Intergovernmental Oceanographic Commission
Reports of Governing and Major Subsidiary Bodies

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

Second Session

Hyderabad, India
14–16 December 2005

UNESCO

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ICG/IOTWS-II/3
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1. WELCOME AND OPENING

1 The inaugural function of the Second Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS) started at 09:00 hrs on 14th December 2005 in the House of Windsor Hall–I of the Hotel Viceroy at Hyderabad, India, with a welcome speech by Dr V. Sampath, Director, Indian National Centre for Ocean Information Services (INCOIS), Hyderabad, India. In doing so, he welcomed Dr P.S. Goel, Secretary to the Government of India, Department of Ocean Development and Chairman for ICG/IOTWS, Dr Patricio Bernal, Assistant Director-General, UNESCO and Executive Secretary of IOC, Professor B.L. Deekshatulu, Former Director, National Remote Sensing Agency (NRSA), India & CSSTE-AP of the UN and Visiting Professor, University of Hyderabad, Mr William Erb, Head, IOC Perth Regional Programme Office, Australia, Dr Harsh Gupta, Former Secretary to Government of India, Department of Ocean Development, the distinguished delegates from the Member States, UN Agencies, NGOs, Observers, Invitees, press and media. This was followed by lighting of the lamp.

2 Dr Patricio Bernal, Assistant Director-General of UNESCO and Executive Secretary of IOC, opened the first session of the ICG/IOTWS by recalling the role of IOC in establishing and operationalising the Tsunami Early Warning System (TEWS) in the Indian Ocean Rim Countries, the issues discussed in the first session of the ICG/IOTWS held in August 2005 at Perth, Australia, and the detailed agenda for the second session of ICG/IOTWS at Hyderabad, India, which is aimed mainly at implementation of an action plan for setting up and operationalising the TEWS in the Member States. He recalled that during the last one year effective warning was provided to the people of the region to save their life and property, by establishing the interim tsunami early warning system. Presently there are 26 information centres operating in the Indian Ocean region. He outlined the steps taken by the IOC and UN agencies in proving the mechanisms and linkages for upgrading the tsunami detection networks in the African nations, Indian Ocean Islands and nations around the Indian Ocean Rim, awareness programmes, etc., to put in place a fool-proof system. With the deployment of several deep sea pressure sensors, upgrading of the GLOSS sea-level network, a satellite-based real time data transmission and several centres which will be capable to interpret the data and launch warnings, there will be an initial system in operation to detect and confirm the generation of tsunamis in the Indian Ocean region by June/July 2006.

3 Dr P.S. Goel, Chairman ICG/IOTWS and Secretary to the Government of India, Department of Ocean Development, appreciated in his address the overwhelming response to this meeting and the contribution of the Member States in setting up the Tsunami Early Warning System, which has a major role in reducing the loss of life and property. He appreciated the coordination mechanism put in place and role played by UNESCO/IOC in this regard. The role of IOC as an enabler should try to bring in expertise wherever it is available, and assist the Member States in capacity building, networking, modelling, etc. He further observed that we should aim at putting in place a system of systems, identify the gaps in the existing system during the course of this Session and evolve a mechanism each country should have for generating and giving the early warning. The modalities of the inter-action/linking of the national and regional tsunami warning systems should be discussed in greater detail in this second session. He emphasised the need for reducing the time lag between issuing the warning to communicating the warning to the people. If we could ensure this happening, our objective/goal of this meeting would have been fulfilled.

4 Professor B.K. Deekshatulu, Former Director, NRSA and presently Visiting Professor in the University of Hyderabad was the chief guest speaker and inaugurated the Second Session of

ICG/IOTWS. In his inaugural address, he appreciated the view of the Director-General of UNESCO that the National Centres should develop their own educational/training and awareness plans besides the detection networks, risk assessment and preparedness plans. He further emphasized that the task of predicting the tsunami cannot be handled without the coordinated operation from many countries. One has to delineate the effects of tsunami with respect to the corresponding plate boundary movements. The warning system, the rapid evacuation and relief actions have to be designed to meet the local specific requirements of the region. He hoped that this meeting would provide a very good opportunity as well as challenge for scientists and administrators and a common platform for sharing knowledge and information as well as resolving issues of bilateral/multi-national nature on the topic of tsunami warning.

5 Mr William Erb, Head of the Perth Regional Programme Office of IOC, proposed a vote of thanks.

2. ORGANISATION OF THE SESSION

2.1 ADOPTION OF THE AGENDA

6 **The ICG adopted** its agenda for the session as given in Annex I. **It agreed** that the order in which agenda items might be dealt with could be modified as required.

2.2 DESIGNATION OF THE RAPPORTEUR

7 **The ICG accepted** the proposal of the ICG/IOTWS Technical Secretary and **welcomed** Mr Len Broadbridge of the IOC Perth Regional Programme Office as the Rapporteur for the session.

2.3 CONDUCT OF THE SESSION, TIMETABLE AND DOCUMENTATION

8 **The ICG adopted** the provisional timetable.

9 The List of Participants is presented in Annex X.

3. REPORT ON INTERSESSIONAL ACTIVITIES

3.1 REPORT FROM IOC HEADQUATERS

10 Dr Bernal reminded participants that following the 26 December 2004 tragic tsunami the IOC took the lead in coordinating the partnership of UN agencies, sponsors and countries necessary to establish a Tsunami Warning System (TWS) in the Indian Ocean. A number of major international coordination meetings and workshops have been organized by the IOC and various partners. This placed a tremendous strain on the IOC staff and there was a strong need to recruit personnel to fulfil the needs. Fortunately, during the course of the process several donors contributed funding or in-kind support enabling the IOC to staff the newly established tsunami unit. The Government of Australia generously contributed funds to establish the Secretariat for the Intergovernmental Coordination Group at the IOC Perth Regional Programme Office in Perth, Australia. Contracts were established to recruit temporary and permanent staff at IOC Perth and to support ICG intersessional workshops and meetings. A P-4 position will be advertised soon to complete the tsunami team in Perth and to act as ICG/IOTWS secretariat. Additionally, the Governments of Japan and Germany have provided support for two experts to work on the global coordination aspects of the tsunami warning system at IOC Headquarters in

Paris. Finally, the Government of Norway has provided funds to employ the head of the tsunami unit in IOC Headquarters, which will be announced soon, as well as additional administrative support in Paris through the end of 2007. The Executive Secretary of IOC expressed his hope to have the complete tsunami team in place by the second half of 2006. Although this team will be able to cover the necessary initial support for all regional ICGs he expressed some concern about the lack of sustainable funding for tsunami coordination and future programme activities both at the Headquarters and in the regions.

3.2 NATIONAL PROGRESS REPORTS FROM MEMBER STATES PROVIDING CAPABILITY TO THE IOTWS

11 The full presentations are presented as Annexes I-IV, and are also published on the ICG/IOTWS-II website: http://ioc3.unesco.org/idotsunami/hyderabad/.

12 Australia: Mr Rick Bailey, Project Director of the Australian TWS (ATWS), reported on Australia's tsunami vulnerability. He described their (ATWS) response to the 26 December 2004, tsunami. This included a government outlay of nearly $AUD 70 M over the next four years to provide an Australian National TWS, and support of international efforts in the Pacific and IO regions. The full ATWS is expected to be implemented by 2009.

13 Indonesia: Dr Jan Sopaheluwakan, Deputy-Chairman for Earth Sciences, Indonesian Institute of Sciences (LIPI), emphasized that following the several international and intergovernmental coordination meetings in 2005, Indonesia in cooperation with their German partners was able to deploy two DART-like tsunami-detection-buoys off the Indonesian coast. Additionally the first tide gauges have been installed/updated to provide real time data. Before December 2006, 25 new tide gauges will be installed. He reported that the Indonesian National Tsunami Warning Centre (BMG) already operates a 24/7 service. Dr Sopaheluwakan presented an overview of several very promising projects and activities on risk assessment, inundation modelling and education in Indonesia. He confirmed that Indonesia is strictly following the implementation time-line identified by IOC.

14 India: Dr V. Sampath, the Director of the Indian National Ocean Information Services (INCOIS), showed maps of the planned update of the seismic network and the anticipated 50 satellite-linked tide gauges. Dr Sampath identified India's capability and strength in the various scientific fields, which are necessary to plan, implement and operate an end-to-end TWS. The Department of Ocean Development is identified as the Nodal Ministry and the Government of India has given very high priority to the project. INCOIS acts as the national TWC for India. The commencement of the Emergency Warning Centre with 24/7 operational capability is expected to be operational by September 2007. Dr Sampath stated that India could play a major role for the IO region.

15 Malaysia: Professor Sinn Chye Ho, Director of the National Oceanography Directorate, reported on the upgrade of the national broadband seismic network and stated that seven stations will be operational by the first quarter of 2006. Additionally six new tide gauges in strategic locations, will complete the sea level station network. Twelve coastal cameras will augment the instrumentation for the intended multi-hazard warning system including hurricanes, storm surges and flooding.

16 France: Mr Gérard Therry, Regional Director of Météo-France, La Réunion, reported that France will concentrate on upgrading instrumentation in the Southwest Indian Ocean. The government will provide:

- € 800 k to update the real time seismic network
- € 90 k to upgrade tide gauges and buoys
- € 550 k to upgrade the WMO Global Telecommunication System (GTS)
- € 20 k for public education.

The NTWC at La Reunion has been operational on a 24/7 basis since April 2005.

17 Madagascar: Mr Andriamiranto Ravelson from the Institute of Geophysics in Atananarivo outlined activities and plans to assess the inundation of the December 2004, tsunami and to upgrade instrumentation. He described risk assessment initiatives, which included post tsunami surveys. Their modelling shows that at one location in Madagascar there is the potential of an eight-meter wave.

18 Thailand: Mr Kriengkrai Khovadhana from the Thailand Meteorological Department reported on their national plans for the next three years. Thailand will deploy three DART-like buoys off the Thai coast by 2008. There are plans for 15 new digital seismic by the end of 2006, bringing the total to 45 by 2008. Also, a multi-donor voluntary trust fund for the establishment of a TWS for the region has been established, which will be managed by UN-ESCAP. The Government of Thailand provided $US 10 M as a start-up budget.

3.3 REPORTS FROM UN AGENCIES AND ADPC

19 WMO: Mr Dieter Schiessl, Director of the World Weather Watch Department, reported on the WMO operational network and the GTS upgrades implemented in 2005. He emphasized the close cooperation with UNESCO/IOC and ISDR in planning and implementing regional TWS, and its planned integration within a multi purpose multi-hazard early warning strategy. Although the necessary upgrade of the WMO/GTS is well under way, some countries have delays of up to 20 mn for the delivery of a tsunami warning due to slow data connections. Although $US 1.5 M has been provided by donor countries to upgrade WMO's Global Telecommunication System, there is still a need for an additional $US 1.8 M to finalize the project for all Indian Ocean countries. In cooperation with IOC, educational and training modules are being developed within the UN flash appeal project.

20 ISDR: Mr Reid Basher, Coordinator, Platform for the Promotion of Early Warning, UN International Strategy for Disaster Reduction (PPEW, UN/ISDR reported on the different activities within the project "Evaluation and Strengthening of Early Warning Systems in Countries Affected by the 26 December 2004 Tsunami" and presented some preliminary results. He emphasized that ICG/IOTWS should take into account that a TWS should be embedded into a much broader, people-orientated early warning system.

21 UNU: Dr Torsten Schlurmann from the Institute for Environment and Human Security presented the Institute's capacity building activities in Indonesia as part of the German TEWS project. He expressed that it is intended to expand activities and cooperation within the project to other countries bordering the Indian Ocean.

22 ADPC: Mr A Subbiah reported on the recent activities and cooperative projects undertaken by the Asian Disaster Preparedness Centre.

