Intergovernmental Oceanographic Commission
Reports of Meetings of Experts and Equivalent Bodies

Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region (SCS–WG)

Second Meeting

Petaling Jaya, Malaysia
16–18 October 2012

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ICG/PTWS-WG-SCS-II/3
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1. WELCOME AND OPENING

The Chair of the Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region (SCS-WG), Dr Mohd. Rosaidi bin Che Abas, Malaysia, welcomed everyone to the meeting and invited the participants to introduce themselves. He provided an overview of the WG-SCS, recalling that the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS) meetings leading to the creation of the group. All Member States of the South China Sea (SCS) region were invited to join the Working Group (WG).

2. ORGANIZATION OF THE SESSION

2.1 ADOPTION OF THE AGENDA

The provisional agenda circulated prior to the meeting was adopted and is available in ANNEX I. A full list of participants is provided in ANNEX V.

2.2 DESIGNATION OF RAPPORTEUR

Dr Mohd. Rosaidi bin Che Abas (Malaysia) nominated Ms Zaty Aktar Haji Mokhtar as rapporteur and this was accepted by the delegates.

2.3 CONDUCT OF THE SESSION, TIMETABLE AND DOCUMENTATION

Mr Tony Elliott (IOC/UNESCO) introduced the timetable for the meeting and provided details of the meeting documentation, which had been made available on the meeting website. The timetable was adopted without any comments.

3. REVIEW OF DECISIONS, RECOMMENDATIONS AND ACTIONS ARISING FROM ICG/PTWS-WG-SCS-I MEETING

Dr Rosaidi explained that the First Meeting of the Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region (ICG/PTWS-WG-SCS-I) held in Sanya, China, from 12 to 14 December 2011, had not made many decisions or recommendations, as it had mostly been a discussion of the key components of the proposed regional Tsunami Warning System (TWS). He noted that it had been proposed that two Task Teams (TT) should be created to undertake a seismo-tectonic study of the South China Sea region and to advise the WG on the establishment of a Regional Tsunami Warning Centre. This meeting should discuss the Terms of Reference (ToRs) for both Task Teams.

4. REPORTS

4.1 NATIONAL PROGRESS REPORTS

Brunei

Ms Leong Wai Fong explained the responsibilities of Brunei government agencies in tsunami warning. She informed that no tsunami risk assessment has been conducted in Brunei yet. The new national digital earthquake monitoring system is expected to be operational by January 2013. There are a total of 5 seismic stations (4 Short Period and 1 Broadband) mainly for monitoring of local earthquakes. Four−five tide gauge stations are operated by the Survey Department, but not in real-time mode. Brunei is currently preparing a national tsunami response plan and the National Disaster Management Centre (NDMC) is

preparing an emergency handbook. A tsunami drill has been conducted for 1 water village in Brunei, involving 2 schools. The drill engaged the relevant agencies in emergency response.

China

Dr Yuan Ye presented China's report. He provided an update on the upgrading of the Tsunami Warning System of China and facilities at the National Marine Environmental Forecasting Center (NMEFC) which will become operational in 2012 or early 2013. The Tsunami Warning Centre has capabilities for earthquake monitoring, global and regional sea level monitoring, tsunami buoy data collecting in the South China Sea, tsunami modelling and risk assessment, and production and dissemination of tsunami bulletins and warnings.

Dr Yuan Ye noted that NMEFC monitored real-time sea level data from 107 coastal sea level stations in the South China Sea region, and 2 tsunami buoys operated by the State Oceanographic Administration (SOA) to serve as a critical component of the South China Sea Tsunami Warning System (SCSTWS) to facilitate tsunami early warning detection.

NMEFC has more than 20 tidal gauges along the SCS coast, transmitting with 1 minute interval through VSAT (very small aperture terminal) and cable. Dr Ye explained that China's tsunami warnings are classified into 4 levels: red level (especially severe disaster possibly causing a number of casualties and large economic losses), orange level (possibility of severe damage), yellow level (watch for potential danger near the coastline), and blue level (watch for potential danger offshore).

China is considering upgrading the tsunami warning classifications according to the new products of the Pacific Tsunami Warning Center (PTWC) as well as expanding its SCS tsunami scenario database. The dissemination of tsunami warnings through fax, broadcast and TV, website, email, SMS and Weibo (like twitter).

Dr Yuan Ye informed that NMEFC was cooperating with the Pacific Marine Environmental Laboratory (PMEL) of the National Oceanic and Atmospheric Administration (NOAA) of the United States of America on the development of SCS regional tsunami warning capabilities. He noted that a joint project for the development of SCS Real-time Tsunami Forecasting Capabilities between the NMEFC and PMEL had been assigned, and a joint working group was initiated in June 2012. The project will focus on the development of a regional tsunami forecast system in the SCS region using both the tsunami detection data assimilation and database skills; a technical review of the selection of new tsunami detection locations; development of refined numerical tools for tsunami generation, propagation and inundation in the SCS region; and the development of tsunami risk assessment skills in the SCS region.

He explained that a 5 year workplan had been formulated to upgrade the tsunami warning system based on database technology with propagating scenarios expanding up to 100,000 cases and warning coverage extending to all the SCS regions and coasts.

NMEFC hosted the WESTPAC−PTWS South China Sea Tsunami Modeling Training, a workshop on tsunami models and risk assessment, held in Beijing, China, from 24 to 27 September 2012, and the Sino-ASEAN workshop on marine disaster prevention and mitigation held in Kunming, China, from 17 to 19 July 2012.

Dr Yuan Ye presented the results of tsunami risk assessment study for nuclear power plants along the Chinese coasts after the March 2011 great tsunami, which investigated the potential threat of tsunamis from the Ryuku and Manila Trenches and showed the results of 5 possible earthquake scenarios with magnitude 9.1 in Nankai Trough, Japan.

Mr Saw Bun Liong (Malaysia) enquired if the tide gauge and buoy data are available on the Global Telecommunications System (GTS). Dr Chen Zhi (China) informed that there are about 100 tide gauges in China and 2 tsunami buoys deployed but the data are not available in GTS at present. NMEFC will try to make some of the tsunami buoy data available in GTS and will also evaluate which tide gauges are suitable for sharing in the SCS Tsunami Warning System.

Dr Wandono (Indonesia) enquired about the dissemination of tsunami products through the GTS.

Dr Chen Zhi responded that the GTS is a good tool for data, but for tsunami warning messages China presently has a special system for dissemination.

Dr Noraieni Haji Mokhtar (Malaysia) thanked the Government of China for its support for capacity building. She requested further information about the joint operations between SOA and NOAA. Dr Yafeng Yang (China) commented that in principle details of the programme could be provided to the Member States and noted that other countries are welcome to participate.

Ms Zaty Aktar Haji Mokhtar (Malaysia) commented on the 5 year workplan for NMEFC and, in particular, its plans to develop a database of 100,000 scenarios. She enquired if this database would apply only to the SCS region. A representative from China responded that the database will focus on the SCS, not the Pacific Ocean.

Hong Kong

Mr Mok Hing-Yim reported that the Hong Kong Observatory (HKO) had upgraded much of its hardware system. Two Broadband and 8 Short Period stations are now operational. The Antelope software system and hardware has also been upgraded and waveform data can now be received from 500 stations. This represents a major improvement in earthquake magnitude and time of detection at the Hong Kong Observatory.

Indonesia

Dr Wandono reported on the current status of the Indonesia Tsunami Early Warning System (InaTEWS). He informed that InaTEWS disseminate tsunami warnings within 5 minutes after the earthquake. The Decision Support System (DSS) was launched on 23 March 2012. There are currently 162 Broadband (BB) stations, 216 accelerograph stations, 2 tsunameter buoys, 58 tide gauge stations, 1 wave radar station, and 20 GPS-land stations. Their 2014 goals are to have 160 BB stations, 500 accelerograph stations, 25 buoys, 80 tide gauge stations, 2 tsunami radar stations, and 50 GPS-land stations. InaTEWS started operation in November 2008 and so far 14 tsunami warnings have been issued of which 6 were actual tsunamis.

Mr Zhao Lianda (China) asked Dr Wandono about the performance of the German tsunameter buoys in Indonesia. Dr Wandono replied that it is difficult to maintain the buoys. The buoys were deployed but not fully operational and are not used in the DSS.

Dr Chen Zhi enquired if Indonesia had any plan to deploy tsunami buoys in the SCS. Dr Wandono clarified that the buoys will not be deployed in the SCS.

Mr Saw enquired about the range of tsunami radar. Dr Wandono replied that the range is about 7 kilometres, but the radar was not in operational yet.

Dr Wandono reported that Indonesia receiving the sea level data from 58 sea level gauges.

Dr Rosaidi commented that many Indonesian tide gauges data are not available in GTS. Dr Wandono replied that he will look into this matter.

Malaysia

Mr Saw Bun Liong reported that since 2011, the Malaysian Meteorological Department (MMD) has disseminated earthquake information in less than 10 minutes, compared to 12 minutes before 2011. In 2012, MMD upgraded the accelerograph stations from 29 to 44. In April 2012, MMD upgraded the Antelope system version to version 5.2. In January 2012, Seiscomp3 version was upgraded to Seiscomp3 Zurich version. By end of the 2012, MMD will commit to sharing sea level data from 6−7 gauges internationally. One of Malaysia's tsunameter buoys deployed at Rondo (north of Sumatra) is missing, and will in future be covered by tide gauge stations. A total of 36,260 tsunami modelling scenarios have been computed at present. By the end of 2012, MMD will have a total of 38,880 scenarios including tsunami scenarios for the Japan Trench.

Mr Elliott suggested that MMD could announce the availability of sea level data from 6−7 tide gauges before the year in the Ninth Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS-IX) held in Yakarta, Indonesia, from 27 to 30 November 2012. Mr Elliott also asked if the tsunameter buoy data would be available in GTS.

Mr Saw commented that the buoy data is still difficult to share as the data is unstable.

However, MMD will try to look into sharing the data in the future.

Dr Rosaidi commented that MMD previously had 3 tsunami buoys but the Malaysian Government had decided not to redeploy at Rondo Island, Indonesia. MMD has 2 buoys at present.

Philippines

Dr Renato Solidum presented the report of Philippines and informed that the Philippine Institute of Volcanology and Seismology (PHIVOLCS) is the responsible organization for multi-hazard early warning, including tsunamis, earthquakes and volcanoes. There are active faults on both sides of the Philippines and approximately 40 local and distant source tsunamis have occurred over the past 400 years. Dr Solidum highlighted the M6.9 thrust earthquake in Negros on 6 February 2012, which generated a 5 metres wave height local tsunami and 30−50 metres inundation affecting about 100 metres of coastline.

Dr Solidum provided an overview of tsunami risk reduction in the Philippines, including hazard assessment, risk assessment and mitigation measures. Vulnerable coastlines have been identified, for which tsunami models and inundation maps have been produced.

Philippines seismic network comprises 69 stations of which 33 are unmanned with real-time data telemetry via VSAT. The remainder are manned stations reporting events via SSB, telephone and internet. It is planned to expand the seismic network up to 85 stations by 2016.

The sea level monitoring network comprises 5 real-time stations and 40 non real-time stations. PHIVOLCS plans to expand the real-time network up to 15 stations, and to install at

least 10 “wet sensors” as part of community tsunami monitoring and warning systems. Five community tsunami early warning systems are currently installed in vulnerable embayments.

Philippines operates 3 levels of tsunami alert and disseminates warnings over by telephone/fax, broadcast media, SMS, internet, Twitter and Facebook.

Dr Solidum provided details of the education and awareness materials developed in Philippines, including awareness materials and preparedness tools developed through a project of the United Nations Educational, Scientific and Cultural Organization (UNESCO) funded by the Economic and Social Commission for Asia and the Pacific (UNESCAP). Community based preparedness activities are also undertaken, including hazard assessments, preparation of evacuation maps, installation of tsunami signage, coastal village education campaigns and tsunami drills.

Mr Saw Bun Liong enquired if tsunami warning criteria in Philippines took tsunami travel time into consideration. Dr Solidum replied that PHILVOCS issue alert level 0 which informs the people that a tsunami has occurred but there is no threat to Philippines.

Dr Phuong enquired if PHILVOCS had developed a pre-defined tsunami scenario database. Dr Solidum replied that some modelling work had been undertaken but the database was not complete.

Singapore

Dr Felicia Shaw presented the national report of Singapore. She explained that Singapore is relatively sheltered from tsunamis and that exposure is to coastal regions only. Singapore operates 5−6 seismic stations of which 1 are Broadband. Warning messages are disseminated to public agencies only and not directly to the public. Singapore is more interested in far field sources. It is updating its database of source parameters and is considering better integration of its systems. Singapore does not currently hold a catalogue of seismic data as it does not have many earthquakes.

Thailand

Mr Kriengkrai Khovadhana presented Thailand’s national report and provided a detailed description of the national disaster warning system of Thailand. The National Disaster Warning Centre (NDWC) has developed Standard Operating Procedures (SOPs) for tsunamis and earthquakes and conducts tsunami drills at least twice per year. It utilises a comprehensive decision support system for emergency management, developed by the Pacific Disaster Centre (PDC). Warning messages are disseminated over a wide variety of media and, in particular, Thailand operates 328 warning towers installed throughout the country. The towers are for multi-hazard warning and they broadcast pre-recorded messages for different hazard types.

Dr Phuong asked Mr Kriengkrai which agencies were responsible for issuing tsunami warnings in Thailand. Mr Kriengkrai replied that the Thai Meteorological Department (TMD) was responsible for issuing earthquake information whereas the NDWC was responsible for activating the sirens to evacuate the people. The Department of Disaster Prevention and Mitigation (DDPM) was responsible for coordinating the evacuation of people on the ground.

