Intergovernmental Oceanographic Commission
Reports of Governing and Major Subsidiary Bodies

Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS)

Third Session

Bali, Indonesia
31 July–2 August 2006

UNESCO

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1. WELCOME AND OPENING

1 The Session was opened on Monday, 31 July at 09:00 under the Chairmanship of Dr P.S Goel, ICG/IOTWS Chairman. The Executive Secretary of Intergovernmental Oceanographic Commission (IOC), Dr Patricio Bernal, opened the session by welcoming the participants. On behalf of Director-General of UNESCO, Mr Matsuura, Dr Bernal expressed his condolences to the families of the victims of the recent tsunami hitting central Java on July 17 and encouraged the represented member states to take the insufficiency of the actual system as a unique opportunity to renew engagement and commitment to the process.

2 He recalled briefly the international IOC coordination meetings on the establishment of an Indian Ocean Tsunami Warning System (IOTWS) in Paris and Mauritius, the preceding ICG/IOTWS meetings in Perth and Hyderabad and the according decisions and progress achieved so far. In the aftermath of the greatest tsunami in recorded history on December 2004 an interim IOTWS has been put in place, which comprises 26 new tide gauges, 25 additional seismic stations and 4 deep ocean DART buoys. The data are transmitted in real-time to the PTWC and JMA which both provide tsunami alert bulletins to Indian Ocean Member States until a fully-fledged system in the region is in place. He closed by emphasizing that process is far from having a fully-fledged system up and running and that there is an urgent need to especially have the downstream part of the end to end system set up and strengthened in close cooperation and under the sovereign authority on the participating nations.

3 The Chairman ICG/IOTWS and Secretary to Government of India, Department of Ocean Development, Dr P.S. Goel, appreciated in his opening address the overwhelming response to this meeting. Based on the experience of the recent earthquakes and subsequent tsunamis within the last months he reminded participants on the huge tasks ahead in improving the Indian Ocean Tsunami Early Warning System, which has a major role in reducing the loss of life and property. He especially mentioned the urgent need for real-time data transmission to all Member States contributing to the IOTWS and appreciated the coordination mechanism put in place and role played by UNESCO/IOC in this regard.

4 Dr Goel then read a supporting message by the UN Special Envoy for Tsunami Recovery, President Bill Clinton, who raised the importance of the ICG/IOTWS process in the light of the recent destructive tsunami in Java and the importance of public awareness, education and community preparedness as crucial parts of an effective warning system. He stressed the need to synchronize national and regional efforts with the regional system now further ahead than most of the national systems especially in addressing “the last mile” of the TWS. He finally addressed the recently established Consortium of seven international organizations under the coordination of UN-ISDR which intend to facilitate and help Indian Ocean Member States with the implementation of their national TWS. The full speech is in Annex VIII.

5 Dr Kusmayanto, Minister of Science and Technology of Indonesia, welcomed the representatives and experts from the various member states bordering the Indian Ocean in his inaugural speech. He also commemorated the 26 December 2004 tsunami and its major impact on Indonesia. Referring to the two proceeding speakers he reminded the participants that the end-to-end tsunami warning system can be divided into two parts, the structural and the cultural part. He emphasized that the instrumentation or structural part of the system, although not fully in place, is comparatively easy to implement. The second or cultural part which represents the downstream part of the system is much more difficult to achieve. He especially emphasized that in implementing the cultural part of the system by capacity building, outreach and civil defence emergency plans, local knowledge and culture should be taken into account. Following this idea

e.g. mosques and their loudspeakers should be taken into account. He reminded the participants that besides the people in the endangered coastal regions, numerous tourists in the Indian Ocean region will also benefit from an effective TEWS.

2. ORGANISATION OF THE SESSION

2.1 ADOPTION OF THE AGENDA

6 Tony Elliott, the Head of the ICG/IOTWS Secretariat, introduced this item and explained the foci of this session. Noting two comments from the plenary, the agenda was adopted. See Annex I for the adopted agenda.

2.2 DESIGNATION OF THE RAPPORTEUR

7 The Group was requested to consider the need to nominate a Rapporteur for the Session. Mr Foster Gultom from the Indonesian Ministry for Foreign Affairs was nominated, and accepted the position.

2.3 CONDUCT OF THE SESSION, TIMETABLE AND DOCUMENTATION

8 The Chairman introduced the Session Time Table and Documentation. He mentioned that all working documents are made available through the IOTWS web site at http://ioc3.unesco.org/icg-iii/.

3. REPORT ON INTERSESSIONAL ACTIVITIES

3.1 IOC EXECUTIVE SECRETARY'S REPORT

9 The IOC Executive Secretary reported that, as requested in Hyderabad, the Secretariat prepared an IOTWS Implementation Plan for discussion and endorsement at ICG/IOTWS-III. As well, national implementations plans have been developed by several countries of the Indian Ocean, including among others Australia, India, Malaysia, and Thailand. These are major contributions that need to be appropriately included in the Implementation Plan as it develops.

10 The Executive Secretary recalled that the downstream flow of information required for delivering at the national level is still missing in several countries, as proved by the recent tsunami on 17 July 2006 in Java, Indonesia. This is a serious gap that should be filled through the development of National Tsunami Warnings Plans in all Member States of the IOTWS. He invited Member States to commit to the development of all national plans for ICG/IOTWS-IV. He recalled that the ISDR Consortium is offering support to develop tsunami national plans and that there will be an Indian Ocean Tsunami donor's conference that the UN will hold next October in New York. This is a meeting for the ICG/IOTWS to inform donors about the state of the system, in order to get the appropriate support for the full implementation of IOTWS.

11 The Executive Secretary then recalled that the system we are setting in place needs to be sustainable and durable. In order to do this we need to reach the high levels of governments in each nation to make it an integral part of the governance process. For this to work, Member States need to reach the ministers of finance The ownership of the system is with the Member States and the costs of running the system are not negligible so it needs to be factored into the budget of each nation.

12 He told the Group that our first and absolute priority is to look at the downstream part of the system, and called on all heads of delegations to take up the challenge and come up with national plans as soon as possible. He urged the Member States to look at the sustainability of the system so that it is still running in many years time, and reminded them of the need to maintain the momentum, move the system forward and look to the future in the long term.

3.2 CHAIRMAN'S REPORT

13 The ICG/IOTWS Chairman, Dr P.S. Goel of India, welcomed all the Member States, UN agencies and other supportive organisations to the Third Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System. He reminded the ICG members that the IOTWS was formed in 2005, and that at that time the leaders of the region committed to having a regional Tsunami Warning System and to provide public education about tsunamis. The Member States agreed to develop their National Plans to contribute to the system.

14 The Chairman noted that the vulnerability of the Indian Ocean States to tsunami has been realised once again with the Java tsunami of 17 July 2006, which emphasised the importance of tsunami warnings and public education about tsunamis. There are two main tsunamigenic sources in the Indian Ocean, the Makran source and the Sumatra/Java source. The current Early Warning System comprises a technical system of seismic and sea level sensors, and a communication system. While implementation of the network of seismic and sea level sensors is well underway, we need to focus more on the communications systems.

15 He also reminded the Group that a working group was established at the ICG-II session in Hyderabad to consider the IOTWS Implementation Plan, which has now been prepared by the IOC Secretariat in Paris and will be presented at this meeting. Members are requested to review the document and note any issues for discussion during the plenary session after presentation of the Implementation Plan.

16 The Chairman closed by asking the scientific community and Member States to make a commitment to the system so that if and when the next tsunami occurs, we will be able to say we have made a difference.

3.3 IOTWS SECRETARIAT REPORT

17 Tony Elliott, Head of the ICG/IOTWS Secretariat reported on the structure and activities of the secretariat, its budget and future priorities. He recalled that the ICG/IOTWS Secretariat was established at the IOC 23rd Assembly (21–28 June 2005) with the kind support from Australia. The staff of the office comprises the Head of the Office and a Programme Specialist, and is hosted by the Australian Bureau of Meteorology. A one-year secondment from Member States of the Indian Ocean will be funded by AusAID; this support will stand for three years enabling three different secondees from three distinct Member States to work at the ICG/IOTWS Secretariat for one year.

18 He then referred to the support provided by the Secretariat to the intersessional meetings of ICG/IOTWS Working Groups and presented the breakdown of the budget available to the Secretariat, with the criteria established for funding attendees to ICG meetings and working groups. He noted that while the design of the core system of IOTWS is progressing well, the downstream part requires more work. In that sense he agreed that the establishment of a WG 6 on Mitigation and Preparedness and Response is a good step forward to cope with this urgent need. The full report is in Annex X.

19 India requested a clarification on the Terms of Reference for the proposed Working Group 6 (WG6) and its eventual overlap with Working Group 3 (WG3) and Working Group 5 (WG5) that perhaps should be considered when discussing the establishment of a WG6. The Chairman confirmed that this item will be addressed under Agenda Item 4.7.

3.4 REPORT FROM IOC TSUNAMI UNIT

20 Peter Koltermann, Head of the IOC Tsunami Unit (SC/IOC/TSU), reported that the Tsunami Coordination Unit is now composed of 9 networked experts, located in Paris HQ, in the ITIC Office in Hawaii, USA and in the ICG/IOTWS Secretariat in Perth, Australia. He informed the ICG that the Unit is prepared to provide support on:

1. Training of personnel for handling and processing Earthquake and Tsunami relevant data;

2. Training and assistance to produce coastal inundation maps;

3. Technical Assistance for defining, installing, and monitoring seismic and oceanographic equipments;

4. Technical Assistance to prepare Terms of Reference for provision of personnel services or equipments;

5. Technical Assistance for developing manuals, protocols and operating plans, in partnership with JMA, PTWC;

6. Technical Assistance for defining mandates and delegation of authority.

21 In the intersessional period the Unit has been involved in the following activities:

1. Connecting national facilities to the core regional system, including the recently upgraded 23 sea-level stations;

2. Delivering tsunami-resistant new equipment to selected countries, facilitating communication channels, and providing maintenance and training support;

3. Supporting the upgrade of the seismographic network around the Indian Ocean Basin, concentrating mainly in the Indian Ocean Islands, East Africa and other selected countries (Sri Lanka). Equipment and training will be provided;

4. Setting up the permanent Secretariat for the ICG/IOTWS based in Perth to support all the intergovernmental coordination required for the IOTWS;

5. IOC will establish a Tsunami Information Centre (TIC) in Jakarta, Indonesia, to act as a clearinghouse for transferring emergency preparedness material. Backup will be provided through its International Tsunami Information Centre (ITIC) based in Hawaii, USA.

6. IOC will set up an IOC Programme Office in Hawaii, USA to act as the International Tsunami Information Centre (ITIC).

22 The Unit is supported with contributions from Australia, Germany, Ireland, Japan, Norway and USA. Upgrades of sea level stations are being made with substantial contributions from Member States, such as Finland. The opening of a TIC in Jakarta has been arranged

together with Canada and Germany, while the ITIC and its activities have been supported by the USA.

23 The Head of the Tsunami Unit concluded his report by informing that the unit is also supporting the work of the tsunami warning systems being developed in the Mediterranean Sea, the North Eastern Atlantic and Caribbean Sea, and at the same time helping to reinforce the Pacific Tsunami Warning System (PTWS). The full report is in Annex XI.

24 Bangladesh requested that the Unit send public awareness materials to all agencies involved in tsunami reduction at the national level and not only to the focal point, as this is very important material that is required at all levels. In response to this request, the Chairman reminded the plenary that the system works at an intergovernmental level that requires having focal points that distribute the information at the national level through interagency coordination.

25 Red Cross Indonesia requested the meeting to address practical plans and tools for application at the district and sub-district level to prepare people for tsunamis. He also suggested capacity building activities addressing local governments. The Head of the Tsunami Unit responded that this is one of the main issues the meeting plans to address; to get the warning down to the local populations, and also to prepare local populations located near to local tsunamigenic zones to act even in the absence of an official warning.

26 Mauritius asked how to get access to the preparedness material. The Head of the Tsunami Unit responded that the Unit is responding on request, mainly through ITIC which is the IOC repository for all preparedness and public awareness materials related with tsunami.

27 Australia requested information on the status of the global framework for tsunami and related hazards being developed by UNESCO/IOC. The Head of the Tsunami Unit reported that the 39th Executive Council (21–28 June 2006) received an interim report of the Ad Hoc Working Group on Global Ocean-related Hazards Early Warning and Mitigation Systems (GOHWMS) and decided to extend its mandate and requested the group to report to the next Assembly in June 2007.

28 Japan conveyed a message from the Japanese Minister of Foreign Affairs expressing their condolences to the government of Indonesia for the Java tsunami on 17 July 2006. Early warning systems for regional as well as for local tsunamis are required in IOTWS. Japan has been providing tsunami interim information as well as preparedness materials for the IOTWS. The Government of Japan is willing to continue its cooperation with IOTWS.

29 The IOC Executive Secretary took the opportunity to emphasise certain aspects of questions raised by the interventions and made the following statement: It is important for the ICG members to have communication with members of the emergency community. The UN has been raising awareness of emergency preparedness and disaster reduction since 1979. We have a worldwide community which has been working on disaster reduction and they have important knowledge and experience. This is important because in most cases it is the community which has to react to these disasters.

30 The ICG is a group of representatives of the Member States. We take it that this group represents the authority of the governments here. They are the only ones who can provide the system we are setting up here. The ICG will oversee all the work that is required to build an end-to-end system. Some countries have been sending representatives with a more technical background than a disaster management level. This decision is up to the countries. We have been working with other agencies to bring more disaster management and community based

representatives into the ICG, and we have to find the mechanisms to coordinate at the intergovernmental level, the national level and the local level. This is why we are making an effort to bring in WG6. We need to have a single mechanism to guide the whole process, end to end. Tsunamis today have the attention of the world community. We are far from getting the support we need to implement the system and we need to work together to ensure its sustainability.

3.5 REPORTS FROM UN AGENCIES

ISDR

31 Mr Joe Chung from ISDR reported that senior management of UNDP, WMO, The World Bank, OCHA and the International Federation of Red Cross and Red Crescent Societies recently committed themselves to a major strengthening of the ISDR system to support countries' efforts to implement the Hyogo Framework for Action. ISDR is now finalising the multi-donor funded Flash Appeal (FA) initiative for Indian Ocean TEWS that included work in Indonesia in Padang, west coast of Sumatra with UNESCO and LIPI. Other projects either completed or in various stages of completion are in Sri Lanka and India. Other initiatives include those of regional partners such as ADPC and ADRC who have worked directly with a number of countries on school tsunami awareness and on risk communications.

32 Since the ICG-II session in Hyderabad, ISDR and its partners have worked to consolidate the proposal for a WG6 on Mitigation, Preparedness and Response. To that effect in June 2006 ISDR organised a three-day workshop in Bangkok, Thailand to discuss and further develop the draft Terms of Reference for WG6. This preparatory process ended on 30 July, when ISDR convened a workshop on the proposed WG6 just prior to ICG/IOTWS-III. This last meeting refined the Terms of Reference in order to make sure that there are no serious overlaps with the existing ICG Working Groups.

33 The ISDR representative encouraged delegates to develop linkages with the other ISDR-related initiatives in the region, and at home through the National Platform for Disaster Reduction, to ensure that tsunami risk reduction does not become a neglected issue in the coming years.

UNESCAP

34 Mr Khalid Husain from UNESCAP made a short presentation on the Multi-donor Voluntary Trust Fund on Tsunami Early Warning Arrangements in the Indian Ocean and Southeast Asia. This Fund, established in late 2005 through resources from the Governments of Thailand and Sweden and operational since early 2006, is currently capitalized at US$ 12.5 m. The Fund aims to contribute to narrowing the capacity gaps in the Indian Ocean and Southeast Asia and ensuring the development of an integrated regional tsunami early warning system based on adequate resources and comprising a network of collaborative centres. Relevant regional, sub-regional and national organizations with the mandate, capacity, and expertise on early warning systems for tsunamis in a multi-hazard context are eligible to apply for resources.

35 The main focus of the Fund is to receive and review proposals with a view to commencing timely and efficient implementation of project activities. The first round of funding for the Trust Fund is currently open until 31 August 2006. Relevant documents such as grant application form, guidelines for the form, and other policy and operational information on the Trust Fund have been posted on the UNESCAP website at: http://www.unescap.org/pmd/tsunami_index.asp.

UNDP

36 Mr Sanny Jegillos from the UNDP reported that they launched a regional programme for capacity building for sustainable development and disaster risk reduction in December 2005. In performing this task, they are aware that there is a wide variety of capacities and abilities within the countries in the region, and encourage and develop best practice within communities.

37 Tsunami is not the only disaster faced by countries like Indonesia, so the idea of collecting information on disaster history at all levels is promoted, to enable disaster managers to identify potential risks. Many disasters occur at the community level, so long-term disaster risk reduction relies on investment in disaster risk management. UNDP would like to promote a network of information management systems in disaster risk reduction. UNDP also want to work with governments in the area of development and training.

WMO

38 Mr Jean- Michael Rainier and Mr Edgard Cabrera reported on the status of the WMO's Global Telecommunications System (GTS), which has been established as the background for exchange of tsunami-related information and warnings. They presented the WMO's action plan for a fully operational GTS for the IOTWS, showing that the first three of six steps have now been completed. Upgrades, training and operational tests will be ongoing.

39 The WMO's contribution to the IOTWS can be summarised into five main areas:

1. Upgrade of WMO's GTS- WMO Global Telecommunication System (GTS);
2. Support of Regional Warning Centres;
3. IOC/WMO/ISDR Assessments;
4. Multi-Agency Consortium in support of national plans;
5. Multi-hazard approach to ocean-related early warning systems.

40 The WMO will support the IOC Ad Hoc Working Group on the Framework for a Global Tsunami and other Ocean-related Hazards Early Warning System, under its mandate.

3.6 NATIONAL PROGRESS REPORTS

41 Fourteen Member States made short progress reports outlining the activities undertaken during the intersessional period. These countries were: Australia, India, Indonesia, Kenya, Madagascar, Malaysia, Maldives, Mauritius, Oman, Pakistan, Seychelles, Sri Lanka, Tanzania and Thailand. A short summary of each is presented here, and the full reports are available on the ICG-III website at http://ioc3.unesco.org/icg-iii/.

Australia

42 Mr Rick Bailey reported that the Australian Tsunami Warning System (ATWS) Project is a four-year project to greatly enhance the limited capability of the existing Australian Tsunami Alert System (ATAS). The project started in July 2005 and due to its complexity will not be fully completed until July 2009. However, phased enhancements in capability will contribute to the overall development of the IOTWS during this period.

43 Progress is being steadily made on expansion of the sea level and seismic networks, which are due to be completed by end of 2008. Whilst the ATAS continues to be highly dependent on the tsunami advisories from PTWC in Hawaii and JMA in Japan, tools and operational procedures and competencies for the initial configuration of an Australian Tsunami Warning Centre (AusTWC) will be in place by June 2007. Work is being continually undertaken in community awareness and preparedness in consultation with State/Territory emergency management organisations and other stakeholders.

India

44 Dr Shailesh Nayak reported on the projected Indian Early Warning System for Tsunami and Storm Surges. The system includes a Real-time Seismic Network for Tsunami Warning Core Network to be operational by January 2007. A total of twelve Deep Ocean Tsunami Detection Buoys will be deployed, 50 remote tidal observatories are being equipped with state-of-the-art tide gauges , and data from Port Blair, and Visakhapatanam is already available in near real time.

45 India reported that an Interim Tsunami Warning Centre is operational at INCOIS, Hyderabad and currently has round-the-clock operation, Standard Operating Procedure, five project scientists, computers, fax, telephone, 2 Mbps internet facility and technical support facilities. Tsunami Alerts and Warnings will be issued based solely on earthquake information, and the service will be upgraded if tsunami generation is confirmed from sea level and tide gauge data, or cancelled if a tsunami is not generated. The Early Warning Centre & Communication Options provides also travel times, surge height at landfall points and extent of inundation. Data / Products from the system will be available to neighbouring countries through bilateral agreements, through the Intergovernmental Coordination Group for Indian Ocean Tsunami Warning System (ICG/IOTWS) and the Indian Ocean GOOS.

Indonesia

46 Dr Jan Sopaheluwakan of Indonesia reported that Indonesia's system has made good progress but still needs work. There is still a stronger preference for responding rather than preparedness in disaster management practices, and there is a need for better public education and community preparedness for tsunami hazards.

47 Indonesia's grand design concept includes short and long-term plans for all aspects of the warning system, with the long-term aim of having a 24/7 warning centre capable of giving warnings within five minutes of an event. There are also plans to install 27 continuous GPS stations for crustal deformation monitoring, as part of the multi-hazard monitoring system. The National Disaster Management Office is being repositioned and coordination mechanisms will be improved. Other plans include:

1. Strengthening the 24/7 operational capabilities of the Indonesian Tsunami Warning Centre;

2. Accelerating the master plan and scaling up of the public drill, community preparedness, risk assessment and development of SOPs throughout the country (including the sharing of experiences and knowledge with other member countries),

3. Strengthening the future Disaster Management Office and the national coordination mechanism on disaster management;

4. Mainstreaming the disaster, conflict and crisis management into the development plan, policy and practices.

Kenya

48 Dr Joseph Mukabana presented a progress report on the National Tsunami Early Warning Centre (NTEWC). The National (Disaster Operation) Centre (NOC) in the Office of the President, Ministry of State for Special Programmes, was designated as the National Tsunami Information Centre (NTIC) charged with the responsibility of coordinating response, relief and rehabilitation. Kenya reported that the planned system includes 15 drifting buoys already deployed in Western Indian Ocean and 20 more to be deployed this year courtesy of the USA through NOAA, three anchored buoys to be procured during the 2006/2007 financial year (FY) for Lake Victoria, 1 Marine Automatic Weather Station (MAWS) installed at the Port of Mombasa and one to be procured this financial year (FY 2006/2007) for Lake Victoria. As well 22 seismic stations/sensors are to be procured in FY 2006/7–2007/8 and installed around the country. One Deep Ocean anchored buoy will be procured subject to availability of funds.

49 To improve communication, an Automatic Message Switching System (AMSS) for RTH-Nairobi was replaced with a new one early this year and another AMSS has been installed in Mombasa for Tsunami Early Warning courtesy of the Government of France. RANET FM Transmitter Radios are being provided for vulnerable rural communities. Thirty-two Sirens will be procured during FY2006/7–20087/8 for the coastal region and flood prone areas in the country.

50 A National Stakeholders' workshop was held at Mombasa Beach Hotel in Mombasa from 27 to 29 July 2006. The participants at the workshop drafted a Multi-hazard National Tsunami Action Plan, and a National Tsunami Warning and Mitigation Coordination Committee was constituted as an effective mechanism to oversee the implementation of the National Tsunami Action Plan.

Madagascar

51 Madagascar reported on the activities carried out in the intersessional period, and plans for further activities in seven main areas:

1) National tsunami centre established and operating as the authoritative source for tsunami advice and warnings;

2) Strengthening of operational 24/7 national warnings capacities of the National Meteorological Services as part of multi-hazard approach to national warning systems;

3) Warning response plan for coastal regions prepared and disseminated and a national (coastal) response and evacuation exercise undertaken;

4) Awareness-raising and education campaign undertaken on tsunami risks and the warning system in coastal regions;

5) Assessment of Environmental Flashpoints at sub-national level for use in preparedness and spatial planning and disaster risk reduction;

6) Organizations responsible for disaster risk reduction and disaster management established to lead, monitor and coordinate the plan;

7) Intermediate and long-term plan developed for the complete and sustainable tsunami warning and response system with full costing.

52 The intermediate and long-term plan includes the provision of communication equipment through the National Emergency Council (CNS) and installation of three seismic stations and one tide gauge to be carried out by the Antananarivo Geophysical Institute & Observatory (IOGA) & National Meteorological Service.

Malaysia

53 Malaysia reported on the recognition of the need for a strong effort to develop a Tsunami Early Warning System, with system being progressed by a national centre and regional centres. The lead agencies are the Malaysian Meteorological Department and the Malaysian Centre for Remote Sensing. Evacuation operations and rescue awareness are managed by the National Security Division

54 Malaysia is receiving seismic waveform data from the USGS, IRIS, Singapore, Australia and CTBTO through the internet in near real-time. They are also contributing real-time waveform data from seven broadband stations, for regional and international exchange. Tide gauges are monitored on a 24/7 basis, and sea level data is being received from international networks such as GLOSS. Two Deep Ocean Tsunami Buoys have been deployed, with another deployment planned soon. Coastal cameras and sirens are also being utilized as part of the system.

55 Tsunami Advisories are being received from the PTWC and JMA, and are disseminated to the public through SMS, public alerts, telefax, media broadcasting and web pages. This early warning system can also be configured to be used as a multi-hazard early warning system with speedy delivery of warnings to the public, relevant authorities and related agencies.

Maldives

56 Major Mohamed Nazim from the National Disaster Management Centre (NDMC) presented the Maldives plan to establish a framework for a tsunami warning system. The framework has four main parts:

- Assessment of Tsunami Hazard and Risks
- Monitoring and Warning Service
- Warning Dissemination and Communication
- Response Capability

57 A description of the implementation of each part of the framework was followed with planned methods for strengthening capacity in each of the areas.

58 A Tsunami Warning System for the Maldives has been established under the Department of Meteorology. After an event, warnings are sent to the government, media and the public. There are no beach sirens yet but communication is being established at local levels. Pilot community preparedness programs and exercises have been held, and a tsunami awareness day is planned.

Mauritius

59 Mauritius reported on the progress on implementing the national Tsunami Early Warning System. Responsibility for the system is shared between the Prime Minister's office, the Mauritius meteorological Services, the Mauritius Oceanography Institute, and the Ministry of Environment and National Development Unit.

60 Activities implemented to date include improvements to sea level measurements, communication systems and implementation of education and public awareness programmes. An operation warning system and procedures has been designed.

61 Proposed activities are as follows:

1. Strong public awareness campaign;

2. Evacuation strategy to be put in place;

3. Identifying shelters for Tsunami;

4. Coastal population to be informed to seek help from relatives/friends uplands as it would be tremendously onerous to government to maintain a large refugee population for a long time;

5. An IOTWS action plan for the Republic of Mauritius has been prepared and submitted to ISDR/Consortium for approval to consolidate the existing facilities;

6. A seismometer would be shortly installed at the Meteorological Services premises with the collaboration of IOC/UNESCO.

Oman

62 The report from Oman was presented by the Director of Meteorology, Mr Al Harthi.

63 The Ministry of Foreign Affairs has been designated the responsibility for establishing a Tsunami Warning System in Oman. Other stakeholders include the Ministry of Transport and Telecommunications, the Ministry of Regional Municipalities and the Ministry for Environment and Water Resources. The main organisations involved in the technical side of the system are the Meteorological Department, the Earthquake monitoring Centre and the National Committee for Civil Defence.

64 Delegates from Oman have participated in several meetings and training courses, including the recent Numerical Modelling training course held in Belgium in June 2006. Participants will use their new capability to develop a national tsunami hazard map, paying special attention to risks from local tsunamis generated in the Makran source region. Oman is keen to cooperate and coordinate with countries in the region to establish a regional Tsunami Warning System.

65 Oman is currently receiving tsunami watch advisories from the JMA, by GTS, email and fax, and occasionally receives messages from the PTWC as well.

Pakistan

66 Dr Chaudry, Director-General of the Pakistan Meteorological Department, presented an extensive overview of plans to strengthen national capacity for a multi hazard early warning and response system in Pakistan. Pakistan has also submitted a report to the ISDR Consortium requesting assistance in strengthening Tsunami Early Warning systems in Pakistan.

67 The basic elements involved in establishment of the tsunami early warning system in Pakistan include deployment of an efficient national seismic network, a network of at least 3-4 moored sea-level buoys, linkage to regional and global tsunami warning centres, and capacity building. An upgrade of the seismic network has already begun, with establishment of five new broadband stations. A National Tsunami Warning Centre is proposed for Karachi, with backup centres in Islamabad and Quetta.

Seychelles

68 Mr Yann Rosseau of the National Disaster Secretariat, President's Office, presented the Seychelles report. He began by outlining the status and progress of the current system, then covered the existing gaps and constraints, and National priorities.

69 The lead agency is the National Disaster Secretariat, which is supported by the National Disaster Committee and Regional Platforms. The National Meteorological Service has a 24/7 National Tsunami Warning Centre with GTS communication links to JMA and PTWC. There is one seismic observation instrument which is linked to the USGS in San Diego. There is also one sea level monitoring instrument. Plans are underway to implement a National Disaster Policy, complete a risk and vulnerability assessment, and run more education, awareness and sensitisation programmes. The UNDP will assist with a two-year capacity building project from September 2006.