3.4 REPORT FROM THE INTERGOVERNMENTAL COORDINATION GROUP FOR THE TSUNAMI WARNING SYSTEM IN THE PACIFIC (ICG/PTWS, formely ITSU)

23 Mr Fred Stephenson, Vice-chairman ICG/PTWS, reported on recent activities and the decisions of the last ICG/ITSU-XX meeting on 3–7 October 2005 in Chile. He appreciated the announcement by the IOC Executive Secretary that the IOC Secretariat is willing to serve as a coordinating body to integrate TWS related activities and decisions between the different regions around the globe.

24 Dr Laura Kong, Head of the IOC International Tsunami Information Centre (ITIC) reported on alert services and procedures adopted for the Pacific Ocean and ITIC's advisory role for the IOTWS as well as for other regions. She presented open-source tools to provide information and graphical output on GLOSS sea level data and stations and expressed ITIC's interest in preserving tsunami related data as well as to develop products accessible through the web.

3.5 REPORT ON IOC NATIONAL ASSESSMENT PROCESS

25 Dr Laura Kong recalled the cooperation between ISDR, WMO and UNESCO/IOC as well as the role and strength of the partners within the actual project in coordinating the implementation of an end-to-end TWS for the Indian Ocean. In the first phase the above-mentioned UN agencies developed a comprehensive questionnaire under the leadership of IOC to assess the actual situation in the countries bordering the Indian Ocean. The consolidated report as well as the underlying national assessment reports have been provided by the IOC secretariat as background information for ICG/IOTWS-II (on CD-ROM as well as on the web: http://ioc3.unesco.org/indotsunami/nationalassessments.htm). Additionally, the summary report has been published as a printed IOC publication (IOC/INF-1219).

26 Dr Kong clarified that the assessment process is part of an UN-wide (UNDP, UNESCO-IOC, UNEP, UNESCAP, UNU-EHS and WMO) flash appeal project "Evaluation and Strengthening of Early Warning Systems in Countries affected by the 26 December 2004 Tsunami" which comprises the tasks:

- Core System Implementation
- Integrated Risk Management
- Public Awareness & Education
- Community Level Approaches.

4. PROGRAMME ACTIVITIES

27 The conveners of the five Working Groups established during the first session of the ICG in August 2005 provided reports on progress achieved.

4.1 WG-1 (SEISMIC MEASUREMENTS, DATA COLLECTION AND EXCHANGE)

28 The Seismic Measurements, Data Collection and Exchange Group met on 10–11 November 2005, hosted by the Indonesian Bureau of Meteorology (BMG) in Jakarta.

29 The proposed actions included:

(i) Geoscience Australia (GA) to compile a database of seismographic stations and/or networks.

(ii) Data sharing of seismic waveform data.

(iii) Participation of IOC Member States and other organisations in tests GA's tests of seismic waveform data latency.

(iv) Seismographic stations to be deployed with sensor and data specification promulgated by the Federation of Digital Broadband Seismograph Networks —FDSN.

(v) Data acquisition systems to be decided by individual countries, with miniSEED and SEEDLINK to be used for data exchange.

(vi) A standard set of methodologies to be used for the estimation of earthquake magnitudes.

(vii) Participation of technical agencies is welcomed to assist Member States by providing training to build and operate national earthquake monitoring systems.

(viii) Recommendation that national networks become members of the FDSN.

4.2 WG-2 (SEA LEVEL DATA COLLECTION AND EXCHANGE, INCLUDING DEEP OCEAN TSUNAMI DETECTION INSTRUMENTS)

30 The intersessional report from WG2 includes a draft Terms of Reference.

31 Draft ToR intended to be a framework for:

- Consideration of scientifically based tsunameter array design
- Priorities for tsunameter deployment
- Tsunameter standards
- Cooperation on deployment, operations and maintenance
- Long term cooperation on production, etc.

4.3 WG-3 (RISK ASSESSMENT WORKING GROUP)

32 The Risk Assessment Group met soon after its establishment and prepared a Terms of Reference. It was recognised that it would be beneficial to make use of the findings of the Needs Assessment conducted by the UNESCO/IOC for the tsunami affected countries and other studies initiated by the respective countries, to identify the work to be carried out by the Risk Assessment Committee.

33 The Chairman and Co-Chairman prepared a discussion note identifying five proposals for implementation. The proposals covered:

- Tsunami Source Modelling,
- Tsunami Inundation Modelling and Validation,
- Vulnerability and Risk Assessment,
- Exploring Mitigating Options, and
- Building Databases and Information Management.

34 These proposals were discussed at a specialist symposium on Disaster Reduction on Coasts organized by Professor Paul Grundy at Monash University, Melbourne, attended by John

Schneider and Sam Hettiarachchi. The proposals were further refined and presented at this session.

4.4 WG-4 (MODELLING, FORECASTING AND SCENARIO DEVELOPMENT)

35 The WG4 held a workshop in Hyderabad, India, from 10 to 12 December 2005. Countries represented at the meeting were Australia, India, Indonesia, Malaysia, Singapore and Thailand. Proposals arising from the meeting include:

(i) Develop inundation maps for the coastal communities of the Indian Ocean region within 10 years.

(ii) Develop inundation maps for different scenarios.

(iii) Model standards, scenarios and benchmarks to be available on the website.

(iv) Training should include both short-term and long-term strategies

4.5 WG-5 (A SYSTEM FOR INTEROPERABLE ADVISORY AND WARNING CENTRES)

36 The WG5 held a meeting in Singapore on 24 November 2005. Countries and organisations present at the meeting included PTWC, JMA, IOC, Singapore, Mauritius, WMO, Australia, Kenya, India, ISDR, and Germany. The meeting was chaired by Mr Geoff Crane (Australia).

- Brief reports on the progress towards National Tsunami Warning capabilities were presented by India, Indonesia, JMA, Singapore, Kenya, Mauritius, and the PTWC.
- A meeting in Nairobi on 17–19 October (ISDR organised) of East African nations and nearby islands (Western Indian Ocean) discussed various plans for early warning systems. It is expected that they will largely depend on the IOTWS system.
- Operational issues were discussed and are presented in detail.

4.6 INDIAN OCEAN WARNING SYSTEM GAPS, NEEDS AND REQUIREMENTS

37 Dr Patricio Bernal emphasized that the working groups should:

(i) Identify gaps in establishing an end-to-end IOTWS;

(ii) Consider the Consolidated National Assessment Report (IOC/INF-1219);

(iii) Provide guidance to assist with drafting an implementation plan for the IOTWS.

38 He stated that ICG/IOTWS has to recognize three major time lines in their planning: July 2006, end of 2008 and 2015. Also, community based early warning should be taken into account as well as operational instrumentation and data exchange.

5. WORKING GROUPS' SESSIONAL MEETINGS AND AGREEMENT ON ACTION PLAN

39 The Executive Secretary of IOC reported on a breakout meeting with representatives of donor countries to discuss means and procedures to coordinate project funding in relation to IOTWS. The session enabled an exchange of ideas and approaches on how to provide funds to support the building the IOTWS. It was agreed that the donors would work with IOC to identify priority areas for funding and to establish workable mechanisms.

40 Although not acting as an adopted WG a paper produced by Reid Basher and co-workers will be attached to this report. It addresses how to integrate the ICG-coordinated tsunami warning systems into disaster management and national development processes. In the intersessional period before the next ICG in Bali the IOC secretariat will undertake appropriate action to address these issues, possibly utilizing a new WG.

41 The full reports of the Sessional Working Group meetings are given in Annexes III-VII. A table summarising the actions agreed by each working group is given in Annex II. Some of the more significant outcomes or actions to be taken include:

42 WG-1 (Seismic Measurements, Data Collection and Exchange

- Mwp software for fast magnitude estimation to be distributed to members;
- Agreement on a proposed core network of seismic field stations to monitor regional seismicity, and sharing of data;
- Germany (GFZ) and other potential donors to assist with new and upgrading existing seismic stations in East Africa as a high priority; and
- Training for seismological observatories practice to be undertaken as a high priority.

43 WG-2 (Sea Level Data Collection and Exchange, including Deep Ocean Tsunami Detection Instruments)

- Members consider content of the terms of reference for an International Tsunameter Partnership, and agree to hold an intersessional meeting in Melbourne, April 2006 (TBD) ;
- Performance standards to be developed for both coastal sea level instruments and deep-ocean stations, and;
- Further consideration of core coastal and deep ocean networks.

44 WG-3 (Risk Assessment Working Group)

- Case studies to be undertaken in four member nations to form benchmarks for capacity building initiatives;
- Risk assessment methodology and guidelines to be developed for use by all member nations;
- Mitigation and decision support methodology initiatives to be undertaken for benefit of stakeholders; and
- A series of workshops to be undertaken to facilitate knowledge transfer and information sharing.

45 WG-4 (Modelling, Forecasting and Scenario Development)

- Develop inundation maps for the coastal communities of the Indian Ocean region;
- Develop a web-based community model, and;
- Implement model standards and scenarios, and make model benchmarks available on the IOC website.

46 WG-5 (A System for Interoperable Advisory and Warning Centres)

- Agree upon a two-tiered interoperable system of Regional Tsunami Watch Providers and National Tsunami Warning Centres;
- Develop an accreditation process whereby the IOC designates a potential RTWP as being capable of performing the role, and;
- Adopt English as the common language for regional advisory messages.

6. ACTIONS NEEDED TO COMPLETE THE IOTWS

47 Dr William Erb introduced the scope and draft outline of an implementation plan for the IOTWS. **The ICG discussed** the importance of drafting an implementation plan and **set up** a working group to develop the concept. **The ICG accepted** the working group recommendations including:

- The key objectives of the plan are to assist in resource procurement, provide a clear vision of the IOTWS, integrate partnerships, provide management guidance, generate milestones and goals and to depict realistic financial implications. The plan is to depict all the requirements for an IOTWS on the time scale from zero out to fifteen years.
- It should be mostly numeric and graphic with limited descriptive text providing greater detail for nearer term goals.
- The plan should include the requirements of all IOTWS partners.
- Before each subsequent ICG a new chapter will be included to show the status of tasks from minus six-months to zero and also the overall plan will be updated.

48 **The ICG endorsed** the outline of the plan and **decided** that the IOC Tsunami Secretariat in Paris would prepare the plan for presentation at ICG/IOTWS-III (July 2006). The Chairpersons of the ICG Working Groups agreed to participate in the compilation of information, as did other ICG members and partners. A suggested table of contents can be found at Annex IX.

7. PROGRAMME AND BUDGET FOR 2005–2006

49 Under this agenda item, Dr Bernal described the actual funding process in place for the tsunami programme and asked the ICG to decide if the IGC would like to be involved directly in the process with the donor countries.

50 Dr Bernal reported on the initial establishment of a Tsunami Unit at IOC Headquarters in Paris due to a kind contribution from Norway and secondments by Japan and Germany. The unit is mainly responsible for the global coordination of activities in the regional ICG's in the Pacific, Indian Ocean, Caribbean as well as the NE Atlantic and the Mediterranean but also will directly act as a regional secretariat for the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS).

51 Within the cooperative UN-agencies flash appeal project $US 11 M have been allocated to implement four main tasks as well as the coordination under the UN/ISDR Platform for the Promotion of Early Warning (PPEW). Part of the budget is e.g. spent for upgrading sea level stations in the Indian Ocean within the GLOSS framework as well as producing educational material on tsunamis.

8. NEXT MEETING

52 **The ICG welcomed** the kind offer of Indonesia to host the third session of the ICG/IOTWS in Bali, Indonesia in July 2006. As a meeting venue for ICG/IOTWS-IV has not been offered by the end of the meeting member countries are requested to consider possible options.