Vietnam

Dr Phuong Nguyen Hong presented Vietnam’s national report. He provided details of earthquakes in Vietnam, noting that there are no records of historical tsunamis, and no information of casualties or damage. The Institute of Geophysics (ICG) under the Vietnam

Academy of Science and Technology (VAST) has the responsibility for issuing earthquake information and tsunami warnings through the Earthquake Information and Tsunami Warning Centre (EITWC), which was established by Prime Ministerial decision in 2007. At present, there are about 25 seismic stations installed throughout Vietnam, mostly concentrated in the north of the country. The seismic national network will be upgraded by 2014.

Dr Phuong provided comprehensive details of seismic and tsunami hazard assessment studies in Vietnam. Tsunami modelling showed that the tsunami arrival time from the Manila Trench source zone would be approximately 2 hours to reach the Vietnam coast. The tsunami hazard assessment has been used to develop evacuation plans in some coastal regions.

Dr Yuan Ye enquired if Vietnam has undertaken inundation modelling. Dr Phuong replied that IGP has tested several models (eg. COMCOT and MOST) and will choose one.

Dr Solidum enquired if Vietnam has any plans to conduct any palaeotsunami studies. Dr Phuong replied that it is very difficult to distinguish between storm surge and tsunami deposits since there is no historical record of tsunamis in Vietnam.

4.2 REPORT ON WESTPAC − PTWS SOUTH CHINA SEA TSUNAMI MODELING TRAINING WORKSHOP

Ms Zhang Lu (China) presented a report on the WESTPAC − PTWS South China Sea Tsunami Modeling Training Workshop held in Beijing, China, from 24 to 27 September 2012. There were 8 trainers and 32 participants involved in the workshop.

Mr Yafeng Yang thanked the Intergovernmental Oceanographic Commission (IOC) for its contribution in organizing this workshop. However, due to some procedural reasons, the letter of invitation has been issued by IOC Secretariat a month or less than a month before the workshop was held. As a result, not many countries responded due to short notice period. He suggested that for the Second workshop, proposed to be held in 2013, the Circular Letter should be issued earlier to leave enough time for the member countries to respond.

Mr Yafeng Yang reported that a second training workshop on operation of the specific tsunami model is proposed to be conducted in second half of 2013.

Dr Noraeni thanked China on the successful continuation of capacity building cooperation.

Dr Solidum also expressed gratitude to China for organising and hosting the training workshop.

4.3 REPORTS FROM OTHER ORGANIZATIONS

Ms Yohko Igarashi presented a report for the Japan Meteorological Agency (JMA). There were 11 earthquake events since the First Meeting of the Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region (ICG/PTWS-WG-SCS-I) held Sanya, China, from 12 to 14 December 2011 of which only one was tsunamigenic – the event in the Philippines on 31 August 2012. JMA issued a second tsunami bulletin during that event.

On 11 July 2012, JMA conducted a communications test for the community of the Northwest Pacific Tsunami Advisory Center (NWPTAC) in order to check that the GTS, faxes, email and web services are functioning correctly and to ensure that the NTWC

recipients received the information. These tests are conducted twice a year, and the nextone will be conducted in January 2013.

Dr Noraieni Haji Mokhtar gave a brief update on the National Oceanography Directorate (NOD). She informed that NOD work closely with the Malaysian Meteorological Department. NOD is the IOC focal point for Malaysia. She noted that disasters were very close to the people of the region and suggested that the coastal Member States should use the convergence between the IOC Sub-Commission for the Western Pacific (WESTPAC) and the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS).

5. HAZARD ASSESSMENT

5.1 DEVELOPMENT OF PLAN TO INCREASE TSUNAMI HAZARD CAPACITY IN THE SOUTH CHINA SEA REGION

The SCS-WG discussed the development of a plan to increase tsunami hazard capacity in the South China Sea region.

Dr Solidum enquired if any work had been done in the Indian Ocean to understand the capacity of certain subduction zones to deliver particularly large tsunamigenic earthquakes. He considered that it is very important to know the recurrence interval of large tsunamigenic earthquakes.

Mr Elliott clarified that some palaeotsunami studies had been conducted in the Indian Ocean. He considered that palaeotsunami studies were very important for underpinning hazard assessment.

Dr Rosaidi agreed that palaeotsunami studies were important and enquired if a palaeotsunami study in the SCS region can be proposed in the recommendation.

Dr Phuong commented that it is difficult to distinguish between tsunami deposits and storm surge deposits in Vietnam since there was no historical record of tsunamis in their country.

Dr Noraeni suggested conducting a stock taking survey of what scientific work has already been done in the SCS region.

Mr Elliott suggested creating a catalogue of palaeotsunami studies in the SCS region. He also suggested looking into the capacity building requirements to conduct surveys.

Dr Phuong suggested that each country should contribute to an earthquake catalogue for the SCS region. The database can be used for seismic hazard mapping in the future.

Dr Solidum mentioned that the Global Earthquake Model included the Philippines, Vietnam, Indonesia, Thailand, Singapore and Malaysia.

Dr Felicia Shaw (Singapore) commented that the research published by the Earth Observatory of Singapore (an independent research institute) and Institute of Nanyang Technological University (NTU) is available in the public domain and suggested contacting the director of the institute to obtain further information.

Dr Solidum requested further details of the proposed seismotectonic study. Dr Rosaidi explained that the seismotectonic map that should include all the fault lines and

subduction zones in the SCS region. Dr Solidum felt that the study should focus in subduction zones only, and should not include all fault zones.

Mr Elliott noted that the proposed study fell in within the scope of the Terms of Reference of WG1 Task Team on Tsunami Risk Assessment of ICG/PTWS, including the definition of relevant methodology and required data and products for tsunami risk assessment.

Dr Rosaidi asked Mr Elliott if the tsunami hazard map that will produced by WG1 could also cover the SCS region. Mr Elliott said that WG-SCS can request WG1 to consider preparing a tsunami hazard map of the SCS.

Dr Phuong suggested that China and the Philippines should be part of the Task Team on a Seismotectonic Study in the SCS region.

Dr Solidum suggested that stock taking to gather all the scientific information that are available for the earthquake and tsunami sources should be carried out.

The Philippines volunteered to undertake the stock taking survey. Dr Phuong volunteered to be the representative for Vietnam. Mr Elliott suggested that other countries should nominate their experts, who can be any researchers from universities.

Mr Elliott commented that if SCS-WG proposed to create a new task team on Seismotectonic Study of the SCS that this would need to be approved at ICG level. He suggested that the best way forward is to use the existing PTWS WG1 Task Team on Tsunami Risk Assessment.

SCS-WG decided that to request the ICG/PTWS WG1 Task Team on Tsunami Risk Assessment to consider taking on the hazard assessment of the SCS as a case study.

Mr Elliott commented that it would be very useful if Member States could mobilise technical support staff to provide information to the Task Team.

Dr Phuong suggested that each country should nominate one or two representatives to become members of the Task Team. Mr Elliott reminded the group that the nomination should be done through the Tsunami National Contacts (TNCs).

5.2 TERMS OF REFERENCE FOR TASK TEAM ON SEISMO-TECTONIC STUDY OF THE SOUTH CHINA SEA REGION

Dr Phuong presented the Terms of Reference he had prepared for a Task Team on Seismotectonic Study of the South China Sea region. He emphasised two points: recommending standards for data collection and database development; and defining methodology, implementation procedures and products for seismotectonic study of the South China Sea region. Dr Phuong elaborated on these two main points.

Dr Rosaidi reminded the group that the SCS-WG should be focusing on tsunami and he felt that the seismotectonic study should provide an input to the tsunami hazard assessment.

Dr Solidum commented that the scope of seismotectonic study proposed is very broad and that would take a long time to complete.

Mr Mok suggested that as the start point of the study, probably can collect all the literature reviews and journals done by experts related to this particular study.

Dr Shaw suggested identifying the subduction zones that are of interest to SCS countries.

Mr Saw and Ms Waifong felt that one specific Task Team should be created under SCS-WG rather than only depending on ICG/PTWS WG1 Task Teams. Mr Elliott commented that it is possible to propose to create the new Task Team to conduct the study but have to go through the ICG level and probably take at least a year.

Mr Elliott suggested that Dr Phuong bring the study for review at the Meeting of the PTWS Tsunami Hazard Assessment Task Team held in Santiago, Chile, on 12 and 13 December 2012. The study should focus specifically on tsunamigenic source zones in the SCS region.

Dr Rosaidi summarised that the SCS-WG decided not to recommend creation of the Task Team at this time, but to request the WG1 Task Team on Tsunami Risk Assessment to undertake the seismotectonic study. The Members agreed.

6. DETECTION, WARNING AND DISSEMINATION

6.1 CREATING AN INVENTORY OF SEISMIC AND SEA LEVEL STATIONS IN THE SOUTH CHINA SEA REGION, INCLUDING REAL-TIME DATA SHARING MECHANISMS

Mr Elliott described the intention of creating an inventory of seismic and sea level stations, including real-time data sharing availability. He commented that having the inventory could help each country to identify and fill any gaps. He suggested designing an inventory template applicable for each data type. The template would have information on instrument location, sensor type, real-time data availability, real time offline data availability upon request, operational status, etc.

Mr Yafeng Yang suggested that only information about available real-time data to be shared in the SCS region should be collected, rather than listing all available stations.

Dr Rosaidi felt that having an inventory of Broadband seismic stations for all Member States would be beneficial.

Mr Saw suggested obtaining information about seismic metadata from the Incorporated Research Institutions for Seismology (IRIS) and GEOFON networks, GLOSS (Global Sea-Level Observing System) and IOC for sea level stations and whichever country have additional systems can update.

Dr Solidum offered PHIVOLCS to take on the task of compiling the inventory. PHILVOCS will design a template and request the SCS Member States to complete and return.

Dr Rosaidi thanked PHILVOCS for offering to undertake the task. He requested the Member States to give full support to the Philippines in terms of providing the information required for creating the inventory.

Dr Rosaidi enquired if any Member State had a special request to obtain any seismic and sea level shared data. Malaysia requested sea level data sharing from Vietnam, the Philippines and China as soon as possible.

Dr Solidum replied that Philippines' sea level gauges shared in GLOSS are already available and that other tide gauges are not in real-time and do not belong to PHILVOCS. Therefore, he was unable to consider Malaysia's request at this time.

Dr Solidum noted that the inventory of sea level stations should include the Sulu and Celebes Seas in addition to the SCS.

Dr Rosaidi asked Dr Wandono if it would be possible for Indonesia to share sea level data from the Sulawesi Sea. Dr Wandono explained that BKMG is not responsible for sea level stations in the Sulawesi Sea.

Mr Saw commented that one problem is that most agencies other than Meteorological Offices do not have direct connection to GTS.

Mr Elliott noted that other mechanisms for receiving sea level data globally apart from GTS are available, such as ftp file transfer. The IOC Sea Level Monitoring site is also very useful.

Dr Chen informed that China will deploy a tsunami buoy in the SCS in October 2012. The real-time sea level data from 3 sea level gauges from mainland China will also be available on GTS in 2013 and 6 tide gauges data (Hong Kong) can be provided to GLOSS anytime.

The Working Group agreed that access to China's sea level data would be very useful and requested China to share the data as soon as possible.

Mr Mok reported that the Hong Kong Observatory has two seismic stations. One of the seismic stations is already available on GSN.

Dr Rosaidi encouraged Philippines to increase the number of real-time sea level stations for sharing.

Mr Saw suggested Member States consider having direct sharing like Antelope system for seismic monitoring rather than using GTS/GEOFON.

The Philippines and Vietnam use Seiscomp3 seismic processing; Malaysia and Thailand have both Antelope and Seiscomp3.

Dr Rosaidi said that Malaysia is able to share the seismic data using Antelope and encouraged Member States to have the same platform to share the data by using the same Antelope system.

6.2 ENHANCING SEISMIC AND SEA LEVEL STATIONS IN THE SOUTH CHINA SEA REGION

Dr Rosaidi reported that Malaysia will enhance its seismic network and planned to increase the number of Broadband seismic stations. There is no plan to increase the number of sea level stations in Malaysia.

Dr Yuan Ye reported that presently China is operating two tsunami buoys in the SCS and recommended to have denser tsunami buoy and tide gauges networks in the SCS region, especially near to the Manila Trench.

Dr Rosaidi encouraged all Member States to increase the number of sea level stations on the GTS.

Dr Solidum reported that PHILVOCS plans to increase the number of tide gauge stations but was not sure whether these would be real-time or not. PHILVOCS will share some of the relevant tide gauges data.

7. TSUNAMI WARNING AND MITIGATION SYSTEM FOR THE SOUTH CHINA SEA

7.1 REVIEW OF COMMENTS FROM MEMBER STATES TO THE PROPOSAL: "AN OUTLOOK OF TSUNAMI WARNING AND MITIGATION SYSTEM OF SOUTH CHINA SEA" SUBMITTED BY THE NATIONAL MARINE ENVIRONMENTAL FORECASTING CENTER, CHINA

Mr Lianda Zhao presented a revised proposal with only a few minor modifications.

Dr Solidum commented that it will be difficult to install tsunami buoys in national waters particularly in Sulu and Celebes Seas since those are not international waters. He emphasized that the plan for tsunami buoy installation must go through different levels of government (foreign ministry/affairs) and also reminded that several issues may be arise when it involves a national territories.