70 National priorities include improvement of meteorological stations, providing more equipment for rapid warning dissemination (including a network of sirens and reliable communication equipment for outer islands), simulation exercises, education and awareness raising campaigns, and tsunami modelling and risk mapping.

Sri Lanka

71 Major General Gamini Hettiarachchi, Director-General of the Disaster Management Centre, presented an update on Sri Lanka's activities.

72 In May 2005, the Government of Sri Lanka passed the Sri Lanka Disaster Management Act No 13 of 2005 in the Parliament, followed by establishment of the National Council for Disaster Management (NCDM). The Disaster Management Centre (DMC) was established under the National Council for Disaster Management (NCDM) as the lead agency on disaster risk management in the country in implementing the directives of NCDM. In December 2005, the Ministry for Disaster Management was established. On January 2006, the above Ministry was renamed as the Ministry of Disaster Management & Human Rights with human right portfolio being added to the Ministry. The Disaster Management Act provides a national framework for disaster risk management in Sri Lanka. Within the framework, a 10-year roadmap is being implemented within a multi hazard framework.

73 The Meteorology Department is now receiving warnings from the JMA, the PTWC and the California Integrated Seismic Centre. Warning dissemination is carried out via media, police

communication systems, military communication systems, phones (landlines, cell phones and SMS), broadcasts and helicopters. At the village level, Disaster management Committees have been formed in coastal villages, drills and evacuation routes worked out, and education and awareness programmes conducted.

Tanzania

74 Mr David Kirway from the Disaster Management Department of the Prime Minister's Office presented an overview of Tanzania's plans to implement a tsunami early warning system.

75 The Tanzanian Meteorological Agency (TMA) has been identified as the national Tsunami Warning Centre. It has received equipment funded by the French Government, to enhance communication and data processing. Disaster management committees have been formed in all coastal communities, and training sessions have been conducted at a regional and district level.

76 Plans for improving the system follow the objectives outlined as part of the ISDR Consortium proposal, with six out of the total seven objectives clarified.

Thailand

77 Dr Smith Dharmasaroja, Vice Minister for the Office of the Prime Minister's Secretariat, and Chairman for the Development of an Early Warning System in Thailand, presented the National Report.

78 The Master Plan of the multi-hazard early warning system in Thailand can be projected into four phases which include Phase I (2005–2006) put emphasis on earthquake and tsunami warning system, Phase II (2006–2007) put emphasis on flooding and landslide and preparedness and education programme on earthquake and tsunami, Phase III (2007) put emphasis on storm, forest fire, drought, and pollution and preparedness and education programme and establishment of regional disaster early warning network and Phase IV (2006–2011) develop its plan to support initiatives of the Indian Ocean Rim Warning System and the Pacific Tsunami Warning System in conjunction with Indian Ocean Tsunami Warning System and Pacific Tsunami Warning System.

79 NDWC signed many cooperation agreements with international organizations to implement the tsunami early warning arrangement in Thailand. These include Cooperation on Early Warning Arrangement, Preparedness and Mitigation on Natural Hazards for Thailand with Asian Disaster Preparedness Center (ADPC), United States Trade and Development agency (USTDA) in collaboration with Pacific Disaster Center (PDC), United States Agency for International Development (USAID) Indian Ocean Tsunami Warning System (IOTWS) Program, International Ocean Institute (IOI), and United Nations Development Programme (UNDP).

80 Some emerging issues and recommendations in implementation of the cooperation are given for further development and implementation of the effective and durable tsunami early warning arrangement in Thailand. The implementation programmes should be expanded to include other 16 coastal provinces on the Pacific Ocean in the near future.

81 The ICG Chairman thanked all the countries for their presentations and noted that there is scope for increased cooperation in the region. There have been many examples of mutual cooperation, but to make more happen we need a mechanism that is sustainable. To make the system sustainable we need to exercise the system not monthly but weekly.

82 The Group noted the extensive work presented by Member States since the tragic Indian Ocean Tsunami of 24 December 2004. All Member States presented details of their work in the area of technical development and community warning. All countries noted the difficulties in and importance of public response to these warnings. Also, all countries noted the work is ongoing, especially in the areas of deep ocean measurements and community preparedness. Most Member States believe this will require continual effort for sustainability. The Members agreed that governments needed to be aware of the ongoing commitment for this sustainability.

3.7 ITIC AND EXERCISE PACIFIC WAVE REPORTS

83 Dr Laura Kong presented a report on development of the *TsunamiTeacher* resource kit. She discussed the content of the kit, the target audiences, and the applications. The pre-live version of the CD was made available to meeting participants, with the full version available at the end of 2006. The kit will also be translated into several languages.

84 Mr Fred Stephenson, Vice Chairman of the PTWS presented an overview of the Exercise Pacific Wave held in May 2006. This was the first such Pacific-wide exercise, although communications test had been done previously. The primary goals were to test communications and test decision making at government levels.

85 The exercise was conducted over a two-day period with a time compression of four. Forty Member States participated, and five chose to take the exercise right down to the community disaster management level. It has been decided to hold similar tests annually, and in future the tests will run in real time. Member States are also recommended to conduct their own tests on an annual basis.

86 Dr Chip McCreery, Director of the PTWC, presented the timeline for the 17 July 2006 Java earthquake and tsunami. The first bulletin, a local tsunami watch, was issued 17 minutes after the earthquake, which occurred at 08:19UTC. A second bulletin was issued at 11:08UTC to announce a 0.04 m amplitude tsunami at Benoa, Indonesia.

87 Areas for improvement include:

1. Better methods to get more accurate, rapid Mw;
2. Faster PTWC/JMA Coordination;
3. Faster seismic analysis;
4. PTWC faxes too slow – 15 minute delay;
5. Additional information useful for Member States' decision making;
6. Better coordination with and use of the media.

4. PROGRESS REPORT AND FOLLOW UP OF WORKING GROUPS

4.1 REPORT ON IOTWS CAPACITY BUILDING ACTIVITIES

88 Dr Laura Kong presented an overview of IOTWS capacity building activities during the intersessional period. Activities are targeted to fill gaps in the end-to-end systems and provide

training and educational materials. A short summary of training activities during the intersessional period was provided, as well as an overview of materials available from the ITIC.

89 Dr Costas Synolakis presented the results of two numerical modelling training courses held in Kuala Lumpur, Malaysia and Ostend, Belgium. The aim of the courses was to inform local scientists on simple modelling tools to help assess the potential of seismic zones to generate tsunamis.

4.2 WORKING GROUP 1 PROGRESS REPORT: SEISMIC MEASUREMENTS, DATA COLLECTION, AND EXCHANGE

90 Dr Prih Harjadi, Chair of Working Group 1 (WG1), presented the intersessional meeting report from the group. The group met on 29 and 30 July prior to the ICG/IOTWS-III in Bali. Members agreed on the group's objectives and discussed the action plan for each objective. Data formats and sharing issues were discussed at length, as well as various processing systems for earthquake magnitude calculation. It was agreed that new techniques for calculation of magnitude should be investigated.

91 The WG agreed that each national centre must evolve its own standard operating procedures based upon the various components of the warning system within their countries. The working group also agreed that the standard operating procedures should be shared amongst the Member States. Systems for rapid review of automatically derived earthquake parameters were discussed and it was agreed that earthquake parameters should be reviewed before being distributed to the public.

4.3 WORKING GROUP 2 PROGRESS REPORT: SEA LEVEL DATA COLLECTION AND EXCHANGE, INCLUDING DEEP-OCEAN TSUNAMI DETECTION INSTRUMENTS

92 Mr Ken Jarrott, the Vice Chair of Working Group 2 (WG2), presented the results of the findings of the WG in the intersessional period, which met in Melbourne on 1 and 2 May 2006. He emphasized the need to harmonize the national plans as well as the need for interoperability between and standardisation of instruments used and showed the actual plans in upgrading tide-gauges and DART buoys in the Indian Ocean. Real-time data transmission is also a key issue for sea-level measurements and the group looked into possibilities to upgrade the existing network. From examples shown he stressed that it is essential to have sampling intervals from tide gauges from 1min or better to be able to detect signals from local or high frequency tsunamis.

4.4 WORKING GROUP 3 PROGRESS REPORT: RISK ASSESSMENT

93 The Chair of Working Group 3 (WG3), Prof. Sam Hettiarachchi, presented the findings of the intersessional meeting, which took place from 30 June to 1 July 2006 in Sri Lanka. He emphasized that for an effective risk assessment inundation maps from a standardized set of models is essential. He stressed the need for a WG website, training workshops and called for Member States to undertake risk assessment case studies. He recommended better coordination with WG 4 (Modelling, Forecasting and Scenario Development).

4.5 WORKING GROUP 4 PROGRESS REPORT: MODELLING, FORECASTING AND SCENARIO DEVELOPMENT

94 The Chair of Working Group 4 (WG4), Prof. Charitha Pattiaratchi, started his report by reiterating finding from the session in Hyderabad in December 2005, and based on these findings

the Working Group met on 29 and 30July in Bali, prior to the ICG/IOTWS session. The recommendations of the modelling working group concentrated on the definition of benchmarks for model comparison and validation and the necessity of a Tsunami Community Model (TComM) e.g. similar to the one which is actually developed within a project coordinated by NOAA. The Group also recommends planning a workshop with participants from all Working Groups to define possible source zones, and according scenarios for the model runs to be undertaken.

4.6 WORKING GROUP 5 PROGRESS REPORT: THE ESTABLISHMENT OF A SYSTEM OF INTEROPERABLE ADVISORY AND WARNING CENTRES

95 Mr Geoff Crane, the Chair of Working Group 5 (WG5), reported on the updated recommendations from the intersessional meeting on 29 and 30 July in Bali, Indonesia. The group is generally concerned that the state of the interim tsunami warning system is "oversold" by some interviews and press releases by different stakeholders and thus created some unnecessary public criticism e.g. during the failure of the warning system during the recent tsunami on 17 July 2006 in Java. The group developed a draft warning/alert scheme for the IO based on the Pacific scheme and emphasized the need to get the warning to the "last-mile" with clear, easy to understand and culturally adapted messages. Mr Crane emphasized the need for continuous exercises and drills to make an end-to-end warning system effective.

4.7 (PROPOSED) WORKING GROUP 6 PROGRESS REPORT: MITIGATION, PREPAREDNESS AND RESPONSE

96 Mr Che Moin Bin Umar (Malaysia), reported on the outcomes from the ISDR-IOC Regional Workshop on Mitigation, Preparedness and Development of Tsunami Early Warning Systems In The Indian Ocean Region, 14–16 June 2006 and the ISDR Workshop on Disaster Risk Reduction, Bali, Indonesia, 30 July 2006. Both meetings contributed to develop and refine the Terms of Reference for the proposed WG6 on Mitigation, Preparedness and Response.

97 The workshop produced the following mission statement for the expected Working Group 6:

- The Working Group on Mitigation, Preparedness and Response will support national and regional efforts to strengthen capabilities for disaster risk reduction from tsunami within a multi-hazard framework, focusing on improved mitigation, preparedness and response at all levels down to the vulnerable communities.
- The Working Group will assist Member States in the development of good practice in capacity and resilience building, and emergency management to reduce tsunami risk through the following activities:

98 The ICG Chairman proposed that the plenary decide on the establishment of the group at the plenary session under item 7 (Working Group Sessional Meetings).

5. BRIEF ON THE SUPPORT PACKAGE OF THE CONSORTIUM OF ISDR SYSTEM PARTNERS

99 Ms Stefanie Dannenmann from ISDR presented a consortium of ISDR partners that has offered an immediate package of advisory support to governments in the Indian Ocean region. This offer was announced by Jan Egeland, Chair of the ISDR system, at the Roundtable on Indian Ocean Tsunami Warning and Response Systems held in Bonn on 27 March 2006. She

informed that 9 countries (Madagascar, Maldives, Mauritius, Mozambique, Pakistan, Seychelles, Somalia, Sri Lanka and Tanzania) have responded to the offer proposed by the Consortium. The presentation by Stefanie Danemann was followed by short presentations on the seven targeted objectives proposed to build on and extend existing capacities essential to achieve effective people-centred tsunami early warning systems.

1. National tsunami centre established and operating as the authoritative source for tsunami advice and warnings. [Lead partner: UNESCO/IOC, presented by Patricio Bernal]

2. Strengthening of operational 24/7 national warnings capacities of the National Meteorological Services as part of multi-hazard approach to national warning systems. [presented by WMO, presented by Edgard Cabrera]

3. Warning response plan for coastal regions prepared and disseminated and a national (coastal) response and evacuation exercise undertaken. [Lead partner: UN-OCHA, presented by Joe Chung from ISDR]

4. Awareness-raising and education campaign undertaken on tsunami risks and the warning system in coastal regions. [Lead partner: IFRC]

5. Assessment of Environmental Flashpoints at sub-national level for use in preparedness and spatial planning and disaster risk reduction. [Lead partner: UNEP]

6. Organizations responsible for disaster risk reduction and disaster management established to lead, monitor and coordinate the plan. [Lead partner: UNDP, presented by Sanny Jegillos]

7. Intermediate and long-term plan developed for the complete and sustainable tsunami warning and response system with full costing. [Lead partner: World Bank]

100 She provided a timetable for the activities related to the Consortium and emphasized that the Consortium Package was communicated formally to the President or Prime Minister of the Indian Ocean Member States. The main expected outcome from this process is to have National Tsunami Warning Plans developed in countries of the Indian Ocean region.

6. REPORT AND FOLLOW-UP ON IOTWS IMPLEMENTATION PLAN

101 Peter Koltermann, the Head of the IOC Tsunami Unit, introduced this item by reminding the participants on the history of the implementation plan and briefly outlining the actual structure which is essentially based on the outcomes and recommendations of the IOTWS working groups so far. He emphasized that this plan is designed as a living document which will frequently be updated for the online version as the process of the establishment of the IOTWS proceeds. As the implementation plan is designed to reflect the gaps between the actual status and the fully-fledged warning system, Member States are invited to send comments, updated information and improvements to the ICG/IOTWS secretariat.

102 Following the presentation, ICG members were invited to form breakout groups to discuss the plan, before meeting again in a plenary session.

103 Australia recommended updating the rather preliminary document as soon as possible and requests addition of an extra phrase in the WG action plan to reflect how much funding is needed to finalize specific tasks which are partially funded.

104 India requested careful investigation of time spans needed to fulfil the different tasks and whether all tasks are linked to the correct WGs, while the future WG6 should be taken into account.

105 Bangladesh mentioned that some errors in the seismic part need to be corrected and requested incorporation of social implications.

106 GLOSS requested Member States to provide updated information on the national plans to update and install tide-gauges, and to provide WMO GTS header information.

107 UNESCAP emphasized the need to add cost estimates on funding gaps to help potential donors to identify projects which meet their funding requirements.

108 The IOC Executive Secretary welcomed the numerous comments and especially the requests to clarify and assess the funding needs. To keep resources channelled to a wide variety of national needs, the ICG must accept independent assessment of needs to be certified by competent teams of experts. Moreover, the IOC will not take full ownership of the Implementation Plan; they will look to partnership of various agencies (i.e. NGO, UN agencies) for this as well. To do this, the ICG must accept responsibility and accountability of the process.

109 The ICG Chair noted that the national reports are a crucial component of the implementation plan, and requested that countries send updates on their national report to the ICG/IOTWS Secretariat every three months. He also stressed the important role that the Chairpersons of Working Groups can play in providing regular updates on Group activities to the Secretariat for inclusion in the implementation plan.

110 The ICG Chair also noted the importance of sub-regional tsunami warning systems, especially in the Makran region where India, Pakistan, Iran and Oman are at risk. These countries need closer cooperation and coordination to help reduce risk. Although the ICG/IOTWS already has this approach for the region, close sub-regional cooperation can also be helpful, especially between neighbouring countries. Those countries which have independent systems can help their neighbours build capacity.

111 The ICG Chair requested a recommendation regarding the interaction of delegates with the media, and the media's interaction with the public. He suggested that if the media works independently then the language they use could create a panic, so it is important they work together with the knowledge groups. This will work differently in different regions, depending on the relationship between the media and the public. Each country needs to address this issue. He requested that the ICG consider the need for an expert group to design the communication pathways for each region.

7. WORKING GROUP SESSIONAL MEETINGS

112 The Working Groups formed breakout groups to discuss the implementation plan and issues and plans for the next intersessional period, before reporting back to the plenary. Full sessional meeting reports are in Annexes III to VII.

7.1 WORKING GROUP 1 (SEISMIC MEASUREMENTS, DATA COLLECTION AND EXCHANGE)

113 The Group reviewed the recommendations made at the intersessional meeting on 29 and 30 July, and made a series of recommendations regarding the Core Stations and Database,

Processing System, Data Exchange, Standard Operating Procedures, Capacity Building, and the Indian Ocean Consortium. The Group discussed procedures for updating the seismic core stations listed in the Implementation Plan, and agreed that the Chair would provide regular updates.

7.2 WORKING GROUP 2 (SEA LEVEL MEASUREMENTS, DATA COLLECTION AND EXCHANGE)

114 The Group agreed to formalise all relevant interoperability guidance documents, review the sea level observation network and work on a documented rational for the composite IOTWS sea level observation network. They also agreed to support the implementation of a communal web-accessed database that encompasses all deep ocean stations in the IOTWS network, capturing relevant information on equipment types and the progress towards a fully operational state, and to develop recommendations for archiving of high resolution sea level data, in consultation with WG5.

7.3 WORKING GROUP 3 (RISK ASSESSMENT)

115 The Group reviewed the report from the intersessional meeting held in Sri Lanka from 30 June 30 to 1 July 2006, and refined some of the recommendations. The next stage of development for the Group involves the preparation of Risk Assessment Methodology and Guidelines, and Mitigation Options and Decision Support Case Studies. The need for standardised guidelines and methodologies for tsunami risk assessment was discussed, and a sub-group was formed to take responsibility for preparing a draft report by the end of December 2006. The Group also agreed to hold a workshop on Risk Assessment methodology in Dubai in the 2nd quarter of 2007. The need for a website was identified.

7.4 WORKING GROUP 4 (MODELLING, FORECASTING AND SCENARIO DEVELOPMENT)

116 The Group reviewed the results of the intersessional meeting, held in Bali from 29 to 30 July, just prior to the ICG-III session. The following recommendations were endorsed by the Group:

- Model standards be accepted and adopted;
- Model benchmarks to be accepted and be available on the website;
- Development of web-site to provide model standards and benchmark tests;
- In conjunction with other working groups, develop model scenarios (tsunami sources) for the whole of Indian Ocean region;
- Tsunami community model now available. Require training workshops to enable tools to be used effectively in each country.

7.5 WORKING GROUP 5 (THE ESTABLISHMENT OF A SYSTEM OF INTEROPERABLE ADVISORY AND WARNING CENTRES)

117 The Group reviewed the results of the intersessional meeting, held in Bali of 29 and 30 July, just prior to the ICG-III session. The Group made a series of recommendations regarding interaction with the media and effective communication of threat levels. Members of WG5 noted that development of an interoperable tsunami warning system for the Indian Ocean region is a complex and time consuming process. There is a long way to go –attaining the requisite level of capability will take years. It will never be “completed.” technology and techniques are

evolving; system will need to be continually updated; the ongoing demands of sustainability constitute a huge challenge. Reporting of significant milestones could give a positive message of progress without the risk of any implication that the system is complete.

7.6 WORKING GROUP 6 (MITIGATION, PREPAREDNESS AND RESPONSE)

118 An informal session of WG6 took place previous to its formal establishment by the Plenary. The elected Vice-Chair of WG6 chaired the informal session. Participants to this session discussed the Implementation Plan of IOTWS and agreed that it fails to some extent to address the integration of tsunami warning systems into national disaster platforms as well as in its translation into policy, plans and legislation. They recommended that WG6 should address this issue and suggested IFRC and ABU to be invited to participate at WG6 to provide guidance to address community level preparedness and public information and communication, respectively.

119 The Plenary approved the establishment of Working Group 6 on Mitigation, Preparedness and Response, with the following Terms of Reference:

The Working Group will assist Member States in the development of good practice in capacity, resilience building and emergency management to reduce tsunami risk through the following activities:

a. Promotion and enhancement of the institutionalisation of tsunami early warning systems, their implementation and maintenance.

b. Mainstreaming of tsunami warning and mitigation system into development policy, plans, practice and legislation.

c. Integration of national tsunami programs and experts into the defined national platforms for disaster risk reduction and national disaster management processes.

d. Development and adaptation of tsunami-related guidelines, manuals and tools for downstream activities i.e. public information, education, training, communication processes, evacuation planning and drills, standard operating procedures and emergency management.

e. Coordination at regional and sub-regional levels on the above matters.

120 The ICG Chair reminded delegates of the protocol for the funding of Working Group activities. Working Groups should liaise with the ICG Secretariat on all funding matters. The Secretariat has the coordination role on funding issues and should be notified on all offers of financial and in-kind support. Working Groups requesting funding for training, workshops and other meetings should channel these requests through the Secretariat.

8. PROGRAMME AND BUDGET FOR 2006–2007

121 Dr Patricio Bernal presented the programme and budget for 2006–2007.

122 He gave a report on direct funding: this funding is going through the IOC internal accounts, and has been donated to implement specific tasks.

123 He said that the implementation plan will not fulfil its role unless we identify all the things which need to be done. If we do not do that then we are not facilitating the financing of the project, and we can not have a functioning, efficient system.

124 He also said that the IOC is not the only institution involved in setting up the IOTWS, and many other organisations have very important roles in the process. These organisations have other sources of funding, so in order to continue with their support we need to have a clear implementation plan.

9. NEXT MEETING

125 The Group thanked Kenya for its generous offer to host the next meeting of the ICG, provisionally scheduled to be held in the third week of February 2007.

10. OTHER BUSINESS

126 Australia noted the need for a coordination process across the six Working Groups. During the presentation of the Working Groups it was clear that there were areas of overlap that would need to be managed carefully in order to achieve the establishment of a robust IOTWS. This coordination role has currently been carried out by the ICG/IOTWS Secretariat, but as the overall system develops and WGs move further into their action plans, it is important to ensure the coordination of the development of national warning systems of Member States, through their membership and expertise within WGs and therefore the region wide IOTWS.

127 Australia noted that the ICG/PTWS had recently (May 2006) established a medium-term strategy WG to undertake this coordination. Noting this and the strong requirement for effective coordination, Australia requested the ICG to establish an overarching working group to oversee implementation of the IOTWS and its medium-term strategy with the membership comprising the Chairs of the six Working Groups of the ICG/IOTWS and the Chair and vice chair of the ICG/IOTWS. The WG would be chaired by the ICG/IOTWS chair and would meet predominantly by teleconference.

128 The terms of reference would be brief and overarching:

- To ensure cooperation and effective working arrangements between the six WGs;
- To work with the Secretariat to ensure the Implementation Plan of the IOTWS is up to date and meets its performance indicators (PI) for establishment of a robust end-to-end warning system. The reporting of these PIs should be at least six-monthly to assist donor organisations and governments;
- To develop the IOTWS medium-term strategy plan and provide an update on a regular annual basis based on the plans of the individual working groups.

129 USA suggested adding the coordination and facilitating role for funding needs in the terms of reference.

130 India stated that they prefer not to formalize the process by establishing a coordination group within a coordination group and wanted to ensure the well accepted terms of reference are followed accordingly.

131 The IOC Executive Secretary supported India's suggestion and confirmed that the ICG Secretariat will take care that the important and essential issues mentioned in the terms of reference of the proposed group are implemented through similar means as mentioned in the proposal.

132 Australia accepted the alternative proposal of India.

11. ADOPTION OF THE SUMMARY REPORT AND RECOMMENDATIONS

133 The summary report and recommendations were accepted by the ICG. WG Action Items are summarised in Annex II.

1) The Group approved the establishment of the Working Group 6 for Mitigation, Preparedness and Response, and supported the nomination by Mauritius for Seychelles to hold the Chair of the Group. The ICG further approved the election of Malaysia to hold the position of Vice Chair.

2) The Group recommended that the IOTWS work closely with international media to ensure that the information they receive from the IOTWS during events is accurately understood and therefore that information media in turn may provide to threatened areas is useful and not in conflict with national authorities.

3) The Group further recommended that the ICG/IOTWS Secretariat continue to facilitate dialogues with major media networks and organizations. Details presented by NHK at ICG/IOTWS-III regarding the successful JMA and NHK relationship related to Japan's tsunami threat clearly illustrate that the media can be an effective partner for tsunami warning and mitigation.

12. CLOSE OF MEETING

134 In his closing remarks, the IOC Executive Secretary asked the ICG to consider what they want from the Implementation Plan and what they think it should contain. It is up to the Member States to decide how they will implement the plan and how they will sustain it. The ICG will set up the protocols but these protocols are useless unless they are supported at a national level. We are far from achieving our aim of an end-to-end system, and as our first priority we need to get the national plans in place. He concluded his remarks by thanking the ICG for their support, and thanking the Indonesian Government for hosting the meeting and providing such excellent facilities for the meeting.

135 The Vice Chairman, Dr Jan Sopaheluwakan, thanked the ICG members for their participation and contributions during the three days of the meeting. He recalled that Indonesia's offer to host this meeting was made at the ICG-I session in Perth, and was intended to accelerate the implementation of the IOTWS. In this regard he expressed that, as far as Indonesia is concerned, the meeting has stimulated the process of improving Indonesia's system. All the Indonesian teams are very busy and making detailed plans of the end-to-end system, as a result of the decision of the government to accelerate the implementation of the system in Indonesia. Indonesia has made significant progress, despite its inability to meet the people's expectations.

136 On behalf of the Indonesian Government he thanked the Secretariat, the local committee, and the Government of Bali for their generous hospitality, and wished delegates to enjoy the rest of their stay in Indonesia.