9. OTHER BUSINESS

53 No other issues were raised during the session.

10. ADOPTION OF THE SUMMARY REPORT AND RECOMMENDATIONS

54 **The ICG reviewed** and **adopted** the summary report and recommendations of its deliberations.

11. CLOSURE

55 Dr Bernal and the Chairman closed the session by appreciating the significant progress in developing the IOTWS and the support from participants in achieving this. He especially thanked India and INCOIS for their hospitality and the excellent organization of the session.

56 The Session closed at 18.00 on Friday 16 December 2005.

ANNEX I

AGENDA

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ANNEX II

SUMMARY OF ACTIONS ADOPTED BY ICG/IOTWS-II

Working Group 1: SEISMIC MEASUREMENTS, DATA COLLECTION AND EXCHANGE

No	Action	Person responsible	Deadline
1	The Group recognized the importance of regular meetings, and asked for assistance to support an Intersessional Meeting before ICG/IOTWS-III.	Prih Hajardi	Venue and date to be announced by 17 Feb. 2006
2	Mwp should be regarded as the best currently available tool for fast magnitude estimation for tsunami warnings. Software to be provided during February 2006 to all Member States for implementation.	Prih Hajardi	28 Feb. 2006
3	The Working Group requested GA to continue to update the database and make this information available to all Member States. (This database could be used by Member States to request additional stations directly from national networks.)	Alexei Gorbatov	Update reports at each ICG meeting, or as each update completed
4	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
5	Data from a core set of stations to monitor regional seismicity to be shared. The proposed Core Network is shown in Figure 1 and listed in Table 1.	All members of WG-1	31 Dec. 2006
6	Member States consider the use of Mm in their operations to accurately estimate very large earthquakes.	Representatives of appropriate Countries	Report to ICG/IOTWS III (Aug. 06)
7	The USGS reported that upon finalization of its methodology, the software will be made available to Member States.	Walter Mooney	Open-ended
8	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.	Joachim Saul (GFZ); Any other representative of potential donor country	As soon as donor funding allows (preferably by end of 2007)
9	Significant upgrade of existing stations in the western Indian Ocean Countries. High priority.	Joachim Saul (GFZ); Any other	As soon as donor funding allows (preferably by

No	Action	Person responsible	Deadline
		representative of potential donor country	end of 2007)
10	Training for the Indian Ocean Countries on seismological observatories practice be undertaken as a high priority.	Suggest Joachim Saul (GFZ) and Walter Mooney	*As soon as possible*

Working Group 2: SEA LEVEL DATA COLLECTION AND EXCHANGE, INCLUDING DEEP OCEAN TSUNAMI DETECTION INSTRUMENTS

No	Action	Person Responsible	Due Date
1	Members agree to content of the terms of reference	K. Jarrott	31 Dec. 2005
2	**Coastal Sea Level Stations Instrument Standards** - min. standards to be developed for instruments in tsunami watch only (non GLOSS). Requirements to be submitted to VC – Coastal Sea Level Stations	K Jarrott	End Mar. 2006
3	**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 Jan. 2006
4	**Final "Target" Configuration of CORE Coastal Sea Level Network** – to be developed	B. Kilonsky	ICG/IOTWS III (Aug. 2006)
5	**Database for Capturing Progress and Plans for Deep Ocean Network Development** – concept proposed.	(Australia) K. Jarrott	End Feb. 2006
6	**Final "Target" Configuration of CORE Deep Ocean Sea Level Network** – to be refined from conceptual network design of PMEL	K. Jarrott	End Mar. 2006
7	**Nomination of National Focal Points for WG-2** – confirmation by host countries	TBD	End Dec. 2005
8	First response to Details of Terms of Reference for International Tsunameter Partnership	All nations intending to join	End Dec. 2005
9	Conduct Inter-sessional Meeting – International Tsunameter Partnership	K. Jarrott	April 2006

Working Group3: RISK ASSESSMENT

No	Action	Person responsible	Deadline
1	**Risk Assessment Case Studies** Four case studies (Indonesia, Sri Lanka, Kenya, and a sub regional case study in the Oman Sea area) identified for analysis and comparison to inform the development of a methodology and guidelines. They will form benchmarks and best practice, and be used as part of the toolsets for knowledge transfer activities such as workshops and training courses. They will also provide insights into the strategic approaches adopted by different nations for risk assessments. Additional case study contributions are welcomed from other member nations. The working group has committed to identify key datasets to be provided for adoption for this exercise and agree an initial methodology in order to enable comparison and analysis of the identified case studies.	Sam Hettiarachchi	June 2006
2	**Risk Assessment Methodology and Guidelines** A common and best practice methodology and guidelines will be developed for use by member nations. Committee 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	Sam Hettiarachchi	December 2006
3	**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, 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)	Sam Hettiarachchi	December 2006

No	Action	Person responsible	Deadline
4	**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.	Sam Hettiarachchi	June 2007
5	**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
6	**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 Group4: MODELLING, FORECASTING AND SCENARIO DEVELOPMENT

No	Action	Person Responsible	Deadline
1	Develop inundation maps for the coastal communities of the Indian Ocean region.	Charitha Pattiaratchi	End 2015 if possible
2	Develop web based community model (IOC should allocate resources).	Charitha Pattiaratchi	By ICG-III
3	Development of inundation maps for different scenarios. This should also include translation of the inundation projections to evacuation maps over a 10 year (or less) time-frame.	Charitha Pattiaratchi	End 2015 if possible
4	Model standards and scenarios be accepted and implemented.	Charitha Pattiaratchi	
5	Model benchmarks to be available on the IOC website.	Charitha Pattiaratchi	By ICG-III
6	A subgroup to work together with IOC to summarise the results and maintenance of the website.	Charitha Pattiaratchi	
7	Consider publishing the model standards and scenarios as	Charitha	

No	Action	Person Responsible	Deadline
	a scientific paper.	Pattiaratchi	
8	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).	Charitha Pattiaratchi	
9	Recognise that training is a continuous process and support is required for model maintenance, ongoing consultation and support at selected institutions.	Charitha Pattiaratchi	

Working Group 5: A SYSTEM FOR INTEROPERABLE ADVISORY AND WARNING CENTRES

No	Action	Person Responsible	Deadline
1	Two-tiered interoperable system of RTWPs and NTWCs agreed 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, say, 31 Dec. 2008
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, say, 31 Dec. 2008

No	Action	Person Responsible	Deadline
3	English to be adopted as the common language for regional advisory messages.	Appropriate national representatives	As and when needed
4	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 Programme Office	As and when necessary
5	Capability Profiling Initial compilation by email	Chair (Australia) with France (La Reunion)	Mid-April 2006
6	Watch/Warning Guidelines Standardization/format of information/watch Starting point - draft doc App 3.	USA	Mid-April 2006
7	Composing a generic guidelines for the "last mile" of warning/watch (Include a demonstration right through to the beach —RANET)	Indonesia, USA, Thailand(ADPC)	Mid-April 2006
8	Communication and collaboration/platforming among NWTCs-RTWPs (including backup systems)	Germany, USA	Mid-April 2006
9	Intersessional WG meeting to review drafts and confirm information	Chair (Australia)	Late April 2006

ANNEX III

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

SESSIONAL REPORT

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

1. Objectives

1.1 ICG-I

Working Group 1 agreed that it should:

1) Ensure that all earthquakes of magnitude 6 or greater can be reliably located and sized in a timely manner; and

2) Review and make recommendations regarding upgrading and enhancements to the network, communications, processing and analysis to further reduce the time required for earthquake source characterization to meet a local warning response of 5-10 minutes.

1.2 ICG-II

The Chair reviewed the objectives of WG1 specified at ICG -I and provided an overview on the requirements for rapidly and accurately characterizing the earthquake source; specifically in estimating the hypocenter and magnitude in near real-time. These include the use of real-time continuous seismic waveforms from a core network of seismographs, the use of reliable communications and data acquisition systems, and finally the use of a consistent set of seismographic evaluations methods to evaluate the tsunamigenic potential of large earthquakes. As an example, he referenced the need for the sharing of seismic waveform data in real time and presented the agreement of ASEAN countries on the exchange of real time seismic data among members of the National Seismic Centres of ASEAN during the Sub Committee of Meteorology and Geophysics (SCMG) meeting held in July 2005. He referred to the discussions and Working Group Recommendations from the Intersessional Working Group meeting (Jakarta, October 2005), and further elaborated on the requests to the Group made by the Plenary. These provided the basis for Working Group 1 discussions.

The Chair first asked the participants to review and accept the Recommendations concluded in Perth and Jakarta as the guidance for implementing the Regional Seismographic Network for the Indian Ocean. All participants agreed to accept the Recommendations and to work forward to enable an Implementation Plan.

2. Discussion of Issues

2.1 Core Network for Data Sharing

- High-quality, broadband seismic waveform data is essential to ensure accurate and rapid determination of the hypocentral parameters. A delay of even a minute in the dissemination of earthquake information and public warning can result in an increase the number of casualties from earthquake and tsunami disasters.

- The countries of the Indian Ocean region agreed to share data from a core set of stations to monitor regional seismicity. The proposed list of seismic stations to comprise the Core Network is shown in Figure 1 and listed in Table 1.

  WG1 members worked together to identify these stations. For countries that were not represented, existing information from the National Reports and other global reference databases were used to identify possible locations. India offered to provide waveform data of earthquakes of magnitude 6 and above from tsunamigenic sources from 4 stations. From the WG1 meeting in Jakarta, China had offered to provide waveform data from 8 stations in southern China in real time; these were included in the provisional list but confirmation is needed.

Figure 1. Core Regional Seismographic Network for the Indian Ocean.

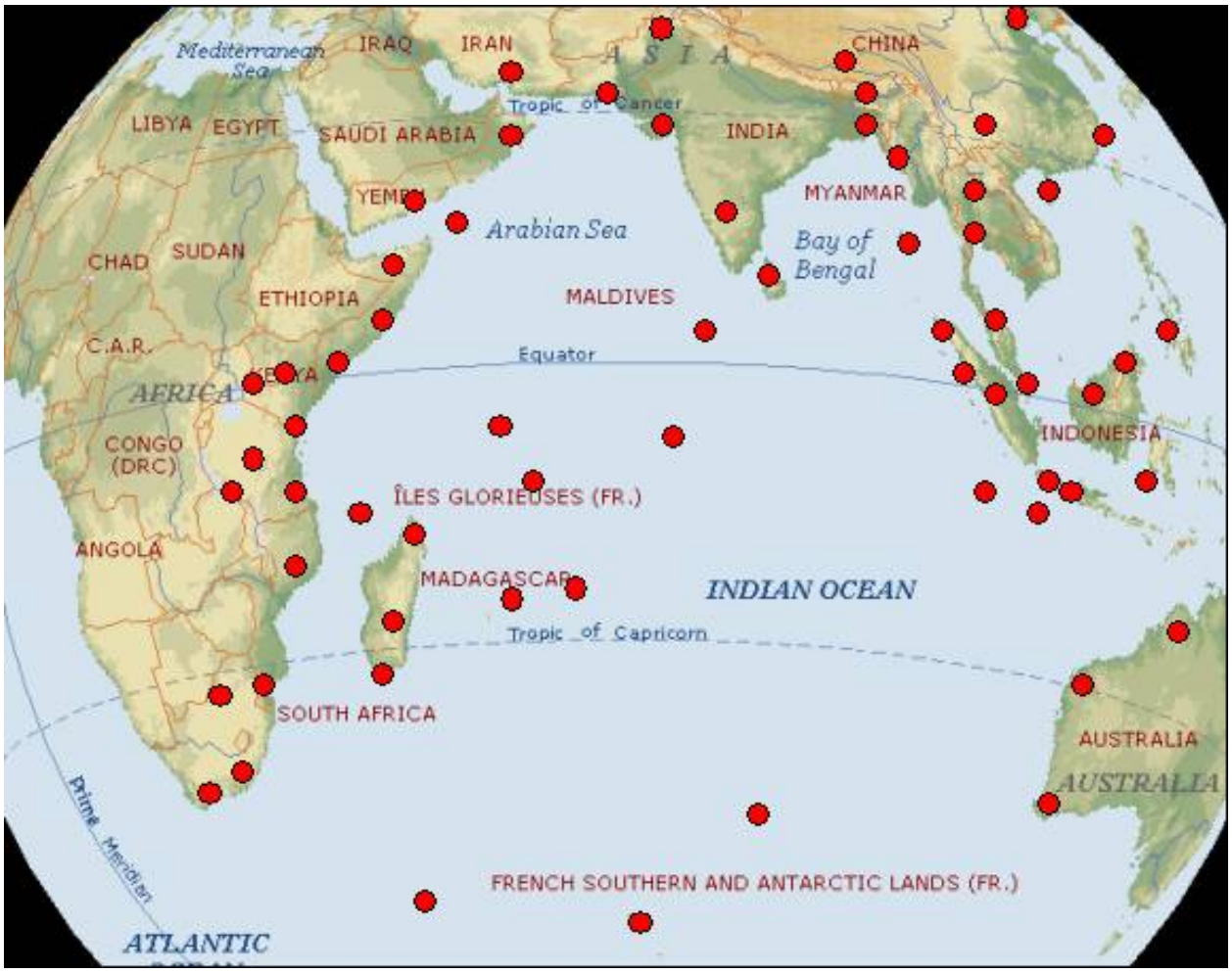

Table 1.