The Working Group agreed to modify paragraphs 2.2.1 and 2.2.2 of the proposal to include the words "subject to the approval of the government concerned".

The Working Group decided to delete the term "island deployments" in sea level section of the proposal.

Ms Zaty enquired if NMEFC/SOA also plans to develop a comprehensive tsunami forecasting database. Mr Yafeng Yang said China has no plan to develop a tsunami forecasting database.

Dr Solidum enquired if a Tsunami Warning Centre or only information centre is proposed, noting that there is a big difference between an information sharing platform and a warning centre.

7.2 REVISION OF PROPOSAL BASED ON MEMBER STATE COMMENTS AND WORKING GROUP DISCUSSION

Dr Rosaidi noted that the name of the centre in the proposal should be changed from the "South China Sea Tsunami Warning Centre (SCSTWC)" to the "South China Sea Tsunami Advisory Centre (SCSTAC)". The Working Group agreed to this change of name.

The Working Group accepted the revised proposal document submitted by China, subject to the agreed amendments. The Working Group requested the Secretariat to attach the amended proposal to the meeting report (attached as ANNEX I) and to submit it for the consideration at the Twenty-fifth Session of the Intergovernmental Coordination Group for the Pacific Ocean Tsunami Warning and Mitigation System (ICG/PTWS-XXV) that will be held in Vladivostok, Russian Federation, from 9 to 11 September 2013.

The Working Group agreed that the TWS and TAC (Tsunami Advisory Centre) would be developed within the framework of the ICG/PTWS. Mr Yafeng Yang suggested that the workplan of the SCSTWS should get approval of the ICG/PTWS first and then possible additional support through the ASEAN-China cooperation mechanism could be looked into.

7.3 TERMS OF REFERENCE FOR TASK TEAM TO ADVISE ON THE ESTABLISHMENT OF A REGIONAL TSUNAMI WARNING CENTRE

Dr Yuan Ye presented the draft Terms of Reference for the Task Team to advice on the establishment of the Sub-Regional South China Sea Tsunami Advisory Centre.

Dr Rosaidi noted that the purpose of the SCSTAC would be to improve on the issuance of timely tsunami advisories for the SCS region, as currently provided by PTWC and NWPTAC. He commented that the SCS-WG would be responsible for monitoring the performance of the SCSTAC.

Mr Elliott suggested that the willingness of China to host the SCSTAC should be noted in the recommendation of the SCS-WG to the ICG/PTWS. He also noted that the ICG/PTWS may decide to coopt other members to the Task Team and may invite representatives from other organisations such as PTWC, JMA and WMO (World Meteorological Organization) to join.

Dr Shaw enquired if the development of a tsunami forecast database should be added to the proposal, as discusses previously. Dr Rosaidi reminded China to take note of this suggestion.

Mr Elliott commented that having tsunami forecasting database is an important requirement for a Tsunami Advisory Centre and should be in the capability requirements of the SCSTAC.

The revised Terms of Reference as agreed by the group are attached to the draft recommendation to the ICG/PTWS in ANNEX II.

7.4 WORKPLAN AND TIMELINE

Mr Yafeng Yang clarified that the training workshop held in 2012 was on tsunami modelling and risk assessment. In 2013, China will organize another tsunami modelling workshop.

Mr Elliott commented that there some confusion between the development of the Tsunami Warning System and the Tsunami Advisory Centre. Mr Yafeng Yang emphasized that the establishment of the centre is part of the system.

Dr Solidum clarified that the Working Group is responsible for planning the end to end Tsunami Warning and Mitigation System and that the Task Team will be responsible for facilitating the establishment of the Tsunami Advisory Centre.

Mr Elliott commented that the proposal does not have all the details that required for the workplan. He reminded that everything should be covered in the plan.

Mr Elliott advised that the Working Group should decide to accept the proposal and/or to modify it and take it to the ICG level as a Working Group proposal, not as a proposal from China.

8. PREPAREDNESS AND RESPONSE

8.1 DEVELOPMENT OF PLAN TO PRODUCE/ADAPT EDUCATIONAL MATERIALS TAILORED TO THE SOUTH CHINA SEA REGION

Dr Solidum enquired what kind of education material it is planned to develop. He felt that the inventory of education material on seismic sensors and sea level gauges that being used in different countries should be shared. Dr Rosaidi clarified that the focus should be on tsunami educational materials.

Mr Elliott noted that there has been a lot of education material developed already by the countries themselves, for example by Japan and ITIC (International Tsunami Information Centre), which may be translated into the languages of the region. However, he felt there was probably a need to produce more specific information for the SCS region.

Dr Yuan Ye enquired if the Tsunami Glossary (IOC/2008/TS/85 REV.) which had been translated into Chinese language is permitted to be published in China. Mr Elliott said that he will refer to the UNESCO publication section for advice. Any other countries would be welcome to volunteer to do translation into their own languages.

Dr Shaw commented that educational materials are very specific to individual countries. She also commented that Member States could share some good practices.

Dr Phuong suggested that each of the Member States should provide a list of their needs. Mr Azren (Malaysia) commented that the content of the materials may be the same but that they would need to be adapted to consider the input and interest from each Member State.

Dr Solidum commented that many other groups within the ASEAN (Association of South-East Asian Nations) region have different awareness and preparedness campaigns. He suggested obtaining information from ASEAN Committee on Disaster Management (ACDM).

Dr Rosaidi enquired if any of the members would be willing to compile the inventory of education materials available in the region.

Mr Elliott informed that he would request UNESCO Jakarta to assist and to liaise with ASEAN in Jakarta and other colleagues in Philippines, Indonesia, Timor-Leste and Thailand. He suggested China to nominate a representative to liaise with UNESCO Jakarta.

Dr Solidum noted that every country should have their own education materials, but lacked specific information, especially in the SCS, Sulu and Celebes Seas, based on the threat to that particular area.

Mr Elliott commented that the initial part of the plan would be to obtain the basic information. The inventory of what is available could be shared by email for members review.

Dr Rosaidi concluded that there is no special request from the Member States at this time.

8.2 DEVELOPMENT OF PLAN FOR STANDARD OPERATING PROCEDURES TRAINING IN THE SOUTH CHINA SEA REGION TO ACCOMPANY THE INTRODUCTION OF ENHANCED PTWS WARNING PRODUCTS

Dr Rosaidi informed the group that there is a Task Team under PTWS to look into the enhancing of PTWC tsunami advisory products. Mr Elliott provided an overview of the PTWS Plan and suggested that the schedule for SOP training should follow the introduction of the enhanced products.

Dr Phuong enquired who would be the instructors for the SCS SOP training workshop. Dr Rosaidi and Mr Elliott advised that the training would be provided by ITIC, PTWC and several other trainers from the PTWS region.

Dr Chen asked if would be possible to organize SOP training together with the tsunami modelling workshop in Beijing in 2013. Mr Elliott explained that it would involve different target groups of participants for both trainings.

Dr Solidum suggested that the SOP training should include the new product of PTWS to maximise the effort.

Dr Solidum commented that the SCS-WG still had to work on the development of the implementation plan even if the training will be held either before or after the new PTWS products are released. Dr Rosaidi enquired if any of the Member States would be willing to host the SOP training.

Dr Chen suggested that each country could share the outcomes of their SOP practise with the new PTWS products during the next SCS-WG meeting. The SOP training workshop could then be decided in 2014 if problems were encountered. The Working Group agreed to this suggestion.

9. NEXT MEETING

Dr Solidum on behalf of PHILVOCS offered to host one meeting in 2014, either the Task Team or the SCS-WG, depending on outcome of the ICG/PTWS session.

China will also consider hosting the next meeting of the SCS-WG in 2014 if there is no other offer from Member States.

Mr Elliott suggested that the SCS-WG Task Team on the Establishment of the SCSTAC (if approved by the ICG/PTWS) should hold its first meeting prior to the next SCS-WG meeting, and that the WG should hold at least one intersessional meeting at which the Task Team would be required to report progress.

10. ANY OTHER BUSINESS

Dr Rosaidi advised that he will be standing down as Chair of the SCS-WG at the Twenty-fifth session of the ICG/PTWS and that a new chair would therefore have to be elected.

Mr Elliott advised that the election of the new Chair and Vice-Chair would take place at the ICG/PTWS meeting.

11. SUMMARY OF DECISIONS, ACTIONS AND RECOMMENDATIONS

The SCS-WG discussed and agreed on a draft recommendation to be submitted to the Twenty-fifth Session of the ICG/PTWS, as attached in ANNEX II. The recommendation includes decisions to:

- Approve the *Proposal for a South China Sea Tsunami Warning and Mitigation System* as the basis for the establishment of the sub-regional Tsunami Warning and Mitigation System within the framework of ICG/PTWS;
- Establish a SCS-WG Task Team on the Establishment of a South China Sea Tsunami Advisory Centre (SCSTAC) with Terms of Reference as agreed;
- Accept China's offer to host the SCSTAC and to initiate the establishment of the SCSTAC under the guidance of the SCS-WG.

The key decisions and actions arising from the meeting are summarized as follows:

1. Development of plan to increase tsunami hazard capacity in the South China Sea region

   - Proposal to prepare a catalogue of palaeotsunami studies and researchers in the SCS region. Each Member States to contact universities/research agencies.

   - Proposal to prepare a tsunami hazard map for the SCS region based on tsunamigenic source zones only.

   - SCS-WG decides to request PTWS WG1 Task Teams on Tsunami Hazard Modelling and Tsunami Risk Assessments to take this on as a case study. The Task Teams were due to meet in Santiago, Chile, on 12 and 13 December 2012 during the Meeting of the PTWS Tsunami Hazard Assessment Task Team. Members of the WG are also members of the Task Team and Dr Phuong is Chair of the Task Team on Risk Assessment.

2. Terms of Reference for Task Team on seismo-tectonic study of the South China Sea region

   - The SCS-WG decided not to recommend creation of a new Task Team at this time, but to request the WG1 Task Teams to undertake this work, as per agenda item 5.1.

3. Creating an inventory of seismic and sea level stations in the South China Sea region, including real time data sharing mechanisms

   - WG decides to prepare an inventory of Broadband seismic stations, sea level stations and tsunameters in the SCS region.

   - Dr Renato Solidum offers PHIVOLCS to take on this task. Will design a template and request the SCS Member States to complete and return. Key metadata are location, sensor type, real time data availability, operational status.

   - Need to differentiate between stations that are available for sharing and those that are for national use only.

- Noted that inventory will identify gaps and needs for densification.

- The Chair encouraged all Member States to increase the number of sea level and tsunameter stations on the GTS.

4. Review of comments from Member States to the proposal: "An Outlook of Tsunami Warning and Mitigation System of South China Sea" submitted by the National Marine Environmental Forecasting Centre, China

   - China presented revised proposal, with only a few minor modifications.
   - Noted that tsunameters not deployed in international waters would require approval of the host government, if not deployed by the host country.
   - Reference to "island deployments" in sea level section deleted.
   - Noted that there is a big difference between information sharing platform and warning centre.
   - SCS-WG decides to rename to the SCS Tsunami Warning Centre as SCS Tsunami Advisory Centre.
   - Agreed that the TWS and TAC would be developed under the framework of the ICG/PTWS. It was suggested that the working plan of the SCSTWS should get approval of the ICG/PTWS first, and then look into possible additional support through the ASEAN-China cooperation mechanism.

5. Revision of proposal based on Member State comments and working group discussion

   - As above. Revised proposal from China accepted by SCS-WG. Secretariat will tidy up proposal and attach to the meeting report.
   - Proposal modified to include tsunami scenario databases for forecasting.

6. Terms of Reference for Task Team to advise on the establishment of a Regional Tsunami Advisory Centre

   - Provided by China. Discussed, modified and agreed by SCS-WG and attached to the draft recommendation in ANNEX II.

7. Workplan and timeline

   - Workshop in China in 2013 to be on Tsunami Mo.elling and Risk Assessment.
   - Clarified that the SCS-WG is responsible for planning the end-to-end Tsunami Warning and Mitigation System for the SCS region, as per its Terms of Reference. The Task Team will be responsible for facilitating the establishment of the Tsunami Advisory Centre.

8. Development of plan to produce/adapt educational materials tailored to the South China Sea region

   - Need a stock-taking survey of existing awareness/preparedness and educational material. Secretariat will ask UNESCO Jakarta to assist, but

only for ASEAN countries. UNESCO Jakarta will liaise with ASEAN in Jakarta and other colleagues in Philippines, Indonesia and Thailand.

- China to nominate a representative to liaise with UNESCO Jakarta.

9. Development of plan for Standard Operating Procedures training in the South China Sea region to accompany the introduction of enhanced PTWS warning products

- SCS-WG considers that it needs to know more about the new PTWC products and PTWC's plans for training before developing a plan for SOP training.

- SCS-WG decides that each Member State should gain experience with the enhanced PTWC warning products in 2013 and then request SOP training support if problems are encountered.

10. Next Meeting

- It was decided that the SCS-WG Task Team on the Establishment of a SCSTAC (if approved by the ICG/PTWS) should hold its first meeting prior to the next SCS-WG meeting, and that the WG should hold at least 1 intersessional meeting at which the Task Team would be required to report progress.

- Philippines offered to host one meeting in late (Q4) 2013, either Task Team or SCS-WG, depending on outcome of ICG/PTWS.

- China can consider hosting the next meeting of the SCS-WG, if there is no other offer from Member States.

12. CLOSE OF MEETING

Dr Rosaidi closed the meeting and thanked the participants for attending and contributing to the discussions.