ANNEX I

AGENDA

1. WELCOME AND OPENING OF FIRST SESSION

- Dr Patricio Bernal: Assistant Director General of UNESCO and Executive Secretary Intergovernmental Oceanographic Commission
- Dr P.S. Goel: Secretary to the Government of India, Department of Ocean Development, ICG/IOTWS Chair.
- Dr Kusmayanto, Minister for Science and Technology, Indonesia
- Group Photo

2. ORGANIZATION OF THE SESSION

2.1 ADOPTION OF AGENDA

2.2 DESIGNATION OF THE RAPPORTEUR

2.3 CONDUCT OF THE SESSION, TIMETABLE AND DOCUMENTATION

3. REPORT ON INTERSESSIONAL ACTIVITIES

3.1 IOC EXECUTIVE SECRETARY'S REPORT

3.2 CHAIRMAN'S REPORT

3.3 IOTWS SECRETARIAT REPORT

3.4 REPORT FROM IOC TSUNAMI UNIT

3.5 REPORTS FROM UN AGENCIES

3.6 NATIONAL PROGRESS REPORTS

3.7 ITIC AND EXERCISE PACIFIC WAVE REPORTS

4. PROGRESS REPORT AND FOLLOW UP OF WORKING GROUPS

4.1 REPORT ON IOTWS CAPACITY BUILDING ACTIVITIES

4.2 WORKING GROUP 1 PROGRESS REPORT: SEISMIC MEASUREMENTS, DATA COLLECTION, AND EXCHANGE

4.3 WORKING GROUP 2 PROGRESS REPORT: SEA LEVEL DATA COLLECTION AND EXCHANGE, INCLUDING DEEP-OCEAN tsunami detection instruments

4.4 WORKING GROUP 3 PROGRESS REPORT: RISK ASSESSMENT

4.5 WORKING GROUP 4 PROGRESS REPORT: MODELLING, FORECASTING AND SCENARIO DEVELOPMENT

4.6 WORKING GROUP 5 PROGRESS REPORT: THE ESTABLISHMENT OF A SYSTEM OF INTEROPERABLE ADVISORY AND WARNING CENTRES

4.7 WORKING GROUP 6 PROGRESS REPORT: MITIGATION AND EMERGENCY MANAGEMENT

5. BRIEF ON THE SUPPORT PACKAGE OF THE CONSORTIUM OF ISDR SYSTEM PARTNERS

6. REPORT AND FOLLOW UP ON IOTWS IMPLEMENTATION PLAN

7. WORKING GROUP SESSIONAL MEETINGS

8. PROGRAMME AND BUDGET FOR 2006-2007

9. NEXT MEETING

- Confirmation of date and place of ICG/IOTWS IV, next meeting
- Confirmation of target date for ICG/IOTWS V

10. OTHER BUSINESS

11. ADOPTION OF THE SUMMARY REPORT AND RECOMMENDATIONS

12. CLOSE OF MEETING

ANNEX II

SUMMARY OF ACTIONS ADOPTED BY ICG/IOTWS-III

WG1 Action Items

Action	Person Responsible	Due Date
1) Maintain and distribute a comprehensive database of the relevant core stations of the member states. The complete metadata should be reported to GA who will maintain the database, including metadata of other types of sensors such as accelerometer and GPS.	Geoscience Australia (Spiro Spilopolous/Alexei Gorbatov)	Update reports at each ICG meeting
2) 70 core seismic stations in operation by the end of 2010 • 38 broadband stations in operation by end 2006 • 45 broadband stations in operation by end 2007 Other stations deployed by donors or member countries should also be available for other members.	All member states of WG1	End 2010
3) Data from core set of stations to monitor regional seismicity to be shared	All members of WG1	31 December 2006
4) New techniques for calculation of magnitude to be investigated.	All members of WG1	Update reports at each ICG meeting
5) Each national centre must evolve its own standard operating procedures based upon the various components of the warning system within their countries. Standard operating procedures should be shared amongst the Member States.	All members of WG1	Update reports at each ICG meeting
6) For a local earthquake, quick interactive evaluation of less than 3 minutes after the automatic hypocenter is determined should be the goal.		Update reports at each ICG meeting
7) Velocity models should be developed for local networks for accurate hypocenter determination		Update reports at each ICG meeting
8) The applicable ranges of all magnitudes (including Mw, Mwp, cumulative mB, Mm, M(JMA), mB(high frequency duration)) should be determined. Note that M(JMA) is calculated using acelerograph and should be applicable to local large earthquake.		Update reports at each ICG meeting
9) Stations close to source zones should have accelerographs installed.		Update reports at each ICG meeting
10) Other methods should be evaluated for rapid determination of magnitudes for great and slow earthquake		Update reports at each ICG meeting

Action	Person Responsible	Due Date
11) The countries of the Indian Ocean region agree to share data from the identified seismic stations listed in Table 1 of the WG report. Where the countries can not provide waveform data in real time, it is recommended to share the parametric data including phase arrival time in real time.		Update reports at each ICG meeting
12) Detailed Standard Operating Procedures (SOP) should be developed and followed for efficient functioning and rapid response. SOP should be shared among the member countries.	Dr Prih Harjadi	31 December 2006
13) Core Network stations must have data latency values of less than 20 seconds. Currently, a few identified Core Stations have larger latencies and the reasons are being investigated. If these problems cannot be resolved, a new Core Network station will be identified.	Representatives of countries with long data latencies	Reviewed at each ICG meeting
14) The USGS reported that upon finalization of its methodology, the software will be made available to Member States.	Dr Walter Mooney	Open-ended
15) New broadband seismic stations be established in eastern African countries (such as Tanzania, Madagascar, Somalia, Kenya), with help of Germany (GFZ) and other donors in order to initiate seismic data interchange in real time. This is a high priority.	Dr Joachim Saul (GFZ) Any other representative of potential donor country	As soon as donor funding allows (preferably by end of 2007)
16) Significant upgrade of existing stations in the western Indian Ocean Countries. High priority.	Dr Joachim Saul (GFZ) Any other representative of potential donor country	As soon as donor funding allows (preferably by end of 2007)
17) Training for the Indian Ocean Countries on seismological observatories practice be undertaken as a high priority.	Suggest Dr Joachim Saul (GFZ) and Dr Walter Mooney	As soon as possible

WG2 Action Items

Action	Person Responsible	Due Date
1) Update of Coastal Station Action Plans Updates required on coastal station plans and achievements from India and Indonesia and Australia to Bernie Kilonsky to complete the picture for the Indian Ocean.	Aust, India and Indonesian Reps	End Oct. 06
2) Performance Standards for Deep Ocean Stations: minimum set of instrument characteristics to be developed in consultation with members and suppliers, for review by members.	K. Jarrott	End Nov. 06
3) Formalisation of Documentation Pertaining to Interoperability WG2 to issue all relevant interoperability guidance documents in a consistent form, with version stamping and change control records if appropriate. IOTWS web site host preferred.	Vice Chair Coastal Stations Vice-Chair Deep Ocean Stations	End Nov. 06
4) Sea Level Observation Network Design WG2 to undertake a review of the composite deep ocean and coastal sea level observing network, based on a consideration of warning times, and of other objectives or pragmatic constraints.	Vice Chair Coastal Stations Vice-Chair Deep Ocean Stations	Prior to ICG / IOTWS IV meet
5) Database for Tracking Progress and Plans for Sea Level Stations to Full Operational Status concept proposed by Australia for Deep Ocean Stations to be developed into web accessed communal data base for both Deep Ocean and Coastal Stations. Map-referenced database to capture relevant information on equipment types, and specifically, the state of plans or progress towards a fully operational state (i.e stations reporting continuous data to agreed protocols via the GTS, with demonstrated end-to-end capacity to receive data by other IOTWS nations). That the coastal and deep ocean data viewers use consistent symbols/colours etc. where possible. A) – Deep Ocean Stations Tracking Database B) – Coastal Stations Database – Concept Structure Developed	(Australia) K Jarrott Vice Chair Coastal Stations + B. Kilonsky	End Nov. 06 End Jan. 06
6) Data Repositories and Archiving for High Resolution Sea Level Data WG2 to develop recommendations for archiving of sea level data, in consultation with WG5.	Chair WG2	Prior to ICG / IOTWS IV meet

Action	Person Responsible	Due Date
7) First Meeting of International DART Partnership To convene the first meeting of the International DART Partnership. Agenda: • Technical Exchange – state of technology survey - all products at R&D, test and operational status • Instrument Standards • Network Design – Deep Ocean Stations • Capability Development – Needs and Objectives • Sustainability Issues • ITP Governance and Reporting Arrangements	Vice-Chair Deep Ocean Stations	Nominal meeting time in late Nov. / Early Dec. 2006.
8) Survey of Ship Deployment Plans in Indian Ocean Region Survey of deployment plans and ship access / deployment mission opportunities in IO area (several deployments planned prior to Dec 06).	Vice-Chair Deep Ocean Stations	Prior to ITP Meeting

WG3 Action Items

Action	Person responsible	Due Date
1) Mitigation options and decision support methodology A common and best practice methodology and guidelines will be developed for use by member nations. The working group will liaise with similar working groups in other IOC Tsunami Working Groups to streamline and standardize methods and guides, and share knowledge and information. The working group recognizes that methods and guides will reflect regional diversity. It is expected that documentation of methodologies and guidelines would be available via the internet.	John Schneider Slava Gusyakov Torsten Schlurmann and Mawardi Nur	End Sept. 2006 (first draft) Final draft by end Dec. 2006
2) Mitigation Options and Decision Support Case Studies Case studies developed by June 2006 will be enhanced through the application of mitigation options to demonstrate decision mechanisms for stakeholders including emergency response managers, land use planners, and national and local governments. These options include: – Environmental Barriers (e.g., mangroves, sand dunes), – Artificial Countermeasures (e.g., tsunami breakwaters, sea walls), – Land Cover and Land Use (e.g., building set-backs,	Sam Hettiarachchi	December 2006

Action	Person responsible	Due Date
tsunami-specific zonation), – Tsunami Resistant Infrastructure (e.g. building codes and certification), – Evacuation Plans (e.g., vertical evacuation, tsunami-safe zones, time is a factor). – Harness indigenous knowledge for reducing vulnerability (e.g. animal behaviour, folklore/songs)		
3) Workshop and training exercises To facilitate knowledge transfer and information sharing a series of workshops and materials to supplement the case studies will be developed.	Sam Hettiarachchi	July 06-June 08
4) Development of an Integrated Regional Tsunami Hazard/Risk Model • Together with WG 4 develop credible tsunami scenarios for the Indian Ocean region, with initial focus on major earthquakes • Generate an Indian Ocean tsunami hazard map for earthquake sources and deep-ocean propagation, followed by consideration of volcanoes and landslides (June 2008).	John Schneider, with Chair of WG4	June 2007 June 2008
5) Training Workshops Training Workshop on Risk Assessment to be supported and hosted by WAPMER in Dubai January or April 2007 for 3-4 days. Tsunami sources, Tsunami inundation scenarios (from WG3), Vulnerability/impact, Probability, Uncertainty will be covered in the workshop. Subsequent Workshop on mitigation in later 2007 or the following year.	Adel Karas Sam Hettiarachchi John Schneider Slava Gusyakov Velly Asvaliantina Beatrice Akunga	Fist half 2007
4) Future Activities It is expected that other activities will be identified through the life of the working group, including information management, data collection standards, and GIS and database development to facilitate access to information for modelling and risk assessment purposes.	Sam Hettiarachchi	TBD

WG4 Action Items

Action	Person Responsible	Due date/ Progress
1) Develop inundation maps for the coastal communities of the Indian Ocean region including translation of the inundation projections to evacuation maps.	C. Pattiaratchi	End 2015 – if possible

Action	Person Responsible	Due date/ Progress
2) Develop web based (internet enabled) community model for tsunami propagation and inundation.	C. Pattiaratchi/ V. Titov	Funds allocated by USAID. TComM model developed and presented at ICG-III.
3) Model standards be accepted and implemented	D. Greenslade / C. Pattiaratchi	Model standards document to adopted immediately after ICG-III
4) Model benchmarks to be accepted and available on the IOC website	Behrens/ Asvaliantina	Model benchmarks identified and to be available from IOC website by August 2007
5) Model scenarios to be developed and available on the IOC website.	C. Pattiaratchi	Model scenarios to be developed by August 2007.
6) Work together with IOC to summarise the results and maintenance of the website.	C. Pattiaratchi	by December 2006
7) Training for member states including both short-term and long-term strategies: • Short term training could include a short course with a form of an IOC sanctioned certification or award of a diploma (similar to that implemented by the WMO). • For long term training we recommend the award of 50 IOC fellowships over 5 years for postgraduate training (~40k per annum).	C. Pattiaratchi / D. Greenslade/ V. Titov / L. Kong ICG Secretariat	At least 3 training courses to be organised within the next 12 months. Funding (~$100k each) is required to make these courses a reality. AusAid may fund one workshop in Melbourne in November 2006 Indonesia, Thailand and Sri Lanka have expressed an interest in organising training programs.

Action	Person Responsible	Due date/ Progress
8) Support long-term training requirements for model maintenance, ongoing consultation and support at selected institutions.	C. Pattiaratchi	2015

WG5 Action Items

Action	Person Responsible	Due Date
1) Two-tiered interoperable system of RTWPs and NTWC upon. • Nations to be responsible for issuing warnings within their own territories • Related relevant information will be freely available • Some nations will derive their own warnings from primary seismic and sea-level observations and seismic and ocean models • Other nations will receive watches upon bilateral arrangements from RTWPs that should assist them in preparing and issuing their own national warnings	Each national Focal Point or representative	On or before 31/12/08
2) The RTWPs serving NTWCs will issue the following messages: • An **Earthquake Alert** message for potentially tsunamigenic under-sea earthquakes as soon as possible after the event's detection. This will be followed by either: • A **Tsunami Detection Alert** message within 15 minutes of detection of a tsunami, including information on tsunami height, extent and arrival times at designated locations, which may be repeated or updated as new data becomes available.); or • A **Nil Tsunami Advisory** providing confirmation that although an earthquake has occurred, a tsunami has not been detected by buoys, gauges and/or experienced at inhabited nearby coastal locations.	Each national Focal Point or representative	On or before 31/12/08
3) Develop a method of stratifying the level of threat within tsunami watch bulletins, based on predicted tsunami amplitude, which would also allow appropriate emphasis on the dangers associated with even very small tsunami.	Chair, in conjunction with other WGs	December 2006

Action	Person Responsible	Due Date
4) Develop a mechanism for conveying the overall level of threat in a very brief form, such as the category system for tropical cyclones.	Chair	December 2006
5) There should be an accreditation process whereby the IOC designates a potential RTWP as being capable of performing the role. Designation would involve: • A specified range of capabilities (see Section 2); and • A demonstration of performance.	IOC HQ/IOC Perth Regional Program Office	As and when necessary
6) Capability Profiling Initial compilation by email	Chair (Australia) with France (La Reunion)	December 2006
7) Watch/Warning Guidelines Standardization/format of information/watch Starting point - draft doc App 3.	USA	December 2006
8) Composing a generic guidelines for the “last mile” of w (Include a demonstration right through to the beach — (RANET))	Indonesia, USA, Thailand(ADPC)	December 2006
9) Communication and collaboration/platforming among NWTCs-RTWPs (including backup systems)	Germany, USA	December 2006
10) International Basin-wide exercises to test the entire sys coordinated by the IOC	WG Chairs, IOC	By end 2008

ANNEX III

ICG/IOTWS WORKING GROUP 1 (WG1)
SEISMIC MEASUREMENTS, DATA COLLECTION AND EXCHANGE

Chair: Dr Fauzi, Indonesia (on behalf of Dr Prih Harjadi)

OBJECTIVES

The objectives of WG-1 are:

- *To review and report on existing and proposed arrangements with regard to seismic measurements, data collection and exchange*
- *To advise on how best to ensure that all earthquakes of magnitude 6 or greater can be reliably located and sized in a timely manner*
- *To review and make recommendations regarding upgrading and enhancements to the IOTWS network, communications, processing and analysis to further reduce the time required for an earthquake source characterization to meet desired warning responses.*

DISCUSSION OF ISSUES

Dr Fauzi of BMG chaired the breakout session on behalf of the chairman of WG1 Dr.Prih Harjadi of BMG who could not come to the ICG/IOTWS meeting. The chair suggests using the PTWS-WG-1 report as the reference for the objective of IOTWS-WG-1 for actions and plans in each seismic network center. After the meeting agreed on the objective, the meeting continued to discuss the action plan in each center. The report of intersessional meeting of ICG3-WG-1 was also discussed for the plenary session and for further action plan.

➢ Reporting

Implementation Plan

The chair collects all new stations to update the long list of core station as attached in table 1. Some of the stations have been completed the installation or fixed the schedule by the end of 2006 and 2007 and put it in operation in real time to the members. In summary, time frame of establishing new Broadband seismic station is very promising to support seismic network in Indian Ocean region. We have identified 70 core seismic stations in Indian Ocean region in ICG 2 meeting Figure 1. By the end of 2006, 38 broadband stations will be in operation and by the end of 2007, 45 broadband stations will be in operation. The meeting expects that all core seismic stations will be in operation by the end of 2010 as shown in Figure 2. Moreover, the donor countries or some countries will deploy new stations for their own purposes and should be available also for other members.

➢ Data Sharing

The WG reviewed and updated the network of seismic stations that Member States had agreed to share waveform data at the previous meeting (ICG/IOTWS-II). In addition a number of new

stations for inclusion in this list were tabled. The WG recommended that Member States should consider making those listed stations that lie on their territory available for waveform data sharing.

Issues relating to the current data sharing arrangements were discussed. It was noted that some countries had developed bi-lateral waveform data sharing arrangements.

The usefulness of continuous, real-time sharing of parametric data like phase arrival times and hypocentral information was discussed. It was noted that this data might be provided from stations where the waveform data was not continuously available in real-time. There are a number of formats available for the distribution of this data. A preferred format for the parametric data was not proposed at this time.

- **Processing Systems**

The processing system for the rapid and accurate determination of earthquake parameters (hypocentre, magnitude and mechanism) was discussed by the WG. During this discussion Japan provided a detailed explanation of their processing system. In particular Japan noted the benefit to their system of: using strong motion data for calculating magnitudes; using auto-regressive techniques for accurate onsets; using S waves to constrain depth; and; using regionalised 1D velocity models. The WG discussed these techniques and agreed that accurate velocity models need to be developed and the use of magnitude calculated from strong motion instruments needs to be investigated.

The WG discussed the merits of Mwp for rapid calculation of earthquake magnitude particularly in the case of great earthquakes or slow earthquakes. It was agreed that new techniques for calculation of magnitude should be investigated. The range of hypocentral distances and earthquake sizes that magnitude formulas are valid for was also discussed.

- **Standard Operating Procedures**

The WG agreed that each national centre must evolve its own standard operating procedures based upon the various components of the warning system within their countries. The working group agreed that the standard operating procedures should be shared amongst the Member States. Systems for rapid review of automatically derived earthquake parameters were discussed. The WG agreed that earthquake parameters should be reviewed before being distributed to the public.

Recommendations

Core stations and Database

- Maintain and distribute a comprehensive database of the relevant stations of the member states. The complete metadata should be reported to GA who will maintain the database, including metadata of other types of sensors such as accelerometer and GPS. Geoscience Australia agreed to maintain and distribute the database.
- Recommended regional network was agreed upon and a draft table included in summary report.
- It is recommended to provide time frame for making TWS in operation.

Processing System

- Automatic processing and interactive analysis should be tightly integrated for rapid analysis.
- Automatic solution should not be broadly broadcast to general public
- For a local earthquake, quick interactive evaluation of less than 3 minutes after the automatic hypocenter is determined should be the goal.
- Velocity models should be developed for local networks for accurate hypocenter determination
- Mwp source code is available from JMA and PTWC and provided to all members state on request.
- The applicable ranges of all magnitudes (including Mw, Mwp, cumulative mB, Mm, M(JMA), mB(high frequency duration)) should be determined. Note that M(JMA) is calculated using acelerograph and should be applicable to local large earthquake.
- Stations close to source zones should have accelerographs installed.
- Other methods should be evaluated for rapid determination of magnitudes for great and slow earthquakes

Data Exchange

- The group endorsed the high importance of sharing waveform data in real time.
- The countries of the Indian Ocean region agree to share data from the identified seismic stations listed in Table 1
- Where the countries can not provide waveform data in real time, it is recommended to share the parametric data including phase arrival time in real time.
- The SeedLink protocol and miniseed format are the recommended method for real time waveform data exchange

Standard Operating Procedures

- Detailed Standard Operating Procedures (SOP) should be developed and followed for efficient functioning and rapid response.
- SOP should be shared among the member countries.

Capacity building

- The meeting reported a number of cooperative training involving participants and lectures from a number of countries in eastern Indian Ocean. The WG recommended that the training be extended to all Indian Ocean sub-Regions.

Indian Ocean Consortium of IOTWS

Member countries are encouraged to explore the possibilities of support from the Indian Ocean Consortium.

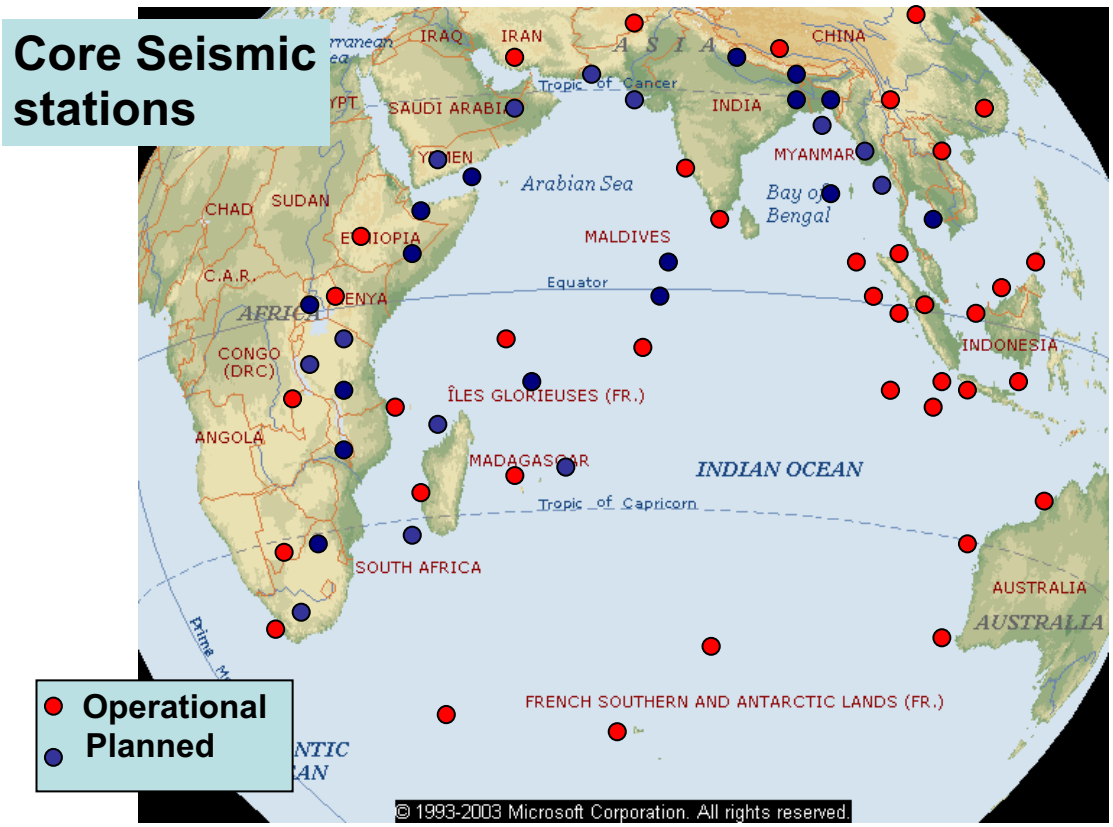

Figure 1. Configuration of core seismic stations in Indian Ocean countries that that has been identified and agreed to be shared for the members.

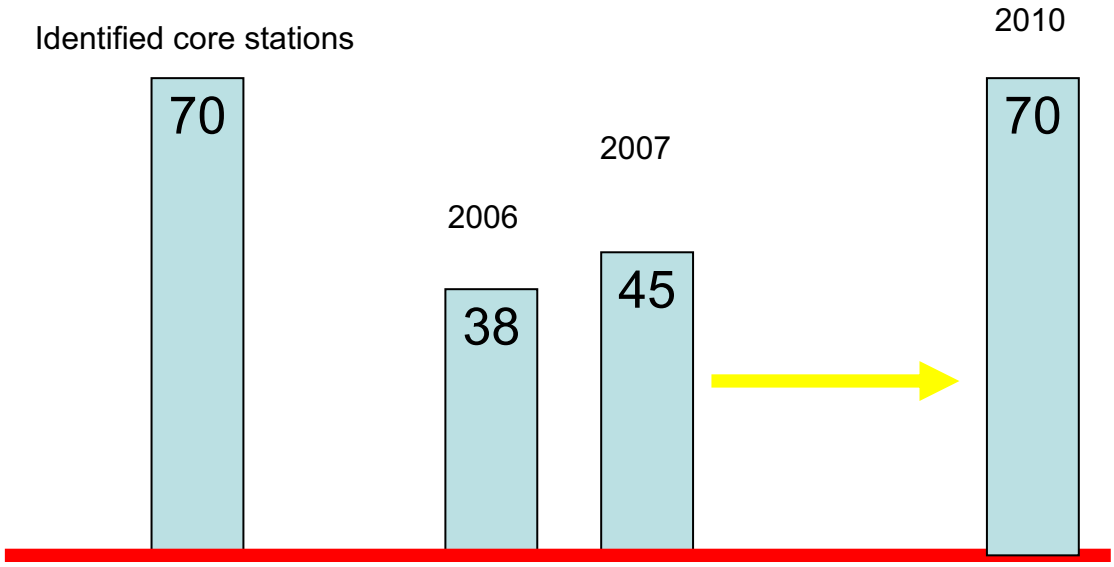

Figure 2. Seventy seismic stations have been identified as a core in Indian Ocean region. In 2006, 38 stations are in operation and 45 stations will be in operation by the end of 2007. By the end of 2010, all of core stations will be in operation.

as of 2 August 2006										
Status	**country**	**Station name**	**Code**	**Parent**		**Lat**	**Lon**	**Height**		**Status**
add	Afganistan	Kabul	KBU	BMG/GEOFON		34.51	69.13	1920	BB	operational
add	Antarctica	Mawson	MAW	AGSO/CTBT(PS)	VSAT	-67.6039	62.8706	12	BB	operational
add	Antarctica	Sanae	SNAA	GEOFON/CTBT(AS)	VSAT	-71.6707	-2.8379	846	BB	operational
add	Antarctica	Casey	CASY	GSN (IRIS/USGS)	VSAT	-66.2792	110.536	154	BB	operational
	Antarctica	Dumont d'Urville	DRV	GEOSCOPE		-66.665	140.01	40	STS1	operational
	Australia	Learmonth	tbd	GA						end of 2006
	Australia	Fizroy Crossing	FITZ	GA	VSAT	-18.102	125.639	110	BB	operational
	Australia	Christmas Island	XMIS	GA	VSAT	-10.4807	105.652	230	BB	operational
	Australia	New Amsterdam	tbd	GA						proposed
	Australia	Narrogin	NWAO	GSN (IRIS/USGS)	VSAT	-32.9269	117.234	365	BB	operational
add	Australia	Cocos (Keeling) Is	COCO	GSN (IRIS/IDA)	VSAT	-12.1901	96.8349	-69	BB	operational
add	Australia	Tennant Creek	WRAB	GSN (IRIS/IDA)	Internet	-19.9333	134.35	366	BB	operational
add	Australia	Marble Bar	MBWA	GSN (IRIS/USGS)	VSAT	-21.159	119.731	185	BB	operational
add	Australia	Minton Dam	MTN	GA						end of 2006
	Bangladesh	Dhaka	tbd							proposed
	Bangladesh	Cox's Corner	tbd							proposed
add	Botswana	Lobatse	LBTB	GSN Affiliate / CTBT(AS)	VSAT	-25.0145	25.597	1028	BB	operational
	Bhutan	tbd	tbd							proposed
	China	Enshi	ENH	CDSN/ GSN (IRIS/USGS)	VSAT	30.2718	109.487	487	BB	operational
	China	Kunming	KMI	CDSN/ GSN (IRIS/USGS)	VSAT	25.1233	102.74	1940	BB	30 min delay
	China	Sheshan	SSE	CDSN/ GSN (IRIS/USGS)	VSAT	31.0956	121.187	15	BB	30 min delay
	China	Baijiatuan (Beijing)	BJT	CDSN/ GSN (IRIS/USGS)	VSAT	40.0403	116.175	43	BB	30 min delay
	China	Lhasa	LSA	CDSN/ GSN (IRIS/USGS)	VSAT	29.7	91.15	3789	BB	30 min delay
	China	Urumqi	WMQ	CDSN/ GSN (IRIS/USGS)	VSAT	43.8211	87.695	897	BB	30 min delay

as of 2 August 2006										
Status	**country**	**Station name**	**Code**	**Parent**		**Lat**	**Lon**	**Height**		**Status**
	China	Hailar	HIA	CDSN/ GSN (IRIS/USGS)	VSAT	49.2667	119.742	610	BB	30 min delay
	China	Mudanjiang	MDJ	CDSN/ GSN (IRIS/USGS)	VSAT	44.6164	129.592	250	BB	30 min delay
	China	Xi'an	XAN	GSN (IRIS/USGS)	VSAT	34.2483	108.92	395	BB	30 min delay
	China	Qiongzhong	QIZ	CDSN/ GSN (IRIS/USGS)	VSAT	19.0294	109.843	230	BB	30 min delay
	China	Lanzhou	tbd						BB	30 min delay
	Comoros	tbd	tbd							proposed
	Djibouti	Arta Tunnel	ATD	CTBT(AS)/GEOSCOPE	VSAT	11.53	42.847	610	STS2	operational
add	Ethiopia	Furi	FURI	GSN (IRIS/USGS) /CTBT(AS)		8.8967	38.6793	2560	BB	operational
	France	La Reunion	RER	GEOSCOPE		-21.159	55.746	834	STS1	underway
	France	Amsterdam Is	AIS	GEOSCOPE		-37.7966	77.5694	36	STS2	underway
	France	Port Alfred (Crozet Is)	CRZF	GEOSCOPE		-46.4296	51.8612	140	STS1	underway
	France	Port-aux-Fransais (Kerguelen Is)	PAF	GEOSCOPE		-49.3506	70.2133	17	STS1	underway
	India	Port Blair	PBA	IMD	VSAT	11.6559	92.7428	17	BB	May 2007
	India	Bhuj	BHJ	IMD	VSAT	23.254	69.654	80	BB	May 2007
	India	Shillong	SHL	IMD	VSAT	25.5667	91.8833	1600	BB	May 2007
	India	Hyderabad	HYB	NGRI/GEOSCOPE	VSAT	17.4169	78.5531	510	BB	May 2007
	Indonesia	Gunung Sitoli	GSI	BMG/GEOFON	VSAT	1.3033	97.5757	107	STS2	operational
	Indonesia	Wanagama	UGM	BMG/GEOFON	VSAT	-7.9125	110.523	350	STS2	end of 2006
	Indonesia	Banda Aceh	BSI	Upgraded/JISNET	VSAT	5.4962	95.2947	192	CMG3 T/100	operational
	Indonesia	Padang Panjang	PPI	Upgraded/JISNET	VSAT	-0.4568	100.397	0	CMG3 T/100	operational
	Indonesia	Lembang	LEM	Upgraded/JISNET		-6.8263	107.618	1293	CMG3 T/100	operational