No	Country	Station	Code	Type	Comm to HQ	Remarks
1	Indonesia	Gunung Sitoli	GSI	BB	VSAT	Operational
		Yogyakarta	YOGI	BB	VSAT	operational
		Banda Aceh	BSI	BB	VSAT	operational
		Padang Panjang	PPI	BB	VSAT	
		Lembang	LEM	BB	VSAT	operational
2	India	Port Blair	PBA	BB	VSAT	VSAT to be
		Bhuj	BHUJ	BB	VSAT	made operational
		Shillong	SHL	BB	VSAT	same as above
		Hyderabad	HYB	BB	VSAT	To be made operational
3	Malaysia	KULIM	KUM	BB	VSAT	
		Kuching	KSM	BB	VSAT	
		Kota Kinabalu	KKM	BB	VSAT	
4	Thailand	Chiengmai	CHTO	BB	Leased Line	15 stations will be
		Khanchanaburi	KAN	BB	VSAT	established in 2006
5	Vietnam			BB		will be available
6	Myanmar			BB		3-4 stations proposed
				BB		Station Location
				BB		to be determined
7	Sri Lanka	Kandy	PALK	BB	VSAT	Operational, GSN station
8	Pakistan	Nilore	NIL	BB	VSAT	Operational
		Karachi		BB	VSAT	proposed
9	Bangladesh	Dhaka		BB	VSAT	
		Cox's Corner		BB	VSAT	proposed
10	Maldives	Male		BB	VSAT	Operational, GSN station
		TBD		BB	VSAT	Proposed
11	Madagascar	Antananarivo	ABPO	BB		GSN station
		2 stations TBD		BB		Proposed
12	Singapore	Bukit Timah	BTDF	BB	Leased Line	Operational exchange in Feb 2006
13	Tanzania	Dodoma		BB		Proposed
		Tukuyu		BB		Proposed
14	Kenya	Nairobi		BB		GSN station
		Kilima Mbogo	KMBO	BB		GEOFON/IRIS
15	Somalia	two locations to		BB		Proposed
		be determined		BB		Proposed
16	Seychelles	Mahe	MSEY	BB		Operational, GSN station
17	Mauritius			BB		Proposed
18	Mozambique	3 stations TBD		BB		Proposed
19	Comoros	TBD		BB		Proposed
20	France	La Reunion				Operational, to be real-time
		3 southern IO				Operational, to be real-time
21	Australia	Lermouth		BB	VSAT	proposed
		Fitzroy Crossing		BB	VSAT	Operational
		Chrismas Island		BB	VSAT	Operational
		Nerrogin		BB	VSAT	Operational
		New Amsterdam		BB	VSAT	proposed

No	Country	Station	Code	Type	Comm to HQ	Remarks
22	China	Heinan		BB	VSAT	100 minute delay
		Kunming	KNM	BB	VSAT	100 minute delay
		Shanghai		BB	VSAT	100 minute delay
		Beijing	BJI	BB	VSAT	100 minute delay
		Lhasa	LSA	BB	VSAT	100 minute delay
		Urumqi	WMQ	BB	VSAT	100 minute delay
		Hailar		BB	VSAT	100 minute delay
		Lanzhou		BB	VSAT	100 minute delay
		Xi'an		BB	VSAT	100 minute delay
23	Nepal	TBD		BB		Proposed
24	Bhutan	TBD		BB		Proposed
25	South Africa	Sutherland	SUR	BB		Operational, GSN
		more TBD				
26	Philippines	Davao	DAV	BB		Operational, GSN station
27	Papua New Guinea	Port Moresby	PMG	BB		Oper., GEOFON/GSN

2.2 Database of Existing and Planned Seismographic Stations

The Working Group assembled a database of the existing and planned broadband seismic field stations in and around the Indian Ocean, in order to determine the Core Network. Geoscience Australia (GA) developed a GIS database for this effort and distributed copies to WG1 Members on 15 December 2005. The Working Group acknowledged the importance of the database in that it gives Member States information on the full extent of seismographic data available in the Indian Ocean. This database could be used by Member States to request additional stations directly from national networks GA is asked to continue to update the database periodically and make this information available to all Member States.

2.3 Data latency

- Data latency investigations were carried out by GA to determine the speed of data communications from the field station to seismic centres. When data latency is high, (e.g. data is delayed in transmission and receipt) these stations cannot be used in the preliminary automatic determination of the hypocenter, thereby resulting in poorer estimates. GA reported that latency from GSN and national networks in the eastern Indian Ocean was generally less than 20 s for most stations. A few stations showed latencies up to 300 s, and data dropouts of up to 80%. These problems are being investigated cooperatively with the network operators. Data latency tests will continue to be conducted as data are made available for sharing.
- The Working Group recognized the important efforts of GA and encouraged greater participation by all Indian Ocean countries.
- The Working Group agreed that all 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.

2.4 Magnitude calculation

- The Group discussed a number of methods that have been formulated to describe the size and mechanism of an earthquake. The Pacific Tsunami Warning Centre and the Japan Meteorological Agency have both adopted procedures that automatically estimate the seismic moment, Mwp, based on the first arriving P wave. Their calibration studies have shown Mwp to be a robust method for quickly estimating magnitude to meet tsunami warning requirements. The Working Group agreed that Mwp should be regarded as the best currently available tool for fast magnitude estimation for tsunami warning. The Working Group requested that this software be made available to all Member States for their implementation. It was further requested that that software be documented and available in February 2006.
- The PTWC and other Pacific-based warning centres utilize the mantle magnitude Mm for tsunami warning (e.g., TREMORS system for tsunami warning developed by France). This method is especially robust for great earthquakes above M8, but requires the use of seismic waves with periods up to 400 s and so will take longer before the first estimate is available. It requires a broadband station and hypocentral coordinates, and has been tested with more than 100 GSN stations by France. This software is a part of the Utility Programmes of STK (Seismic ToolKit) Software. It is freely available on the ORFEUS website, or directly from http://freashmeat.net/projects/seismictoolkit-STK The Working Group also recommended that Member States consider the use of Mm in their operations to accurately estimate very large earthquakes.
- The Working Group acknowledged the other efforts at fast magnitude calculation, including cumulative Mb being developed by Germany for implementation in Indonesia. The use of moment tensor formulations is being routinely used by the USGS for fast magnitude estimation, and the USGS reported that upon finalization of its methodology, the software will be made available to Member States.

2.5 Capacity building

- The Working Group recognized the importance of sharing information on standard practices of seismological observatories and the importance of building robust infrastructures for the collection of data and installation of high-quality stations, and recommended training to meet these requirements.
- Additionally, Member States from the western Indian Ocean, including Tanzania, Madagascar, Somalia, and Kenya, indicated the strong need to enhance their monitoring capabilities of both onshore and offshore seismicity. Assistance is needed both for the upgrade of existing short period stations, installation of new stations, and in the establishment of seismic monitoring system. In this regard, Germany offered their assistance for the installation of new stations and in the provision of training on seismological observatory practice through their existing UNESCO-sponsored training held at GFZ, Potsdam, Germany. However, additional resource assistance is needed to meet the requirements in full.

3. Agreed Actions and deadlines

ACTION	PERSON RESPONSIBLE	DEADLINE
1. The Group recognized the importance of regular meetings, and asked for assistance to support an Intersessional Meeting before ICG/IOTWS-III.	Prih Hajardi	Venue and date to be announced by 17 February 2006
2. Mwp should be regarded as the best currently available tool for fast magnitude estimation for tsunami warnings. Software to be provided during February 2006 to all Member States for implementation.	Prih Hajardi	28 February 2006
3. The Working Group requested GA to continue to update the database and make this information available to all Member States. (This database could be used by Member States to request additional stations directly from national networks.)	Alexei Gorbatov	Update reports at each ICG meeting, or as each update completed.
4. 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
5. Data from a core set of stations to monitor regional seismicity to be shared. The proposed Core Network is shown in Figure 1 and listed in Table 1.	All members of WG-1	31 December 2006
6. Member States consider the use of Mm in their operations to accurately estimate very large earthquakes.	Representatives of appropriate Countries	Report to next ICG meeting
7 The USGS reported that upon finalization of its methodology, the software will be made available to Member States.	Walter Mooney	Open-ended
8. 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.	Joachim Saul (GFZ)Any other representative of potential donor country	As soon as donor funding allows (preferably by end of 2007)
9. Significant upgrade of existing stations in the western Indian Ocean Countries. High priority.	Joachim Saul (GFZ)Any other representative of potential donor country	As soon as donor funding allows (preferably by end of 2007)
10. Training for the Indian Ocean Countries on seismological observatories practice be undertaken as a high priority.	Suggest Joachim Saul (GFZ) and Walter Mooney	As soon as possible

4. Working Group Participant List

Dr. Alexei Gorbatov	Australia	alexei.gorbatov@ga.gov.au
Dr. R. K. Chadha	India	chadha@ngri.res.in
Dr. Ashok Bhatnagar	India	bhatnagar.ashok@gmail.com
Dr. G. D. Gupta	India	gdgupta48@yahoo.com
Dr. R. S. Dattatrayam	India	dattatrayam_rs@hotmail.com
Dr. Fauzi	Indonesia (Chair)	fauzi@bmg.go.id
Ms. Beatrice Akunga	Kenya	nyabokeakunga@yahoo.com
Mr. Andriamiranto Raveloson	Madagascar	r_raveloson@yahoo.com
Mr. Kong Chiew Low	Malaysia	kclow@kjc.gov.my
Abdulkadir Nur	Somalia	arraleh05@yahoo.com
Mr. Sarath Weerawarnakula	Sri Lanka	gsmb@slt.lk
Mr. Philbert Tibaijuka	Tanzania	tibaijukap@meteo.go.tz
Dr. Joachim Saul	Germany	saul@gfz-potsdam.de
Dr. Walter Mooney	USA	mooney@usgs.gov
Mr. Masahiro Yamamoto	IOC	m.yamamoto@unesco.org
Dr. Laura Kong	IOC	l.kong@unesco.org
Dr. Pennung Warnitchai	Thailand	--
Professor John Webb	Australia	john.webb@aei.gov.au

5. Next Meeting

The venue and date of an intersessional meeting before ICG-III will provided by the Chairman by 17 February 2006.