ANNEX I

AGENDA

1. WELCOME AND OPENING

2. ORGANISATION OF THE MEETING

2.1 ADOPTION OF AGENDA

2.2 DESIGNATION OF RAPPORTEUR

2.3 CONDUCT OF THE MEETING, TIMETABLE AND DOCUMENTATION

3. REVIEW OF DECISIONS, RECOMMENDATIONS AND ACTIONS ARISING FROM THE ICG/PTWS-WG-SCS/I MEETING

4. REPORTS

4.1 NATIONAL PROGRESS REPORTS

4.2 REPORT ON TSUNAMI MODELLING TRAINING WORKSHOP HELD IN BEIJING, 24-27 SEPTEMBER 2012

4.3 REPORTS FROM OTHER ORGANISATIONS

5 HAZARD ASSESSMENT

5.1 DEVELOPMENT OF PLAN TO INCREASE TSUNAMI HAZARD CAPACITY IN THE SOUTH CHINA SEA REGION

5.2 TERMS OF REFERENCE FOR TASK TEAM ON SEISMO-TECTONIC STUDY IN THE SOUTH CHINA SEA REGION

6 DETECTION, WARNING AND DISSEMINATION

6.1 CREATING AN INVENTORY OF SEISMIC AND SEA LEVEL STATIONS IN THE SOUTH CHINA SEA REGION, INCLUDING REAL-TIME DATA SHARING MECHANISMS

6.2 ENHANCING SEISMIC AND SEA LEVEL STATIONS IN THE SOUTH CHINA SEA REGION

7 TSUNAMI WARNING AND MITIGATION SYSTEM FOR THE SOUTH CHINA SEA

7.1 REVIEW OF COMMENTS FROM MEMBER STATES TO THE PROPOSAL: 'AN OUTLOOK OF TSUNAMI WARNING AND MITIGATION SYSTEM OF SOUTH CHINA SEA' SUBMITTED BY THE NATIONAL MARINE ENVIRONMENTAL FORECASTING CENTRE, CHINA

7.2 REVISION OF PROPOSAL BASED ON MEMBER STATE COMMENTS AND WORKING GROUP DISCUSSION

7.3 TERMS OF REFERENCE FOR TASK TEAM TO ADVISE ON THE ESTABLISHMENT OF A REGIONAL TSUNAMI WARNING CENTRE

7.4 WORKPLAN AND TIMELINE

8. PREPAREDNESS AND RESPONSE

8.1 DEVELOPMENT OF PLAN TO PRODUCE/ADAPT EDUCATIONAL MATERIALS TAILORED TO THE SOUTH CHINA SEA REGION

8.2 DEVELOPMENT OF PLAN FOR STANDARD OPERATING PROCEDURES TRAINING IN THE SOUTH CHINA SEA REGION TO ACCOMPANY THE INTRODUCTION OF ENHANCED PTWS WARNING PRODUCTS

9. NEXT MEETING

10. ANY OTHER BUSINESS

11. SUMMARY OF DECISIONS, RECOMMENDATIONS AND ACTIONS

12. CLOSE OF MEETING

ANNEX II

DRAFT RECOMMENDATION ICG/PTWS-XXV-*

Sub-Regional Tsunami Warning and Mitigation System for the South China Sea Region (SCS–WG)

The Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS);

Recalling that the Intergovernmental Oceanographic Commission (IOC) adopted Resolution EC-XLI.6, which the Member States around the South China Sea and other regional seas, as appropriate, to actively promote the development, establishment and sustained operation of national and Sub-regional Tsunami Warning and Mitigation Systems within the framework of ICGs;

Recalling further that the ICG/PTWS adopted Recommendation ICG/PTWS-XXIII.5, which established the Working Group for the South China Sea, and Recommendation ICG/PTWS-XXIV.4 to establish a Sub-regional Tsunami Warning and Mitigation System for the South China Sea region within the framework of the ICG/PTWS;

Having considered the reports of:

- The First Meeting of the ICG/PTWS-WG-SCS-I, held in Sanya, China, from 12 to 14 December 2011.

- The Second Meeting of the ICG/PTWS WG-SCS-II, held in Petaling Jaya, Malaysia, from 16 to 18 October 2012.

Having considered the *Proposal for a South China Sea Tsunami Warning and Mitigation System* submitted by China;

Noting with appreciation that PTWC and NWPTAC are providing tsunami advisory services on an interim basis to the South China Sea region;

Reaffirms its commitment to establish a Sub-regional Tsunami Warning and Mitigation System for the South China Sea region within the framework of ICG/PTWS;

Decides to approve the *Proposal for a South China Sea Tsunami Warning and Mitigation System* as the basis for the establishment of the sub-regional Tsunami Warning and Mitigation System within the framework of ICG/PTWS;

Decides further to establish a SCS-WG Task Team on the Establishment of a South China Sea Tsunami Advisory Centre (SCSTAC), with Terms of Reference attached as ANNEX III.

Noting the offer of China to host the SCSTAC at the National Marine Environmental Forecasting Centre in Beijing, China,

Decides to accept China's offer to host the SCSTAC and **recommends** to initiate the establishment of the SCSTAC under the guidance of the WG-SCS.

Encourages members of the Working Group of the South China Sea as well as all coastal countries of this region to actively participate in and contribute to the establishment of the sub-regional Tsunami Warning and Mitigation System within the framework of ICG/PTWS,

Invites countries outside the South China Sea region to provide appropriate support to the establishment of the Sub-regional Tsunami Warning and Mitigation System within the framework of ICG/PTWS;

Decides to organize an inter-sessional meeting of the SCS-WG in either late 2013 or in 2014;

Expresses gratitude to the Government of China for hosting the First Meeting of the WG-SCS in Sanya, China, from 12 to 14 December 2011, a the WESTPAC – PTWS South China Sea Tsunami Modelling Training, held in Beijing, China, from 24 to 27 September 2012;

Expresses gratitude to the Government of Malaysia for hosting the Second Meeting of the WG-SCS in Petaling Jaya, Malaysia, from 16 to 18 October 2012.

Financial Implications: None

ANNEX III

TERMS OF REFERENCE FOR TASK TEAM ON ESTABLISHMENT OF THE SOUTH CHINA SEA TSUNAMI ADVISORY CENTRE

Task team

Establishment of the SCS Tsunami Advisory Center (SCSTAC).

Purpose

Assist the SCS Working Group in establishment of the SCSTAC until it has the ability to provide operational service.

Mandate

Under the guidance of the ICG/PTWS-WG-SCS, the Task Team shall strengthen coordination and cooperation among the SCS countries to establish the SCSTAC:

1. Develop capability guidelines and performance indicators for the SCSTAC;
2. Explore ways for facilitating the sharing and exchange of data and relevant information necessary for the establishment of the SCSTAC;
3. Consult with National Tsunami Warning Focal Points of the SCS region to determine appropriate requirements for tsunami service/products;
4. Develop the SOP and the contents of tsunami advisory products for the SCSTAC;
5. Identify potential resource requirements for the establishment of the SCSTAC;
6. Keep contact with PTWC and NWPTAC (JMA) for guidance and assistance.

Membership

Representatives of Member States of the ICG/PTWS-WG-SCS (Brunei Darussalam, China, Cambodia, Indonesia, Malaysia, the Philippines, Singapore, Thailand and Vietnam) and invited experts; representatives of PTWC and NWPTAC (JMA); with Chairperson and Vice-chairperson to be elected.

Modus operandi

The Task Team will work mainly by correspondence, and prepare report for the SCS-WG meeting.

ANNEX IV

PROPOSAL FOR TSUNAMI WARNING AND MITIGATION SYSTEM OF SOUTH CHINA SEA

National Marine Environmental Forecasting Centre of State Oceanic Administration, China

8 October 2012

[Reviewed and amended by the Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region at its Second Meeting held in Petaling Jaya, Malaysia, from 16 to 18 October 2012]

1. BACKGROUND

The areas of responsibility (AOR) for tsunami warning specified by Pacific Tsunami Warning and Mitigation System in the South China Sea region include South China Sea, Sulu Sea and Celebes Sea. A total of nine countries are in the South China Sea region, namely, Brunei, Cambodia, China, Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam (Figure 1). According to the statistics of NGDC/NOAA, major earthquake sources of the South China Sea region are Taiwan Island, the Philippines and Indonesia Islands, and a small part of volcanoes also locate in this region (Figure 2). Since tsunami is mainly triggered by earthquake and volcano activity, the distribution of historical tsunami events are consistent with the earthquake and volcano zones in the South China Sea region (Figure 3).

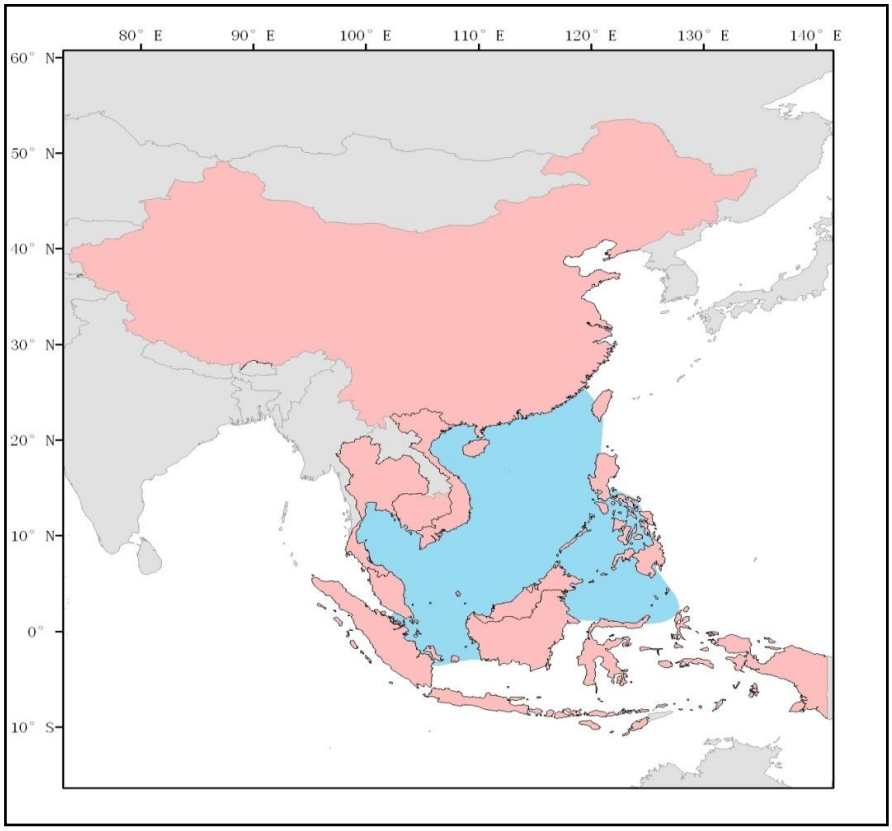

Figure 1. Countries in the South China Sea region
(Red for the South China Sea countries, blue for the area of responsibility for tsunami warning)

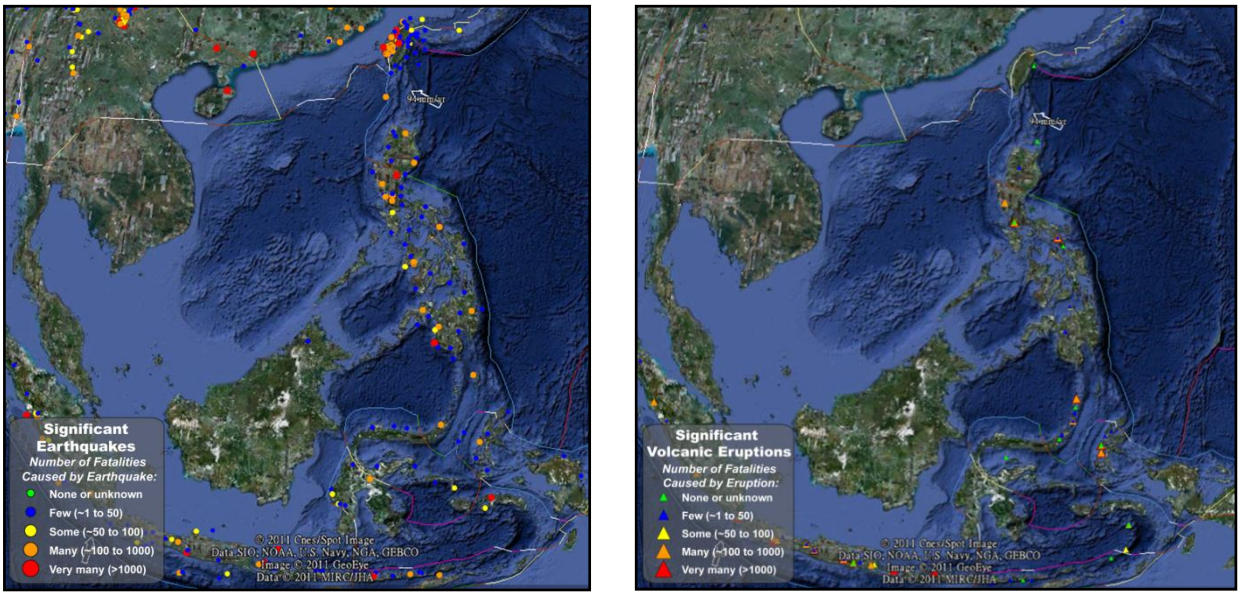

Figure 2. Historical earthquake epicentres distribution and fatalities since 2150 BC in the South China Sea region (left), and historical volcanic origins distribution and fatalities in the South China Sea region since 4350 BC (right).