as of 2 August 2006										
Status	**country**	**Station name**	**Code**	**Parent**		**Lat**	**Lon**	**Height**		**Status**
add	Indonesia	Balikbapan	tbd	BMG/GEOFON						end of 2006
add	Indonesia	Maumere	tbd	BMG/GEOFON						end of 2006
add	Indonesia	Fakfak	tbd	BMG/GEOFON						2007
add	Indonesia	Tanah Merah	tbd	BMG/GEOFON						2007
add	Indonesia	Ternate	TNT	BMG/GEOFON						2007
add	Indonesia	Kappang	KAPI	GSN (IRIS/IDA) /CTBT(AS)	VSAT	-5.0142	119.752	30	BB	operational
add	Indonesia	Lembang	LEM	CTBT(AS)						
add	Iran	Tehran	THR	CTBTO(PS)	VSAT					
add	Israel	Eilat	EIL	GII/GEOFON		29.67	34.95	210	BB	operational
	Kenya	Nairobi	NAI	GSN	Dial up	-1.2739	36.8037	1692	BB	operational
	Kenya	Kilima Mbogo	KMBO	GSN (IRIS/USGS) /GEOFON CTBT/PS	VSAT	-1.1268	37.2523	1940	BB	operational
add	Kenya	Mombasa	tbd							proposed
add	Kenya	Malindi	tbd							proposed
add	Kenya	Lamu	tbd							proposed
	Madagascar	Ambohimpanompo	ABPO	GSN (IRIS/IDA)	Internet/VSAT	-19.0174	47.227			Sep. 2006
	Madagascar	Ambohidratompo	OPO	France/CTBT	VSAT	-18.5122	47.5517	1375	LP/SP	operational
add	Madagascar	Fort Dauphin		Frane (IPGP/DASE)	internet					2007
	Malaysia	Kulim	KUM	KLM/MMS	VSAT	5.2902	100.649	74	STS2	operational
	Malaysia	Kuching	KSM	KLM/MMS	VSAT	1.4733	110.308	66	STS2	operational
	Malaysia	Kota Kinabalu	KKM	KLM/MMS	VSAT	6.0443	116.215	830	STS2	operational
add	Malaysia	Ipoh	IPM	KLM/MMS	VSAT	4.5795	101.026	246	BB	operational
add	Malaysia	Kota Tinggi	KOM	KLM/MMS	VSAT	1.8	103.9		BB	operational
add	Malaysia	Sibu	SBM	KLM/MMS	VSAT	2.25	111.983	30.9	BB	operational
add	Malaysia	Lahad Datu	LDM	KLM/MMS	VSAT	5	118.3		BB	operational

as of 2 August 2006										
Status	**country**	**Station name**	**Code**	**Parent**		**Lat**	**Lon**	**Height**		**Status**
	Maldives	tbd	tbd	GEOFON						2008
	Maldives	tbd	tbd	GEOFON						2008
	Mauritius	Mauritius	tbd							Nov. 2006
add	Mauritius	Rodrigues	tbd							proposed
add	Mauritius	St.Brandon	tbd							proposed
add	Mauritius	Agalega	tbd							proposed
	Mozambique	tbd	tbd							proposed
	Mozambique	tbd	tbd							proposed
	Mozambique	tbd	tbd							proposed
	Myanmar	tbd	tbd							proposed
	Myanmar	tbd	tbd							proposed
	Myanmar	tbd	tbd							proposed
add	Nepal	Everest	EVN	CTBT(AS)		27.96	86.82		BB	operational
	Nepal	tbd	tbd							proposed
add	Oman	Wadi Sarin	WSAR	CTBT						proposed
	Pakistan	Karachi	KAR			24.9333	67.1433	34		Jun. 2007
	Pakistan	Nilore	NIL	GSN (IRIS/IDA)	VSAT	33.65	73.2517	536	BB	operational
add	Pakistan	Pasni	tbd							Jun. 2007
	Papua New Guinea	Port Moresby	PMG	GSN (IRIS/USGS) /Pacific21 /GEOFON /CTBT(AS)	VSAT	-9.4062	147.159	65	BB	operational
	Philippines	Davao	DAV	GSN (IRIS/USGS) /CTBT(AS)	VSAT	7.07	125.579	145.7		operational
add	Philippines	Tagaytay	TGY	CTBT(AS)	VSAT	14.1022	120.937	600		operational
add	Saudi Arabia	Ar Rayn	RAYN	GSN (IRIS/IDA)		23.5225	45.5032	631		operational
add	Saudi Arabia	tbd	tbd	CTBT(PS,AS)						proposed
	Seychelles	Mahe	MSEY	GSN (IRIS/IDA)	VSAT	-4.6737	55.4792	475	BB	operational
	Singapore	Bukit Timah	BTDF	Singapore Met/GSN Affiliate	leased line	1.3608	103.773	64.4	KS54000	operational
	Somalia	Benadir	tbd							proposed
	Somalia	Bossaso	tbd							proposed

as of 2 August 2006										
Status	**country**	**Station name**	**Code**	**Parent**		**Lat**	**Lon**	**Height**		**Status**
	South Africa	Sutherland	SUR	GSN (IRIS/IDA) /CTBT(AS)	VSAT/ Internet	-32.3797	20.8117	1760	BB	operational
add	South Africa	Marion Is.	tbd	CGS/GEOFON						proposed
add	South Africa	Northern part	tbd	CGS/GEOFON						proposed
add	South Africa	Boshof	BOSA	CTBT(PS)	VSAT	-28.6141	25.2555	1202	BB	operational
	Sri Lanka	Pallekele	PALK	GSN (IRIS/IDA) /CTBT(AS)	VSAT	7.2728	80.7022	460	BB	operational
	Tanzania	Dodoma	tbd							proposed
	Tanzania	Tukuyu	tbd							proposed
add	Thailand	Chieng Mai 2	CM01	CTBT(PS)	VSAT	18.4205	98.9588	292	BB	operational
	Thailand	Chieng Mai	CHTO	GSN (IRIS/USGS)	Leased line	18.8138	98.9438	316	BB	operational
	Thailand	Khanchanaburi	KBR	Upgrade underway/ Nanometrics	VSAT	14.0167	98.5925	173.3	BB	operational
add	UAE	Wadi Hilu	tbd	GSN (IRIS/IDA)	Internet	24.9425	56.2027			2007
add	UK	Diego Garcia	DGAR	GSN (IRIS/IDA)	Internet	-7.4121	72.4525		BB	operational
add	Uganda	Mbarara	MBAR	GSN (IRIS/IDA) /CTBT(AS)	VSAT	-0.6019	30.7382	1390	BB	operational
	Vietnam	tbd	tbd							proposed
add	Yemen	tbd	tbd	GEOFON						proposed
add	Yemen	Socotra Is	tbd	GEOFON						proposed
add	Zambia	Lusaka	LSZ	GSN (IRIS/USGS) /CTBT(AS)	VSAT	-15.2766	28.1882	1184	BB	operational
add	Zimbabwe	Matopos	BUL?	CTBT(AS)	VSAT	-20.1433	28.6133	1341	BB	operational

AGREED ACTIONS AND DEADLINES

Action	Person Responsible	Date
1) Maintain and distribute a comprehensive database of the relevant core stations of the member states. The complete metadata should be reported to GA who will maintain the database, including metadata of other types of sensors such as accelerometer and GPS.	Geoscience Australia (Spiro Spilopolous/Alexei Gorbatov)	Update reports at each ICG meeting
2) 70 core seismic stations in operation by the end of 2010 • 38 broadband stations in operation by end 2006 • 45 broadband stations in operation by end 2007 Other stations deployed by donors or member countries should also be available for other members.	All member states of WG1	End 2010
3) Data from core set of stations to monitor regional seismicity to be shared	All members of WG1	31 December 2006
4) New techniques for calculation of magnitude to be investigated.	All members of WG1	Update reports at each ICG meeting
5) Each national centre must evolve its own standard operating procedures based upon the various components of the warning system within their countries. Standard operating procedures should be shared amongst the Member States.	All members of WG1	Update reports at each ICG meeting
6) For a local earthquake, quick interactive evaluation of less than 3 minutes after the automatic hypocenter is determined should be the goal.		Update reports at each ICG meeting
7) Velocity models should be developed for local networks for accurate hypocenter determination		Update reports at each ICG meeting
8) The applicable ranges of all magnitudes (including Mw, Mwp, cumulative mB, Mm, M(JMA), mB(high frequency duration)) should be determined. Note that M(JMA) is calculated using acelerograph and should be applicable to local large earthquake.		Update reports at each ICG meeting
9) Stations close to source zones should have accelerographs installed.		Update reports at each ICG meeting
10) Other methods should be evaluated for rapid determination of magnitudes for great and slow earthquake		Update reports at each ICG meeting
11) The countries of the Indian Ocean region agree to share data from the identified seismic stations listed in Table 1 of the WG report. Where the countries can not provide waveform data in real time, it is recommended to share the parametric data including phase arrival time in real time.		Update reports at each ICG meeting

Action	Person Responsible	Date
12) Detailed Standard Operating Procedures (SOP) should be developed and followed for efficient functioning and rapid response. SOP should be shared among the member countries.	Dr Prih Harjadi	31 December 2006
13) Core Network stations must have data latency values of less than 20 seconds. Currently, a few identified Core Stations have larger latencies and the reasons are being investigated. If these problems cannot be resolved, a new Core Network station will be identified.	Representatives of countries with long data latencies	Reviewed at each ICG meeting
14) The USGS reported that upon finalization of its methodology, the software will be made available to Member States.	Dr Walter Mooney	Open-ended
15) New broadband seismic stations be established in eastern African countries (such as Tanzania, Madagascar, Somalia, Kenya), with help of Germany (GFZ) and other donors in order to initiate seismic data interchange in real time. This is a high priority.	Dr Joachim Saul (GFZ) Any other representative of potential donor country	As soon as donor funding allows (preferably by end of 2007)
16) Significant upgrade of existing stations in the western Indian Ocean Countries. High priority.	Dr Joachim Saul (GFZ) Any other representative of potential donor country	As soon as donor funding allows (preferably by end of 2007)
17) Training for the Indian Ocean Countries on seismological observatories practice be undertaken as a high priority.	Suggest Dr Joachim Saul (GFZ) and Dr Walter Mooney	As soon as possible

WORKING GROUP PARTICIPANT LIST

1. Fauzi (Indonesia), representing the Chair, Dr Prih Harjadi 2. Ashok Bhatnagar (India) 3. Mohd. Rosaidi Bin Che Abas (Malaysia) 4. Saw Bin Liong (Malaysia) 5. Joachim Saul (Germany) 6. Toni Kraft (Germany) 7. Masahiro Yamamoto (IOC/UNESCO) 8. Osamu Kamigaichi (Japan)	9. Spiro Spiliopoulos (Australia) 10. Stuart Sipkin (USA) 11. Gerard Rambolananana (Madagascar) 12. Emmanuel Vainean (France) 13. Qamar Z. Chaudhry (Pakistan) 14. Ephantus Nyaga Ngotho, (Kenya) 15. Emmanuel Mpeta, (Tanzania)

ANNEX IV

ICG/IOTWS WORKING GROUP 2 (WG2)
SEA LEVEL DATA COLLECTION AND EXCHANGE, INCLUDING DEEP OCEAN TSUNAMI DETECTION INSTRUMENTS

Chair: Mr K. Jarrott, Australia, on behalf of Dr K. Premkumar, India
Vice Chair (Coastal Sea Level Stations): Mr B. Kilonsky, GLOSS-USA
Vice Chair (Deep Sea Stations): Mr Ken Jarrott, Australia

OBJECTIVES

Working Group 2 agreed on the following Terms of Reference:

- *Examine various user requirements (i.e. a multi-hazard approach) for the IOTWS sea level gauge network;*
- *Examine the current and future requirements for the IOTWS, taking account of information obtained from the IOC National Assessment on the Sea Level Network;*
- *Investigate the technical issues of bandwidth and satellite coverage;*
- *Investigate the issues with interoperability between existing (and future) sea level stations, such as the lack of meta data;*
- *Address the issue of the sustainability of the system; and*
- *Form a DART operators group to investigate various issues relating to the IOTWS deep-ocean tsunami detection instruments network.*

DISCUSSION OF ISSUES

➢ Reaffirmation of National Focal Points and On-going Group Structure

Ken Jarrott noted that continuity of national representation had been a problem, and that persistent focal point representatives would be required to deliver maximum benefit.
Two new national focal points were identified from previously unrepresented countries:

- Dr Qamar Z Chaudhry (Pakistan); and
- Ahmed Al Harthi (Oman)

➢ Review of Coastal Tide Gauge Stations During South Java Tsunami, 17 July

Bernie Kilonsky reviewed the function of the network of Indian Ocean coastal stations during the recent tsunami. Points made were:

- The tsunami was represented in small-wave records of GLOSS tide gauge stations close to the affected region in Indonesia (specifically, Benoa, Bali), and in neighbouring stations at Cocos Island (Australia). A wave of greater amplitude was registered at the more distant station of Rodrigues Island, due to an energy funnelling effect in that vicinity. The data from these stations was available to the PTWC in near real time, and the Benoa gauge tsunami detection was referred to in a PTWC bulletin. The tsunami presence in tide gauge data at all of these sites generally appeared to be slightly later than PTWC's predicted arrival

times. One NOAA/ USAID gauge on Java, closer to the site of damaging waves, was not operational due to an absence of power at the site.

The natural focus of an event analysis is on the function of warning systems to detect seismic events and tsunami generation, and to alert at-risk communities and mitigate human and other loss. However, another important outcome of the observation and warning systems is the proper interpretation of the event, and the delivery of advice to downstream communities. In this respect, the sea level networks did substantiate the tsunami to have only local damaging impact. From a basin-wide perspective, the sea level observation networks confirmed in real time that the tsunami had potential for localised damage only. Without this knowledge many nations and communities would otherwise have had to react with the knowledge of severe losses in Java, but with uncertainty about local consequences.

- Ken Jarrott noted that the tsunami was first recognised at an Australian experimental radar sea level station at Christmas Island. The station registered the first presence of a tsunami at exactly the PTWC's predicted arrival time. Because the station is not yet in a stable operational configuration, it was not broadcasting data on the GTS. However, the data, sampled and reported at 1 minute intervals, was available to the Australian national alert service, and was conveyed to PTWC by fax during the event. The observations at this location indicate a set of waves of less than 4 minute wave period.

  This circumstance highlights the importance of high-frequency sampling (even one minute averaged samples will not reliably capture waves of this frequency). Apart from the fidelity of the wave observation, high sampling and reporting rates from sites such as this will be critical to the rapid detection of tsunamis and to lengthening warning times for some communities. This reinforces WG2's prior recommendation for high frequency sampling and reporting times at stations close to tsunamigenic zones, or for primary short-warning stations for communities at risk. It also reinforced the need for data interchange protocols to include relevant metadata.
- Bernie Kilonsky also presented the status and schedule for planned new installations and communications upgrades for GLOSS stations serving the IOTWS. He indicated that the information was not complete, and that he required updates on plans, for example, from India, Indonesia and Australia.

➢ **Re-focussing the Efforts of WG2 for the Next Period of Development**

The previous discussions and efforts of the Group had centred around:

- primary interoperability issues (such as instrument standards, data sampling and reporting rates, data interchange formats, including metadata);

- network design and sitting principles (for coastal stations, but more specifically with regard to a "core network" concept for deep ocean stations, for which network optimisation can deliver large sustainability dividends);

- endorsement of a Terms of Reference for an International Tsunameter Partnership (subsequently endorsed by the PTWC WG2 at a joint meeting);

- reporting and exchanging information on the plans and progress of national sea level observation networks.

This work had provided a foundation for moving forward, and extending access to key observational data beyond national boundaries. The recent tsunami experience highlighted the need for that to take place as rapidly as possible.

Ken Jarrott encouraged the group to sign off on the key interoperability arrangements, and to collectively step up beyond national plans to address the IOTWS communal agenda - to ensure the effective real-time delivery of quality observation data from trustworthy instruments beyond national boundaries, to all IO warning centres.

Collective action aimed at a higher level "team agenda" was supported. Out of the subsequent discussion, the following recommendations were made, for consideration by a full WG2 meeting:

- Formalisation of WG2 Documentation Pertaining to Interoperability
    - WG2 to issue all relevant interoperability guidance documents (eg recommended instrument standards, data formats, key discussion documents) in a consistent form, with version stamping and change control records, if appropriate, as a basis for national representatives to act on. The document set should be available via an IOTWS web site.
- Network Design (following a question from Thailand, regarding the rationale for placement of internationally supported coastal stations in its vicinity):
    - That WG2 undertake a review of the composite deep ocean and coastal sea level observing network, based on a consideration of warning times, and of other objectives or pragmatic constraints (eg multi-role potential, use of existing stations, access, sustainability and cost). That review should lead to a documented rationale for the composite IOTWS sea level observation network. (Bernie Kilonsky noted that a warning time rationale was used at a meeting in Mauritius to select sites for new GLOSS stations, but the process hadn't resulted in a reviewable document, and that design rationale used then needs to be recaptured. The PMEL-developed "Conceptual Core Network" of deep ocean stations was developed with a similar rationale, using easy-to-apply software tools.)
- Sea Level Network Progress Tracking – Collective Data Set and Viewing Tools (following an illustration by Ken Jarrott of a map projection of planned or deployed deep ocean stations from all IOTWS nations).
    - That WG2 support the implementation of a communal web-accessed database that encompasses all deep ocean stations in the IOTWS network, capturing relevant information on equipment types, and specifically, the state of plans or progress towards a fully operational state (ie stations reporting globally to agreed protocols). This data set was seen to be a useful collective window on progress during the network's initial development, and a pre-cursor to a more comprehensive data base, with appropriate operational status and metadata data elements, in a mature network.
    - That a similar map-referenced data set be used for the network of coastal sea level stations. (Bernie Kilonsky indicated that GLOSS has such a data set and viewing environment, but recommended that the composite coastal-deep ocean data set should be commonly hosted.)
    - That the coastal and deep ocean data viewers use consistent symbols / colours etc where possible.
    - That these tools be used to help demonstrate status via an IOTWS web site, with longer term hosting of an operational data set by the IOC.

- Data Repositories and Archiving
    - That WG2 develop recommendations for archiving of high resolution sea level data, in consultation with WG5. There are already global archives for low resolution sea level data through GLOSS.

➢ **Issues Arising in General Discussion**

- Alternate (Non GTS) Communications between National Warning Centres
    - Joern Lauterjung noted that alternate high-bandwidth communications options might be productively used for data exchange between national warning centres, eg between Indonesia and Australia, with GTS data distribution remaining the mechanism for international distribution of data. The consideration of such options are to be referred to WG5.
- Sustainability of the Sea Level Observation Network
    - Joern Lauterjung expressed concern that the future sustainability, and hence future operational performance of the IOTWS sea level observation networks was at risk, unless strategies and mechanisms for sustainability were put in place. The WG recommended that the IOC Secretariat in Paris should address the scope of the sustainability problem, and facilitate solutions, eg through donor funding.

RECOMMENDATIONS AND FOLLOW-UP ACTIONS

AGREED ACTIONS AND DEADLINES

Ref	Action	Person Responsible	Due Date
1	Update of Coastal Station Action Plans Updates required on coastal station plans and achievements from India and Indonesia and Australia to Bernie Kilonsky to complete the picture for the Indian Ocean	Aust, India and Indonesian Reps	End Oct 06
2	Performance Standards for Deep Ocean Stations – minimum set of instrument characteristics to be developed in consultation with members and suppliers, for review by members.	K. Jarrott	End Nov 06
3	Formalisation of Documentation Pertaining to Interoperability WG2 to issue all relevant interoperability guidance documents in a consistent form, with version stamping and change control records if appropriate. IOTWS web site host preferred.	Vice Chair Coastal Stations Vice-Chair Deep Ocean Stations	End Nov 06
4	Sea Level Observation Network Design. WG2 to undertake a review of the composite deep ocean and coastal sea level observing network, based on a consideration of warning times, and of other objectives or pragmatic constraints.	Vice Chair Coastal Stations Vice-Chair Deep Ocean Stations	Prior to ICG / IOTWS IV meet

Ref	Action	Person Responsible	Due Date
5	Database for Tracking Progress and Plans for Sea Level Stations to Full Operational Status – concept proposed by Australia for Deep Ocean Stations to be developed into web accessed communal data base for both Deep Ocean and Coastal Stations. Map-referenced database to capture relevant information on equipment types, and specifically, the state of plans or progress towards a fully operational state (i.e stations reporting continuous data to agreed protocols via the GTS, with demonstrated end-to-end capacity to receive data by other IOTWS nations). That the coastal and deep ocean data viewers use consistent symbols/colours etc. where possible. A) – Deep Ocean Stations Tracking Database B) – Coastal Stations Database – Concept Structure Developed	(Australia) K Jarrott Vice Chair Coastal Stations + B. Kilonski	End Nov 06 End Jan 06
6	Data Repositories and Archiving for High Resolution Sea Level Data WG2 to develop recommendations for archiving of sea level data, in consultation with WG5.	Chair WG2	Prior to ICG / IOTWS IV meet
7	First Meeting of International DART Partnership. To convene the first meeting of the International DART Partnership. Agenda: • Technical Exchange – state of technology survey - all products at R&D, test and operational status • Instrument Standards • Network Design – Deep Ocean Stations • Capability Development – Needs and Objectives • Sustainability Issues • ITP Governance and Reporting Arrangements	Vice-Chair Deep Ocean Stations	Nominal meeting time in late Nov / Early Dec 2006.
8	Survey of Ship Deployment Plans in Indian Ocean Region. Survey of deployment plans and ship access / deployment mission opportunities in IO area (several deployments planned prior to Dec 06).	Vice-Chair Deep Ocean Stations	Prior to ITP Meeting

SUMMARY OF RECOMMENDATIONS (COMBINED FROM MELBOURNE INTER-SESSIONAL MEETING AND ICG/IOTWS MEETING IN BALI)

	Recommendations	**Directed to**
1	Data Format for International Exchange of Sea Level Data. That the CREX format be adopted for the transfer from one nation to other warning centre. (Member countries have been provided with copies of CREX format for their study and confirmation before IOTWS Bali meeting.)	WG2 Members
2	Preference for Multi-purpose Configuration of Sea Level Stations. Wherever possible, sea level stations should be of multi-purpose configuration, to facilitate the long-term sustainability of the observing network.	WG2 Members
3	Coastal Instrument Standards. Wherever possible, and for the initial coastal sea level network, sea level stations should conform to GLOSS climate related standards, but the WG noted that requirements for tsunami detection need not coincide with those of GLOSS, and could conceivably be single-purpose or multi-purpose, with application to services other than climate monitoring.	WG2 Members
4	Exchange of Information between Working Groups on Technology Evaluations. Chairs of relevant IOTWS and PTWS Working Groups to ensure coordination and communication of outcomes from evaluations of existing and new technologies (e.g. radar).	All ICG / IOTWS Working Groups
5	US Government Proposal to Contribute Two DART Buoys: With respect to the US Govt proposal to contribute 2 DART buoys to the IOTWS, WG2 representatives agreed that: o The Working Group appreciates the offer of 2 DART buoys o The Working Group endorses the siting logic explained by NOAA, and recognises that it provides additional value to the Indian Ocean community. o The constraints of not being able to extend similar assistance to other parts of the Indian Ocean are recognized and accepted. o The Working Group encourages member countries to support the deployment and ongoing operation of the US donated buoys. o The Working Group recommended that the ICG endorse the US Government contribution and the actions of IOTWS member states to support the installation and support of the donated buoys.	ICG/ IOTWS
6	Use of Other Communication Channels Between National Warning Centres. That WG5 address the prospect that other communication channels between national warning centres might be used in addition to the global GTS broadcast of data (eg higher bandwidth local exchanges). Such consideration to include the prospect of enhanced GTS links. (Indonesia / Australia in particular.)	WG5

	Recommendations	Directed to
7	Sustainability of Sea Level Observation Networks. That IOC Secretariat in Paris assess the scope of the sustainability problem for the sea level observation network, and facilitate solutions, eg through donors or other channels. (Note: This risk may extend beyond the scope of the observation networks.)	IOC Secretariat
8	International Hosting of Web Accessed Databases for Sea Level Observation Network Monitoring. That the IOC host the web accessed databases developed for sea level observation network development tracking and longer term operational monitoring. (Interim systems to be developed locally.)	IOC Secretariat
9	Post Event Analysis – That any post event analysis include in its scope the collection of evidential material (witness statements, photos, etc) that can be used to validate and analyse the performance of sea level instruments, and that advance provision for collection of such evidence be considered by all IOTWS nations.	All IOTWS Nations
10	Data Repositories and Archiving of High Resolution Sea Level Data: that WG2, in consultation with WG5, develop proposals for archiving high-resolution sea level data.	WG5 (refer related WG2 Action)
11	Adoption of the Terms of Reference for the International DART Partnership. That the ICG adopt the Terms of Reference for the ITP, as endorsed by the IOTWS WG2 and by the PTWS WG2 at its meeting in Melbourne, May 2006.	ICG / IOTWS

PARTICIPANT LIST

Name	COUNTRY / ORG.	Email Contact
Stanley Goosby	NDWC, Thailand	sgoosby@pdc.org
Tony Elliott	IOC/ UNESCO	t.elliott@unesco.org
Mohd Rosaidi bin Che Abas	Malaysia	rosaidi@kjc.gov.my
Smith Dharmasaroja	Thailand	kk-kajon@hotmail.com
Cherdsak Virapat	Thailand	cvirapat@hotmail.com
Wahyu W. Pandoe	Indonesia	wpandoe@cbn.net.id
Dr Ridwan Djamaluddin	Indonesia	ridwan@webmail.bppt.go.id
Kriengkrai Khovadhana	Thailand	kriengkrai@metmet.tmd.do.th
Bernard Kilonsky	GLOSS	kilonsky@hawaii.edu
Rick Bailey	Australia	r.bailey@bom.gov.au
Ken Jarrott	Australia	k.jarrott@bom.gov.au
Sugiarta Wirasantosa	Indonesia	igi1@dkp.go.id
Dr Qamar Z Chaudhry	Pakistan	dgmetpak@hotmail.com
Curt Barrett	USA	curt.barrett@noaa.gov
Parluhutan Manurung	Indonesia	parluhutan@bakasurtanal.co.id
Rustandi Poerawiardi	Indonesia	opera@bakosurtanal.co.id
Joern Lauterjung	Germany	lau@gft-potsdam.de
David McKinnie	USA	david.mckinnie@noaa.gov
Stella Aura	Kenya	aura@meteo.go.ke

Name	**COUNTRY / ORG.**	**Email Contact**
Ken du Vall	USA	kduvall@lighthousehouston.com
Jean-Michel Rainer	WMO	jmrainer@wmo.int
Cathryn Primrose	Norway / Oceanor	c.primrose@oceanor.com
Jerome Aucan	GLOSS	jerome@hawaii.edu
Eddie Bernard	USA / PMEL	eddie.n.bernard@noaa.gov

ANNEX V

ICG/IOTWS WORKING GROUP 3 (WG3)
RISK ASSESSMENT

Chair: Dr Sam Hettiarachchi, Sri Lanka

OBJECTIVES

The development of a tsunami early warning system for the Indian Ocean needs to be put into a risk management framework that can be applied at global, regional, national and local levels. The goal is to reduce vulnerability and strengthen coping capacities of communities with regard to tsunami risk as outlined below:

- *Develop guidelines for tsunami risk assessment as part of a multihazard risk management framework.*
- *Provide guidance to emergency response managers on the preparation of risk assessment products.*
- *Facilitate the application and use of model outputs for tsunami hazard and risk assessment.*
- *Facilitate data sharing, including access to and development of databases, incorporating exposure, tsunami hazard and vulnerability.*
- *Facilitate capacity building, including knowledge transfer, in the form of workshops, training programs and case studies for risk assessment in all Indian Ocean countries.*
- *Facilitate and promote the process of developing cost-effective and practical mitigation options and measures.*
- *Liaise with other modelling committees (including other ICG/IOTWS working groups) and organisations or professional groups that are developing models and data for their implementation.*

DISCUSSION OF ISSUES

Terms of Reference for the Working Group 3 on Risk Assessment prepared in Hyderabad identified five activities listed below:

(1) Risk assessment Case Studies (Completed by June 2006)

(2) Risk assessment Methodology and Guidelines (Completed by Dec 2006)

(3) Mitigation Options and Decision Support Case Studies (Completed by Dec 2006)

(4) Mitigation Options and Decision Support Methodology (Completed by June 2007)

(5) Workshop and Training Exercises (to be implemented during the period (July 2006-June 2008)

In relation to the above activities, four Risk Assessment Case Studies were completed by June 2006 and discussed at the intersessional meeting. The next stage of development to be completed by December 2006, refers to,

- Risk Assessment Methodology and Guidelines
- Mitigation Options and Decision Support Case Studies

It is expected to enhance the case studies through the application of mitigating options. The guest presentations were identified to focus on key areas of the above two stages to be implemented.