ANNEX IV

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

SESSIONAL REPORT

Chair: Mr. Premkumar India

Vice Chair (Coastal Sea Level Stations): Mr. B. Kilonsky, GLOSS-USA
Vice Chair (Deep Sea Stations): Mr. K. Jarrott, Australia

1. Objectives

1.1 ICG-I

Working Group 2 agreed that it should:

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

1.2 ICG-II

No changes to above objectives

2. Discussion of Issues

Specifications and Standards to be followed:

2.1 Coastal Sea Level Stations

For the interim sea level network, coastal sea level stations need to conform to:

- IOC/GLOSS / or equivalent proven equipment in the field;
- Minimum standards for any alternate instrument with the capacity to detect tsunamis at coastal locations, but which do not need to meet the GLOSS requirement, are to be established.

2.2 Deep Ocean Stations

- Proposed minimum performance standards (below) have been compiled by Dr E. Bernard Pacific Marine Environmental Laboratory (PMEL). They are to be expanded for review by Jan 06 after consultation with members and observers.

2.3 Tsunami Forecasting Deep Ocean Measurement Requirements/Standards

1. Measurement type - tsunami amplitude over time for input into forecast models

2. Measurement accuracy - 0.5 cm

3. Measurement sample rate – 1 min or less

4. Measurement processing – within 2 min

5. Measurement availability – within 5 minutes to assimilate into forecast models

6. Measurement access – a reliable request mode

7. Interoperability – data must be placed on Global Telecommunications System operated by the World Meteorological Organizations

2.4 Network, Locations, Data exchange, Plan for Implementation

- Coastal Sea level Station:The Working Group accepted the concept of a "CORE" network for Indian Ocean basin-level protection, whose operational performance was essential for effective performance of the IOTWS. This CORE network is to provide sea level data exchanges to the Tsunami Warning Centres, and all elements must meet requirements for instrument standards and data exchange. Nations may supplement the CORE network with additional stations. These supplementary national stations may have different characteristics such as reporting frequencies to suit local interests or warning priorities.
- Interim station locations for the core network (primarily GLOSS station upgrades, with some new locations) are shown below ▼.
- A target "final network" configuration will be proposed in time for the ICG/IOTWS-III meeting, in collaboration with WG4 and WG5.

  The locations could be marginally shifted by the Nations to suit the operability and sustainability of the stations

- 28 stations are currently identified for upgrades/ installations and scheduled for completion by July 2006. Eight are currently completed. Nations are encouraged to provide historical data and metadata from above station for post analysis. Nations have been requested to increase the network over a period.
- The data from the above core network on a real time basis for Tsunami confirmation need to be available through GTS. The requirement is for real time data transmission at 15 minute or less transmission cycles with 1 mn sample intervals. The Working Group strongly recommended that data is continuously transmitted.
- Member countries are also strongly recommended to supply historical data sets for sea level data, where available, for historical event analysis.

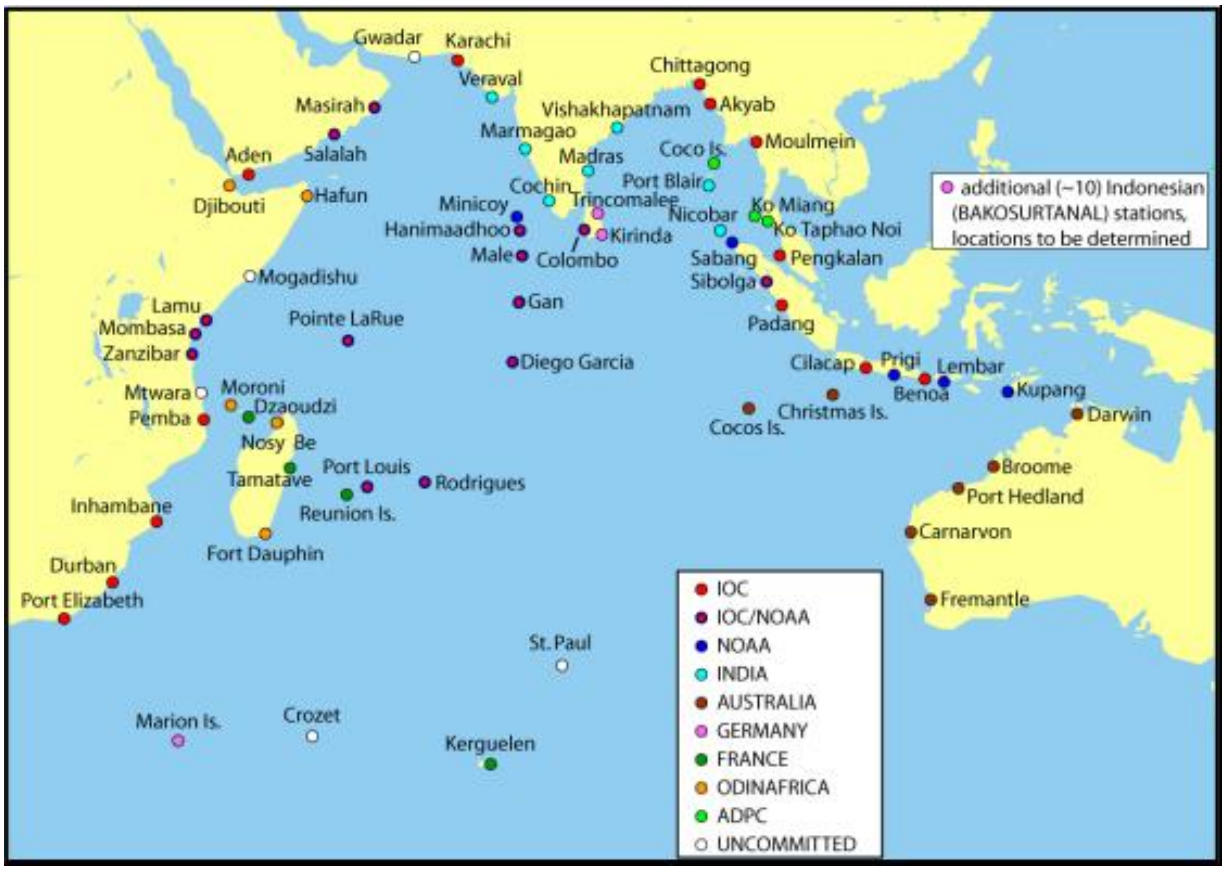

Figure 1. Interim station locations for the core network (primarily GLOSS station upgrades, with some new locations)

2.5 Capacity Building and Training

Capacity building and training in respect of coastal gauge operation and application to multi-hazard functions can be provided through GLOSS, in collaboration with WG5.

2.6 Deep Ocean Stations

- The Working Group recognized, as with coastal sea level gauges, the concept of a CORE network of deep ocean gauges that ensured effective international access to data needed for Indian Ocean basin-level tsunami warning. A conceptual network of locations for CORE deep ocean stations, developed by PMEL, is shown below ▼.

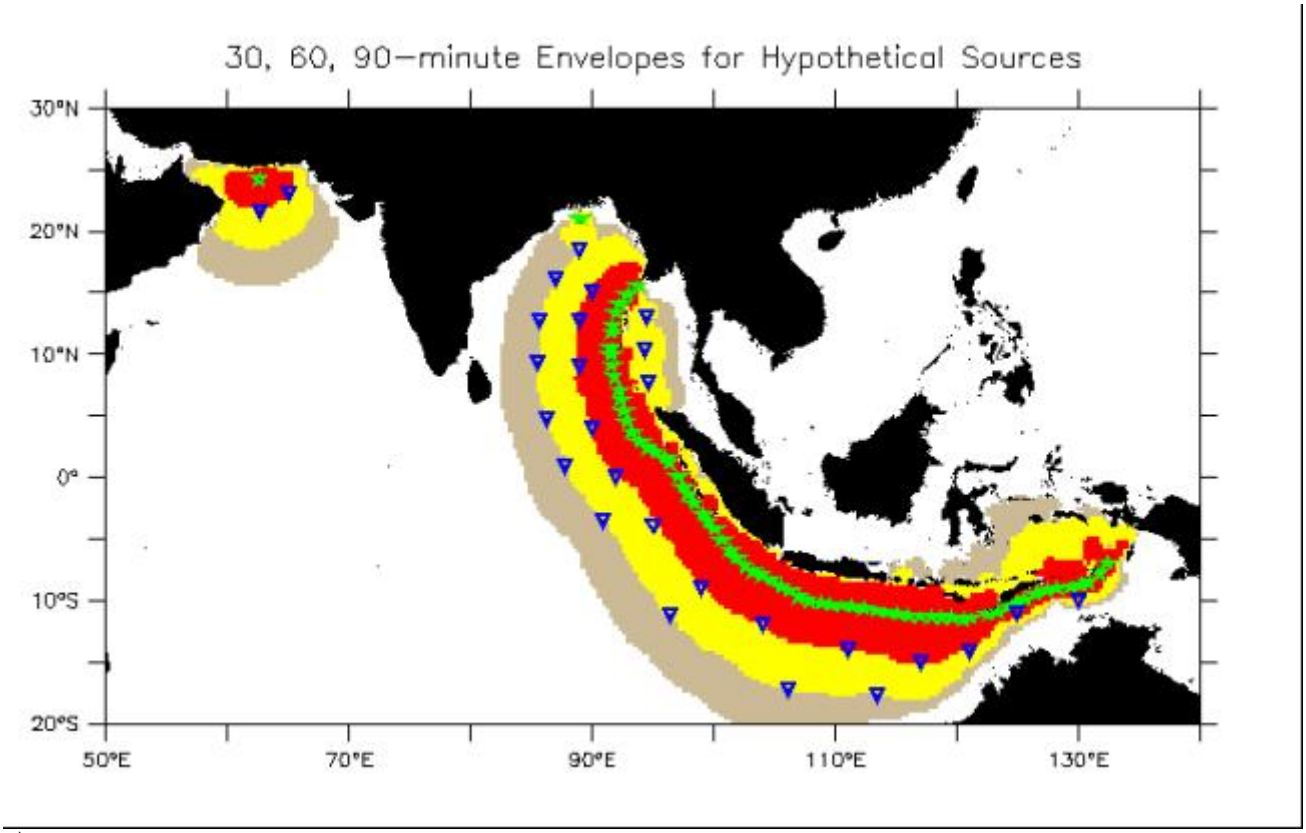

Figure 2. A conceptual network of locations for CORE deep ocean stations, developed by PMEL

- Australia has offered to compile a database of planned and actual deployments of deep ocean stations, equipment configurations, and indicative times for external data availability.
- The conceptual network is to be refined with attention to the national priorities for warning times, and existing national network plans, in collaboration with WG4 and WG5.
- The scheduled plan of establishment of deep ocean stations in the short term is:

Indonesia/Germany	2 Buoys already in place – data transmission by Feb 06. 3 more Buoys by end 2006. 7 more Buoys would be established in progressively by 2008.
Malaysia	3 Buoys by mid 06.
India	3 Buoys by Aug 2006. 7 Buoys progressively by Sep 2007.
Thailand	3 Buoys by September 2007
Australia	2 buoys by mid 2008
USA	2 Buoys for the Indian Ocean before the end of 2006. Location and partners to be determined.

NOTE: Not all of the above buoy deployments are in the Indian Ocean. Some of the Indonesian buoys will be deployed to cover Pacific Ocean tsunami sources.

- The data from CORE deep ocean stations shall be transmitted on a real-time basis through GTS as per the tide gauges format at every 3 hour interval during the

normal mode. In the tsunami event, the transmission would be at a 5-min interval or less with 1 min sampling, and would continue until a tsunami event was confirmed or cancelled. The Working Group recognized that the consistency of the process by which host nations would initiate special "event mode" reporting would be a factor in the end-to-end consistency of the IO TWS. Collaboration with WG5 is required.