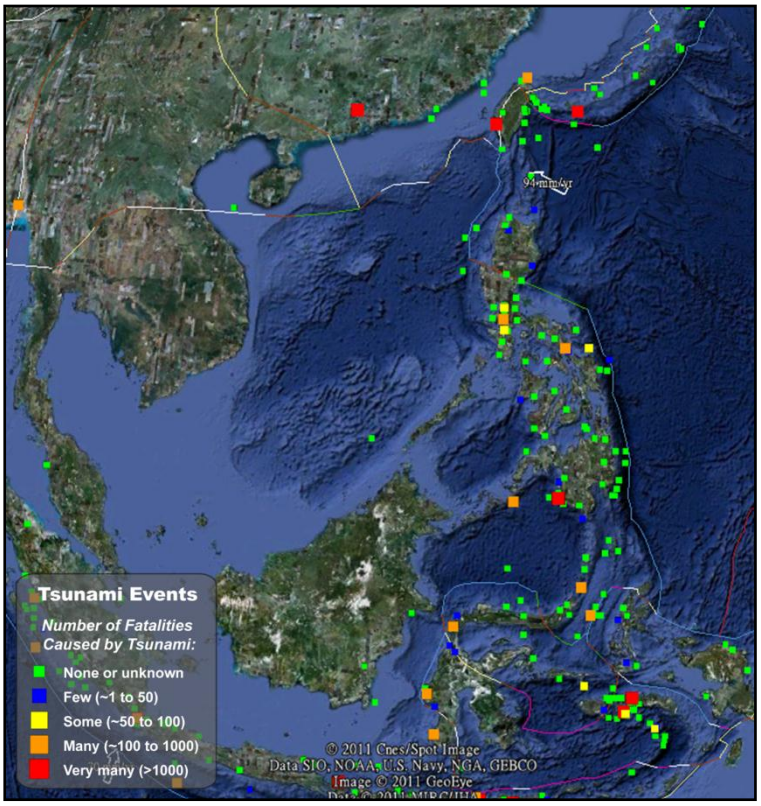

Figure 3. Historical tsunami sources distribution in the South China Sea region since 2000 BC.

All waters in the South China Sea region are under the threat of tsunamis. To name a few, the potential tsunami source in the South China Sea is Manila Trench, in the Sulu Sea in the southern Philippines, and in the Celebes Sea are the southern Philippines and Indonesia islands.

Being a concern in the international tsunami warning and mitigation area, the regional South China Sea Tsunami Warning System is not yet available. In realistic sense, a regional tsunami warning and mitigation system covering all South China Sea countries needs constructing urgently, so as to improve the cooperation and communication, and to develop the capability of tsunami detecting, warning and mitigation.

Currently, PTWC (based in US), WCATWC (based in Alaska, US) and NWPTAC (based in JMA, Japan) provide temporary tsunami warning services to the South China Sea region (Figure 4). In May 2008, National Marine Environmental Forecasting Centre (NMEFC, based in Beijing, China) proposed the construction of the South China Sea Tsunami Warning System in the Seventh Intergovernmental Session of the IOC Sub-Commission for the Western Pacific (IOC/SC-WESTPAC-VII/3), and this proposal was submitted to the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS) by the Chairman of WESTPAC on request of the Sub-Commission. The Forty-first Session of the IOC Executive Council (IOC/EC-XLI/3) held in Paris, France, from 24 June to 1 July 2008 passed an act and encouraged all the countries concerned in the South China Sea to establish a regional tsunami warning and hazard mitigation system under the framework of ICG/PTWS. The Twenty-third Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS-XXIII) held in Apia, Samoa, from 16 to 18 February 2009, South China Sea Region Working Group was set up to facilitate the buildup of the system in this region. During the Twenty-fourth Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS-XXIV) held in Beijing, China, from 24 to 27 May 2011 was discussed the fundamental document proposed by China “An Outlook of Tsunami Warning and Mitigation System of the South China Sea”. The session agreed to establish the sub-regional South China Sea Tsunami Warning and Mitigation System (SCSTWS), and requested ICG/PTWS secretariat to widely distribute the proposal and encouraged countries concerned to collaborate in the system buildup. The Twenty-sixth session of the IOC Assembly (IOC-XXVI/3) approved the report and recommendations of the ICG/PTWS-XXIV.

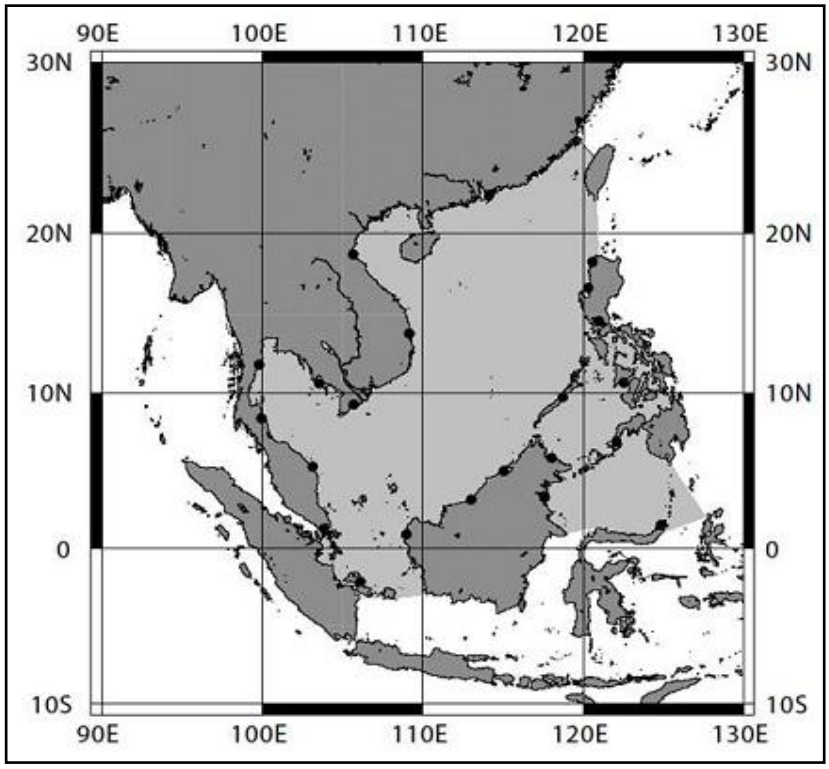

Figure 4. PTWS defined South China Sea tsunami warning AOR.
(Llight gray region in the figure)

2. SYSTEM COMPONENTS

The South China Sea Tsunami Warning System will be installed as a sub-regional tsunami warning and hazard mitigation system under the framework of ICG/PTWS. The system is based on resources and voluntary information from countries concerned. It will be supported, maintained, managed and operated by all countries of this region. The South China Sea Tsunami Warning and Mitigation System is made up of five sub-systems: Earthquake Monitoring System, Sea Level Monitoring System, Information Sharing Platform, Tsunami Warning Centre, and Hazard Mitigation and Emergency Management System.

2.1 EARTHQUAKE MONITORING SYSTEM

Initial seismic warnings based on data from networks of seismic gauges are subsequently refined by the detection of tsunami-generated changes in sea level, measured by the coastal tide gauges and buoys.

The earthquake monitoring system will consist of local earthquake monitoring networks and GSN (Figure 5). The establishment of South China Sea region earthquake monitoring system should take full advantage of the existing seismic gauges of all the countries concerned. In the meantime, according to tsunami warning need, additional seismic gauges may be recommended by the South China Sea related countries.

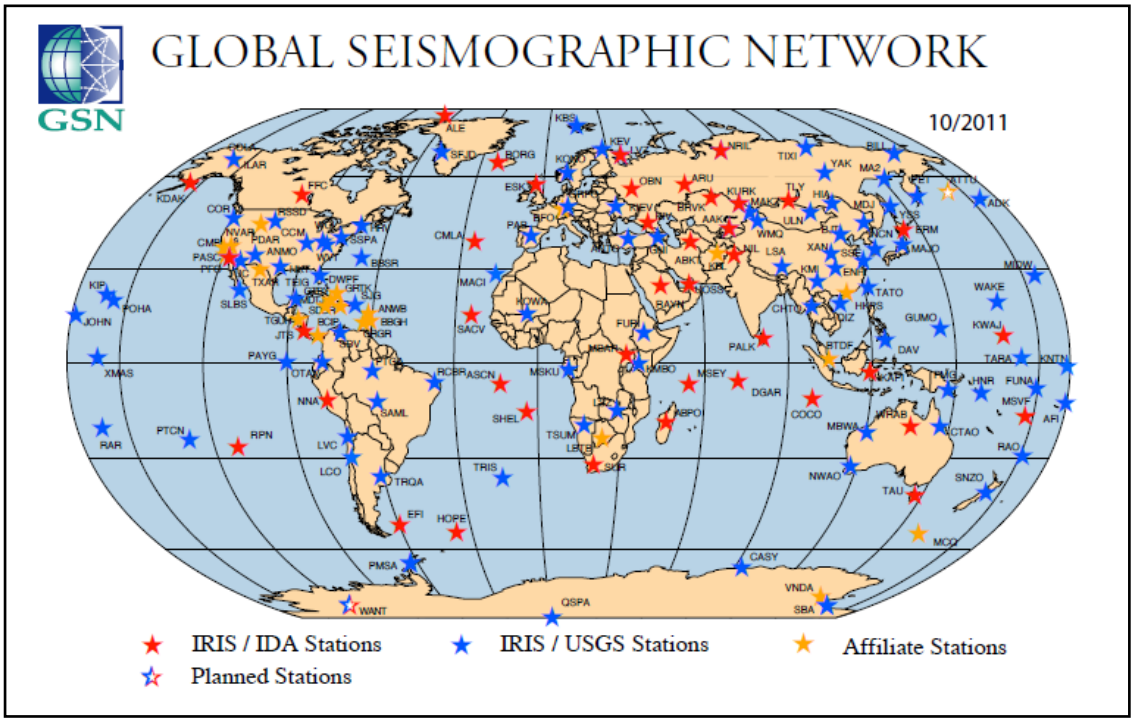

Figure 5. Distribution of GSN stations

2.2 SEA LEVEL MONITORING SYSTEM

Sea level monitoring system is formed by tsunami buoy monitoring networks and tide gauge station networks in the South China Sea region.

2.2.1 Tsunami Buoy Monitoring

Tsunami buoy is one of the efficient tools to detect real-time tsunami wave and determine early tsunami warning. Buoys normally spread close to the tsunami sources, and are used to detect real-time abnormal oscillation on the sea surface.

Once tsunami wave is detected by tsunami buoy, its information will be sent to the tsunami warning centre. After the data processed and analysed, issuing a tsunami warning or information statement is followed. If tsunami wave is identified, quantitative tsunami warning information will be successively released through observation data assimilation. If tsunami wave is not detected, further tsunami warning information will not be released. Tsunami buoy observation data can greatly improve forecast accuracy.

According to the potential tsunami sources in the South China Sea, five tsunami buoys are suggested (Figure 6). Two tsunami buoys are planted in northern and central South China Sea, one in deep water zone of central Sulu Sea, one in eastern Luzon Strait and one in deep water zone of central Celebes Sea, subject to the agreement of the governments concerned. (Numbers and locations of tsunami buoys can be further discussed and modified).

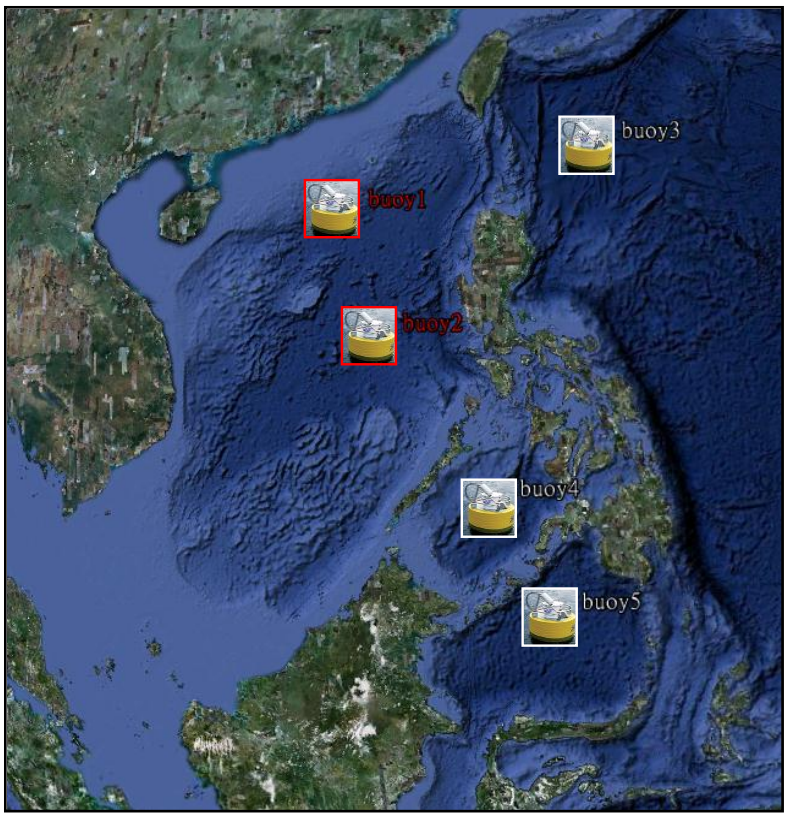

Figure 6. Layout of the running and proposed tsunami buoys in the South China Sea.
(Red for running buoy and white for proposed buoy)

2.2.2 Tide Gauge Monitoring

According to the potential tsunami sources in the South China Sea region, it is proposed to fully utilise existing tide gauge stations, and to build a number of coastal tide gauge stations at South China Sea, Sulu Sea and Celebes Sea, where in need. To be specific, coastal tide gauge stations at Philippines, China, Vietnam, Malaysia, Brunei, Thailand and Singapore are used to detect South China Sea tsunamis, tide gauge stations at the southern Philippines and Malaysia are used to detect Sulu Sea tsunamis, and the southern Philippines, Malaysia

and Indonesia should take the responsibility of detecting Celebes Sea tsunamis with their tide stations.