The other two activities identified in the TOR are

- Mitigating Options and Decision Support Methodology (June 2007)
- Workshop and Training Exercises (July 2006-June 2008)

Arising from the discussions, the recommendations are as follows:

1) Establishment of a Website for the ICG/IOTWS Working Group 3.

- Establish a dedicated Website for IOC/IOTWS Group 3, to contain details of activities of the Group, case studies and presentations of the Group Members. WAPMERR offered to host and maintain the website.

2) Focus on the Collection of Data and Case Studies.

- Further strengthen the existing Case Studies.
- Implement scenario impact assessment by applying available numerical models to selected areas of the affected countries.
- Develop vulnerability and resiliency models from Case Studies.
- Implement risk assessments based on the impacts arising from different scenarios.
- Prepare tsunami mitigation plans (based on risk assessment), including protection methods such as artificial and natural protection structures and systems.

3) Development of an Integrated Regional Tsunami Hazard/Risk Model (in cooperation with other working groups)

- Develop tools and methods for tsunami risk assessment within a multi-hazard risk assessment framework
    - A common and best practice methodology and guidelines will be developed for use by member nations. The working group will liaise with similar working groups in other IOC Tsunami Working Groups to streamline and standardize methods and guides, and share knowledge and information. The working group recognizes that methods and guides will reflect regional diversity. It is expected that documentation of methodologies and guidelines would be available via the internet.
- Identify hazard sources and the associated probabilities.
    - Together with WG 4 develop credible tsunami scenarios for the Indian Ocean region, with initial focus on major earthquakes (June 2007)

- Conduct studies of historic and pre-historic tsunami deposits and tsunami source displacements (e.g., from earthquakes or submarine landslides) to improve understanding of tsunami hazard.
- Generate an Indian Ocean tsunami hazard map for earthquake sources and deep-ocean propagation, followed by consideration of volcanoes and landslides (June 2008).
- Extend to risk assessment in areas of highest hazard and exposure, including inundation and vulnerability assessment.

4) Training Workshops on Risk Assessment and Mitigation.

  - Workshop on risk assessment to be supported and hosted by WAPMER in Dubai in 2nd Q (March or April) 2007 for 3-4 days. (Adel, Sam, John, Slava, Velly, Beatrice): tsunami sources, tsunami inundation scenarios (from WG3), vulnerability/impact, probability, uncertainty.
  - Subsequent workshop on mitigation in following year.

The current knowledge base, experience and capacity of the Group Membership on Risk Assessment of natural hazards vary significantly across the countries.

It is recommended to implement Training Workshops for the:

- Enhancement of the Knowledge base, Sharing of experiences and Capacity Building
- Develop National Guidelines relevant to Multi Hazard Risk Assessment.
- Develop Regional Guidelines based on National Guidelines.

AGREED ACTIONS AND DEADLINES

Action	Person responsible	Deadline
1) Mitigation options and decision support methodology A common and best practice methodology and guidelines will be developed for use by member nations. The working group will liaise with similar working groups in other IOC Tsunami Working Groups to streamline and standardize methods and guides, and share knowledge and information. The working group recognizes that methods and guides will reflect regional diversity. It is expected that documentation of methodologies and guidelines would be available via the internet.	John Schneider Slava Gusyakov Torsten Schlurmann and Mawardi Nur	End Sept 2006 (first draft) Final draft by end Dec 2006
2) Mitigation Options and Decision Support Case Studies Case studies developed by June 2006 will be enhanced through the application of mitigation options to demonstrate decision mechanisms for stakeholders including emergency response managers, land use planners, and national and local governments. These options include:	Sam Hettiarachchi	December 2006

Action	Person responsible	Deadline
– Environmental Barriers (e.g., mangroves, sand dunes), – Artificial Countermeasures (e.g., tsunami breakwaters, sea walls), – Land Cover and Land Use (e.g., building set-backs, tsunami-specific zonation), – Tsunami Resistant Infrastructure (e.g., building codes and certification), – Evacuation Plans (e.g., vertical evacuation, tsunami-safe zones, time is a factor). – Harness indigenous knowledge for reducing vulnerability (e.g., animal behaviour, folklore/songs)		
3) Workshop and training exercises To facilitate knowledge transfer and information sharing a series of workshops and materials to supplement the case studies will be developed.	Sam Hettiarachchi	July 06-June 08
4) Development of an Integrated Regional Tsunami Hazard/Risk Model • Together with WG 4 develop credible tsunami scenarios for the Indian Ocean region, with initial focus on major earthquakes • Generate an Indian Ocean tsunami hazard map for earthquake sources and deep-ocean propagation, followed by consideration of volcanoes and landslides (June 2008).	John Schneider, with Chair of WG4	June 2007 June 2008
5) Training Workshops Training Workshop on Risk Assessment to be supported and hosted by WAPMER in Dubai January or April 2007 for 3-4 days. Tsunami sources, Tsunami inundation scenarios (from WG3), Vulnerability/impact, Probability, Uncertainty will be covered in the workshop. Subsequent Workshop on mitigation in later 2007 or the following year.	Adel Karas Sam Hettiarachchi John Schneider Slava Gusyakov Velly Asvaliantina Beatrice Akunga	Fist half 2007
4) Future Activities It is expected that other activities will be identified through the life of the working group, including information management, data collection standards, and GIS and database development to facilitate access to information for modelling and risk assessment purposes.	Sam Hettiarachchi	TBD

WORKING GROUP PARTICIPANT LIST

Prof Sam Hettiarachchi (Chair), Sri Lanka
Dr John Schneider, Australia
Dr Torsten Schlurmann, UNU-EHS
Mr Adel Karas, WAPMERR
Mr David Khidasheli, WAPMERR
Dr Slava Gusiakov, WAPMERR
Ms Beatrice Akunga, Kenya
Mrs Velly Asvaliantina, Indonesia
Mr Marwardi Nur, Indonesia
Dr Jane Cunneen, IOC/UNESCO

ANNEX VI

ICG/IOTWS WORKING GROUP 4 (WG4)
MODELLING, FORECASTING AND SCENARIO DEVELOPMENT

Chair: Prof Charitha Pattiaratchi, Sri Lanka

OBJECTIVES

The objectives for this group are to:

- *Develop standards for operation and application of models.*
- *Facilitate the development: source, deep water propagation, inundation and forecast models.*
- *Develop bench mark tests for model verification and validation.*
- *Facilitate the development of a web-based community model.*
- *Development of credible case scenarios for model application for the entire Indian Ocean including all possible sources (Sunda Arc, Makran region etc).*
- *Facilitate capacity building and knowledge transfer in the form of web-based tools and training programs.*
- *Liaise with other working groups, especially WG3 - Tsunami hazard detection, characterisation and risk assessment for model requirements and effective model usage and application.*

DISCUSSION OF ISSUES

➢ Model Standards

A draft document entitled 'Standards, Criteria and Procedures for Evaluation of Tsunami Numerical Models' authored by C.E. Synolakis, E. Bernard, V. Titov, F. González was presented at the intersessional meeting. The group discussed the document and suggested some changes. A second draft of document will be drafted by Diana Greenslade and Chari Pattiaratchi, and e-mailed to the group for comment before being adopted.

The Group recommended that a standard glossary including all terms that are used to measure tsunami inundation be developed, agreed to and included in the model standards documents.

➢ Scenario Development

There was discussion of the specific action item relating to the development of credible scenarios for the Indian Ocean region. It was noted that WG 3 has an action item related to facilitating the development of hazard maps for the Indian Ocean. This involves the development of source characteristics for tsunami scenarios. It was also noted that the development of source

characteristics to define credible scenarios is a task that crosses disciplines and it is necessary to bring different groups of scientists together to address this issue.

The group recommended that as an initial starting point, the credible scenarios be limited to historical events. It is then up to individual countries to develop their own scenarios. It was also recommended that any scenarios developed by any particular country or organisation be available to other countries and TComM. Chari Pattiaratchi agreed to compile a list of historical events and post them on the IOC website.

The Group also recommended holding a workshop (within the next 12 months) to bring together geologists, seismologists and tsunami modellers. This should include representatives from WG1, WG3, WG4 and WG6. The aim of the workshop is to define credible tsunami sources and associated probabilities of occurrence. The definition of a "tsunami source" should include full characterisation of the source, including depth, dips etc.

- **Community Tsunami Model (TComM)**

A Tsunami Community Model is being developed through funding provided by USAID to PMEL/NOAA. Vasily Titov (PMEL/NOAA) made a presentation on "Tsunami Community Model Prototype for Mapping and Forecast in the Indian Ocean" detailing the model structure and current status.

Summary:

- TComM will provide deep-water propagation and inundation mapping capability to countries of the Indian Ocean region.
- It aims to develop effective ways to transfer modelling expertise and capabilities between IO countries
- The model system includes access to pre-computed deep water propagation scenarios and inundation.

The Group recognised that TComM provides a useful tool for the countries of the Indian Ocean region to develop a capacity for numerical modelling of tsunami propagation and to develop inundation maps which may used to develop hazard and risk maps. Hence, to disseminate this tool widely, training workshops are required. With the aim of training at least 2 people from each Indian Ocean country (56 in total), at least 3 training programs be undertaken before June 2007. There were expressions of interest from Indonesia and Sri Lanka to host future workshops.

RECOMMENDATIONS

- Model standards be accepted and adopted.
- Model benchmarks to be accepted and be available on the website.
- Development of web-site to provide model standards and benchmark tests.
- In conjunction with other working groups, develop model scenarios (tsunami sources) for the whole of Indian Ocean region.
- Tsunami community model now available. Require training workshops to enable tools to be used effectively in each country.

AGREED ACTIONS AND DEADLINES

The action items were reviewed and modified as follows:

Action	Person Responsible	Deadline/Progress
1. Develop inundation maps for the coastal communities of the Indian Ocean region including translation of the inundation projections to evacuation maps.	C. Pattiaratchi	End 2015 – if possible
2. Develop web based (internet enabled) community model for tsunami propagation and inundation.	C. Pattiaratchi/ V. Titov	Funds allocated by USAID. TComM model developed and presented at ICG-III.
3. Model standards be accepted and implemented	D. Greenslade / C. Pattiaratchi	Model standards document to adopted immediately after ICG-III
4. Model benchmarks to be accepted and available on the IOC website	Behrens/ Asvaliantina	Model benchmarks identified and to be available from IOC website by August 2007
5. Model scenarios to be developed and available on the IOC website.	C. Pattiaratchi	Model scenarios to be developed by August 2007.
6. Work together with IOC to summarise the results and maintenance of the website.	C. Pattiaratchi	by December 2006
7. Training for member states including both short-term and long-term strategies: • Short term training could include a short course with a form of an IOC sanctioned certification or award of a diploma (similar to that implemented by the WMO). • For long term training we recommend the award of 50 IOC fellowships over 5 years for postgraduate training (~40k per annum).	C. Pattiaratchi / D. Greenslade/ V. Titov / L. Kong ICG Secretariat	At least 3 training courses to be organised within the next 12 months. Funding (~$100k each) is required to make these courses a reality. AusAid may fund one workshop in Melbourne in November 2006 Indonesia, Thailand and Sri Lanka have expressed an interest in organising training programs.
8. Support long-term training requirements for model maintenance, ongoing consultation and support at selected institutions.	C. Pattiaratchi	2015

PARTICIPANT LIST

Chari Pattiaratchi, Sri Lanka (Chair)
Diana Greenslade, Australia
Azlikamil Napiah, Malaysia
Widjo Kongko, Indonesia
Velly Asvaliantina, Indonesia
Yap Chui Wah, Singapore
Joern Behrens, Germany
Costas Synolakis, USA
Absornsuda Siripong, Thailand
J.R. Mukabana, Kenya

ANNEX VII

ICG/IOTWS WORKING GROUP 5 (WG5)
A SYSTEM FOR INTEROPERABLE ADVISORY AND WARNING CENTRES

Chair: Mr Geoff Crane, Australia

OBJECTIVES

- *To progress the establishment of a coordinated regional warning system for the entire Indian Ocean basin, through the establishment of a network of National inter-operable Warning Centres.*
- *Advise on the modalities of operation, methods and standards for development and issuance of warnings, and requirements in terms of coordination and operating within a multi-hazard approach.*
- *In consultation with the IOC Secretariat, examine the IOC/WMO Assessment process results still underway, and develop guidelines for the distribution of tsunami warnings by National Tsunami Warning Centres (NTWCs) to emergency centres in their country, the media and the public. These Guidelines will be included in the IOTWS master plan being developed by the IOC tsunami technical unit.*
- *Provide further detailed elaboration of the roles of RTWPs (including responsibility for advisories) and NTWCs.*

The WG-5 held an intersessional meeting in Bali, Indonesia, from July 29-30 2006. A series of recommendations were made for consideration at ICG III.

DISCUSSION OF ISSUES

➢ OUTCOME FROM ICG II (Hyderabad)

2.1 At ICG II the members of WG 5 reviewed the recommendations from the intersessional meeting at Singapore and made several modifications. The concerns of members and reasons for those modifications are recorded in the report of WG 5 to ICG II. The modified model was accepted by IOC IOTWS/ICG II.

2.2 In summary, the adopted two tiered model would be comprised of a number of Regional Tsunami Watch Providers (RTWPs), with all countries in the region responsible for delivering warnings to their own citizens through National Tsunami Warning Centres (NTWCs). The NTWCs would enter into bilateral agreements.with Watch Providers of their choice to receive Tsunami Watches.

2.3 The RTWPs serving NTWCs will issue an **Earthquake Alert** message , followed by either a **Tsunami Detection Alert** message within 15 minutes of detection of a tsunami, including information on tsunami height, or a **Nil Tsunami Advisory** providing confirmation that a tsunami has not been detected.

2.4 The IOC would administer an accreditation process for potential RTWPs to ensure capability of performing the role. This would involve acquiring a specified range of capabilities and a demonstration of performance

2.5 To ensure that the membership of WG 5 included all countries proposing to establish RTWPs, plus a representative number of countries from around the Indian Ocean, the membership was augmented by the addition of Indonesia and France.

2.6 To successfully implement a system of systems throughout the Indian Ocean region would require in-country institutional capacity to deliver warnings right through to threatened communities, complemented by public education and awareness to ensure appropriate response. Well tested material has already been developed for the Pacific region.

➢ DISCUSSIONS AT ICG III (Bali)

3.1 The intersessional meeting of WG 5 was held in Bali, Indonesia, on 29–30 July 2006. Very productive and constructive discussion was facilitated by the attendance of members from a representative cross section of countries in the Indian Ocean region.

3.2 Members of WG5 expressed some concern over the degree of achievement implied in releases to the international media in respect of the overall progress and state of development of the IOTWS. Whilst it is recognised that it is important to recognise and acknowledge the amount of progress that has been made, it is equally important not to overstate the progress to date. The danger is that there will be unrealistic expectations created on the parts of both the general public and the governments of the region. That would be likely to lead to diminished confidence in the warning agency and reduced level of appropriate response by the public under threat. And it could disappoint the governments within the region who might then withdraw support from the project. There was a clear concern among members of WG 5 that IOC doesn't "over sell" the level of capability achieved and create unrealistic expectations too soon.

3.3 Members of WG 5 noted that development of an interoperable tsunami warning system for the Indian Ocean region is a complex and time consuming process. There is a long way to go – attaining the requisite level of capability will take years. It will never be "completed." Technology and techniques are evolving; system will need to be continually updated; the onging demands of sustainability constitute a hugh challenge. Reporting of significant milestones could give a positive message of progress without the risk of any implication that the system is complete.

3.4 The concerns of members of WG 5 that the IOC to promote the achievements to date in positive but constrained terms is captured in Recommendation 1.

3.5 The members of WG 5 saw a need for greater media involvement. There is a need to educate the media so that they recognise that they are part of the warning system and should accept a level of responsibility to the community. There is a need to have standard procedures so the media understand the appropriate source for authoritative information. There is a need to raise the overall awareness and understand of the media so that they understand that not all tsunami are destructive. They need to be aware of the consequences of sensationalising and event. But it is equally important that national warning system officials understand that they cannot say NO THREAT. There is a need to be conservative, and to initially build in the possibility of a higher threat. The media response needs to be managed. Their initial position is to only report casualties, with no reference to those saved by warnings. But they need to understand the limitations of any

warning system to address events such as the South Java Tsunami where there was no possibility of a warning. The media involvement is captured in Recommendation 6.

3.6 Following the recent South Java Tsunami it was appropriate to review the operation of the tsunami warning system in the countries of the region. The group spent some time on this review and country comments are recorded in Attachment 2(a). A time line of the operation of PTWC through the period of the South Java Tsunami is included in this report as Attachment 2(b), and a summary of the message transit times through the WMO GTS is included as Attachment 2(c).

3.7 It was recognised that the necessary capacity within a sufficient number of countries in the region to become IOC designated RTWPs and provide an effective IOTWS would take up to three years. Whilst acknowledging the expressed desires of both JMA and PTWC to withdraw from the interim arrangement for the provision of Tsunami Watches to the Indian Ocean region, and it was too early to nominate a specific date for the withdrawal to occur. This position is captured in Recommendation 2.

3.8 The meeting noted the challenge in formulating warnings to the general public. There is a need for more detail in national warning messages than in the bulletins issued by the international tsunami watch providers. It would be of significant help to national agencies for there to be a greater degree of stratification of the tsunami potential included in the international bulletins. It was noted that the international watch providers have historically used a scale of earthquake intensity to determine the extent of the threat of tsunami. National agencies have a responsibility to warn on tsunami. Currently they have to undertake the interpretive step between earthquake magnitude and potential tsunami amplitude on the coast of their countries. The members of WG 5 saw the potential for much more direct guidance to be provided to national agencies if the bulletins from the international watch providers stratified the tsunami threat on predicted amplitudes of tsunami, either instead of, or as well as, on earthquake magnitude. A stratification scheme, covering the full range of potential threat, would enable the threat of even small tsunami, to be captured. A hierarchy of warnings, such as applies for other hazards, for example for wind warnings for shipping on the high seas or the category system used for hurricanes, typhoons and tropical cyclones, was considered by WG 5 as warranting investigation. Most helpful would be a scheme of gradations of warnings and scales or categories of intensity included in warnings as very quick and simple indicators of the level of threat. WG 5 proposes that a gradation scheme for tsunami warnings be considered. The components of this proposal are covered by Recommendations 3(a) and 3(b). A possible model is included in this report at Attachment 3.

3.9 It was noted that PTWC bulletins are very technical documents, and that any possibility of making them more easily understood should be explored. It was suggested that a graphical version should be considered. The huge popularity of graphical products for tropical cyclone warnings (track and threat maps) was noted. It was noted that the current procedure of declaring local or regional tsunami threats in terms of radii from the epicentre does not take into account the asymmetry of the energy dispersion from a tsunami generated from an earthquake on a subduction trench. A graphical product would capture this asymmetry and better reflect the potential area of threat. A graphical product would best be made available via an electronic process (eg web site, email) to allow it to be a coloured product. But it may be necessary to also have a monochrome version for delivery by fax. The proposal to provide a graphical product to support tsunami watch bulletins is included as Recommendation 4. A possibly format is shown in Attachment 5.

3.10 The members of WG 5 discussed the Tsunami Advices issued by PTWC. There was a request for a greater number of tsunami travel time predictions. The Director of PTWC explained

that there could not be any increase within the Advices which would become unacceptably long. But there was no problem in computing travel times for many more locations. They could perhaps be posted to an internet site. It was stated by members that they would not want the additional predictions directly available to the public and in particular not to the media, so it would need to be a registered user web page. After some discussion the members came to the view that it might be preferable for no travel times to be directly publicly available, but that all travel time predictions could be listed on a registered user web page. There was a view that it should be the prerogative of national governments to release predicted arrival times of tsunami on their country. There was also the view that media could infer that the publishing of a predicted arrival time meant automatically that there would be a significant tsunami. Where the tsunami threat was insignificant and no national warning would be issued it was considered to be highly desirable for there to be no other statement about the possibility published to unnecessarily alarm the public. This proposal is included in Recommendation 5.

3.11 While discussing the timeframe for issue of Watch Bulletins it was noted that in the Pacific region the PTWC prepares a brief Preliminary Observation message for very limited distribution. It contains the earliest possible initial information of just earthquake magnitude, and location, and is usually distributed within 5 or 10 minutes of a seismic event. Also sometimes the earthquake depth will be given. The Director of PTWC indicated that the Preliminary message could be made more widely available. This issue is captured in Recommendation 8.

3.12 The necessity for regular review of performance of the warning systems within the Indian Ocean region was stressed by members of WG 5. It was noted that in recent months a basin wide exercise was conducted for the Pacific Ocean region. But members considered that the overall development of the IOTWS needs to advance further before a basin wide exercise would be practical. Meanwhile smaller national exercises should be encouraged, and all realtime events should be reviewed to also provide an opportunity to critically examine the progress and operational effectiveness of the system. This issue is captured by Recommendation 7.

3.13 The WG 5 members discussed the Ranet system. EMWIN to GOES E and W. The Australian Bureau of Meteorology receives the signal then sends it to Asia Star satellite to WorldSpace. The system has two way capability. SMS to subscribers. It has the facility to send a reply to the SMS back to PTWC.

EMWIN was originally developed to service Emergency Managers in the US. Need software the take data then put alarm on it. There are lots of versions of alarm including for handicapped people. The intention is to include nationally generated warnings. Would need to get message from local countries to the Australian Bureau of Meteorology. The signal goes through a ground relay station in Brisbane. The members agreed to keep abreast of developments with the Ranet system but made no recommendation at this time.

RECOMMENDATIONS

Recommendation 1: The IOC promote the progress of development of the Indian Ocean Tsunami Warning and Mitigation System in a positive but restrained manner to avoid creating unrealistic expectations of the system in the minds of the governments of the region and the general public.

Recommendation 2: The ICG/IOTWS note that development of an interoperable tsunami warning system for the Indian Ocean region still has a long way to go and it is likely to take at least three to five years before a transition from the interim warning system to a fully independent

Indian Ocean Tsunami Warning System could be implemented. The ICG/IOTWS should insure that an adequate level of sustainability of systems and communications infrastructure be identified to support the operation of the IOTWS and the RTWPs and the NWTCs.

Recommendation 3(a): A method of stratifying the level of threat within tsunami watch bulletins, based on predicted tsunami amplitude, which would also allow appropriate emphasis on the dangers associated with even very small tsunami, should be developed. This enhancement to international watch bulletins would provide more specific guidance to national warning agencies in their formulation of warnings to the general public. This should be a coordinated effort with the other Working Groups.

Recommendation 3(b): A mechanism for conveying the overall level of threat in a very brief form, such as the category system for tropical cyclones, should be developed. This enhancement to international watch bulletins would provide an immediate indication of the level of threat to national warning agencies, and, if carried over into their public warnings, would minimise the chance of any significant misunderstanding of the severity of the threat by both media and public.

Recommendation 4: In order to better indicate the diverse areas of threat from a tsunami, international watch providers consider issuing a graphical product to accompany their Tsunami Watch messages.

Recommendation 5: International watch providers provide tsunami travel time predictions for a greater number of locations. These extra travel times could be posted to a restricted access internet site. Consideration be given to ceasing the inclusion of any tsunami travel time predictions in watch messages but posting them all to such a web site.

Recommendation 6: The integral role of the media in tsunami warning systems, at the international, national and local level, should be recognised. The ICG/IOTWS should support the criticality of engaging the media in all stages of the development and operation of tsunami warning systems to enhance the positive real time contribution of the media to the effective delivery of early warnings. This work should be fully coordinated with that of WG 6, and the philosophy should be reflected in national implementation plans.

Recommendation 7: Countries within the IOTWS should internally review all seismic and tsunamigenic events to regularly assess the progress of development of their systems. International basin wide exercises should be coordinated by the IOC for testing the whole system when the development has advanced sufficiently. This could be considered for 2008 or beyond.

Recommendation 8: PTWC be requested to issue the earliest available information, in the form of its preliminary message, to national tsunami warning agencies within the Indian Ocean region.

AGREED ACTIONS AND DEADLINES

Action	Person Responsible	Deadline
1) Two-tiered interoperable system of RTWPs and NTWC upon. • Nations to be responsible for issuing warnings within their own territories • Related relevant information will be freely available • Some nations will derive their own warnings from primary seismic and sea-level observations and seismic and ocean models • Other nations will receive watches upon bilateral arrangements from RTWPs that should assist them in preparing and issuing their own national warnings	Each national Focal Point or representative	On or before 31/12/08
2) The RTWPs serving NTWCs will issue the following messages: • An **Earthquake Alert** message for potentially tsunamigenic under-sea earthquakes as soon as possible after the event's detection. This will be followed by either: • A **Tsunami Detection Alert** message within 15 minutes of detection of a tsunami, including information on tsunami height, extent and arrival times at designated locations, which may be repeated or updated as new data becomes available.); or • A **Nil Tsunami Advisory** providing confirmation that although an earthquake has occurred, a tsunami has not been detected by buoys, gauges and/or experienced at inhabited nearby coastal locations.	Each national Focal Point or representative	On or before 31/12/08
3) Develop a method of stratifying the level of threat within tsunami watch bulletins, based on predicted tsunami amplitude, which would also allow appropriate emphasis on the dangers associated with even very small tsunami.	Chair, in conjunction with other WGs	December 2006
4) Develop a mechanism for conveying the overall level of threat in a very brief form, such as the category system for tropical cyclones.	Chair	December 2006

Action	Person Responsible	Deadline
5) There should be an accreditation process whereby the IOC designates a potential RTWP as being capable of performing the role. Designation would involve: • A specified range of capabilities (see Section 2); and • A demonstration of performance.	IOC HQ/IOC Perth Regional Program Office	As and when necessary
6) Capability Profiling Initial compilation by email	Chair (Australia) with France (La Reunion)	December 2006
7) Watch/Warning Guidelines Standardization/format of information/watch Starting point - draft doc App 3.	USA	December 2006
8) Composing a generic guidelines for the "last mile" of warning/watch (Include a demonstration right through to the beach (RANET)	Indonesia, USA, Thailand(ADPC)	December 2006
9) Communication and collaboration/platforming among NWTCs-RTWPs (including backup systems)	Germany, USA	December 2006
10) International Basin-wide exercises to test the entire sy coordinated by the IOC	WG Chairs, IOC	By end 2008

PARTICIPANT LIST

Australia	Geoff Crane (Chair)
East Timor	Jane Mocellin
France	Gerard Therry
Germany	Torsten Riedlinger
India	M Ravichandran
Mauritius	Sok Appadu
Pakistan	Qamar Z Chaudhry
Singapore	Lesley Choo
Sri Lanka	G H P Dharmaratna
Tanzania	David Kirway
Thailand	Angsana Sihapitak
USA	Chip McCreery
	Ed Young
Yemen	Al Shabaan
ADPC	A Subbiah
WMO	Edgard Cabrera

Countries intending to develop independent tsunami warning capability

A Regional Tsunami Watch Provider
B National Tsunami Watch Provider
C National Tsunami Warning Service

X PTWC
Y JMA
Z ADPC

Country	Intended Capability	Target Date #	Current Source	Final Source
Australia	A C	07/09	X Y	B
India	A C	09/07	X Y (B)	B
Indonesia	A C	12/08	X Y (B)	B
Iran	A C		X Y	
Malaysia	A C		X Y	
Singapore	C	12/08	X Y	
ADPC Thailand	A B C	12/09* N/A	X Y	B/ADPC

* 07/07 for minimum critical monitoring network (5-6 Sea level + 5-6 seismic), data processing facilities and communications facilities

Subject to variation when minimal requirements are established

Countries not intending to develop national tsunami warning capability

Country	Intended Capability	Target Date	Current Source	Final Source
Bangladesh	C		X Y	ADPC
Comoros	C		X Y	
East Timor	C		X Y	
France	C		X Y	
Kenya	C		X Y	
Madagascar	C		X Y	
Maldives	C		X Y	ADPC
Mauritius	C	10/07	X Y	
Mozambique	C		X Y	
Myanmar	C		X Y	ADPC
Oman	C		X Y	
Pakistan	C	12/08	X Y	
Saudi Arabia	C		X Y	
Seychelles	C		X Y	
Somalia	C		X Y	
South Africa	C		X Y	
Sri Lanka	C		X Y	ADPC
Tanzania	C		X Y	
United Arab Republic	C		X Y	
United Kingdom	C		X Y	
Yemen	C		X Y	

CATEGORY SYSTEM FOR TSUNAMI WARNINGS

There is a need for warnings to be able to discriminate more levels of threat. Perhaps a category scale could be used. The situation is not quite the same as for hurricanes or tornados. The effect will be different for each country, and even different parts of the one country. But there is some analogy, as there is also with wind warnings for shipping on the high seas which can discriminate various levels of threat with gale, storm and hurricane warnings.