- The draft of the Terms of Reference on the International Tsunameter Partnership was deliberated. Members present generally agreed to the principles of the partnership and the content of the Terms of Reference. However some members sought more time and desire consultations with their national experts about details of the partnership terms.
- The Partnership will have with following national focal points:

Australia:	Mr. K. Jarrott
India:	Mr. K. Premkumar
Indonesia:	Wahyu Pandoe
Malaysia:	Mr Alui Bin Bahari
Thailand:	Captain Witoon Tantigoon
Tanzania:	Mr Shigalla Mahongo
USA:	Dr Eddie Bernard
Germany:	Dr. Joern Lauterjung
Kenya:	Mr Ali Mafimbo Juma
Chile:	Captain Rodrigo Nunez

3. Agreed actions and deadlines

No	Action	Person Responsible	Due Date
1	Members agree to content of the terms of reference	K. Jarrott	31 Dec. 2005
2	**Coastal Sea Level Stations Instrument Standards** - min. standards to be developed for instruments in tsunami watch only (non GLOSS). Requirements to be submitted to VC – Coastal Sea Level Stations	K Jarrott	End Mar. 2006
3	**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 Jan. 2006
4	**Final "Target" Configuration of CORE Coastal Sea Level Network** – to be developed	B. Kilonsky	ICG/IOTWS III (Aug. 2006)
5	**Database for Capturing Progress and Plans for Deep Ocean Network Development** – concept proposed.	(Australia) K. Jarrott	End Feb. 2006
6	**Final "Target" Configuration of CORE Deep Ocean Sea Level Network** – to be refined from conceptual network design of PMEL	K. Jarrott	End Mar. 2006

No	Action	Person Responsible	Due Date
7	**Nomination of National Focal Points for WG-2** – confirmation by host countries	TBD	End Dec. 2005
8	First response to Details of Terms of Reference for International Tsunameter Partnership	All nations intending to join	End Dec. 2005
9	Conduct Inter-sessional Meeting – International Tsunameter Partnership	K. Jarrott	April 2006

Participating Members – ICG/IOTWS-II Working Group 2

Name	Country	email
Mr Rick Bailey	Australia	r.bailey@bom.gov.au
Mr Ken Jarrott	Australia	k.jarrott@bom.gov.au
Mr K Premkumar	India	
K. Somasunder	India	
B. Nagarajan	India	
Dr Wahyu W Pandoe	Indonesia	
Mr Yuji Nishimae	Japan	nishimae@met.kishou.go.jp
Dr Joseph Mukabana	Kenya	mukabana@meteo.go.ke
Mr Ali Mafimbo	Kenya	mafimbo@meteo-go.ke
Prof Hock Lye KOH	Malaysia	hlkoh@cs.usm.my
Mr S N Sok Appadu	Mauritius	meteo@intnet.mu
Mr Philbert Tibaijuka	Tanzania	tibaijukap@meteo.go.tz
Thonkchai Simking	Thailand	thongchai@gistda.or.th
Mr Bernard Kilonsky	USA	kilonsky@hawaii.edu
Dr Eddie Bernard	USA	eddie.n.bernard@noaa.gov
Mr David McKinnie	USA	david.mckinnie@noaa.gov
Dr Joern Lauterjung	Germany	lau@gfz-potsdam.de
Mr Tony Elliott	Fugro Oceanor (observer)	t.elliott@geos.com
Mr Fred Stephenson	ICG/PTWS (observer)	stephensonf@pac.dfo-mpo.gc.ca
Dr Ulrich Wolf	IOC/UNESCO (observer)	u.wolf@unesco.org
Mr Mika Odido	IOC/UNESCO (observer)	m.odido@unesco.org
Wil Doran	Eumetsat (observer)	wil.doran@eumetsat.int

National Focal Points identified are:

Australia:	Dr. Jane Warne	j.warne@bom.gov.au
Malaysia:	Mr. Alui Bin Bahari	alui@kjc.gov.my
Thailand:	Capt. Witoon Tantigoon	Witoon.t@navy.mi.h

Tanzania	Mr. Shigalla Mahango	shingalla@yahoo.co.in
Indonesia	Dr. Ridwan Djamaluddin *(alternate)* Dr Wahyu W Pandoe	ridwan@bppt.go.id

Others are to be confirmed within a week by the host countries.

5. Next Meeting

An intersessional meeting will be held in Melbourne in April 2006.

ANNEX V

ICG/IOTWS WORKING GROUP 3 (WG3)
RISK ASSESSMENT

SESSIONAL REPORT

Chair: Dr Sam Hettiarachchi, Sri Lanka

1. Objectives

At ICG-II, it was decided to establish a separate working group dealing with Risk Assessment, while the newly-formed Working Group 4 dealt with numerical modelling, forecasting and scenario development.

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.

2. Discussion of Issues

The expected outcome for the suite of activities described for this working group is to facilitate the development and use of the following products by member nations:

- Hazard Maps showing areas of high potential for tsunami inundation.
- Inundation Maps (inundation and run-up) for maximum credible tsunami scenarios for areas of high vulnerability or risk.
- Risk Maps capturing the potential aggregated impact of all tsunami sources on the built environment, population and local and regional economy.

- Evacuation Maps, which include safe areas and shelters, how to get there, and where to go, based on scientific products.
- Decision support for appropriate mitigation options.

3. Agreed Actions and Deadlines

No	Action	Person responsible	Deadline
1	**Risk Assessment Case Studies** Four case studies (Indonesia, Sri Lanka, Kenya, and a sub regional case study in the Oman Sea area) identified for analysis and comparison to inform the development of a methodology and guidelines. They will form benchmarks and best practice, and be used as part of the toolsets for knowledge transfer activities such as workshops and training courses. They will also provide insights into the strategic approaches adopted by different nations for risk assessments. Additional case study contributions are welcomed from other member nations. The working group has committed to identify key datasets to be provided for adoption for this exercise and agree an initial methodology in order to enable comparison and analysis of the identified case studies.	Sam Hettiarachchi	June 2006
2	**Risk Assessment Methodology and Guidelines** A common and best practice methodology and guidelines will be developed for use by member nations. Committee 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	Sam Hettiarachchi	December 2006
3	**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, tsunami-specific zonation), - Tsunami Resistant Infrastructure (e.g. building codes and certification),	Sam Hettiarachchi	December 2006

No	Action	Person responsible	Deadline
	- 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)		
4	**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.	Sam Hettiarachchi	June 2007
5	**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
6	**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

4. Working Group Participant List

Name	Country	Email
Dr Sam Hettiarachchi	Sri Lanka	sslh@civil.mrt.ac.lk
Dr John Schneider	Australia	johnschneider@ga.gov.au
Ms Suzanne Edgecombe	Australia	Suzanne.edgecombe@ausaid.gov.au
Dr Edie Prihantoro	Indonesia	--
Dr Ir Sugiarta Wirasantosa	Indonesia	--
Dr Joseph Mukabana	Kenya	mukabana@meteo.go.ke
Mr Ali Mafimbo Juma	Kenya	mafimbo@meteo-go.ke
Ms Beatrice Akunga	Kenya	nyabokeakunga@yahoo.com
Mr Denis Chang-Seng	Seychelles	d.chang-seng@pps.gov.sc
Dr Harald Mehl	UNU-EHS	harald.mehl@dlr.de
Dr Torsten Schlurmann	UNU-EHS	schlurmann@ehs.unu.edu
Ms Akiko Nakamura	ADRC	nakamura@adrc.or.jp
Mr Adel Karas	WAPMERR	akaras@wapmerr.org
Mr David Khidasheli	WAPMERR	d_khidasheli@wapmerr.org

ANNEX VI

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

SESSIONAL REPORT

Chair: Prof Charitha Pattiaratchi, Sri Lanka

1. Objectives

At ICG-II, it was decided to establish a separate working group dealing with Risk Assessment, while the newly-formed Working Group 4 dealt with numerical modelling, forecasting and scenario development. 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, Mokran 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.

2. Discussion of Issues

At ICG/IOTWS-1 meeting it was recommended that a model inter-comparison workshop for the Indian Ocean region be undertaken prior to the second meeting of ICG/IOTWS-II. The main tasks of workshop were to: (1) Obtain details on models that are currently used in the region or in development; and, (2) Provide benchmark tests. The workshop was held on 12-13 December. Presentations were made by Australia (Diana Greenslade), Indonesia (Velly Asvaliantina), India (M.V. Ramana Murthy), Malaysia (Koh Hock Lye), Singapore (Chui Wah Yap), Thailand (Absornsuda Siripong), USA (Costas Synolakis, Vasily Titov). These presentations included the current status of tsunami modelling (Synolakis, Titov) and information on the various models being used in the region which include: MOST, TUNAMI-N2, VOF, NTC, ANUGA, MIKE21, TUNA.

The workshop developed model standards that should apply to tsunami models. These include: (1) accepted peer review process (published in ISI journals, presentation at benchmarking workshops); (2) Model documentation (how to run the model, model parameters); (3) benchmark testing to compare with data and other models; and, (4) practical application tests. In view of (3) and (4), a series of benchmark tests were identified, based on analytical, laboratory and field approaches and included the definition of source parameters, deep water propagation, run-up (inundation).

At ICG/IOTWS-II, it was decided to establish a separate working group dealing with numerical modelling, forecasting and scenario development.

3. Agreed Actions and Deadlines

No	Action	Person Responsible	Deadline
1	Develop inundation maps for the coastal communities of the Indian Ocean region.	Charitha Pattiaratchi	End 2015 if possible
2	Develop web based community model (IOC should allocate resources).	Charitha Pattiaratchi	By ICG-III
3	Development of inundation maps for different scenarios. This should also include translation of the inundation projections to evacuation maps over a 10 year (or less) time-frame.	Charitha Pattiaratchi	End 2015 if possible
4	Model standards and scenarios be accepted and implemented.	Charitha Pattiaratchi	
5	Model benchmarks to be available on the IOC website.	Charitha Pattiaratchi	By ICG-III
6	A subgroup to work together with IOC to summarise the results and maintenance of the website.	Charitha Pattiaratchi	
7	Consider publishing the model standards and scenarios as a scientific paper.	Charitha Pattiaratchi	
8	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).	Charitha Pattiaratchi	
9	Recognise that training is a continuous process and support is required for model maintenance, ongoing consultation and support at selected institutions.	Charitha Pattiaratchi	

4. Capacity Building

- Training and software for numerical modelling to develop inundation maps and to evaluate tsunami hazards and vulnerability.

Required by, BAN, COM, INDONESIA, KEN, MAD, MAL, MAU, MOZ, MYA, PAK, SEY, SOM, SRI, TAN, THA. SINGAPORE, INDIA, IRAN

Over 6 months

Development of web-based model	$500K

Annual

Travel 20 fellowships (20 @ 5k)	$100K
Long-term Fellowships (50 @$40K)	$ 2 million

'One Off'

for field measurements after a tsunami	$100K

5. Working Group Participant List

Name	Country	email
Diana Greenslade	Australia	dag@bom.gov.au
Velly Asvaliantina	Indonesia	velly@bppt.go.id
M.V. Ramana Murthy	India	--
B.R. Subramaniam	India	--
M. Ravichandran	India	ravi@incois.gov.in
Ravi Prakash Srivastova	India	ravi_prakash@ngri.res.in
Koh Hock Lye	Malaysia	hlkoh@cs.usm.my
Chui Wah Yap	Singapore	Yap_Chui_Wah@nea.gov.sg
Absornsuda Siripong	Thailand	sabsorns@chula.ac.th
Costas Synolakis	USA	costas@usc.edu
Vasily Titov	USA	vasily.titov@noaa.gov
Charitha Pattiaratchi	Sri Lanka (Chair)	pattiara@cwr.uwa.edu.au
Andriamiranto Raveloson	Madagascar	r_raveloson@yahoo.com
Joseph R. Mukabana	Kenya	mukabana@meteo.go.ke
Denis Chang-Seng	Seychelles	d.chang-seng@pps.gov.sc

ANNEX VII

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

SESSIONAL REPORT

Chair: Mr Geoff Crane, Australia

1. 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 to consider these issues in Singapore on 24 November 2005. Countries and organisations present at the meeting included Australia, Germany, India, Kenya, Mauritius, Singapore, IOC, ISDR, JMA, PTWC and WMO.

