming 50th Anniversary Historical Book, Pacific Tsunami Warning System: A Half-Century of Protecting the Pacific, 1965-2015. From left to right: Nicolas Arcos (ITIC), Paula Dunbar (NGDC), Viacheslav K. Gusiakov (Novosibirsk Tsunami Laboratory, Russian Federation), Eddie Bernard (USA), Laura Kong (ITIC), Alexander Rabinovich (Shirshov Institute of Oceanology Russian Federation). Courtesy of ITIC.*



AGU, *continued*



PTWC's Nathan Becker presented a talk on the use of animations as decision support tools during an event. Courtesy of ITIC.

create a standardized, but flexible course, applicable across countries and ICG regions. The pilot process would begin to be developed through a 1-2 year pilot project in the Central American region starting in 2015.

Finally, the Working Group agreed to support Nicaragua's proposal to establish a Regional Seismic Network. This effort would (1) improve the information on strong earthquakes; (2) support tsunami warnings at the regional-level; (3) facilitate an earthquake early warning system; and, (4) initiate the development of a seismic database.

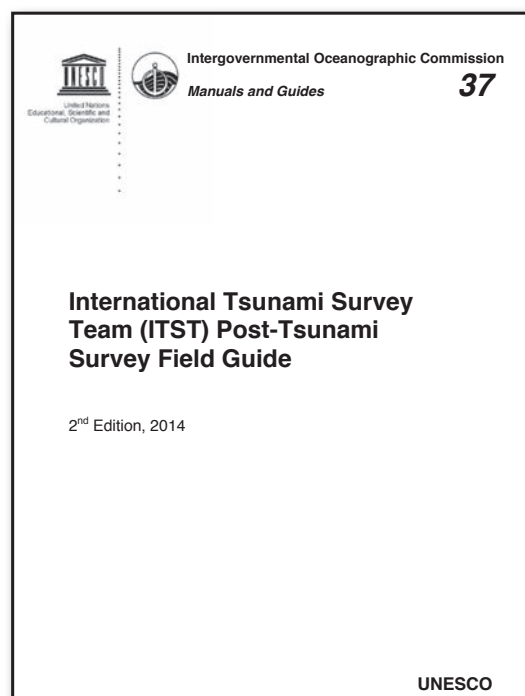
### American Geophysical Union Fall Meeting, San Francisco, California, USA, 15-19 December 2014

<http://fallmeeting.agu.org/2014/scientific-program/>

The Fall Meeting of the American Geophysical Union (AGU) took place on 15-19 December 2014 in San Francisco, California, USA. Dedicated tsunami sessions took place on 15-16 December. The *Decade of Megatsunamis: Science and Tsunami Warning Systems after the 2004 Sumatra Event* session (oral: S13E, S14A; joint Seismology and Geophysics sections) included keynote talks by Dr. Eddie Bernard, and Professors Kenji Satake, Costas Synolakis, Chari Pattiaratchi, and Emile Okal. The *Advances in Tsunami Hazard Mitigation and Response* session (oral: NH11C, NH12A; poster: NH13A; joint Natural Hazards and Seismology sections) covered a wide variety of topics, including tsunami events, hazard analysis, mitigation, preparedness, tsunami warning, policy, and science communications. Altogether throughout the Meeting, 32 talks and 35 posters were presented.



Dr. Laura Kong (ITIC) and Dr. Harsh Gupta (President of IUGG) meet at the 2014 AGU. Courtesy of ITIC.



The IOC International Tsunami Survey Team (ITST) Post-Tsunami Survey Field Guide (Manual and Guides 37, 1998, 2nd ed 2014) was updated to include modern guiding principles and protocols, techniques, and measurements in order to assist in standardizing data collection.



AGU, *continued*

Session ID	Author(s)	Title
S13E-01	E N Bernard	Tsunami Science for Society
S13E-02	K Satake	Lessons from the 2004 Indian Ocean and 2011 Tohoku Tsunamis, Developments, and Future Directions
S13E-03	C Synolakis, U Kanoglu	Lessons Learned and Unlearned from the 2004 Great Sumatran Tsunami
S13E-04	C B Pattiaratchi	Lessons learnt from the Indian Ocean Tsunami 2004: the role of surface and subsurface topography in deep water tsunami propagation
S13E-05	E A Okal	A Dozen Tsunamis from 2004 to 2014: Lessons and Revelations
S13E-06	Y Wei, V V Titov, E N Bernard, M C Spillane	New Measurements and Modeling Capability to Improve Real-time Forecast of Cascadia Tsunamis along U.S. West Coast
S13E-07	P J Lynett, N Kalligeris, A Ayca	Large-Scale Physical Modelling of Complex Tsunami-Generated Currents
S13E-08	H M Fritz, D A Phillips, A Okayasu, T Shimozone, H Liu, S Takeda, F Mohammed, V Skanavis, C Synolakis, T Takahashi	2011 Tohoku tsunami runup hydrographs, ship tracks, upriver and overland flow velocities based on video, LiDAR and AIS measurements
S14A-01	V V Titov	Tsunami Forecast: Connecting Science with Warning Operations
S14A-02	J C Borrero, D Greer, D G G Goring, W L Power	Modeling tools for the real-time evaluation and historical reconstruction of tsunami events in New Zealand
S14A-03	V K Gusiakov	Mega Tsunamis of the World Ocean and Their Implication for the Tsunami Hazard Assessment
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