Currently the interim Tsunami watch providers for the Indian Ocean both designate the severity of a tsunami by relating the extent of the threat (local, regional, basin wide) to the magnitude of the earthquake. But the recipient National Tsunami Warning Centres have to use the information to assess the requirement to issue a tsunami warning, not any bulletin about the earthquake. It would be conceptually more appropriate to classify the event in terms of potential tsunami amplitude.

The following table combines these ideas into a Tsunami Category Scale.

Tsunami Category	Tsunami at 20m depth	Description of potential effect	Type of message
5 Major Regional	> 5.0m	vast area (multi national)	Warning Destructive
4 Major National	> 3.0m	extensive area (national)	Warning Destructive
3 Major Local	>= 0.5m	coastal communities (local)	Warning Destructive
2 Moderate	0.3-0.5m	foreshores (on the beach, immediate coastline structures)	Warning Damaging
1 Minor	0.2-0.3m	in water (swimmers, divers, small craft in marinas, ports)	Warning Dangerous
0 No Sig	<0.2m	Negligible threat (cannot say “No threat”)	Information Bulletin

ANNEX VIII

STATEMENT/MESSAGE BY UN SPECIAL ENVOY FOR TSUNAMI RECOVERY, PRESIDENT BILL CLINTON

(to be read by the Chairman of the ICG)

On the occasion of the Third Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System
Bali, Indonesia, July 31- 2 August, 2006

The recent destructive tsunami in Java underscored the urgency of improving national and local tsunami warning and response capacities and makes your meeting this week even more critical. Public awareness, education and community preparedness are crucial in making sure that warning systems are effective.

I am very pleased about the good progress that has been made in developing the Indian Ocean Tsunami Early Warning System and it is encouraging to know that the basic technical elements of the regional system are already in place. This will certainly contribute to increased safety in the region and influence the recovery process in a positive way. In fact, these elements appear to have functioned reasonably well during the most recent tsunami. I would like to congratulate all of you who have made this possible through your hard work.

However, as you know, further work still needs to be done to synchronize national and regional efforts; the regional system is now further ahead than most of the national systems. And the challenge remains to address "the last mile" of the warning systems at the national level and ensure that all the coastal communities are prepared to act in case of a warning. I am pleased to hear that more countries are in the process of developing their national tsunami warning and response plans. When I was in Bonn, at the Third Early Warning Conference last March, we launched a special initiative to accelerate the process of developing effective national plans, with seven international agencies forming a Consortium to offer support to the Indian Ocean countries. The initiative, which is coordinated by the UN International Strategy for Disaster Reduction, aims to help countries develop their national warning and mitigation systems. So far, several countries have requested this assistance, and the seven Consortium members will make maximum efforts to ensure countries have their plans ready in the near future. This initiative has my full support, and I look forward to learning more details on the progress made at the country level. I wish you a successful session and will continue to support your crucial work.

ANNEX IX

REPORT FROM UN/ISDR WORKSHOP ON DISASTER RISK REDUCTION: CONTEXT FOR INDIAN OCEAN TSUNAMI EARLY WARNING SYSTEMS (TEWS)

Bali, Indonesia, 30 July 2006

Background and Rationale

At the second session of ICG-IOTWS in Hyderabad, 14-16 December 2005, a group of representatives of DFID, USAID, AUSAID/MFA, EMA, ADRC and UN/ISDR stressed the importance of integrating disaster risk reduction and development expertise into the work of ICG. The group proposed a draft terms of reference for a sixth Working Group on Mitigation, Preparedness and Response. The ICG Chair invited ISDR to undertake consultation on the matter and report back to ICG-IOTWS-3, in Bali, Indonesia, 31 July–2 August 2006.

As part of this consultative process, ISDR in cooperation with UNESCAP, UNESCO-IOC and members of the ISDR Asia Partnership, convened a Regional Workshop on Mitigation, Preparedness and Development for Tsunami Early Warning Systems, 14-16 June 2006 in Bangkok, Thailand. The overall objective of this workshop was to address the societal aspects of tsunami early warning systems (TEWS), by initiating a three-way dialogue between partners from the technical, disaster risk reduction and development communities. The principal outcome of the workshop was the endorsement of the proposal to establish a working group under the ICG/IOTWS on mitigation, preparedness and response, to complement the existing ICG/IOTWS technical working groups, and development of proposed terms of reference for this new working group.

In order to finalise this consultative process and further refine the terms of reference UN/ISDR convened a "Workshop on Disaster Risk Reduction: Context for Indian Ocean Tsunami Early Warning Systems" 30 July in Bali. (See Appendix A for Workshop Agenda). All IOC Member States were invited to attend and 37 representatives of countries, UN agencies and NGO's participated. (See Annex II for List of Participants). UN/ISDR facilitated, co-chaired and reported for the meeting.

The **purpose** of the workshop was to identify ways for the technical, disaster management and development communities to interact better – on national level as well as on regional level such as within the ICG/IOTWS process. The workshop **objectives** were:

- To increase the involvement among disaster risk reduction and development experts in the future implementation of TEWS in the Indian Ocean region.

- To finalise the preparation for the establishment of the proposed sixth Working Group on Mitigation, Preparedness and Response, at the ICG/IOTWS-III.

- To strengthen regional networking among the invited disaster management and development experts.

Workshop outcomes

The workshop was held between 09:00-17:00, where large parts of the meeting were dedicated to presentations and discussions on the ICG/IOTWS process in general and the proposed Working Group 6 in particular.

Chair and Deputy chair of Working Group 6

The meeting started with identifying and proposing a chair and deputy chair for the proposed Working Group 6 on Mitigation, Preparedness and Response. Mr Michel Vielle, Director General of the National Secretariat for Disaster Risk and Management, Seychelles, was nominated as chair. Although not able to attend the meeting, Mr Vielle affirmed his acceptance to the nomination through his colleague Mr Yann Rousseau. The meeting concluded that not only has Mr Vielle shown serious engagement and expertise in the areas of mitigation, preparedness and response; as a representative of an African Member State, his possible chairmanship would also diversify the regional focus of existing Working Group chairs. *Mr Michel Vielle was elected as the Chair of the proposed Working Group 6.* As deputy chair, Mr Che Moin Umar, Focal point for the National Disaster Centre, Malaysia, was nominated. Mr Umar accepted the nomination and with the support from all attending representatives *Mr Che Moin Umar was elected as the Deputy Chair of the proposed Working Group 6.*

The ICG/IOTWS process and Working Groups

IOC representatives briefed the participants on the previous ICG sessions in Perth and Hyderabad and the ICG process. Going through the five existing working groups, Mr Tony Elliot, Head of the ICG/IOTWS Secretariat, made a brief presentation of each working group's specific areas of work and mandate. These are the following working groups and chairs:

WG 1 Seismic measurements, data collection, and exchange.
Chair: Dr Prih Harjadi, Indonesia

WG 2 Sea level data collection and exchange, including deep-sea tsunami detection instruments.
Chair: Dr Premkumar, India

WG 3 Risk assessment
Chair: Prof. Sam Hettiarachchi, Sri Lanka

WG 4 Tsunami hazard identification and characterisation, including modelling, prediction and scenario development.
Chair: Prof. Charitha Pattiaratchi, Sri Lanka

WG 5 The establishment of a system of interoperable operational centres.
Chair: Mr Geoff Crane, Australia

Both Mr Elliott and Dr Bernal, Executive Secretary of the IOC, stressed the importance that the participants coordinate the terms of reference and planned activities of the proposed Working Group 6 with existing ones. There is potential overlap with several of these Working Groups (especially Working Groups 3 and 5) and the meeting should secure that there is no possible duplication. For this reason the chair persons for both WG3 and WG5 were present and advised during the refining of the terms of reference.

When discussing the relationship between WG6 and the other working groups it was suggested that the WG6 should be seen as the client of the existing working groups, consuming the findings and results being produced by them. In this perspective WG6 should not necessarily produce a lot of its own data; rather, try to implement the existing findings from other working groups at national and community levels – addressing the downstream parts of TEWS.

Terms of reference for WG6

A group of participants, including the present chair persons of Working Groups 3 and 5 met during lunch time to review the proposed terms of reference developed at the ISDR workshop in Bangkok. In the afternoon session the group presented a refined terms of reference, considering the area of work of the existing working groups.

Dr Bernal stressed that the ICG has a role of governance and can – with the help of WG6 - support the process of establishing and implementing Member States' National Plans. Consequently, it was suggested that WG6 should in part focus on assisting countries to develop national plans. In accordance to this matter, it was also stressed that the WG6 should promote and engage in ICG's efforts in developing minimum standard of each component for an end-to-end TEWS and assess each country's capacity in relation to this. Such benchmarking was seen as an important factor for the working group's activities.

One of the main expressed concerns with the draft terms of reference developed in Bangkok was that several parts overlapped with the role of the ICG/IOTWS Secretariat. Therefore, in the finalisation of the terms of reference several issues were removed or rephrased.

The meeting discussed and finalised the proposed terms of reference. For the final draft terms of reference for working group 6, see Appendix C.

Presentation - UNESCO

Mr Koen Myers presented the results of a UNESCO study on preparedness conducted in Padang, Indonesia. The report presents a framework for identifying and assessing community preparedness. The framework, based on interviews, was applied at the following levels:

- Individual and household level
- Community level
- School community
- Supporting stakeholders (Community institutions, NGO's, professional groups etc)

The study was developed to meet the need of a methodology to assess the existing level of preparedness in disaster prone societies. Such assessment is crucial in order to make sure that implemented activities address the existing gaps. This particular study focuses on earthquakes and tsunamis, but the aim is that the methodological framework will be applicable for other hazard-types and other communities/countries.

By studying the areas of knowledge and awareness, policy, emergency response planning, disaster warning systems and resource mobilisation the framework can define the existing weaknesses in the levels of preparedness. One of the main findings of the study in Padang is that public awareness is shown to have key importance and the media has a crucial role in the enhancement of this area.

The report will soon be translated into English and widely disseminated by UNESCO.

Presentation - NHK Japan

Ms Aya Fujito presented the work of NHK and stressed the important role of broadcasters in reducing disaster risk. NHK organised a workshop in February 2005 to examine how broadcasters acted at the time of the tsunami disaster. The advantage of broadcasting is its possibility of wide announcement, dissemination of early warnings and role in education.

The meeting recognised the important role of media and agreed that the WG6 should address this issue in its future activities.

Presentation - National Platform Madagascar

Mr Jacky Randimbiarison and Prof. Gerard Rambolamanana presented the organisation and running of Madagascar's National Platform for Disaster Reduction. The platform consists of several government entities; Commission of health, education, logistics, water management and assessment/monitoring. After the Tsunami Disaster 26 December 2004 the Tsunami Commission has also been integrated in this institutionalised coordinating mechanism. In addition to government bodies, the National Platform comprises UN agencies, NGOs, religious communities and the private sector.

The close cooperation between the different Government Commissions has created several productive synergies. For example, the Commission of tsunami and education have together developed educational tools for learning about tsunamis. In addition, the Commission of assessment/monitoring and tsunami have organised drills and training for preparedness on community level.

APPENDIX A

Agenda

Venue: The Patra Bali Resort & Villas
Jl. Ir. H. Juanda, South Kuta Beach, Kuta 80361, Bali, Indonesia

Workshop Agenda (27 July 2006)

09:00-09:10	**Introduction to the Workshop**
09:10-10:30	**The ICG process & the proposed new ICG-IOTWS Working Group 6 on Mitigation, Preparedness and Response.** - Briefing on the ICG process. - Presentation of draft terms of reference for Working Group 6. - Discussion on the establishment and operation of Working Group 6.
10:30-11:00	Coffee break
11:00-12:00	**Open discussion on the linkages between Working Group 6 on Mitigation, Preparedness and Response and the work within Working Group 1-5.**

12:00-14:00 LUNCH

14:00-15:00 **Linking Indian Ocean TEWS to national multi-hazard Disaster Risk Reduction agendas.**
- Linkages between TEWS activities and the Hyogo Framework for Action.
- Open discussion on multi-hazard approaches to TEWS activities.
- Progress update on the ISDR System Consortium.

15:00-15:30 Coffee break

15:30-17:00 **The role of National Platforms for enhanced Disaster Risk Reduction.**
- Presentation on the concept and role of National Platforms.
- Madagascar's experiences with National Platform development. Presentation by Jacky Randimbiarison.
- Experiences from other countries.
- Open discussion on how to link and integrate TEWS activities into National Platforms.

APPENDIX B

List of Participants

Name	Country/Organisation
Abdulkadir Nur Arale	Deputy Minister of Fisheries and Marine Resources, Somalia
Abdulkhaleq Yahia Al-Ghaberi	Director General of Environment Emergency, Yemen
Aya Fujito	NHK
Akiko Nakamura	ADRC
Bernardo Aliaga	UNESCO/IOC Tsunami Coordination Unit
Brian Flanagan	Emergency Management Australia
Brian Yanagi	International Tsunami Information Centre, Hawaii
Che Moin Umar	Malaysia
Cherdsak Virapat	National Disaster Warning Center, Thailand
Davies Mwaluma	Ministry of State for Special Programmes, Kenya
Farooq Ahmad Khan	National Disaster Management Authority, Pakistan
Fransisco F. M. Rosario	National Disaster Management Office, East Timor
Fred Stephenson	ICG-PTWS Vice Chair
Gerard Rambolamanana	Focal point for EWTS in Madagascar
Harald Spahn	German-Indonesian Tsunami Early Warning System, GTZ
Jacky Randimbiarison	Secrétaire Exécutif du Conseil National de Secours
Jane Mocellin	UNDP East Timor
Joe Chung	UN/ISDR Bangkok
Katherine Mitchell	Australian Government Overseas Aid Program (AusAID)

Koen Meyers	UNESCO Jakarta
Gamini Hettiarachchi	Disaster Management Centre, Sri Lanka
Michael Rottmann	UNESCO Jakarta
Naveen Verma	Disaster Management Division, Ministry of Home Affairs, Government of India
Noroarisoa Rakotondrandria	UN/ISDR Nairobi
Patricio Bernal	Executive Secretary, UNESCO/IOC
Patrick Kratt	UN/ISDR-Platform for the Promotion of Early Warning
Paul McAlonan	Emergency Management Australia
Peter Koltermann	Head, UNESCO/IOC Tsunami Coordination Unit
Qamar Z. Chaudry	Pakistan Metrological Department, Pakistan
Sam Hettiarachchi	Chair, ICG/IOTWS Working Group3
Sanny Jegillos	UNDP Bangkok
Stefanie Dannenmann	UN/ISDR-Platform for the Promotion of Early Warning
Sue Williams	UNESCO Bureau for Public Information
Syed Ashraf	Disaster Management Bureau, Ministry of Food and Disaster Management
Tony Elliott	UNESCO-IOC ICG/IOTWS Secretariat
William Erb	UNESCO/IOC Perth Office
Yann Rousseau	National Disaster Secretariat, President's Office, Seychelles

APPENDIX C

Proposed terms of reference for new ICG-IOTWS Working Group on Mitigation, Preparedness and Response

The Working Group on Mitigation, Preparedness and Response will support national and regional efforts to strengthen capabilities for disaster risk-reduction from tsunami within a multi-hazard framework, focusing on improved mitigation, preparedness and response at all levels down to the vulnerable communities.

The Working Group will assist member states in the development of good practice in capacity, resilience building and emergency management to reduce tsunami risk through the following activities:

a. Promotion and enhancement of the institutionalisation of tsunami early warning systems, their implementation and maintenance.

b. Mainstreaming of tsunami warning and mitigation system into development policy, plans, practice and legislation.

c. Integration of national tsunami programs and experts into the defined national platforms for disaster risk reduction and national disaster management processes.

d. Development and adaptation of tsunami-related guidelines, manuals and tools for downstream activities i.e. public information, education, training, communication processes, evacuation planning and drills, standard operating procedures and emergency management.

e. Coordination at regional and sub-regional levels on the above matters.

ANNEX X

REPORT FROM THE ICG/IOTWS SECRETARIAT

(Agenda Item 3.3)

The ICG Secretariat was established by decision of the 23rd IOC Assembly (Paris, 2005) to support the coordination and implementation work of the IOTWS. The duties were initially undertaken by the Paris HQ office of IOC but it was recognised that a dedicated team would be required to fulfil the terms of reference. The Government of Australia generously contributed funds to establish the Secretariat in Perth and has committed to continue this funding up to mid 2009.

Since the ICG-II meeting in Hyderabad, two permanent staff members have joined the Secretariat: Jane Cunneen was appointed in mid-January and Tony Elliott joined as Head of Secretariat at the beginning of July. A third person from an IOTWS Member State will be seconded to the team in September 2006, funded by a generous grant from AusAID. The secondment funding has been offered for up to 3 years and it is envisaged that the duration of each secondment will be a minimum of 1 year, allowing up to 3 secondees from different developing Indian Ocean countries to work for the Secretariat in Perth and provide further opportunities for capacity building.

The main activities of the Secretariat during the last intersessional period have been to support, organise and attend this ICG meeting and support and attend the following Working Group (WG) meetings and workshops:

- USAID Meeting, Bangkok, 30–31 January.
- IOC/WESTPAC Post Disaster Assesment Meeting, Phuket, 17–24 February.
- ISDR – Regional workshop on mitigation, preparedness and development for TEWS in the Indian Ocean region, Bangkok, 14-16 June.
- Tsunami Teacher review meeting, Delhi, 29 March-1 April.
- IOTWS WG2 meeting and ICG/PTWS-XXI meeting, 1–5 May, Melbourne. The Secretariat also assisted with the reporting of this meeting.

The planning and organisation of meetings, particularly ICGs, takes a considerable amount of Secretariat time. With limited resources, it is essential for WGs to liaise closely with us to allow us to plan our activities efficiently. This will be important as the Secretariat starts to become more involved in other activities, such as assessment missions, setting up of training courses, capacity building etc. This will also have an impact on our operating budget and attention is drawn to the budgetary constraints under which the Secretariat operates. If the Secretariat is to assume a broader, more proactive regional responsibility for ensuring the implementation of an end to end TWS, it will require extra resources and a commensurate increase in operating budget.

Budget limitations also have an impact on the level of financial support the Secretariat is able to provide to delegates requesting funds to attend meetings, and Member States understanding is sought in restricting future requests. In general, each Member State is requested to fund its own delegates to attend ICG and WG meetings.

The most important activity for the next intersessional period will be to turn the Implementation Plan into action. A key outcome of ICG-III must be to approve this plan, and a large proportion

of meeting time will be devoted to this task. Each WG is urged to give top priority to discussing and finalising their action plan. Another important outcome from this meeting will be the establishment of WG 6 – Mitigation, Preparedness and Response. The need for this new WG has been brought into sharp focus by the Java tsunami on 17th July, when dissemination of warnings to the communities at threat and their preparedness for a tsunami emergency proved to be deficient. With the design and implementation of the "hard" system progressing well there is a clear need to concentrate more effort on developing the "soft", or downstream part of the system. This is particularly the case for those Member States with coastal communities most vulnerable to local tsunamis, where warning times will never be longer than 40 minutes no matter how quickly we can detect potentially tsunamegenic earthquakes and issue alerts.

As part of the IOC Tsunami Unit, the Secretariat will be working closely with colleagues in Paris and Honolulu during the next intersessional period to progressively take over the role of regional IOC office for the IOTWS. The team in Perth will be making every effort to maintain the momentum generated at this ICG meeting and will liaise closely with each WG to ensure that deadlines are being kept and progress is being made. Member States and WGs are strongly encouraged to collaborate closely with the Perth office and to contact them if they require any information or assistance.

ANNEX XI

REPORT FROM THE IOC TSUNAMI UNIT

(Agenda Item 3.4)

The IOC Tsunami Unit was set up in response to an EC decision to organize, plan and secure resources to implement the IOC Tsunami Programme. These services are provided by:

- The Tsunami Coordination Unit, composed of 9 experts, located in Paris HQ, in the ITIC Office in Hawaii/USA and in the ICG/IOTWS Secretariat in Perth/Australia that will technically back-stop the IOTWS. Through this unit, IOC is ready to offer technical assistance to countries requesting it to setup their National Tsunami Warning Centres, in the form of:
    1. Training of personnel for handling and processing Earthquake and Tsunami relevant data.
    2. Training and assistance to produce coastal inundation maps,
    3. Technical Assistance for defining, installing, and monitoring seismic and oceanographic equipments
    4. Technical Assistance to prepare Terms of Reference for provision of personnel services or equipments.
    5. Technical Assistance for developing manuals, protocols and operating plans, in partnership with JMA, PTWC,
    6. Technical Assistance for defining mandates and delegation of authority.

For the **IOTWS,** the Unit has been involved in:

- Connecting national facilities to the core regional system, including the recently upgraded 23 sea-level stations.
- Delivering tsunami-resistant new equipment to selected countries, facilitating communication channels, and providing maintenance and training support.
- Supporting the upgrade of the seismographic network around the Indian Ocean Basin, concentrating mainly in the Indian Ocean Islands, East Africa and other selected countries (Sri Lanka). Equipment and training will be provided.
- Setting up the permanent Secretariat for the ICG/IOTWS based in Perth to support all the intergovernmental coordination required for the IOTWS.
- IOC will establish a Tsunami Information Centre TIC in Jakarta, Indonesia, to act as a clearinghouse for transferring emergency preparedness material. Backup will be provided through its International Tsunami Information Centre (ITIC) based in Hawaii, USA.
- OC will set up an IOC Programme Office in Hawaii/USA to act as the International Tsunami Information Centre (ITIC) based in Hawaii, USA

So far, 26 out of a possible 29 national tsunami warning centres, capable of receiving and distributing tsunami advisories around the clock, have been set up in Indian Ocean countries. The seismographic network has been improved, with 25 new stations being deployed that will be linked in real-time to analysis centres. There are also three Deep-ocean Assessment and

Reporting of Tsunamis (DART) systems presently in place. The Commission for the Nuclear-Test Ban Treaty Organization (CTBTO) is also contributing data from seismographic stations.

At present, information bulletins are issued from Japan and Hawaii, pending a final decision on the location of regional centres in the Indian Ocean. This will be facilitated when important additional contributions including instruments such as deep-sea pressure sensors and ground deformation sensors become available in late 2007 and 2008.

Support to the IOC's Tsunami Unit comes from Australia, Germany, Ireland, Japan, Norway and USA. Upgrades of sea level stations are being made with substantial contributions from member states, such as Finland. Setting of TIC in Jakarta has been arranged together with Canada and Germany. ITIC and its activities have been supported by the USA.

Outside the Indian Ocean:

PTWS
The EC decides to rename the International Coordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU) the **Intergovernmental Coordination Group** for the **Pacific Tsunami Warning and Mitigation System (ICG/PTWS).** It renamed ITSU to be the Pacific Tsunami Warning and Mitigation System (PTWS). It then established an Intergovernmental Coordination Group for the PTWS and then decided that the IOC shall provide the Secretariat of the ICG/PTWS; and that ITIC will continue to act as the primary provider of information and expertise for technology transfer, training and capacity building for the PTWS.

The EC welcomed and accepted the generous offer of the United States of America to continue to support the ITIC and instructs the IOC Executive Secretary to establish ITIC as a programme office of IOC; it also agreed that, to facilitate durability, the Pacific Tsunami Warning and Mitigation System should continue to utilize or build on, where possible, existing organizations and institutions and complement existing warning frameworks, within a multi-hazard framework where appropriate;

NEAMTWS
The 2nd ICG meeting developed the system requirements further. The nomination of National Focal Points is only slowly progressing. The 3rd Meeting is being scheduled for the end of February, 2007 in Bonn, Germany.

CARIBE-TWS
After the 1st Meeting in Barbados a 2nd Meeting is being scheduled for March 2007 in Venezuela. In the Caribbean the developing system will take into account the existing, real-time system of the Meteorological Agencies developed for the Hurricane Warning System.

OUTREACH AND AWARENESS

A comprehensive communication and training package, the "TsunamiTeacher" has been developed in English and will be provided in several languages starting with Bahasa Indonesia, Thai, Bangla Bangladeshi and French. Languages versions have been contracted through local IOTWS partners and focal points. A series of training courses in tsunami-related modelling, seismic monitoring, tsunami warning and coastal planning have been conducted. Other courses are in preparation.

Consortium Activities

At the 3rd Early Warning Conference in Bonn, 2006 a consortium has been put together of 10 UN organizations under the aegis of the UN Special Envoy for Tsunami Recovery to support nations in developing and implementing downstream services. For the first ten claiming member states the proposed activities will be given substantial support, seven member states have so far submitted their proposals. A briefing of the Consortium will be given at this ICG meeting.

Global Ocean-related Hazard Early Warning System

A first Meeting of the ad hoc Working Group on the GOHTWS was convened during the last EC to develop terms-of-reference. The mandate of the working group has been extended until 2007 to report to the Assembly. The terms-of-reference will put particular emphasis on the governance of the existing systems and the extension of their respective mandates to cover within a multi-hazard approach ocean—related risk and hazards.

Co-ordination within the UN System and with other organizations

The Tsunami Unit is representing IOC interests at meetings of UN and other bodies in order to promote involvement in the developing and existing tsunami warning systems.