The inaugural Chair of WG-5, Dr Ray Canterford (Australia), withdrew from the role after ICG I. By consensus of the members, Mr Geoff Crane (Australia) was designated as his replacement. Mr Crane chaired the intersessional meeting.

The meeting in Singapore made a series of recommendations for consideration at ICG II.

2. Discussion of Issues

- The terminology Regional Tsunami Advisory Centre was considered too dominant. Rather than giving advice it was determined that a regional office would provide details of an event in a Watch. Also, rather than call the regional office a centre, with overly controlling connotations, it was determined that countries with full tsunami detection and analysis capabilities would be designated as providers. Such offices would thus become Regional Tsunami Watch Providers (RTWP).
- The recommendations from the intersessional meeting that described possible numbers of RTWPs were discarded and replaced by a process of NTWCs receiving Watches from providers under bilateral agreements. Whilst the benefits of dependent countries receiving just two watches to avoid confusion and provide redundancy were discussed, it was considered appropriate to leave it open to individual nations to enter into bilateral arrangements with as many providers as they wished.

- The draft paper "Modalities of Operation - a System of Interoperable Operational Centres" was determined to be inconsistent with this approach and discarded.
- 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, it was noted that the necessary capacity within enough countries in the region to become IOC designated RTWPs would take up to three years and it was too early to nominate a specific date for the withdrawal to occur.
- The need for capacity building to cover the capabilities of recipient countries to formulate and disseminate a tsunami warning from information provided in a Tsunami Watch was discussed. It was noted that in many countries the necessary infrastructure is weak. To successfully implement a system of systems throughout the Indian Ocean region it is essential to ensure in-country capacity to deliver warnings right through to threatened communities.
- Public education and awareness activities have been undertaken for decades in countries in the Pacific basin and that much well developed training material is available. In particular, Japan has material based on long experience with tsunami which it is already sharing with some countries in the Indian Ocean basin. Members recommended that capacity building activities in Indian Ocean countries take advantage of the availability of well tested material that is already developed.
- It was considered essential for membership of WG-5 to include all countries expressing the intention of developing the capability of becoming Regional Tsunami Watch Providers, together with a representative number of countries from around the Indian Ocean that will depend on information from them.
- Membership of WG-5 was augmented by the addition of Indonesia and France.
- The Chair of WG-5 will liaise with members over the next few weeks to determine a work program for the period up to ICG III.
- 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 (shown immediately below) and a demonstration of performance.
- The essential capabilities of a RTWP should include:

    1. Operations as a multi hazard/multi purpose centre that operates on a 24/7 basis.
    2. Contingency plans, secure infrastructure, and uninterruptible power to ensure continuous operation.
    3. Capacity to back up another RTWP and continue the other provider's full capabilities.
    4. The capacity to collect all available data in real time (seismic and oceanic), analyse and interpret the information, and the ability to undertake numerical modelling.
    5. A communications infrastructure capable of effectively disseminating all information to all recipients.

3. Agreed Actions and Deadlines

No	Action	Person Responsible	Deadline
1	Two-tiered interoperable system of RTWPs and NTWCs agreed 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, say, 31 Dec. 2008
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, say, 31 Dec. 2008
3	English to be adopted as the common language for regional advisory messages.	Appropriate national representatives	As and when needed
4	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 Programme Office	As and when necessary
5	Capability Profiling Initial compilation by email	Chair (Australia) with France (La Reunion)	Mid-April 2006
6	Watch/Warning Guidelines Standardization/format of information/watch Starting point - draft doc App 3.	USA	Mid-April 2006

No	Action	Person Responsible	Deadline
7	Composing a generic guidelines for the "last mile" of warning/watch (Include a demonstration right through to the beach —RANET)	Indonesia, USA, Thailand(ADPC)	Mid-April 2006
8	Communication and collaboration/platforming among NWTCs-RTWPs (including backup systems)	Germany, USA	Mid-April 2006
9	Intersessional WG meeting to review drafts and confirm information	Chair (Australia)	Late April 2006

4. Working Group Participant List

Name	**Country**	**email**
Geoff Crane (Chair)	Australia	g.crane@bom.gov.au
Gerard Therry	France	Gerard.therry@meteo.fr
Torsten Riedlinger	Germany	Torsten.riedlinger@dir.de
Prih Harjadi	Indonesia	prih@bmg.go.id
Jan Sopaheluwakan	Indonesia	jans@lipi.go.id jx_hydrogen@yahoo.com
V. Sampath	India	director@incois.gov.in
T Srinivasa Kumar	India	srinivas@incois.gov.in
G H P Dharmaratna	Sri Lanka	Meteo1@sltnet.lk gdharmaratna@yahoo.com
Arjunapermal Subbiah	ADPC	subbiah@adpc.net
Edward Young	USA	Edward.Young@noaa.gov
Takeshi Hachimine	Japan	hachimine@met.kishou.go.jp
Yuji Nishimae	Japan	nishimae@met.kishou.go.jp
Hiroshi Tajihi	Japan	Hiroshi.tajihi@cao.go.jp
S N Sok Appadu	Mauritius	meteo@intnet.mu

ANNEX VIII

LINKING TO DISASTER MANAGEMENT AND DEVELOPMENT
By Reid Basher, Coordinator,
UN/ISDR Platform For The Promotion Of Early Warning (PPEW)

A group of participants met on the side of the meeting to discuss how to integrate the ICG-coordinated tsunami warning systems into disaster management and national development processes. Key issues noted by the group included legal/institutional foundations, community capacities, public awareness, education, mitigation, and emergency management. The group concluded as follows:

- **Disaster management:** The downstream processes of disseminating and acting on the warnings of a tsunami centre are managed by agencies concerned with disaster management, e.g. National Disaster Management Office (NDMO) or equivalent organisations and local authorities. The aim should be to introduce tsunami concerns into their existing plans and procedures, which may need to be modified to address these concerns. NDMOs are not well represented in current ICG processes, and additional effort should be made to engage this constituency as a partner in the warning system development, for example through a special meeting of NDMO representatives and by their participation in the proposed Working Group on Mitigation, Preparedness and Response. Guidelines and tools and information products tailored to disaster manager requirements should be developed.
- **Development context:** Early warning systems development needed to be "mainstreamed" into national disaster risk reduction and development planning, in order to ensure the systems are recognised and valued in national development agendas and are therefore more sustainable. This requires engagement with national priority setting for implementing the Hyogo Framework for Action and in development planning such as National Development Plans, Poverty Reduction Strategy Papers, the Common Country Assessment and UN Development Assistance Framework (CCA/UNDAF). It also requires the advocacy of disaster reduction and early warning, the engagement of development entities such as UNDP in the warning system development, where needed, and the support of development practitioners with useable guidelines and tools.
- **National priority setting:** The national assessment mission reports provide a foundation for choosing priorities for action for developing capacities to make downstream use of warnings. The responsibility for doing so lies with governments, but UN and other external agencies and donors can assist in the process where required. The next step is to elaborate specific national needs and plans for implementing necessary mitigation, preparedness and response projects.
- **Coordination:** There is a need for improved coordination among donors and implementing organisations involved in setting up warning systems, especially for downstream activities such as in public awareness and mitigation. An overall strategy paper for advancing the development of the downstream components has been prepared by the ISDR secretariat to assist in this respect. At the national level, coordination with downstream stakeholders should be facilitated through national platforms for disaster risk reduction (as proposed in the Hyogo Framework for Action 2005-2015.) This would ensure broader based ownership of the tsunami agenda as well as more effective preparedness and use of warning information.

- **Proposed working group:** An additional working group under the ICG process was proposed for this topic area, to be called the Working Group on Mitigation, Preparedness and Response. It can be noted that a similar entity was established by the ICG for the Tsunami Warning System in the Pacific at its meeting in October 2005. Given the wide range of issues and disciplines involved, it is important that firm terms of reference are devised.

The group proposed the following terms of reference.

"The Working Group on Mitigation, Preparedness and Response will support national efforts to make effective use of tsunami warnings through improved mitigation, preparedness and response to warnings, by means of:

- Promoting the identification, dissemination and application of good practice information relevant to mainstreaming tsunami warning systems into development planning and practice, including policy and institutional development, project identification, sector policies, risk mitigation, and recovery processes.
- Promoting and supporting the engagement of national tsunami centres and experts in national platforms for disaster risk reduction, all-hazard integration processes, and national disaster management processes.
- Supporting the provision of guidelines, tools and best practice information for the disaster management sector, concerning inter alia public information, education, training, communication processes, evacuation planning and drills, and emergency management.
- Assisting in communicating the results of other ICG working groups to the development and disaster management communities and vice versa communicating the needs of these communities to the other working groups."

Member states will need to ensure that appropriate officials, particularly from the development and disaster management authorities are able to participate in the working group and in ICG meetings, and that there is engagement with relevant non-state actors such as Red Cross/Red Crescent Societies, NGOs, community groups and the private sector.

The group of participants also examined the initial draft strategy prepared by the ISDR secretariat for advancing the development of the downstream components of the tsunami warning system. This is based on the experience with the current multi-donor, multi-partner Flash Appeal project, and on a recent project evaluation meeting involving partners, donors and the ISDR secretariat. It was agreed that an overall strategy document would be valuable to countries, donors and implementing organisations and that the draft strategy should be further developed. A number of specific suggestions were made. The group noted that while the strategy could stand alone, it should be consistent with the core system implementation plan being developed by IOC and with the terms of reference of the proposed Working Group on Preparedness and Response. The ISDR secretariat agreed to continue working with the IOC secretariat to further develop the strategy.

ANNEX IX

DRAFT TABLE OF CONTENTS FOR AN IOTWS IMPLEMENTATION PLAN

1. Executive Summary
2. Pre-Dec 26, 2004 System Status: this chapter will show graphically the system that existed before the tsunami and describe briefly the readiness.
3. Present Status: graphic status of system in early 2006 and brief description of recent actions to build the system.
4. Future Status; depiction of the optimum system
5. Technical Implementation Plan: each chapter to show graphic implementation plans with milestones, tasks, costs, responsible party and brief descriptions.
   - 5.1 Sea Level (including CB)
   - 5.2 Seismic (including CB)
   - 5.3 Risk Assessment (including CB)
   - 5.4 Modeling (including CB)
   - 5.5 Warning Centers (including CB)
   - 5.6 Mitigation/Emergency Management (including CB)
6. Capacity Building Summary: a summary of all CB shown in above chapters with descriptive text.