All South China Sea countries, especially countries close to potential earthquake zones are encouraged to share more tide gauge data

2.3 INFORMATION SHARING PLATFORM

The function of the information sharing platform is to collect all the South China Sea countries seismic and tsunami observation data, and provide data sharing and dissemination service.

Platform of information sharing will be established, operated and maintained at South China Sea Region Tsunami Warning Centre. Each country will provide voluntary seismic and tsunami observation data to the platform. The routines and equipments connecting to the platform of shared information of each country should be constructed and maintained individually.

South China Sea Region Tsunami Warning Centre should include internet and GTS, so as to timely collect, summarise and analyse regional and global earthquake and tsunami observation data with related information for the warning and evaluation of tsunami.

Tsunami warning centre should, in the meantime, timely collect and summarise issued earthquake and tsunami real-time information from global related organizations, such as the National Earthquake Information Center of the United States Geological Survey (USGS/NEIC), the Pacific Tsunami Warning Center (PTWC), Northwest Pacific Tsunami Advisory Center (NWPTAC), the West Coast and Alaska Tsunami Warning Center (WCATWC) and regional tsunami warning centres affiliated to the United Nations Educational, Scientific and Cultural Organization (UNESCO). The information sharing platform will send the information to the tsunami warning centres of South China Sea countries (Figure 7).

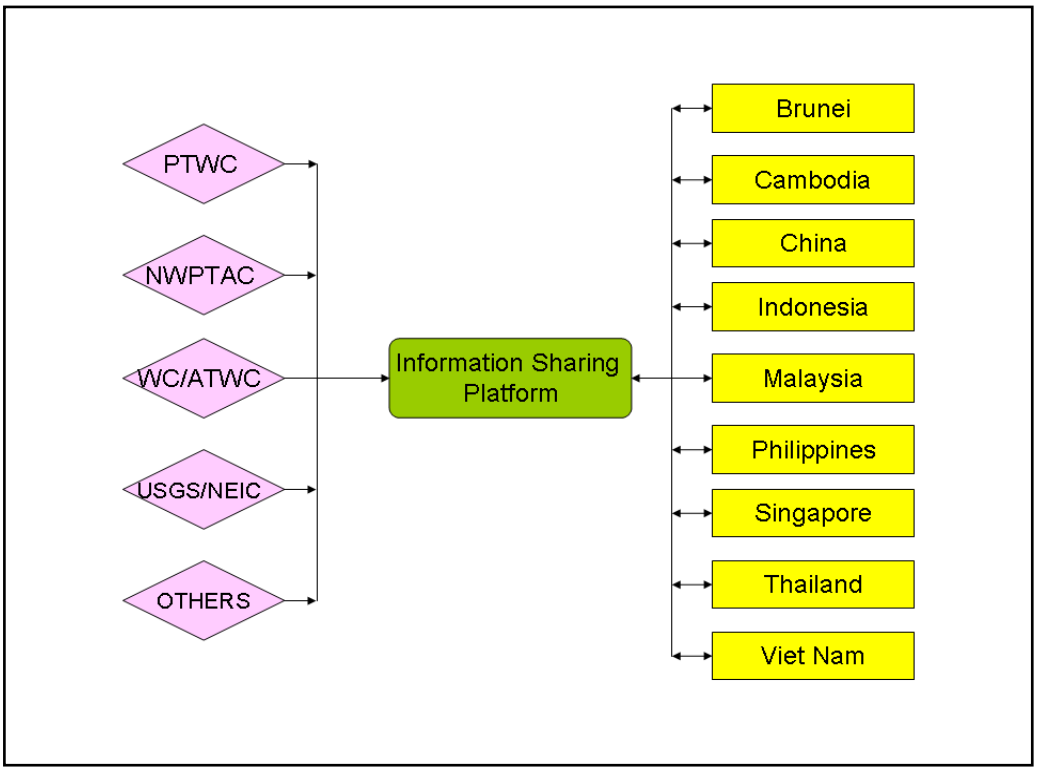

Figure 7. Information flow chart of the platform

2.4 TSUNAMI WARNING CENTRE

2.4.1 FUNCTION

South China Sea Region Tsunami Warning Centre has three key functions: tsunami warning product, tsunami warning product dissemination, and hazard mitigation education and training.

Tsunami warning product

According to the GSN and South China Sea countries seismic observation data, real-time observation information of tsunami buoys and coastal tide gauge stations, the warning platform will calculate tsunami wave arrival time, maximum tsunami wave height and coast dangerous level. This can be carried out automatically, by numerical forecasting and drawing on a database of pre-calculated tsunami scenarios through interaction platform with comprehensive analysis methods (Figure 8).

In the long run, storm surge and wave forecasts may also be included to meet more needs of marine hazard prevention and mitigation of South China Sea countries, and consequently to improve the capacity for preventing various marine hazards in the region.

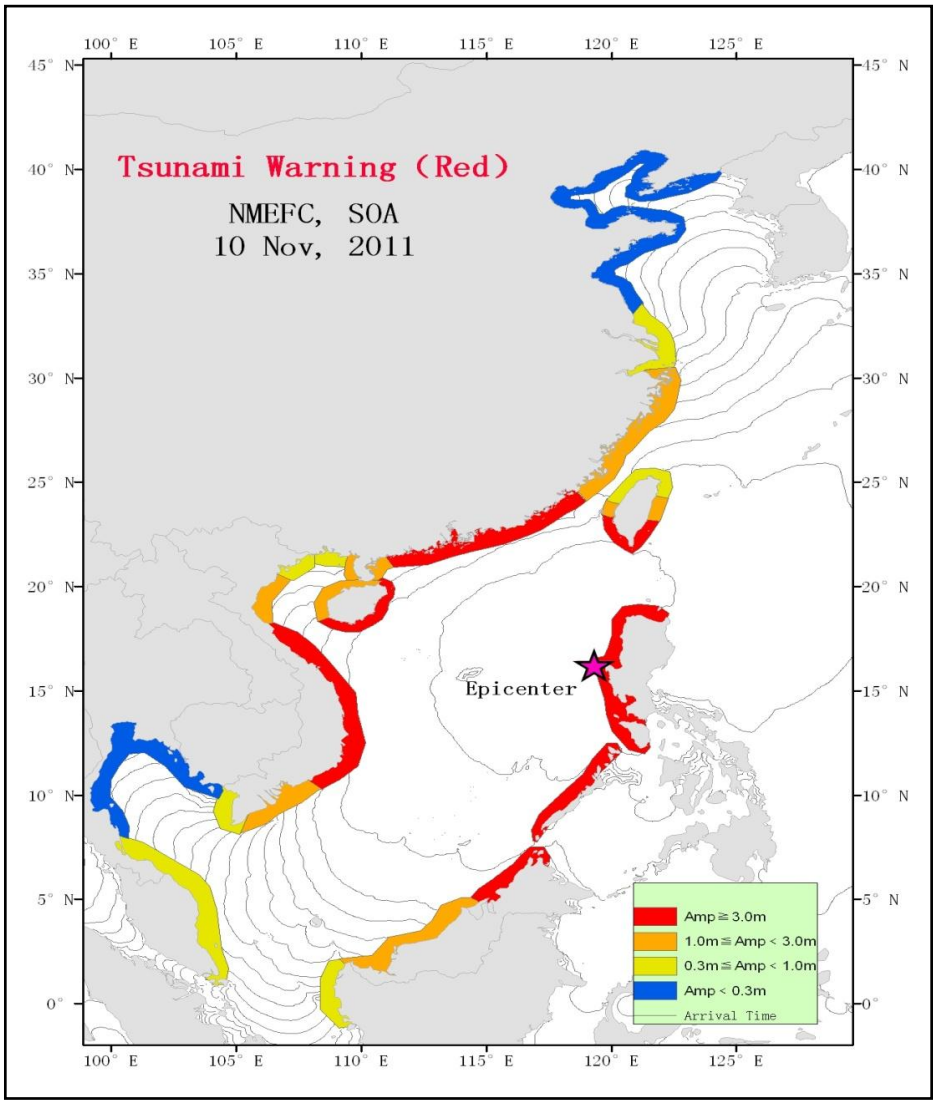

Figure 8.Tsunami warning message
(PacWave11, [IOC/2011/TS/97Vol.1])

Tsunami warning product dissemination

Through reliable information communication, tsunami warning products are disseminated to the tsunami warning centres of South China Sea countries. In order to improve efficiency, dissemination process should apply advanced and automatic information technology and tools, to the most extent save time. To ensure the tsunami information disseminated effectively and smoothly, diversified dissemination methods should be used and regular system tests should be considered.

Products dissemination system should, at least, include GTS, telephone and fax, Internet, e-mail and SMS:

- Deliver tsunami warning products to individual national institutional contacts through GTS.
- Deliver tsunami warning products to individual national and institutional contacts through SMS and fax.
- Release real-time tsunami warning information on the warning centre websites.
- Provide subscribed e-mail service to the public.

Hazard mitigation education and training

Provide technical trainings, such as tsunami warning, tsunami hazard risk assessment, tsunami evacuation mapping and tsunami hazard emergency management to South China Sea tsunami warning institutes. Regular tsunami exercises, protection and rescue education should be organized.

2.4.2 REQUIREMENTS

A tsunami warning centre's operation requires office building(s), technical experts, hardware and software facilities, standardised operation procedure, reliable communication, and sustainable financial support. In principle, all the South China Sea countries should deliberate the construction and operation of the tsunami warning centre, followed by final decision and approval of UNESCO/IOC. The construction content includes the following:

Location Requirement

Permanent office[1], budget, and personnel will be negotiated and decided by all members of South China Sea Region. In general, it is suggested the warning centre be based in one single country which plays a dual role as NTWC for the country in which it resides, and assigns and covers the majority of staff and budget. Other members are expected to support operation of the centre in human resources and finance.

China is willing to commit NMEFC/SOA to taking the charge and operating the South China Sea Tsunami Advisory Centre (SCSTAC).

Staff Requirement

Professional tsunami warning staff group is essential to manage an efficient warning centre. To meet its full mission, a tsunami warning centre requires several critical positions to ensure that all necessary functions could be accomplished. According to the experience at PTWC and WCATWC (tsunami warning centre reference guide[1]), a tsunami warning centre should

[1] U.S. Indian Ocean Tsunami Warning System Program, 2007. *Tsunami Warning Centre Reference Guide*. October 2007 ed. Printed in Bangkok, Thailand.

at least have a team of 25 staff to be effective, including warning centre directors, administrative assistants, scientific officers, operational watch standers and technical supporting officers. Operational staff is primarily provided by the warning centre from the country where it resides. Experts from all South China Sea countries are also strongly expected to contribute.

Equipment and Maintenance

A tsunami warning centre, at the minimum, consists of high performance computers, servers, work stations, necessary storage devices, communication network equipments, tsunami warning producing and disseminating platforms (include hardware and software). Critical equipments and facilities for tsunami warning should have multiple backups, and regular maintenance and repair are recommended so that staff can meet normal operational workloads.

Communication Requirement

Communication hardware and software are also crucial for a tsunami warning centre. Tsunami warning centre requires communications that can receive seismic and tide gauge observation data, contact with other related tsunami institutes, and disseminate tsunami warning products to the South China Sea member countries. Communications should be tested frequently so as to ensure continuity, and identify and solve the problems as soon as founded.

Documentation and Standards

In order to guarantee the responsibility and operation procedures, UNESCO/IOC suggested that a regional tsunami warning centre should at least prepare documentation and regulation as follows:

- Operation Manual: This document elaborates details of all the operational performance procedures and standards needed for tsunami warning centre duty officers to follow on production of warning.

- Operation Troubleshooting Manual: This document describes the problems and solutions for a tsunami operation system frequently meets, i.e. hardware or software computer system poor performance, communication disruption.

- User Guide: This document includes essential knowledge on tsunami warning, format, content and proper concept instructions of tsunami warning information, and preventive measures that government and the public may take.

- List of Tsunami Warning Centre Personnel: This document lists contact information of chief officers, operation officers and technical support officers.

- Tsunami Emergency Response Plan: Tsunami hazard emergency response standards and management procedure.

Capability of a Regional Tsunami Warning Centre

According to PTWC operation experience, a regional tsunami warning centre should have capabilities to perform the following functions:

- Operate on a 24/7 basis,

- Have access to seismic and sea-level data in real-time,
- Fast analysis on seismic parameters (location, magnitude, depth),
- Able to determine countries may be affected and their impact extents within tsunami AOR,
- Revise tsunami prediction timely in light of additional seismic and sea-level data,
- Provide standardised format tsunami warning products,
- Provide in-time tsunami arrival time products through GTS, etc.,
- Coordinate with other regional tsunami warning centres to provide one or more backup services in the events of a major communication failure, etc.,
- Coordinate with other affected member countries in issuing products if time permits.

Financial Source

Financial support is mainly from the country where the regional tsunami warning centre resides, however, other member countries are strongly expected to contribute.