ANNEX XII

LIST OF PARTICIPANTS

MEMBER STATES OF ICG

AUSTRALIA

Dr Ray CANTERFORD (Head of Delegation)
Branch Head
Bureau of Meteorology, 700 Collins ST,
Docklands, Melbourne, Victoria, 3001
Tel: +613 96694087 Fax: +613 96694695
Email: r.canterford@bom.gov.au

Mr Rick BAILEY
Project Director
Australian Tsunami Warning System
Bureau of Meteorology
P.O. Box 1289 Melbourne. VIC. 3001
Tel: +61 3 96694103 Fax: +61 3 96694695
Email: r.bailey@bom.gov.au

Mr Geoff CRANE
Warning System Specialist (Chair WG5)
Bureau of Meteorology
P.O. Box 1289 Melbourne. VIC 3001
Tel: +61 3 966 94110 Fax: +61 3966 94695
Email: g.crane@bom.gov.au

Mr Brian FLANAGAN
Assistant Director, Tsunami Warning Implementation
Emergency Management Australia
P.O. Box 1020 Dickson ACT 2606
Tel: +61 2 6256 4692 Fax: +61 2 6256 4563
Email: brian.flanagan@ema.gov.au

Dr Diana GREENSLADE
Bureau of Meteorology
P.O. Box 1289, Melbourne VIC 3001
Tel : +61 3 9669 4124 Fax: +61 3 9669 4660
Email: dag@bom.gov.au

Mr Ken JARROTT
Head, Observations Systems Section
Observations and Engineering Branch
Bureau of Meteorology
P.O. Box 1289 Melbourne. VIC. 3001
Tel: +61 3 9669 4163 Fax: +61 3 9669 4168
Email: k.jarrott@bom.gov.au

Mr Paul MCALONAN
Assistant Director, International Support
Emergency Management Australia
P.O. Box 1020 Dickson Act 2602
Tel: +61 2 625 64613 Fax: +612 625 64653
Email: paul.mcalonan@ema.gov.au

Ms Katherine MITCHELL
Disaster Risk Reduction Officer
Humanitarian and Emergency Section, AusAID,
GPO Box 887 Canberra ACT 2601
Tel: +61 2 6206 4543 Fax: +61 2 6206 4587
Email: Katherine.mitchell@ausaid.gov.au

Dr John SCHNEIDER
Group Leader, Risk Research,
Geoscience Australia
GPO Box 378 Canberra, ACT 2601
Tel: 61 2 62499667.
Email: john.schneider@ga.gov.au

Dr Spilio SPILIOPOULOS
Project Leader,
Australian Tsunami Warning System
Geoscience Australia
GPO Box 378 Canberra ACT 2601 Australia
Tel +61 262499494
Email: spilio.spiliopoulos@ga.gov.au

Mr Peter WILLETT
Assistant Director Tsunami Warning
Emergency Management Australia,
P.O. BOX 1020 Dickson ACT 2602
Tel: +61 2 62564776
Email: peter.willett@ema.gov.au

BANGLADESH

Mr Ashraf Al Islam SYED,
Disaster Management Bureau,
92-93 Mohakhali C/A (4th floor) Dhaka-1212.
Bangladesh
Tel+ 880-2-8859638, 880-2-8851615
Email: islamasyed@hotmail.com

FRANCE

Mr Gerard THERRY
Meteo France Regional Director La Reunion,
BP4 97491 Sainte Clotilde Cedex La Reunion
Tel: +262 62 92 11 00 Fax: +262 62 92 11 47
Email: Gerard.therry@meteo.fr

INDIA

Dr P.S. GOEL
Secretary to the Govt. of India
Ministry of Earth Science,
Department of Ocean Development
Chairman ICG/IOTWS
Block - 12, Mahasagar Bhavan CGO Complex,
Lodhi Road New Delhi – 110 003
Tel: +91 11 24360874 Fax: +91 11-24362644
Email: dodsec@dod.delhi.nic.in

Dr Shailesh NAYAK
Director, Indian National Centre for Ocean
Information Services (INCOIS) "Ocean valley"
P.B. No.21, IDA, Hyderabad 500055
Tel: +9140 23595000, Fax: +9140 23595001
Email: director@incois.gov.in

Dr Ashok BHATNAGAR
Additional Director General India
Meteorological Department (IMD)
Mausam Bhawan, Lodi Road
New Delhi 110003 India
Tel: +91 11 24697473
Email: bhatnagar.ashok@gmail.com

Dr M. RAVICHANDRAN
Indian National Centre for Ocean Information
Services (INCOIS),
"Ocean Valley", P B No. 21
IDA Jeedimetla P.O
Hyderabad – 55, India
Email: ravi@incois.gov.in

Dr B R SUBRAMANIAN
Project Director Integrated Coastal and Marine
Area Management (ICMAM)
NIOT Campus, Velachery, Tambaram Main
Road, Palikaranai Chennai – 601 302
Tel: +91 44-22460274 Fax: +91 44-22460657
Email: brs@icmam.gov.in

Mr Naveen VERMA
Joint Secretary (Disaster Management)
Ministry of Home Affairs
North Block, New Delhi 110003
Tel: 91 11 23092478
Email: n.verma@nic.in

INDONESIA

Dr Ir. Jan SOPAHELUWAKAN
Deputy Chairman for Earth Sciences
Indonesian Institute of Sciences (LIPI)
Gd. Widya Sarwono Lt. 3 Jl.Jend. Gatot Subroto
10, Jakarta 12710
Tel: +62 21-5251850 Fax: + 62 21-5260804
Email: jans@lipi.go.id;
jx_hydrogen@yahoo.com

Mr Katmoko ARI
Reseacher - LAPAN, Jl. LAPAN no. 70 Pekayon
Jaktim 13710 Indonesia
Tel: 62 218710786 Fax: 62 218722733
Email: k-ari-s@lapanrs.com

Dr Zainal ARIFIN
Deputy Director
Research Centre for Oceanography, Jl. Pasir
Putih I Jakarta 14430
Tel: 62 2164713850 Fax: 62 2164711948
Email: zarifin@dnet.net.id

Ms Velly ASVALIANTINA,
Coastal Dynamics Research Center Agency for
the Asessment & Application Technology
(BPPT) JI.M.H. Thamrin No. 8, Gd.2, Lt. 11
Jakarta 10340
Tel: +62 21-3169396 Fax: +62 21-3169393
Email: velly@bppt.go.id;
sayavelly@yahoo.com

Dr Ridwan DJAMALUDDIN
Head, Marine Survey
Marine Survey Technology Center Agency for
the Assessment & Application of Technology
(BPPT) JI.M.H. Thamrin No. 8 Jakarta Pusat
Tel: +62 21-3168804 Fax: +62 21-3108149
Email: ridwan@ceo.bppt.go.id

Mr Bambang DWIYANTO
Head of Geological Agency,
Ministry of Energy and Mineral Resources
Jl. Gatot Subroto Kau 49 Jakarta 12950
Tel: 62-21-5228371, Fax: 62-21-5228372
Email: bbdwiyanto@yahoo.com

Dr FAUZI
Head of Engineering Seismology and Tsunami
Division Meteorological and Geophysical
Agency (BMG) Jakarta, Indonesia,
Jl. Angkasa I, No. 2, Kemayoran, Jakarta Pusat
Tel: 62 21424 6321 ext 331 Fax: 62 21 654 6316
Email: fauzi@bmg.go.id

Mr Foster GULTOM
Deputy Director,
Department of Foreign Affairs of Indonesia
Jl. Taman Pejambon No 6
Jakarta – 10110 Indonesia
Tel: 62-21-3509061, Fax: 62-21-3509051

Email: fgulty2001@yahoo.com;
foster.gultom@deplu.go.id

Dr.Ing KHAFID
National Coordinating Agency for Surveys and Mapping Jl. Raya Jkt-Bgr km. 46 Cibinong Bogor
Tel: 62 2187907723 Fax: 62 2187901255
Email: khafid67@yahoo.com

Dr Parluhutan MANURUNG
Head of Division for Gravity and Tide, National Coordinating Agency for survey & Mapping
Jl. Raya Jakarta Bogor Km46
Cibinong, Indonesia 16911
Tel: 62-21-87907730, Fax: 62-21-27907730
Email: parluhutan@bakosurtanal.go.id

Mr Mawardi NUR
Head RS Aplication Development
Jl. LAPAN No. 70, Pasar Rebo, Pekayon,
Jakarta, Timur 13710 Indonesia
Tel: 62 218710786 Fax: 62 218722733
Email: m-nur@centrin.net.id;
mnur@lapanrs.com

Dr Wahyu W PANDOE
Marine Survey Technology Center Agency for the Assessment & Application of Technology (BPPT) JI.M.H. Thamrin No. 8 Jakarta Pusat
Tel: +62 21-3168804 Fax: +62 21-3108149
Email: wpandoe@cbn.net.id

Mr Rustandi POERAWIARDI
Head of Geodesy and Geodynamics Centre
National Coordinating Agency for survey & Mapping (Bakosurtanal)
Jalan Raya Jakarta Bogor KM46, Cibinong, West Java
Tel: 62-21-8758061, Fax: 62-21-8758061
Email: poera@bakosurtanal.go.id

Dr Edie PRIHANTORO
Deputy Director for Science and Technology Resources State Ministry of Research and Technology, Gd.II BPPT Lt.6 Jl.M.H. Thamrin No. 8, Jakarta 10340
Tel: + 62 21-3169166 Fax. + 62 21-3101952
Email: edie_pri@ristek.go.id

Dr Arief RACHMAN
Executive Chairman
Ministry National Education Indonesia,
Jl. Jend. Sodirman Senayan Jakarta 10270
Tel: 62 21 5733127
Email: aspenetind@cbn.net.id

Mr Lukaman Hakim SIREGAR
Department of Foreign Affairs of Indonesia,
Jl. Taman Pejambon No 6, Jakarta
Tel: 62-21-3509061, Fax 62-21-3509051
Email: Lukman-Siregar@deplu.go.id

Dr SUHARSONO
Director Research Centre for Oceanography
Jl. Pasir putih I Jakarta 14430
Tel: 62 2164713850 Fax: 62 2164711948
Email: shar@indo.net.id

Dr SURONO
Head of Center Volcanology and Geological Hazard Mitigation,
Jl. Diponegoro 57 Bandung 40122,
E-mail: surono@vsi.esdm.go.id

Mr Bambang TRISAKTI
Reseacher- LAPAN,
Jl. LAPAN No. 70, Pasar Rebo, Pekayon,
Jakarta, Timur 13710 Indonesia
Tel: 62 218710786 Fax: 62 218722733
Email: btris01@yahoo.com

Mr Didin WAHYUDIN
Deputy Permanent Delegate
Permanent Delegation of Indonesia to UNESCO
1 rue Miollis, Paris, France 75011
Email: dip.indonesia@unesco.org

Dr WARDIYATMO
Expert Staff for Minister on Economic, Science and Technology
Department of Culture & Tourism,
Jl. Medan Merdeka Barat No. 17. Jakarta 10110
Tel: 62-21-3838404, 3867587
Email: ardiyatmo@budpar.go.id

Mr Kongko WIDJO
Tsunami Modeller
BPPT Jl. Grafika 2 Bulaksumur Yogyakarta Indonesia
Tel: 62 274586239 Fax:62 274 542789
Email: widjo@webmail.bppt.go.id

Prof. Dr. M. Aman WIRAKARTAKUSUMA
Ambassador Permanent Delegate
Permanent Delegation of Indonesia to UNESCO
1 rue Miollis, Paris, France 750015
Email: amb.indonesia@unesco.org

Dr Ir Sugiarta WIRASANTOSA
Director Research Center for Marine Territory and Non Living Resources
JI.M.T. Haryono Kav 52-53 Jakarta 12770

Tel: +62 21-79191202 Fax: +62 21-79180303
Email: igi1@dlep.go.id

KENYA

Dr Joseph R. MUKABANA (Head of Delegation)
Director, Kenya Meteorological Department
P.O. Box 30259, Nairobi 00100
Tel: +254 020 3874214 Fax: +254 020 3876955
Email: mukabana@meteo.go.ke; director@meteo.go.ke

Ms Beatrice AKUNGA
Fisheries Officer, Ministry of Livestock and Fisheries Development
PO Box 58187 Nairobi
Tel: +254 020 0733423938 Fax: +254 20 342149
Email: nyabokeakunga@yahoo.com

Ms Stella AURA
Assistant Director
Kenya Meteorological Departement,
PO BOX 30259-00100 Nairobi
Tel: 254 203867880 Fax: 254 2076955
Email: aura@meteo.go.ke

Mr Davies Micho MWALUMA
Deputy Secretary
Ministry of State for Special Programes-OOP
Tel: +254-020251550
Email: michomwalumadridland.go.ke@yahoo.com

Mr Ephantus Nyaga NGOTHO
Senior Planning Project Development Officer
Kenya Meteorological Department
P.O. Box 30259-00100 Nairobi
Tel: 254-20-3867880, Fax: 254-20-3876955
E-mail: enngotho@yahoo.com

Mr Boniface W. WANYAMA
Assistant secretary General, Kenya National Commission for UNESCO,
PO BOX 72107-00200 Nairobi
Tel: 254 721 434057 Fax: 254 20213025
Email: bwwekesa@yahoo.com

MADAGASCAR

Mr Jacky Roland RANDIMBIARISON (Head of Delegation)
Secretary Executive of Conseil National De Secours, Route Mausolée, Antanimora
Antananarivo 101, Madagascar
Tel: 00261 20 22 594 50
Mobile Phone: 00261 32 02 288 02
Fax: 00261 20 22 594 51
Email: cnsmira@netclub.mg

Prof. Gerard RAMBOLAMANANA
Head of the Laboratory of Seismology and Infrasound
IOGA, University of Antananarivo,
PO BOX 3843, Antananarivo 101
Tel: 002613207050803, Fax: 00261202230182
Email: rambolamanana_gerard@yahoo.fr

MALAYSIA

Mr Che Moin UMAR (Head of Delegation)
National Security Division,
Prime Minister Department
Tel: 602-8888-2050, Fax: 603-8888-3057
Email: moin@bkn.jpm.my

Dr Mohd Rosaidi BIN CHE ABAS
Director of Seismological Division
Malaysian Meteorological Department,
Jalan Sultan, 46667 Petaling Jaya, Selangor
Tel: 603-7967-8000, Fax: 603-79550946
Email: rosaidi@kjc.gov.mg

Dr Aidy Mohamed MUSLIM
Head Software Department,
Malaysian Centre for Remote Sensing
Macres No 13 Jalan Tun Ismail, 50480
Kuala Lumpur
Tel: 603-26966819
Email: aidy@macres.gov.my

Mr Azlikamil NAPIAH
Malaysian Centre for Remote Sensing,
13, Jalan Tun Ismail 50480 Kuala Lumpur
Tel: 603-2697-3400, Fax: 603-2697-3360
Email: azli@macres.gov.my

Mr Bun-Liong SAW
Principal Assistant Director
Malaysian Meteolological Service,
Jalan Sultan, Petaling Jaya, Selangor 43200
Tel: 603-7967-8063. Fax: 603-7958-4824
Email: sawbl@kjc.gov.mg

MALDIVES

Mr Abdullah ALGEEN
Director, Department of Meteorology
Orchid Magu, Male
Tel: 960-332-5766; Fax: 960-332-0021
Email: algeen@meteorology.gov.mv

Major Mohamed NAZIM
National Disaster Management Centre (NDMC)
Boduthakurufaanu Magu, Male 20-20
Tel: 960-332-2607, Fax: 960-332-2901
Email: naxcym@hotmail.com

MAURITIUS

Mr S.C. SEEBALLUCK (Head of Delegation)
Secretary to the Cabinet and Head of the Civil Service, Prime Ministers Office
Treasury Building, Port Louis
Tel: +230 201 2850 Fax: +230 201 6642
Email: sseeballuck@gov.mu

Mr Soobaraj Nayroo Sok APPADU
Director Meteorological Services
St. Paul Road, Vacoas
Tel: +230 686 1031 Fax: +230 686 1033
Email: meteo@intnet.mu

Mrs Sin Lan NG YUN WING
Director, Ministry of Environment & National Development Unit,
Barracks Street, Port Louis
Tel: +230-212-6080, Fax: +230 212 6671
Email: dirdoe@mail.gov.mu

OMAN

Mr Ahmed AL HARTHI
Director of Meteorology
Ministry of Transport and Communications
P.O. Box 1, Seeb Airport
Muscat 111, Sultanate of Oman
Tel:+968-24-519360, fax: +968-24-518360
Email: a.alharthy@met.gov.om

Mr Ali Abdullah AL-RASHDI
Representative of Sultanate of Oman
c/o Embassy of the State of Qatar
Jl. Mega Kunungan Barat I/No. 7
Kawasan Mega Kuningan
Jakarta Selatan 12950
Tel: 62-21-2510757, Fax: 62-21-5764334
Email: omanreps@dnet.net.id

PAKISTAN

Mr Farooq Ahmad KHAN
National Disaster Management Authority,
Prime Minister Secretariat
Islamabad
Tel: 0092-51-9222-373, Fax: 0092-51-920-4197
Email: farhan23@gmail.com

Dr Qamar Z. CHAUDHRY
Director General
Pakistan Meteorological Department
Sector H-8/2, Islamabad
Tel: 92-51-9250367, Fax: 92-51-9250368
Email: DGMETPAK@hotmail.com

SEYCHELLES

Mr Yann ROUSSEAU
Technical advisor
Seychelles Fire Brigade
PO Box 46, Ltaner Road
Victoria, Seychelles
Tel: +248-289958, Fax: +248-289966
Email: Rousseau_yann@yahoo.fr , vielle@statehouse.gov.sc

SINGAPORE

Mr Lesley CHOO BOUN PHENG
Head Systems and Communications
Meteorological Services, National Environment Agency
P.O. Box 8, Changi Airport Singapore 918141
Tel: +65 65 429804 Fax: +65 65 45 7192
Email: Lesley_Choo@nea.gov.sg

Ms Yap Chui WAH
Meteorological Officer National Environment Agency,
PO BOX 8, Changi Airport, Singapore 918141
Tel: +65 65429189 fax: +65 65457192
Email: yap_chui_wah@nev.gov.sg

SOMALIA

Dr Abdi Mohamoud SIAD
Ministry of Fishery and Marine Research,
No. 5 North Street, Unit 314,
Oxford Court, Illovo 2196
South Africa
Mobile: +27-76-1009779
Fax: +27-11-6374707
Email: amsiad@mweb.co.za

Hon. Abdulkadir NUR ARALE
Deputy Minister of Fisheries and Marine Resources, Baidao
Tel: +2521-871170, +2521-214532
Email: arraleh05@yahoo.com

SRI LANKA

Mr G.H.P. DHARMARATNA
Director General, Department of Meteorology,
383, Buddhaloka Mawatha, Colombo 7.
Tel: +94 11 2694 104 Fax: +94 11 2698 311

Email : gdharmaratna@yahoo.com,
Meteo1@sltnet.lk

Major General Gamini HETTIARACHCHI
Director General, Disaster Management Centre,
Room No.2-201 BMICH, Bandditaloka
Mawatha Colombo MB-07
Tel: +001 2670082 Fax 001 2670070
Email: dgdmcsl@gmail.com

Prof. Sam HETTIARACHCHI
Professor of Civil Engineering
University of Moratuwa, Moratuwa
Tel: +94 11 265 0567/8 Fax: +94 11 265 0622
Email: sslh@civil.mrt.ac.lk

THAILAND

Group Captain Chitipat BEJRABURNIN
Chief of Policy and Planning
National Disaster Warning Center,
Rahanatibet Road, Bang Kra Sor,
Muang, Nonthaburi
Tel: 02-5892497, Fax: 02-5896008
Email: bejraburnin5@hotmail.com

Rear Admiral Thaworn CHAROENDEE
Vice Executive Director,
National Disaster Warning Center,
RaHanatibet Road, Bang Kra Sor, Muang,
Nonthaburi
Tel: 025892497, Fax: 025896008
Email: ndwc_thawon@hotmail.com

Dr. Smith DHARMASAROJA
Vice Minister/Chairman for the Development of
an Early Warning System,
Office of the Prime Minister's Secretariat
Government House, Dusit, Bangkok 10300
Tel: 662-2807613, Fax: +662-2807164
Email: kk_kajon@hotmail.com

Dr Stanley GOOSBY
National Disaster Warning Center,
Rattanathibet Road, Bang Kra Sor
Muang, Nontaburi 11000
Email: sgoosby@pdc.org

Mr Kriengkrai KHOVADHANA
Deputy Director-General
Thailand Meteorological Department
4353 Sukhumvit Road, Bangna
Bangkok. 10260
Tel: +662 398 9888 Fax: +662 399 4016
Email: kriengkrai@metnet.tmd.go.th

Mr Sethapan KRAJANGWONGS
First Secretary, Ministry of Foreign Affairs,
Sriayudhya Road, Bangkok 10400
Tel: 662-6435078, Fax: 6626435080
Email: sethapan@mfa.go.th

Ms Angsana SIHAPITAK
Director, Development Affairs Division
Ministry of Foreign Affairs,
Sriayudhaya Rd, Bangkok 10400
Tel: 02-6435077, Fax: 02-6435080
Email: angsana@mfa.go.th

Dr Cherdsak VIRAPAT
Chief, International Coordination,
National Disaster Warning Center
Rattanathibet Road, Bang Kra Sor
Muang, Nontaburi 11000
Tel: 66-2589-2497 ext 17, Fax: 66-25896008
Email: cvirapat@hotmail.com

TIMOR LESTE

Dr Aurelio GUTERRES
National Disaster Management Office (NDMO),
Palacio du Governo, Building-5
Kobe IV, Dili
Tel: +670 7231552; Fax: 670-3322537
Email: aurelioguterres@yahoo.com

Dr Jane S.P. MOCELLIN
National Disaster Reduction Advisor to
Ministry of Interior, National Disaster
Management Office (NDMO)
Kobe House, 6
Palacio do Governo
Dili, East Timor
Tel: 670-33-22597, Fax: 670-33-12408
Email: jane2.mocellin@undp.org

Mr Francisco FM ROSARIO
Head, National Disaster Management Office
Palacio Du Governo, Building-5,
Kobe IV Dili,
Tel: 670-7230107
Email: francisco_ndmo@yahoo.com

UNITED-REP. OF TANZANIA

Mr David N. KIRWAY
Disaster Management Department,
Prime Ministers Office
P.O. Box 3021, Dar-es-Salaam
Tel: +255222117266, Fax: +255222717266
Email: disaster@pmo.go.tz

Dr Emmanuel Jonathan MPETA
Director, Tanzania Meteorological Agency,
Orogogo Road, Dar-Es-Salaam, PO Box 3056
Tel: +255222460701, Fax: +255222460700
Email: empeta@meteo.go.tz

YEMEN

Mr Abdulkhaleg Yahia AL GHABERI
Director General of Environmental Emergency
Ministry of Water & Environment,
PO Box 20391 Sana'a
Tel: +962 1418295, Fax: 9671418295
Email: alGhaberi1@gmail.com;
eeuyememem@yemen.net.ye

Mr Mannaa Mane AL OMITHELY
Chairman of the Service Cyrcle,
President's Office
P.O. Box 20391 Yemen
Tel: 4967-7777-1486

Mr Mohammed AL-SHABAAN
Director Disaster Management Unit
P.O. Box 551
Sana'a, Republic of Yemen
Tel: 967-1-472357, Fax: 967-1-472368
Email: mahshabaan@yahoo.com

MEMBER STATES OF IOC OBSERVERS TO ICG

EGYPT

Prof. Ibrahim A. MAIYZA,
Head of Environmental Division
National Institute of Oceanography & Fisheries,
Kayat-Bey, Alexandria, Egypt
Tel: 02-03-4810491, Fax: 02-03-4807138
Email: i_maiyza@hotmail.com

FINLAND

Ms Heidi MARTTILA
Embassy of Finland
Menara Rajawali, Jl. Mega Kuningan Lot 5.1
Indonesia
Tel: +62-215761650
Email: heidi.marttila@formin.fi

GERMANY

Dr Reinhold OLLIG (Head of Delegation)
Director, Ministry for Education and Research
Heinemannstrasse 2 D-53175 Bonn
Tel: +4 91888 573469 Fax: +49 1888 57 83469
Email: reinhold.ollig@bmbf.bund.de

Dr Joern BEHRENS
Head, Tsunami Modelling Group
Alfred Wegener Institute, Am Hadelshafen 12,
22570 Bremerhaven Germany
Tel: +47 471 4831128
Email: jbehrens@awi-bremerham.de

Prof. Dr. Azhar DJALOEIS
Forschungszentrum Juelich, Germany
Tel: +49 24622609
Email: demita2004@yahoo.com

Mr Rainer HANER
Geoforschungszentrum Potsdam (GFZ)
Telegrafnberg D-14473 Potsdam
Email: rainer.haener@gfz-potsdam.de

Ms Andrea HEYN
Scientific Counsellor, German Embassy
Jl. MH Thamrin 1, Jakarta
11200 Indonesia
Tel: +62 21 39855000 ext.155
Email: andrea.heyn@diplo.de

Dr Toni KRAFT
GeoForschungsZentrum Potsdam
Telegrafenberg, 14473 Potsdam, Germany
Tel: 4933 17403937, Fax: 493317903939
Email: tonik@gfz-potsdam.de

Dr Joern LAUTERJUNG
Head of Scientific Staff
Geoforschungszentrum Potsdam (GFZ)
Telegrafnberg D-14473 Potsdam
Tel: +49 331-2881020 Fax: +49 331 2881002
Email: lau@gfz-potsdam.de

Dr Harald MEHL
German Aerospace Center,
German Remote Sensing Data Center,
Department for Environment and Security,
Oberpfaffenhofen, 82234 Wessling Germany
Tel: +49 8153 28 1137 Fax: +49 8153 28 1445
Email: harald.mehl@dlr.de

Dr Joachim POST
German Aerospace Center,
German Remote Sensing Data Center,
Department for Environment and Security,
Oberpfaffenhofen, 82234 Wessling Germany
Tel: 498153281470 Fax: 498153281445
Email: Joachim.post@dlr.de

Mr Torsten RIEDLINGER
German Aerospace Center (DLR)
Oberpfaffenhofen 82234 Wessling Germany Tel: +49 8153283674 Fax: +49 8 153 28 1445
Email: Torsten.Riedlinger@dlr.de

Dr Joachim SAUL
GeoForschungsZentrum Potsdam
Telegrafenberg, 14473 Potsdam, Germany
Email: Saul@gfz-potsdam.de

Mr Harald SPAHN
GTZ-IS Deutsche Bank Building,
10th floor, Jl. Iman Bonjol 80
Jakarta 10310, Indonesia
Tel: +62 (0)21 39831517
Email: harald.spahn@gtz.de

Dr Guenter STRUNZ
German Aerospace Center (DLR)
Oberpfaffenhofen, 82234 Wessling
Tel: +49 8153281314 Fax: +498153281445
Email: Guenter.strunz@dlr.de

JAPAN

Mr Osamu KAMIGAICHI
Senior Coordinator
Japan Meteorological Agency
1-3-4 Otemachi, Chiyoda, Tokyo 100-8122
Tel: 81(3) 32841743, Fax: 81 (3) 32152963
Email: okamigai@mel.kishau.go.jp

Mr Inone NIROSHI
NIED, Japan
1-13-16 Tennodao, Tsukuba, Japan

NORWAY

Mr Bjorn JOHANNESSEN
Senior Adviser, Ministry of Foreign Affairs,
P.O Box 8114 Dep
N-0032, Oslo, Norway
Tel: +47-22-243628, Fax: +47-22-242726
Email: bjorn.johannessen@mfa.no

U.S.A.