2.5 HAZARD MITIGATION AND EMERGENCY MANAGEMENT SYSTEM

Hazard mitigation and emergency management system is not a single operating system, but a crucial sector section of the South China Sea regional Tsunami Warning and Mitigation System chain. Hazard mitigation and emergency management of member countries corresponding hazard mitigation and emergency management departments will be responsible for fulfilment of this section functions.

Hazard mitigation and emergency management system plays a critical role in a tsunami warning system. Its primary function is to provide public evacuation, hazard rescuing guidance and, hazard prevention and mitigation education and training.

Once there is tsunami alert, all the participants in the hazard mitigation and emergency management system should cooperate with each other for the long-term time highest level preparedness of tsunami emergency. Hazard mitigation and emergency management system associates tsunami warning centre officers, emergency management, tsunami scientists, other governmental institutions, non-government organizations and private sector agencies via a certain mechanism. Life rescue and property protection related policies, arrangements and projects are implemented. As tsunami is low frequent frequency event, it is strongly recommended that tsunami system embedded into multi-hazard system to achieve its sustainability.

Governmental institutions and private groups in the hazard mitigation and emergency management system alert public through by providing tsunami warning centre products to them, and help people in danger transfer move to safer places.

Objectives and focus of hazard mitigation and emergency management system should is to educate the public and other related people about tsunami prevention and safe keeping, as well as to improve tsunami warning program through communication and cooperation with public events, media workshops and public schools. Spokesmen are needed in the hazard

mitigation and emergency management system during actual tsunami event to coordinate with mass media.

3. IMPLEMENTATION PLAN

In the coming 5 years, the South China Sea Tsunami Warning and Mitigation System will be preliminarily established and in operational service. Detailed implementation plan is listed below:

2012

- Organize one or two South China Sea regional Working Group meetings to further discuss and deliberate the plan as an agreement.
- Submit the implement plan to ICG/PTWS.
- Organize a training workshop for South China Sea regional tsunami warning.

2013

- Implementation Plan will be submitted to the Twenty-fifth Session of the ICG/PTWS for further discussion and approval.
- Organize a training workshop for South China Sea regional tsunami warning.

2014

- Set up data sharing platform.
- Plant new earthquake stations, buoys and tidal gauges by members, so as to share monitored information of earthquake and tsunami.
- Establish South China Sea Tsunami Advisory Centre including hardware and software and databases.
- Staff in South China Sea Tsunami Warning and Mitigation System attends training courses in ITIC (International Tsunami Information Centre) or PTWC.

2015

- Plant new earthquake stations, buoys and tidal gauges by members, so as to share monitored information of earthquake and tsunami.
- Establish South China Sea Tsunami Advisory Centre (continued).
- Report progress of South China Sea Tsunami Warning and Mitigation System to Twenty-sixth Session of the ICG/PTWS meeting.
- Preliminarily complete the system and in test runs, and to provide tsunami warning products to members.

2016

- The South China Sea Tsunami Warning and Mitigation System will be in full operational service to deliver tsunami products.
- Formulate procedures and standards for service of the tsunami warning centre.
- Organize tsunami exercise for members in the region to test the performance of the South China Sea Tsunami Warning and Mitigation System.

ANNEX V

LIST OF PARTICIPANTS

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ANNEX VI

LIST OF ACRONYMS

ACDM	Committee on Disaster Management
ASEAN	Association of South-East Asian Nations
BB	Broadband stations
DDPM	Disaster Prevention and Mitigation of Thailand
DSS	Decision Support System
EITWC	Earthquake Information and Tsunami Warning Centre of Vietnam
GLOSS	Global Sea-Level Observing System
GTS	Global Telecommunications System
HKO	Hong Kong Observatory
ICG	Institute of Geophysics of Vietnam
ICG/PTWS	Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System
InaTEWS	Indonesia Tsunami Early Warning System
IOC	Intergovernmental Oceanographic Commission
IOTWS	Indian Ocean Tsunami Warning and Mitigation System
IRIS	Incorporated Research Institutions for Seismology
ITIC	International Tsunami Information Centre
JMA	Japan Meteorological Agency
MMD	Malaysian Meteorological Department
NDMC	National Disaster Management Centre OF Brunei
NDWC	National Disaster Warning Centre of Thailand
NMEFC	National Marine Environmental Forecasting Center of China
NOAA	National Oceanic and Atmospheric Administration of the United States of America
NOD	National Oceanography Directorate
NTU	Institute of Nanyang Technological University
NWPTAC	Northwest Pacific Tsunami Advisory Center
PDC	Pacific Disaster Centre
PHIVOLCS	Philippine Institute of Volcanology and Seismology
PMEL	Pacific Marine Environmental Laboratory of the United States of America
PTWC	Pacific Tsunami Warning Center
SCS	South China Sea
SCSTAC	South China Sea Tsunami Advisory Centre

SCSTWC	South China Sea Tsunami Warning Centre
SCSTWS	South China Sea Tsunami Warning System
SCS-WG	Working Group on Tsunami Warning and Mitigation System for the South China Sea Region
SOA	State Oceanographic Administration of China
SOP	Standard Operating Procedure
TMD	Thai Meteorological Department
ToR	Terms of Reference
TT	Task Teams
TWS	Tsunami Warning System
UNESCAP	Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organization
VAST	Vietnam Academy of Science and Technology
VSAT	very small aperture terminal
WESTPAC	IOC Sub-Commission for the Western Pacific
WG	Working Group
WMO	World Meteorological Organization

In this Series, entitled

Reports of Meetings of Experts and Equivalent Bodies, which was initiated in 1984 and which is published in English only, unless otherwise specified, the reports of the following meetings have already been issued:

1. Third Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans
2. Fourth Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans S. Fourth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño' ***(Also printed in Spanish)***
4. First Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
5. First Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources
6. First Session of the Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
7. First Session of the Joint CCOP(SOPAC)-IOC Working Group on South Pacific Tectonics and Resources
8. First Session of the IODE Group of Experts on Marine Information Management
9. Tenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies in East Asian Tectonics and Resources
10. Sixth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
11. First Session of the IOC Consultative Group on Ocean Mapping ***(Also printed in French and Spanish)***
12. Joint 100-WMO Meeting for Implementation of IGOSS XBT Ships-of-Opportunity Programmes
13. Second Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
14. Third Session of the Group of Experts on Format Development
15. Eleventh Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
16. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
17. Seventh Session of the IOC-UNEP Group of Experts on Methods, Standards and lntercalibration
18. Second Session of the IOC Group of Experts on Effects of Pollutants
19. Primera Reunión del Comité Editorial de la COI para la Carta Batimétrica lnternacional del Mar Caribe y Parte del Océano Pacífico frente a Centroamérica ***(Spanish only)***
20. Third Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
21. Twelfth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
22. Second Session of the IODE Group of Experts on Marine Information Management
23. First Session of the IOC Group of Experts on Marine Geology and Geophysics in the Western Pacific
24. Second Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources ***(Also printed in French and Spanish)***
25. Third Session of the IOC Group of Experts on Effects of Pollutants
26. Eighth Session of the IOC-UNEP Group of Experts on Methods, Standards and lntercalibration
27. Eleventh Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans ***(Also printed in French)***
28. Second Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
29. First Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
30. First Session of the IOCARIBE Group of Experts on Recruitment in Tropical Coastal Demersal Communities ***(Also printed in Spanish)***
31. Second IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
32. Thirteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asia Tectonics and Resources
33. Second Session of the IOC Task Team on the Global Sea-Level Observing System
34. Third Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
35. Fourth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
36. First Consultative Meeting on RNODCs and Climate Data Services
37. Second Joint IOC-WMO Meeting of Experts on IGOSS-IODE Data Flow
38. Fourth Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
39. Fourth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
40. Fourteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asian Tectonics and Resources
41. Third Session of the IOC Consultative Group on Ocean Mapping
42. Sixth Session of the Joint IOC-WMO-CCPS Working Group on the Investigations of 'El Niño' (***Also printed in Spanish)***
43. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
44. Third Session of the IOC-UN(OALOS) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources
45. Ninth Session of the IOC-UNEP Group of Experts on Methods, Standards and lntercalibration
46. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico
47. Cancelled
48. Twelfth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans
49. Fifteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asian Tectonics and Resources
50. Third Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
51. First Session of the IOC Group of Experts on the Global Sea-Level Observing System
52. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean
53. First Session of the IOC Editorial Board for the International Chart of the Central Eastern Atlantic ***(Also printed in French)***
54. Third Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico ***(Also printed in Spanish)***
55. Fifth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
56. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
57. First Meeting of the IOC *ad hoc* Group of Experts on Ocean Mapping in the WESTPAC Area
58. Fourth Session of the IOC Consultative Group on Ocean Mapping
59. Second Session of the IOC-WMO/IGOSS Group of Experts on Operations and Technical Applications

60. Second Session of the IOC Group of Experts on the Global Sea-Level Observing System
61. UNEP-IOC-WMO Meeting of Experts on Long-Term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Climate Change
62. Third Session of the IOC-FAO Group of Experts on the Programme of Ocean Science in Relation to Living Resources
63. Second Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
64. Joint Meeting of the Group of Experts on Pollutants and the Group of Experts on Methods, Standards and Intercalibration
65. First Meeting of the Working Group on Oceanographic Co-operation in the ROPME Sea Area
66. Fifth Session of the Editorial Board for the International Bathymetric and its Geological/Geophysical Series
67. Thirteenth Session of the IOC-IHO Joint Guiding Committee for the General Bathymetric Chart of the Oceans ***(Also printed in French)***
68. International Meeting of Scientific and Technical Experts on Climate Change and Oceans
69. UNEP-IOC-WMO-IUCN Meeting of Experts on a Long-Term Global Monitoring System
70. Fourth Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
71. ROPME-IOC Meeting of the Steering Committee on Oceanographic Co-operation in the ROPME Sea Area
72. Seventh Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño' ***(Spanish only)***
73. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico ***(Also printed in Spanish)***
74. UNEP-IOC-ASPEI Global Task Team on the Implications of Climate Change on Coral Reefs
75. Third Session of the IODE Group of Experts on Marine Information Management
76. Fifth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
77. ROPME-IOC Meeting of the Steering Committee for the Integrated Project Plan for the Coastal and Marine Environment of the ROPME Sea Area
78. Third Session of the IOC Group of Experts on the Global Sea-level Observing System
79. Third Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
80. Fourteenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans
81. Fifth Joint IOG-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
82. Second Meeting of the UNEP-IOC-ASPEI Global Task Team on the Implications of climate Change on Coral Reefs
83. Seventh Session of the JSC Ocean Observing System Development Panel
84. Fourth Session of the IODE Group of Experts on Marine Information Management
85. Sixth Session of the IOC Editorial Board for the International Bathymetric chart of the Mediterranean and its Geological/Geophysical Series
86. Fourth Session of the Joint IOC-JGOFS Panel on Carbon Dioxide
87. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Pacific
88. Eighth Session of the JSC Ocean Observing System Development Panel
89. Ninth Session of the JSC Ocean Observing System Development Panel
90. Sixth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
91. First Session of the IOC-FAO Group of Experts on OSLR for the IOCINCWIO Region
92. Fifth Session of the Joint IOC-JGOFS CO, Advisory Panel Meeting
93. Tenth Session of the JSC Ocean Observing System Development Panel
94. First Session of the Joint CMM-IGOSS-IODE Sub-group on Ocean Satellites and Remote Sensing
95. Third Session of the IOC Editorial Board for the International Chart of the Western Indian Ocean
96. Fourth Session of the IOC Group of Experts on the Global Sea Level Observing System
97. Joint Meeting of GEMSI and GEEP Core Groups
98. First Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
99. Second International Meeting of Scientific and Technical Experts on Climate Change and the Oceans
100. First Meeting of the Officers of the Editorial Board for the International Bathymetric Chart of the Western Pacific
101. Fifth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico
102. Second Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
103. Fifteenth Session of the Joint IOC-IHO Committee for the General Bathymetric Chart of the Oceans
104. Fifth Session of the IOC Consultative Group on Ocean Mapping
105. Fifth Session of the IODE Group of Experts on Marine Information Management
106. IOC-NOAA *Ad hoc* Consultation on Marine Biodiversity
107. Sixth Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
108. Third Session of the Health of the Oceans (HOTO) Panel of the Joint Scientific and Technical Committee for GLOSS
109. Second Session of the Strategy Subcommittee (SSC) of the IOC-WMO-UNEP Intergovernmental Committee for the Global Ocean Observing System
110. Third Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
111. First Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate
112. Sixth Session of the Joint IOC-JGOFS C02 Advisory Panel Meeting
113. First Meeting of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional - Global Ocean Observing System (NEAR-GOOS)
114. Eighth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of "El Niño" ***(Spanish only)***
115. Second Session of the IOC Editorial Board of the International Bathymetric Chart of the Central Eastern Atlantic ***(Also printed in French)***
116. Tenth Session of the Officers Committee for the Joint IOC-IHO General Bathymetric Chart of the Oceans (GEBCO), USA, 1996
117. IOC Group of Experts on the Global Sea Level Observing System (GLOSS), Fifth Session, USA, 1997
118. Joint Scientific Technical Committee for Global Ocean Observing System (J-GOOS), Fourth Session, USA, 1997
199 First Session of the Joint 100-WMO IGOSS Ship-of-Opportunity Programme Implementation Panel, South Africa, 1997
120. Report of Ocean Climate Time-Series Workshop, Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate, USA, 1997
121. IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional Global Ocean Observing System (NEAR-GOOS), Second Session, Thailand, 1997