Dr Eddie BERNARD (Head of Delegation)
Director, PMEL 7600 Sand Point Way NE,
Seattle WA 98115
Tel: +1 206 526 6800 Fax: +1 206 526 4576
Email: eddie.n.bernard@noaa.gov

Mr Orestes ANASTASIA
Program Manager US IOTWS Program USAID
Regional Development Mission/Asia,
Diethelm Towers A, 10th Floor
93/I Wireless Road Bangkok 10330 Thailand
Tel: +66 2 263 7468 Fax: +66 2 263 7497
Email: oanastasia@usaid.gov

Mr Curtis BARRETT
Manager NOAA Tsunami Project,
1325 East West Highway,
SSMCII, Room 11, 152
Silver Spring MD, Maryland 20910
Tel: 301-713-1784x136
Email: curtis.barrett@noaa.gov

Mr Winston H. BOWMAN
Regional Environmental Director
USAID, Regional Development Mission
Diethelm Towers A, 10th Floor
93/I Wireless Road
Bangkok 10330 Thailand
Tel: +66 2 263 7469 Fax: +66 2 263 7499
Email: wbowman@usaid.gov

Dr David MCKINNIE
Coordinator, NOAA Indian Ocean Tsunami Warning System Project
7600 Sand Point Way NE Seattle, WA 98115
Tel: +1 206 526 6950 Fax: +1 206 526 4576
Email: david.mckinnie@noaa.gov

Dr Edward YOUNG
Assistant Regional Director
NOAA National Weather Service Pacific Region
Grosvenor Center, Mauka Tower
737 Bishop Street, Suite #2200
Honolulu, HI 95813
Tel: 1 808 532 6412, Fax: 1 808 5325569
Email: Edward.young@noaa.gov

UNITED KINGDOM

Mr Martin DAWSON
Deputy Head DFID Indonesia,
c/o British Embassy
Jl. MH. Thamrin No. 75
Jakarta 10310 Indonesia
Tel: 62-21-315-6264, Fax: 62-21-314-1824
Email: m-dawson@dfid.gov.uk

ORGANIZATIONS / INSTITUTIONS

ASIAN DISASTER REDUCTION CENTER (ADRC)

Ms Akiko NAKAMURA
Researcher, Asian Disaster Reduction Center
Hitomiraikan 5F 1-5-2 Wakinohamakaigan-dori
Chuo-ku Kobe 651-0073 JAPAN
Tel: +81 78 262 5540 Fax: +81 78 262 5546
Email: nakamura@adrc.or.jp

ASIAN DISASTER PREPAREDNESS CENTER (ADPC)

Mr Arjunapermal SUBBIAH
Director, Asian Disaster Preparedness Center
CRM AIT Campus Bangkok
P.O. Box 4,Klong Luang Pathumthani
12120,Thailand
Tel: +66 2 516 5900, Fax: +66 2 524 5360
Email: subbiah@adpc.net

INTERGOVERNMENTAL COORDINATION GROUP/ PACIFIC TSUNAMI WARNING AND MITIGATION SYSTEM (ICG/PTWS)

Mr Fred STEPHENSON
Vice Chairman ICG/PTWS,
Manager, Geomatics Engineering
Canadian Hydrographic Service
Institute of Ocean Sciences
P.O. Box 6000 9860 West Saanich Road Sidney,
BC CANADA V8L 4B2
Tel: +1 250 363 6350 Fax: +1 250 363 6323
Email: stephensonf@pac.dfo-mpo.gc.ca

INTERNATIONAL FEDERATION OF RED CROSS AND RED CRESCENT SOCIETIES

Harun AL-RASHID
Disaster Management Delegate,
Banda Aceh 18, Fatalilla, Indonesia
Tel: 8012 100 4078
Email: harun.alrashid@ifrc.org

Dr Ida Bagus UDIANA
Secretary, Bali Chapter Red Cross,
Jl. Imam Bonjol KM 3
Denpasar 80119
Tel: 081-23993177
Email: pmibali@net.id

Teresita USAPDIN
Information Delegate,
Federator, Banda Aceh, Indonesia
Email: Teresita.usapdin@ifrc.org

UNIVERSITY OF HAWAII SEA LEVEL CENTER/ GLOBAL SEA LEVEL OBSERVING. SYSTEM (UHSLC/GLOSS)

Dr Bernard KILONSKY
Department of Oceanography Univ. of Hawaii,
2770 Lai Road, Honolulu, Hawaii 96816 USA
Tel: +1 808 956 6574 Fax +1 808 956 2352
Email: kilonsky@hawaii.edu

Dr Jerome Aucan,
100 Pope Road, Honolulu, Hawaii 96822 USA
Email: Jerome@hawaii.edu

UNITED NATIONS INTERNATIONAL STRATEGY FOR DISASTER REDUCTION (UN/ISDR)

Joe CHUNG
Senior Regional coordinator UN/ISDR,
Asia-Pacific Region
UN Building Rajdamnern Nok Ave,
Bangkok 10200 Thailand,
Tel: 6622882750
Email: chung2@un.org

Stefanie DANNENMANN
Programme Officer
UN/ISDR-PPEW,
UN Campus, Hermann-Ehlers-Strasse 10
D-55113 Bonn, Germany
Tel: +492288150304
Email: Dannenmann@un.org

Patrick KRATT
Associate Expert
UN/ISDR Platform for the Promotion of Early Warning (PPEW)
Herrnamm-Ehlers-Strasse 10
D-53113 Bonn, Germany
Tel: +492288150307, Fax: 49-2282498888
Email: kratt@un.org

Noroarisoa RAKOTONDRANDRIA
Regional Programme Officer, UN/ISDR
Block T, 328, PO Box 47074, Gijin (UN Complex), Nairobi, Kenya
Tel : 254-207624568, Fax : 254-207624726
Email: noroarisoa.Rakotondrandria@unep.org

UNDP

Sanny JEGILLOS
Regional Programme Coordinator
UNDP Regional Center Bangkok
GPO Box 618
Bangkok 10501, Thailand,
Tel: 639 189191736
Email: sanny.jegillos@undp.org

WORLD AGENCY OF PLANETARY MONITORING & EARTHQUAKE RISK REDUCTION (WAPMERR)

Mr Adel KARAS
Regional Director, Africa, Asia & Middle East
Post Box No. 33280 Dubai UAE
Tel: +9714 332 2299 Fax: +9714 332 9988
Email: a_karas@wapmerr.org

Mr David KHIDASHELI
Director of Operations
Route de Jargonnant 2
CH-1207 Geneva Switzerland
Tel: +41 22 700 5544 Fax: +41 22 700 0044
Email: d_khidasheli@wapmerr.org

Mr Vadim CHESNOKOV
Senior Programmer
Tsunami Laboratory
Institute of Computational Mathematics and Mathematical Geophysics
Siberian Division, Russian Academy of Sciences
Pr.Lavrentieva, 6 Novosibirsk 630090 Russia
Fax. +7(383)330-8783
Email: wadsl@ngs.ru

Prof. Viacheslav GUSIAKOV
Head, Tsunami Laboratory
Institute of Computational Mathematics and Mathematical Geophysics
Siberian Division, Russian Academy of Sciences
Pr.Lavrentieva, 6 Novosibirsk 630090 Russia
Tel: 7-383-330-7070 Fax. +7(383)330-8783
Email: gvu@sscc.ru

Mr Igor MARININ
Head of Programming Group
Tsunami Laboratory
Institute of Computational Mathematics and Mathematical Geophysics
Siberian Division, Russian Academy of Sciences
Pr.Lavrentieva, 6 Novosibirsk 630090 Russia
Fax. +7(383)330-8783
Email: igor.marinin@inloje.ru

UNESCAP

Khalid HUSAIN
Regional Tsunami Trust Fund
UNESCAP, Programme Management Division
Rajadamnoen Nok Avenue
Bangkok 10200, Thailand
Tel.: (662) 288-1948, Fax: (662) 288-3035
Email: hussain@un.org

UNU-EHS

Dr Torsten SCHLURMANN
United Nations University, Institute for Environment and Human Security (UNU-EHS)
Goerresstr. 15 D-53113, Bonn Germany
Tel: +49 228 42285518 Fax: +49 228 42285599
Email: schlurmann@ehs.unu.edu

WORLD METEOROLOLGICAL ORGANIZATION (WMO)

Jean-Michel RAINER
Chief of Information System and Services Division, World Weather Watch
7 bis avenue de la Paix
Case Postale 2300
CH 1211 Geneve 2, Switzerland
Tel. +41 227308219, Fax: +41 227308021
Email: jmrainer@wmo.int

Edgard CABRERA
Chief of Ocean Affairs Division,
Applications Programme Department
7 bis avenue de la Paix
Case Postale 2300
CH 1211 Geneve 2, Switzerland
Tel. +41 227308237, Fax: +41 227308028
Email: ecabrera@wmo.int

SECRETARIAT

IOC/UNESCO

Patricio BERNAL
Executive Secretary IOC / ADG 1 rue Miollis
Paris 75015 France
Tel: +33 1 45 68 39 83 Fax: +33 1 45 68 58 12
Email: p.bernal@unesco.org

Peter KOLTERMANN
Head of IOC Tsunami Unit, Tsunami Office
1 Rue Miollis 75732 Paris CEDEX 15,
Tel: +33 1 45 68 40 15, Fax: +33 1 45 68 58 10,
Email: p.koltermann@unesco.org

Tony ELLIOTT
Head of ICG/IOTWS Secretariat IOC
IOC Perth Regional Office
P.O. Box 1370, West Perth Australia 6872
Tel: 618 9226 0191, Fax: 61 8 9263 2211
Email: t.elliott@unesco.org

Bernardo ALIAGA
Programme Specialist SC/IOC, Tsunami Office
1 Rue Miollis 75732 Paris CEDEX 15,
Tel:+33 145 68 39 80, Fax: +33 1 45 68 58 10
Email: b.aliaga@unesco.org

Ulrich WOLF
Programme Specialist SC/IOC Tsunami Office
1 Rue Miollis 75732 Paris CEDEX 15
Tel: +33 1 45 68 39 29 Fax: +33 1 45 68 58 10
Email : u.wolf@unesco.org

Jane CUNNEEN
ICG/IOTWS Secretariat
IOC Perth Regional Office
P.O. Box 1370, West Perth WA 6872 Australia
Tel: +61 8 9226 0191 Fax: +61 8 9263 2211
Email: j.cunneen@unesco.org

William ERB
IOC Perth Regional Office
C/- Bureau of Meteorology
P.O. Box 1370, Perth W.A. 6872 Australia
Tel: +61 8 9226 2899 Fax: +61 8 9226 0599
Email: w.erb@bom.gov.au

Laura KONG,
Director, IOC International Tsunami
Information Centre
737 Bishop St., Ste. 2200 Honolulu, Hawaii
96813 USA
Tel: +1 808 532 6423 Fax: +1 808 532 5576
Email: l.kong@unesco.org

Michael ROTTMANN,
UNESCO Jakarta Office, UNESCO House
Jl Galuh II, No15
Kebayoran Baru, Jakarta 12110,
Tel +62 8161936327, fax +62 2172796489,
Email: m.rottmann@unesco.org

Masahiro YAMAMOTO
Senior Tsunami Advisor
1 rue Miollis Paris 75015 France
Tel : +33 1 45 68 39 60 Fax: +33 1 45 68 58 10
Email: m.yamamoto@unesco.org

Brian YANAGI
IOC International Tsunami Information Centre,
737 Bishop St., Ste. 2200 Honolulu,
Hawaii 96813 USA
Tel: (1)808 532 6424 Fax: (1) 808 532 5576,
Email: brian.yanagi@noaa.gov

Michael ROTTMANN,
UNESCO Jakarta Office, UNESCO House
Jl Galuh II, No15
Kebayoran Baru, Jakarta 12110,
Tel: +62 8161936327, fax +62 2172796489,
Email: m.rottmann@unesco.org

OBSERVERS

Mr Kenneth DU VALL
Ligthhouse R+D Enterprises, Inc.
16945 Northchase Drive, Suite 100
Houston, Texas 77060 USA
Tel: 281 4474100, Fax: 281 447 4106
Email: kduvall@ligthhousehouston.com

Mr R. Craig HOBBS
Asia-Pacific Broadcasting Union,
PO Box 1164
59700 Kuala Lumpur, Malaysia
Tel: 60-3 2282 3592, Fax: 60-3 2282 5292
Email: craig.h@abu.org.my

Dr Hock Lye KOH
School of Mathematical Sciences,
Universiti Sains Malaysia,
11800 Penang, Malaysia
Tel: +604-6533657
Fax: +604-6570910
Email: hlkoh@cs.usm.my

Dr Charles MCCREERY
Director, Pacific Tsunami Warning Centre
91-270 Ft.Weaver Rd
Ewa Beach, HI 96706 USA
Tel: +1 808 6898207, Fax:1 808 68944543
Email: charles.mccreery@noaa.gov

Ms Cathryn PRIMROSE
Senior Oceanographer
Fugro Oceanor AS,
Pir-Senteret Trondheim
Norway N-7462
Tel: 47 7354 5211, Fax: 47 7354 5201
Email: c.primrose@oceanor.com

Dr Vasily TITOV
Research Scientist
PMEL/NOAA 7600 Sand Point Way NE Seattle,
WA 98115 USA
Tel: +1 206 526 4536 Fax: +1 206 526 6485
Email: vasily.titov@noaa.gov

Dr Costas SYNOLAKIS
Professor of Natural Hazards
University of Southern California
Los Angeles, CA 90089 USA
Tel: +1 213 740 0613 Fax: +1 213 744 1426
Email: costas@usc.edu

Assoc. Prof. Absornsuda SIRIPONG
Marine Science Department, Faculty of Science,
Chulalongkorn University,
Khet Pathumnan, Phya Thai Road,
Bangkok 10330, Thailand
Tel: 662-2185405, Fax : 662-2550780
Email: sabsorns@chula.ac.th

LOCAL ORGANIZING COMMITTEE

Dr Ir. Jan SOPAHELUWAKAN Deputy Chairman for Earth Sciences Indonesian Institute of Sciences (LIPI) Gd. Widya Sarwono Lt. 3 Jl.Jend. Gatot Subroto 10, Jakarta 12710 Tel: +62 21-5251850 Fax: + 62 21-5260804 Email: jans@lipi.go.id; jx_hydrogen@yahoo.com

Dr Edie PRIHANTORO Deputy Director for Science and Technology Resources, State Ministry of Research and Technology, Gd.II BPPT Lt.6 Jl.M.H. Thamrin No. 8, Jakarta 10340 Tel: + 62 21-3169166 Fax. + 62 21-3101952 Email: edie_pri@ristek.go.id

Dr Ridwan DJAMALUDDIN, Marine Survey Technology Center Agency for the Assessment & Application of Technology (BPPT) JI.M.H. Thamrin No. 8 Jakarta Pusat Tel: +62 21-3168804 Fax: +62 21-3108149 Email: ridwan@ceo.bppt.go.id

Dr Ir. Wahyu W PANDOE, Marine Survey Technology Center Agency for the Assessment & Application of Technology (BPPT) JI.M.H. Thamrin No. 8 Jakarta Pusat Tel: +62 21-3168804 Fax: +62 21-3108149 Email: wpandoe@cbn.net.id

Dr. Aryo HANGGONO, Ministry of Marine Affairs and Fisheries, Jl. MT.Haryono Kav. 52-53 Jakarta Selatan, Tel: +62 21 79180303, E-mail: arfarhan@geologist.com

Aulia Riza FARHAN, Ministry of Marine Affairs and Fisheries, Jl. MT.Haryono Kav. 52-53 Jakarta Selatan, Tel: +62 21 79180303, E-mail: arfarhan@geologist.com

Ariani ANDAYANI, Ministry of Marine Affairs and Fisheries, Institute for Marine Reseach and Observation, Desa perancak, Negara, Bali, E-mail: ariani02@yahoo.com

Asmi Marintan NAPITU, Ministry of Marine Affairs and Fisheries, Institute for Marine Reseach and Observation, Desa perancak, Negara, Bali, E-mail: asminapitu@ppk.itb.ac.id

Deny Wijaya KUSUMA, Ministry of Marine Affairs and Fisheries, Institute for Marine Reseach and Observation, Desa perancak, Negara, Bali, E-mail: deny_k@yahoo.com

ANNEX XIII

LIST OF ACRONYMS

ABU	Asia-Pacific Broadcasting Union
ADPC	Asian Disaster Preparedness Center
AFTN	Aeronautical Fixed Telecommunications Network
ASEAN	Association of Southeast Asian Nations
ATWS	Australian Tsunami Warning System
AUD	Australian Dollars
BMG	Badan Meteorologi and Geofisika (Indonesian Bureau of Meteorology)
CB	Capacity Building
CTBTO	Comprehensive Nuclear-Test-Ban Treaty Organization
CLIVAR	Climate Variability and Predictability
DART	Deep Ocean Assessment & Reporting of Tsunamis
EMWIN	Emergency Managers Weather Information Network
EU	European Union
FDSN	Federation of Digital Broadband Seismograph Networks
GA	Geoscience Australia
GDPFS	Global Data-Processing Meteorological Centre
GEOSS	Global Earth Observation System of Systems
GLOSS	Global sea Level Observing System
GMDSS	Global Maritime Distress & Safety System
GOOS	Global Ocean Observing System
GOS	Global Observing System
GTS	Global Telecommunication System
ICG	Intergovernmental Coordination Group
ICG/IOTWS	Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning & Mitigation System
ICG-I	Intergovernmental Coordination Group Meeting I – Perth, August 2005
ICG-II	Intergovernmental Coordination Group Meeting II – Hyderabad, December 2005
ICG-III	Intergovernmental Coordination Group Meeting III – Bali, July 2006
ICG/PTWS	International Coordination Group for the Pacific Tsunami Warning System
IFRC	International Federation of Red Cross & Red Crescent Societies
IMO	International Maritime Organization
IO	Indian Ocean
IOC	Intergovernmental Oceanographic Commission (of UNESCO)
IOGOOS	Indian Ocean GOOS
IOTWS	Indian Ocean Tsunami Warning System
ISDR	International Strategy for Disaster Reduction
ITIC	International Tsunami Information Center (IOC/UNESCO)
ITU	International Telecommunications Union
JMA	Japan Meteorological Agency
LIPI	Indonesian Institute of Sciences
NHK	Japan Broadcasting Corporation
NMC	National Meteorological Centre
NMHSs	National Meteorological & Hydrological Services
NRSA	National Remote Sensing Agency, India
NTWC	National Tsunami Warning Centre

OCHA	Office for the Coordination of Humanitarian Affairs
PPEW	Platform for the Promotion of Early Warning
PTWC	Pacific Tsunami Warning System
RMSCs	Regional Specialized Meteorological Centre
RTIC	Regional Tsunami Information Centre
RTH	Regional Telecommunication Hub
RTWP	Regional Tsunami Watch Provider
TEWS	Tsunami Early Warning System
TIC	Tsunami Information Centre
TWI	Tsunami Watch Information
TWS	Tsunami Warning System
UN	United Nations
UNDP	United Nations Development Programme
UNESCAP	United Nations Economic & Social Commission for Asia & the Pacific
UNESCO	United Nations Educational, Scientific & Cultural Organization
UNGA	United Nations General Assembly
UNU-EHS	United Nations University, Institute for Environment and Human Security
WAPMERR	World Agency of Planetary Monitoring & Earthquake Risk Reduction
WG	Working Group
WMC	Word Meteorological Centre
WMO	World Meteorological Organization

In this Series *Languages*

Reports of Governing and Major Subsidiary Bodies, which was initiated at the beginning of 1984, the reports of the following meetings have already been issued:

1.	Eleventh Session of the Working Committee on international Oceanographic Data Exchange	E, F, S, R
2.	Seventeenth Session of the Executive Council	E , F, S, R,Ar
3.	Fourth Session of the Working Committee for Training, Education and Mutual Assistance	E, F, S, R
4.	Fifth Session of the Working Committee for the Global Investigation of Pollution in the Marine Environment	E, F, S, R
5.	First Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions	E, F, S
6.	Third Session of the *ad hoc* Task team to Study the Implications, for the Commission, of the UN Convention on the Law of the Sea and the New Ocean Regime	E, F, S, R
7.	First Session of the Programme Group on Ocean Processes and Climate	E, F, S, R
8.	Eighteenth Session of the Executive Council	E, F, S, R, Ar
9.	Thirteenth Session of the Assembly	E, F, S, R, Ar
10.	Tenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific	
11.	Nineteenth Session of the Executive Council, Paris, 1986	E, F, S, R, Ar
12.	Sixth Session of the IOC Scientific Committee for the Global Investigation of Pollution in the Marine Environment	E, F, S
13.	Twelfth Session of the IOC Working Committee on International Oceanographic Data Exchange	E, F, S, R
14.	Second Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions, Havana, 1986	E, F, S
15.	First Session of the IOC Regional Committee for the Central Eastern Atlantic, Praia, 1987	E, F, S
16.	Second Session of the IOC Programme Group on Ocean Processes and Climate	E, F, S
17.	Twentieth Session of the Executive Council, Paris, 1987	E, F, S, R, Ar
18.	Fourteenth Session of the Assembly, Paris, 1987	E, F, S, R, Ar
19.	Fifth Session of the IOC Regional Committee for the Southern Ocean	E, F, S, R
20.	Eleventh Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Beijing, 1987	E, F, S, R
21.	Second Session of the IOC Regional Committee for the Co-operative Investigation in the North and Central Western Indian Ocean, Arusha, 1987	E, F
22.	Fourth Session of the IOC Regional Committee for the Western Pacific, Bangkok, 1987	E only
23.	Twenty-first Session of the Executive Council, Paris, 1988	E, F, S, R
24.	Twenty-second Session of the Executive Council, Paris, 1989	E, F, S, R
25.	Fifteenth Session of the Assembly, Paris, 1989	E, F, S, R
26.	Third Session of the IOC Committee on Ocean Processes and Climate, Paris, 1989	E, F, S, R
27.	Twelfth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Novosibirski, 1989	E, F, S, R
28.	Third Session of the Sub-Commission for the Caribbean and Adjacent Regions, Caracas, 1989	E, S
29.	First Session of the IOC Sub-Commission for the Western Pacific, Hangzhou, 1990	E only
30.	Fifth Session of the IOC Regional Committee for the Western Pacific, Hangzhou, 1990	E only
31.	Twenty-third Session of the Executive Council, Paris, 1990	E, F, S, R
32.	Thirteenth Session of the IOC Committee on International Oceanographic Data and Information Exchange, New York, 1990	E only
33.	Seventh Session of the IOC Committee for the Global Investigation of Pollution in the Marine Environment, Paris, 1991	E, F, S, R
34.	Fifth Session of the IOC Committee for Training, Education and Mutual Assistance in Marine Sciences, Paris, 1991	E, F, S, R
35.	Fourth Session of the IOC Committee on Ocean Processes and Climate, Paris, 1991	E, F, S, R
36.	Twenty-fourth Session of the Executive Council, Paris, 1991	E, F, S, R
37.	Sixteenth Session of the Assembly, Paris, 1991	E, F, S, R, Ar
38.	Thirteenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Baja California, 1991	E, F, S, R
39.	Second Session of the IOC-WMO Intergovernmental WOCE Panel, Paris, 1992	E only
40.	Twenty-fifth Session of the Executive Council, Paris, 1992	E, F, S, R
41.	Fifth Session of the IOC Committee on Ocean Processes and Climate, Paris, 1992	E, F, S, R
42.	Second Session of the IOC Regional Committee for the Central Eastern Atlantic, Lagos, 1990	E, F
43.	First Session of the Joint IOC-UNEP Intergovernmental Panel for the Global Investigation of Pollution in the Marine Environment, Paris, 1992	E, F, S, R
44.	First Session of the IOC-FAO Intergovernmental Panel on Harmful Algal Blooms, Paris, 1992	E, F, S
45.	Fourteenth Session of the IOC Committee on International Oceanographic Data and Information Exchange, Paris, 1992	E, F, S, R
46.	Third Session of the IOC Regional Committee for the Co-operative Investigation in the North and Central Western Indian Ocean, Vascoas, 1992	E, F
47.	Second Session of the IOC Sub-Commission for the Western Pacific, Bangkok, 1993	E only
48.	Fourth Session of the IOC Sub-Cornmission for the Caribbean and Adjacent Regions, Veracruz, 1992	E, S
49.	Third Session of the IOC Regional Committee for the Central Eastern Atlantic, Dakar, 1993	E, F
50.	First Session of the IOC Committee for the Global Ocean Observing System, Paris, 1993	E, F, S, R
51.	Twenty-sixth Session of the Executive Council, Paris, 1993	E, F, S, R
52.	Seventeenth Session of the Assembly, Paris, 1993	E, F, S, R
53.	Fourteenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Tokyo, 1993	E, F, S, R
54.	Second Session of the IOC-FAO Intergovernmental Panel on Harmful Algal Blooms, Paris, 1993	E, F, S
55.	Twenty-seventh Session of the Executive Council, Paris, 1994	E, F, S, R
56.	First Planning Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Melbourne, 1994	E, F, S, R
57.	Eighth Session of the IOC-UNEP-IMO Committee for the Global Investigation of Pollution in the Marine Environment, San José, Costa Rica, 1994	E, F, S
58.	Twenty-eighth Session of the Executive Council, Paris, 1995	E, F, S, R
59.	Eighteenth Session of the Assembly, Paris, 1995	E, F, S, R
60.	Second Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 1995	E, F, S, R

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61.	Third Session of the IOC-WMO Intergovernmental WOCE Panel, Paris, 1995	E only
62.	Fifteenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Papetee, 1995	E, F, S, R
63.	Third Session of the IOC-FAO Intergovernmental Panel on Harmful Algal Blooms, Paris, 1995	E, F, S
64.	Fifteenth Session of the IOC Committee on International Oceanographic Data and Information Exchange	E, F, S, R
65.	Second Planning Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 1995	E only
66.	Third Session of the IOC Sub-Commission for the Western Pacific, Tokyo, 1996	E only
67.	Fifth Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions, Christ Church, 1995	E, S
68.	Intergovernmental Meeting on the IOC Black Sea Regional Programme in Marine Sciences and Services	E, R
69.	Fourth Session of the IOC Regional Committee for the Central Eastern Atlantic, Las Palmas, 1995	E, F, S
70.	Twenty-ninth Session of the Executive Council, Paris, 1996	E, F, S, R
71.	Sixth Session for the IOC Regional Committee for the Southern Ocean and the First Southern Ocean Forum, Bremerhaven, 1996	E, F, S,
72.	IOC Black Sea Regional Committee, First Session, Varna, 1996	E, R
73.	IOC Regional Committee for the Co-operative Investigation in the North and Central Western Indian Ocean, Fourth Session, Mombasa, 1997	E, F
74.	Nineteenth Session of the Assembly, Paris, 1997	E, F, S, R
75.	Third Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 1997	E, F, S, R
76.	Thirtieth Session of the Executive Council, Paris, 1997	E, F, S, R
77.	Second Session of the IOC Regional Committee for the Central Indian Ocean, Goa, 1996	E only
78.	Sixteenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Lima, 1997	E, F, S, R
79.	Thirty-first Session of the Executive Council, Paris, 1998	E, F, S, R
80.	Thirty-second Session of the Executive Council, Paris, 1999	E, F, S, R
81.	Second Session of the IOC Black Sea Regional Committee, Istanbul, 1999	E only
82.	Twentieth Session of the Assembly, Paris, 1999	E, F, S, R
83.	Fourth Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 1999	E, F, S, R
84.	Seventeenth Session of the International Coordination Group for the Tsunami Warning System in the Pacific, Seoul, 1999	E, F, S, R
85.	Fourth Session of the IOC Sub-Commission for the Western Pacific, Seoul, 1999	E only
86.	Thirty-third Session of the Executive Council, Paris, 2000	E, F, S, R
87.	Thirty-fourth Session of the Executive Council, Paris, 2001	E, F, S, R
88.	Extraordinary Session of the Executive Council, Paris, 2001	E, F, S, R
89.	Sixth Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions, San José, 1999	E only
90.	Twenty-first Session of the Assembly, Paris, 2001	E, F, S, R
91.	Thirty-fifth Session of the Executive Council, Paris, 2002	E, F, S, R
92.	Sixteenth Session of the IOC Committee on International Oceanographic Data and Information Exchange, Lisbon, 2000	E, F, S, R
93.	Eighteenth Session of the International Coordination Group for the Tsunami Warning System in the Pacific, Cartagena, 2001	E, F, S, R
94.	Fifth Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 2001	E, F, S, R
95.	Seventh Session of the IOC Sub-commission for the Caribbean and Adjacent Regions (IOCARIBE), Mexico, 2002	E, S
96.	Fifth Session of the IOC Sub-Commission for the Western Pacific, Australia, 2002	E only
97.	Thirty-sixth Session of the Executive Council, Paris, 2003	E, F, S, R
98.	Twenty-second Session of the Assembly, Paris, 2003	E, F, S, R
99.	Fifth Session of the IOC Regional Committee for the Co-operative Investigation in the North and Central Western Indian Ocean, Kenya, 2002 (* Executive Summary available separately in E, F, S & R)	E*
100.	Sixth Session of the IOC Intergovernmental Panel on Harmful Algal Blooms, St. Petersburg (USA), 2002 (* Executive Summary available separately in E, F, S & R)	E*
101.	Seventeenth Session of the IOC Committee on International Oceanographic Data and Information Exchange, Paris, 2003 (* Executive Summary available separately in E, F, S & R)	E*
102.	Sixth Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 2003 (* Executive Summary available separately in E, F, S & R)	E*
103.	Nineteenth Session of the International Coordination Group for the Tsunami Warning System in the Pacific, Wellington, New Zealand, 2003 (* Executive Summary available separately in E, F, S & R)	E*
104.	Third Session of the IOC Regional Committee for the Central Indian Ocean, Tehran, Islamic Republic of Iran, 21-23 February 2000	E only
105.	Thirty-seventh Session of the Executive Council, Paris, 2004	E, F, S, R
106.	Seventh Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 2005 (* Executive Summary available separately in E, F, S & R); and Extraordinary Session, Paris, 20 June 2005	E*
107.	First Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS), Perth, Australia, 3–5 August 2005	E only
108.	Twentieth Session of the Intergovernmental Coordination Group for the Tsunami Warning System in the Pacific, Viña del Mar, Chile, 3–7 October 2005 (* Executive Summary available separately in E, F, S & R)	E*
109.	Twenty-Third Session of the Assembly, Paris, 21–30 June 2005	E, F, S, R
110.	First Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS), Rome, Italy, 21–22 November 2005	E only
111.	Eighth Session of the IOC Sub-commission for the Caribbean and Adjacent Regions (IOCARIBE), Recife, Brazil, 14–17 April 2004 (* Executive Summary available separately in E, F, S & R)	E*
112.	First Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions (ICG/CARIBE-EWS), Bridgetown, Barbados, 10–12 January 2006	E only
113.	Ninth Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE), Cartagena de Indias, Colombia, 19–22 April 2006 (* Executive Summary available separately in E, F, S & R)	E S*

114.	Second Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS), Hyderabad, India, 14–16 December 2005	E only
115.	Second Session of the WMO-IOC Joint Technical Commission for Oceanography and Marine Meteorology, Halifax, Canada, 19–27 September 2005 (Abridged final report with resolutions and recommendations)	E, F, R, S
116.	Sixth Session of the IOC Regional Committee for the Western Indian Ocean (IOCWIO), Maputo, Mozambique, 2–4 November 2005 (* Executive Summary available separately in E, F, S & R)	E*
117.	Fourth Session of the IOC Regional Committee for the Central Indian Ocean, Colombo, Sri Lanka 8–10 December 2005 (* Executive Summary available separately in E, F, S & R)	E*
118.	Thirty-eighth Session of the Executive Council, Paris, 20 June 2005 (Electronic copy only)	E, F, R, S
119.	Thirty-ninth Session of the Executive Council, Paris, 21–28 June 2006	E, F, R, S
120.	Third Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS), Bali, Indonesia, 31 July–2 August 2006	E only