122. First Session of the IOC-IUCN-NOAA *Ad hoc* Consultative Meeting on Large Marine Ecosystems (LME), France, 1997

123. Second Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), South Africa, 1997

124. Sixth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico, Colombia, 1996 ***(also printed in Spanish)***

125. Seventh Session of the IODE Group of Experts on Technical Aspects of Data Exchange, Ireland, 1997

126. IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), First Session, France, 1997

127. Second Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LME), France, 1998

128. Sixth Session of the IOC Consultative Group on Ocean Mapping (CGOM), Monaco, 1997

129. Sixth Session of the Tropical Atmosphere - Ocean Array (TAO) Implementation Panel, United Kingdom, 1997

130. First Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System (GOOS), France, 1998

131. Fourth Session of the Health of the Oceans (HOTO) Panel of the Global Ocean Observing System (GOOS), Singapore, 1997

132. Sixteenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans (GEBCO), United Kingdom, 1997

133. First Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS), France, 1998

134. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean (IOC/EB-IBCWIO-IW3), South Africa, 1997

135. Third Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), France, 1998

136. Seventh Session of the Joint IOC-JGOFS C02 Advisory Panel Meeting, Germany, 1997

137. Implementation of Global Ocean Observations for GOOS/GCOS, First Session, Australia, 1998

138. Implementation of Global Ocean Observations for GOOS/GCOS, Second Session, France, 1998

139. Second Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Brazil, 1998

140. Third Session of IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional - Global Ocean Observing System (NEAR-GOOS), China, 1998

141. Ninth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño', Ecuador, 1998 ***(Spanish only)***

142. Seventh Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and its Geological/Geophysical Series, Croatia, 1998

143. Seventh Session of the Tropical Atmosphere-Ocean Array (TAO) Implementation Panel, Abidjan, Côte d'Ivoire, 1998

144. Sixth Session of the IODE Group of Experts on Marine Information Management (GEMIM), USA, 1999

145. Second Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System (GOOS), China, 1999

146. Third Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Ghana, 1999

147. Fourth Session of the GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC); Fourth Session of the WCRP CLIVAR Upper Ocean Panel (UOP); Special Joint Session of OOPC and UOP, USA, 1999

148. Second Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS), France, 1999

149. Eighth Session of the Joint IOC-JGOFS CO2 Advisory Panel Meeting, Japan, 1999

150. Fourth Session of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional – Global Ocean Observing System (NEAR-GOOS), Japan, 1999

151. Seventh Session of the IOC Consultative Group on Ocean Mapping (CGOM), Monaco, 1999

152. Sixth Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), France, 1999

153. Seventeenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans (GEBCO), Canada, 1999

154. Comité Editorial de la COI para la Carta Batimétrica Internacional del Mar Caribe y el Golfo de Mexico (IBCCA), Septima Reunión, Mexico, 1998

IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico (IBCCA), Seventh Session, Mexico, 1998

155. Initial Global Ocean Observing System (GOOS) Commitments Meeting, IOC-WMO-UNEP-ICSU/Impl-III/3, France, 1999

156. First Session of the *ad hoc* Advisory Group for IOCARIBE-GOOS, Venezuela, 1999 ***(also printed in Spanish and French)***

157. Fourth Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), China, 1999

158. Eighth Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and its Geological/Geophysical Series, Russian Federation, 1999

159. Third Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS), Chile, 1999

160. Fourth Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS). Hawaii, 2000

161. Eighth Session of the IODE Group of Experts on Technical Aspects of Data Exchange, USA, 2000

162. Third Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LME), France, 2000

163. Fifth Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Poland, 2000

164. Third Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System (GOOS), France, 2000

165. Second Session of the *ad hoc* Advisory Group for IOCARIBE-GOOS, Cuba, 2000 ***(also printed in Spanish and French)***

166. First Session of the Coastal Ocean Observations Panel, Costa Rica, 2000

167. First GOOS Users' Forum, 2000

168. Seventh Session of the Group of Experts on the Global Sea Level Observing System, Honolulu, 2001

169. First Session of the Advisory Body of Experts on the Law of the Sea (ABE-LOS), France, 2001 ***(also printed in French)***

170. Fourth Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System, Chile, 2001

171. First Session of the IOC-SCOR Ocean CO_2 Advisory Panel, France, 2000

172. Fifth Session of the GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), Norway, 2000 ***(electronic copy only)***

173. Third Session of the *ad hoc* Advisory Group for IOCARIBE-GOOS, USA, 2001 ***(also printed in Spanish and French)***

174. Second Session of the Coastal Ocean Observations Panel and GOOS Users' Forum, Italy, 2001

175. Second Session of the Black Sea GOOS Workshop, Georgia, 2001

176. Fifth Session of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional – Global Ocean Observing System (NEAR-GOOS), Republic of Korea, 2000

177. Second Session of the Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Morocco, 2002 ***(also printed in French)***

178. Sixth Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), Australia, 2001 ***(electronic copy only)***

179. *Cancelled*

180. Second Session of the IOC-SCOR Ocean CO_2 Advisory Panel, Honolulu, Hawaii, U.S.A, 2002 ***(electronic copy only)***

181. IOC Workshop on the Establishment of SEAGOOS in the Wider Southeast Asian Region, Seoul, Republic of Korea, 2001 (SEAGOOS preparatory workshop) ***(electronic copy only)***

182. First Session of the IODE Steering Group for the Resource Kit, USA, 19–21 March 2001

183. Fourth Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LMEs), France, 2002

184. Seventh Session of the IODE Group of Experts on Marine Information Management (GEMIM), France, 2002 ***(electronic copy only)***

185. Sixth Session of IOC/WESTPAC Coordinating Committee for the North-East Asian Regional - Global Ocean Observing System (NEAR-GOOS), Republic of Korea, 2001 ***(electronic copy only)***

186. First Session of the Global Ocean Observing System (GOOS) Capacity Building Panel, Switzerland, 2002 ***(electronic copy only)***

187. Fourth Session of the ad hoc Advisory Group for IOCARIBE-GOOS, 2002, Mexico ***(also printed in French and Spanish)***

188. Fifth Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean (IBCWIO), Mauritius, 2000

189. Third session of the Editorial Board for the International Bathymetric Chart of the Western Pacific, Chine, 2000

190. Third Session of the Coastal Ocean Observations Panel and GOOS Users' Forum, Vietnam, 2002

191. Eighth Session of the IOC Consultative Group on Ocean Mapping, Russian Federation, 2001

192. Third Session of the Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Lisbon, 2003 ***(also printed in French)***

193. Extraordinary Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño', Chile, 1999 ***(Spanish only; electronic copy only)***

194. Fifth Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System, France, 2002

195. Sixth Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System, South Africa, 2003

196. Fourth Session of the Coastal Ocean Observations Panel, South Africa, 2002 ***(electronic copy only)***

197. First Session of the JCOMM/IODE Expert Team On Data Management Practices, Belgium, 2003 *(also JCOMM Meeting Report No. 25)*

198. Fifth Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LMEs), Paris, 2003

199. Ninth Session of the IOC Consultative Group on Ocean Mapping, Monaco, 2003 ***(Recommendations in English, French, Russian and Spanish included)***

200. Eighth Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), France, 2003 ***(electronic copy only)***

201. Fourth Session of the Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Greece, 2004 ***(also printed in French)***

202. Sixth Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LMEs), Paris, 2004 ***(electronic copy only)***

203. Fifth Session of the Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Argentina, 2005 ***(also printed in French)***

204. Ninth Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), France, 2005 ***(electronic copy only)***

205. Eighth Session of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional – Global Ocean Observing System (NEAR-GOOS), China, 2003 ***(electronic copy only)***

206. Sixth Meeting of the Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Spain, 2006 ***(also printed in French)***

207. Third Session of the Regional Forum of the Global Ocean Observing System, South Africa, 2006 ***(electronic copy only)***

208. Seventh Session of the IOC-UNEP-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LMEs), Paris, 2005 ***(electronic copy only)***

209. Eighth Session of the IOC-UNEP-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LMEs), Paris, 2006 ***(electronic copy only)***

210. Seventh Meeting of the IOC Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Gabon, 2007 ***(bilingual English/French)***

211. First Meeting of the IOC Working Group on the Future of IOC, Paris, 2008 ***(Executive Summary in English, French, Russian and Spanish included)***

212. First meeting of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Paris, 3–4 April 2008 ***(Executive Summary in English, French, Russian and Spanish included)***

213. First Session of the Panel for Integrated Coastal Observation (PICO-I), Paris, 10–11 April 2008 ***(electronic copy only)***

214. Tenth Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), Paris, 6–8 June 2007 ***(electronic copy only)***

215. Eighth Meeting of the IOC Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Paris, 21–25 April 2008 ***(bilingual English/French)***

216. Fourth Session of the Global Ocean Observing System (GOOS) Regional Alliances Forum (GRF), Guayaquil, Ecuador, 25–27 November 2008 ***(electronic copy only)***

217. Second Session of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Paris, 27 March 2009 ***(Executive Summary in English, French, Russian and Spanish included)***

218. Ninth Meeting of the IOC Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Paris, 30 March–3 April 2009 ***(bilingual English/French)***

219. First Session of the IOC-SCOR International Ocean Carbon Coordination Project (IOCCP) Scientific Steering Group (also IOCCP Reports, 3), Broomfield, Colorado, U.S.A., 1 October 2005 ***(electronic copy only)***

220. Second Session of the IOC-SCOR International Ocean Carbon Coordination Project (IOCCP) Scientific Steering Group (also IOCCP Reports, 6), Paris, France, 20 April 2007 ***(electronic copy only)***

221. Third Session of the IOC-SCOR International Ocean Carbon Coordination Project (IOCCP) Scientific Steering Group (also IOCCP Reports, 10), Villefranche-sur-mer, France, 3–4 October 2008 ***(electronic copy only)***

222. Fourth Session of the IOC-SCOR International Ocean Carbon Coordination Project (IOCCP) Scientific Steering Group (also IOCCP Reports, 15), Jena, Germany, 14 September 2009 ***(electronic copy only)***

223. First Meeting of the joint IOC-ICES Study Group on Nutrient Standards (SGONS) (also IOCCP Reports, 20), Paris, France, 23–24 March 2010 *(Executive Summary in E, F, R, S included)*

224. Third Session of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Lisbon, Portugal, 5–6 May 2010 ***(Executive Summary in English, French, Russian and Spanish included)***

225. Eleventh Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), Paris, 13–15 May 2009 ***(electronic copy only)***

226. Second Session of the Panel for Integrated Coastal Observation (PICO-II), Paris, 24–26 February 2009 ***(electronic copy only)***

227. First meeting of the Task Team on Seismic Data Exchange in the South West Pacific of the ICG/PTWS Regional Working Group for the Southwest Pacific, Port Vila, Vanuatu, 19–20 October 2009 ***(electronic copy only)***

228. Fourth Session of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Paris, France, 20–21 March 2011 ***(Executive Summary in English, French, Russian and Spanish included)***

229. Second Session of the IODE Steering Group for Ocean Teacher (SG-OT), Miami, Florida, 11–15 April 2011

230. First Meeting of the Inter-ICG Task Team 1 on Sea Level Monitoring for Tsunami (Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Seattle, USA, 29 November–1 December 2010

231. First Meeting of the Inter-ICG Task Team 2 on Disaster Management and Preparedness (Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Seattle, USA, 29 November–1 December 2010

232. First Meeting of the Inter-ICG Task Team 3 on Tsunami Watch Operations (Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Seattle, USA, 29 November–1 December 2010

233. Primera Reunión del Grupo de Trabajo Regional para América Central del Grupo Intergubernamental de Coordinación del Sistema de Alerta contra los Tsunamis y Atenuación de sus Efectos en el Pacífico (ICG/PTWS), Managua (Nicaragua) del 4 al 6 de noviembre de 2009 ***(Resumen dispositivo en español e inglés)***

234. Segunda Reunión del Grupo de Trabajo Regional para América Central del Grupo Intergubernamental de Coordinación del Sistema de Alerta contra los Tsunamis y Atenuación de sus Efectos en el Pacífico (ICG/PTWS), San Salvador (El Salvador) del 28 al 30 de septiembre de 2011 ***(Resumen dispositivo en español e inglés)***

235. First Session of the Joint IODE-JCOMM Steering Group for the Global Temperature-Salinity Profile Programme (SG-GTSPP), 16–20 April 2012, Ostend, Belgium

236. Ad hoc Session of the Joint JCOMM-IODE Steering Group for the Ocean Data Standards Pilot Project (SG-ODSPP), 23–25 April 2012, Ostend, Belgium

237. First Meeting of the Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region (SCS-WG), Sanya, China, 12–14 December 2011

238. First Meeting of the IODE Steering Group for OceanDocs (SG-OceanDocs), 24–27 January 2012, Ostend, Belgium

239. Fifth Session of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Tokyo, Japan, 15 February 2012 ***(Executive Summary in English, French, Russian and Spanish included)***

240. Ad hoc Session of the IODE Group of Experts on Biological and Chemical Data Management and Exchange Practices (GE-BICH), Ostend, Belgium, 25 October 2012

241. Twelfth Session of the IODE Group of Experts on Marine Information Management (GE-MIM), Miami, USA, 22–25 January 2013

242. Twelfth Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), Paris, 9–11 November 2011 ***(electronic copy only)***

243. Meeting of the Pacific Tsunami Warning System Working Group 2 on Detection, Warning and Dissemination Task Team on PacWave11, Honolulu, USA, 21 May 2012 ***(electronic copy only)***

244. Sixth Session of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Paris, 20–21 February 2013 ***(Executive Summary in English, French, Russian and Spanish included)***

245. Second Meeting of the Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region (SCS-WG), Petaling Jaya, Malaysia, 16–18 October 2012 ***(electronic copy only)***