ANNEX X

LIST OF PARTICIPANTS

I. MEMBER STATES OF ICG

AUSTRALIA

Mr Rick BAILEY (Head of Delegation)
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 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 Brian FLANAGAN
Assistant Director
Tsunami Warning Implementation
Emergency Management Australia
PO Box 1020
Dickson ACT 2606
Tel: +61 2 6256 4692
Fax: +61 2 6256 4563
Email: brian.flanagan@ema.gov.au

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

Mr Geoff CRANE
Bureau of Meteorology
P.O. Box 1289
Melbourne. VIC 3001
Tel: +61 3966 94110
Fax: +61 3966 94695
Email: g.crane@bom.gov.au

Ms Suzanne EDGECOMBE
Director, Humanitarian and
Emergencies Section
AusAID
GPO Box 887 Canberra
ACT 2601
Tel +61 2 62064660
Fax +61 2 62064587
Email: Suzanne.edgecombe@ausaid.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 Alexei GORBATOV
Geoscience Australia
GPO Box 378
Canberra ACT 2601
Tel: +61 2 6249 9376
Fax: +61 2 6249 9969
Email: alexei.gorbatov@ga.gov.au

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

FRANCE

Mr Gerard THERRY
Regional Director La Reunion
Meteo France, BP 4
97491 Sainte Clotilde Cedex
La Reunion
Tel: +33 2 62 92 11 01
Fax: +33 2 62 92 11 47
Email: Gerard.therry@meteo.fr

INDIA

Dr Harsh K GUPTA
Raja Ramanna Fellow &
Former Secretary, DOD
2-64/1, Kakatiya Nagar
Hyderabad – 500 007
Tel: +91 40 27155971
Fax: +91 40-23434651
Email: harshgupta@nic.in

Dr P.S. GOEL
Secretary to the Govt. of India
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

Dr K RADHAKRISHNAN
Director
National Remote Sensing Agency (NRSA)
Balanagar, Hyderabad – 500 037
Tel: +91 40 - 23878360
Fax: +91 40 - 23877210
Email: director@nrsa.gov.in

Dr V SAMPATH
Director
Indian National Centre for Ocean
Information Services (INCOIS)
"Ocean Valley", P B No. 21
IDA Jeedimetla P.O
Hyderabad – 55
Tel: +91 40-23895000
Fax: +91 40-23895001
Email: director@incois.gov.in

Mr R K SHARMA
Scientist – F
Department of Ocean Development (DOD)
"Mahasagar Bhavan", Block – 12,
CGO Complex, Lodhi Road,
New Delhi 110 003
Tel: 011-24361436
Fax: 011-24362644

Dr R.K. CHADHA
Scientist
National Geophysical Research Institute (NGRI)
Uppal Road
Hyderabad 500007
Tel: +91 40 23434630
Fax: +91 40 23434651
Email: chadha@ngri.res.in

Dr K SOMASUNDAR
Scientist-E
Department of Ocean Development (DOD)
"Mahasagar Bhavan", Block – 12,
CGO Complex, Lodhi Road, New Delhi 110 003
Tel: +91 11-24361068
Fax: + 9111-24362644

Dr S KATHIROLI
Director
National Institute of Ocean Technology (NIOT)
Velachery, Tambaram Main Road
Palikaranai, Chennai – 601 302
Tel: +91 44-55783301
Fax: + 91 44-22460645

Mr K PREMKUMAR
Project Director, NDBP,
National Institute of Ocean Technology (NIOT)
Velachery, Tambaram Main Road
Palikaranai
Chennai – 601 302
Tel: +91 44-55783535
Fax: +91 44-22460645

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

Dr B MANIKIAM
Scientist/Engr SG/DMS
Indian Space Research Organisation
Antariksha Bhavan
New BEL Road
Bangalore – 560 094
Tel: + 91 80-22172272
Fax: +91 80-23415414
Email: manikiam@isro.gov.in

Dr V S HEGDE
Dy.Director-Applns.Proj, EOS/
Assoc. Programme Director, DMS
Indian Space Research Organisation
Antariksha Bhavan
New BEL Road
Bangalore – 560 094
Tel: + 91 80-23412471
Fax: +91 80-23417455
Email: vshegde@isro.gov.in

Dr Satish R SHETYE
Director
National Institute of Oceanography (NIO)
Dona Paula, Goa – 403 004
Tel: +91 832-2450450
Fax: +91 832-2450602/603

Dr Ashok BHATNAGAR
Additional Director General
Indian Meteorology Department (IMD)
New Delhi
TeleFax: +91 11 24697473
Email: bhatnagar.ashok@gmail.com

Mr Brig B. NAGARAJAN
Survey of India
Post Box No.37
Dehradun (Uttaranchal)
Fax: + 91 135 2744064

Dr V P DIMRI
Director
National Geophysical Research Institute (NGRI)
Uppal Road
Hyderabad – 500 007
Tel: +91 40-23434600
Fax: +91 40-23434651
Email: director@ngri.res.in

Mr Ravi Prakash SRIVASTOVA
Scientist
National Geophysical Research Institute (NGRI)
Hyderabad 500007
Email: ravi_prakash@ngri.res.in

Dr G D GUPTA
Adviser & Head
(Seismology Division)
Department of Science & Technology
Technology Bhavan
New Mehrauli Road
New Delhi-110016
Fax: +91 11-269 62742
Email: gdgupta48@yahoo.com

Dr A. K. GHOSH
Outstanding Scientist & Head, Reactor Safety Division
Bhabha Atomic Research Centre
Trombay
Mumbai – 400 085
Tel: + 91 22-25505050
Fax: + 91 22-25505151

Dr P S ROY
Dy. Director-RS&GIS
National Remote Sensing Agency (NRSA) ,
Balanagar
Hyderabad – 500 037
Tel: + 91 40-23884210
Fax: + 91 40-23877210

Dr V RAJENDRAN
Head, Instrumentation & Control,
National Institute of Ocean Technology (NIOT)
Velachery, Tambaram Main Road
Pallikaranai, Chennai – 601 302
Tel: + 91 44-55783400
Fax: + 91 44-22460645

Mr Reghu VENKATARAMAN
Head AS & DPD
National Remote Sensing Agency (NRSA)
Balanagar
Hyderabad – 500 037
Tel: + 91 40-23884472
Fax: + 91 40-23877210

Dr R. S. DATTATRAYAM
Director (Seismology)
India Meteorological Department
Mausam Bhavan, Lodi Road
New Delhi – 110 003
Tel: + 91 11 24611305
Fax: + 91 11 24619943
Email: dattatrayam_rs@hotmail.com

Dr M RAVICHANDRAN
Scientist "E"& Head, MOG, INCOIS
Indian National Centre for Ocean
Information Services (INCOIS)
"Ocean Valley", P B No. 21
IDA Jeedimetla P.O
Hyderabad – 55
Tel: + 91 40-23895004
Fax: + 91 40-23892910
Email: ravi@incois.gov.in

Dr M V Ramana MURTHY
Scientist "D"
Integrated Coastal and Marine
Area Management (ICMAM)
NIOT Campus, Velachery, Tambaram Main Road
Palikaranai, Chennai – 601 302
Tel : + 91 44-557835866
Fax: + 91 44-22460657

Mr B V SATYANARAYANA,
Scientist "D" & Head, CDG,
Indian National Centre for Ocean
Information Services (INCOIS)

"Ocean Valley", P B No. 21
IDA Jeedimetla P.O
Hyderabad – 55
Tel: + 91 40 - 23895005
Fax : + 91 40-23892910
Email : bvs@incois.gov.in

Mr T Srinivasa KUMAR
Scientist "D" & Head, ASG, INCOIS
Indian National Centre for Ocean
Information Services (INCOIS)
"Ocean Valley", P B No. 21
IDA Jeedimetla P.O
Hyderabad – 55
Tel: + 91 40 - 23895006
Fax : + 91 40 - 23892910
Email: srinivas@incois.gov.in

INDONESIA

Dr Ir. Jan SOPAHELUWAKAN M.Sc
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

Mr FAUZI
Head of Engineering Seismology and Tsunami
Division Meteorological and
Geophysical Agency Jakarta, Indonesia, Jl.
Angkasa I, No. 2, Kemayoran, Jakarta Pusat
Tel: +62 21 424 6321 ext 331
Fax: +62 21 654 6316
Email: fauzi@bmg.go.id

Ms Velly ASVALIANTINA, M Eng. Sc
Researcher
Coastal Dynamics Research Center
Agency for the Asessment & Application
Technology (BPPT)
Jl.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 Ir Sugiarta WIRASANTOSA, M.Sc
Director Research Center for Marine Territory
and Non Living Resources Agency for Marine
and Fisheries Research, Ministry of Marine
Affairs and Fisheries
Jl.M.H. Haryono Kav 52-53
Jakarta 12770
Tel: +62 21-79191202
Fax: +62 21-79180303

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

KENYA

Dr Joseph R. MUKABANA
Director of Meteorological Services and Perm.
Rep. of Kenya with WMO,
P.O. Box 30259 -00100, Nairobi
Tel: +254 20 3867880
Fax: +254 20 3876955
Email: mukabana@meteo.go.ke

Mr Ali MAFIMBO JUMA
Meteorologist
Kenya Meteorological Dept.
P.O. Box 30259, 00100 GPO
Nairobi
Tel: +254 20 386 7880
Fax: +254 20 387 6955
E-mail: mafimbo@meteo.go.ke
mafimbo@yahoo.com

Ms Beatrice AKUNGA
Fisheries Department
58187 Nairobi
Tel: +254 20 3742349/3579
Fax: +254 20 342149
Email: nyabokeakunga@yahoo.com

MADAGASCAR

Mr Andriamiranto RAVELOSON
Institute and Observatory of Geophysics in
Antananarivo (I.O.G.A.)
PoBox: 3843
101 Antananarivo MADAGASCAR
Tel: +261 32 04 039 36 (mobile)

+261 20 22 301 82 (Office)
Email: r_raveloson@yahoo.com

MALAYSIA

Mr Kong Chiew LOW
Director of Seismological Div.
Malaysian Met. Service
Jalan Sultan
46667 Petaling Jaya
Tel: 603 79 67 8062
Fax: 603 79550964
Email: kclow@kjc.gov.my

Prof Hock Lye KOH
Professor
Universiti Saivs Malaysia
11800 USM Pulau Pinang
Tel: +604 653 3657
Fax: +604 657 0910
Email: hlkoh@cs.usm.my

Prof Dr Sinn Chye HO
Director, National Oceanography Directorate
Ministry of Science, Technology & Innovation
Ground Floor, Block C5, Parcel C
Federal Govt. Administrative Centre
62662 Putrajaya
Tel: 603 8885 8068
Fax: 603 8889 3008
E-mail: scho@mosti.gov.my

MALDIVES

Mr Abdullah Algeen
Director
Dept. of Meteorology
Male
Email: admin@meteorology.gov.mv

MAURITIUS

Mr S.N. Sok APPADU
Director, Meteorological Services
St. Paul Road
Vacoas
Tel: +230 686 1031/32
Fax: +230 686 1033
E-mail: meteo@intnet.mu

Mr S.C. SEEBALLUCK
Secretary for Home Affairs of the Prime
Minister's Office of Mauritius
Government House
Port Louis
Tel: +230 201 1006
Fax: +230 201 3859
Email: sseeballuck@hotmail.com

MYANMAR

Mr Myint SWE
Deputy Chief of Mission
Minister-Counsellor
Embassy of the Union of Myanmar
3/50 F Nyaya Marg
Chanakyapur
New Delhi 220 032
India
Tel: +91 11 2687 7327
Fax: +91 11 2467 8824
Email: myandeli@nda.vsni.net.in

Mr Thet Win TU
First Secretary
Embassy of the Union of Myanmar
3/50 F Nyaya Marg
Chanakyapur
New Delhi 220 032
India
Tel: +91 11 2687 7327
Fax: +91 11 2467 8824
Email: myandeli@nda.vsni.net.in

SEYCHELLES

Mr Denis CHANG-SENG
Acting Director
National Meteorology Services
Ministry of Policy, Planning and Services
PO Box 1145
Mahe
Republic of Seychelles
Tel: +248 384068
Fax: +248 384078
Email: d.chang-seng@pps.gov.sc

SINGAPORE

Mr Lesley CHOO
Head, Computer and Communications
Meteorological Services
The National Env. 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 Chui Wah YAP
Meteorological Officer
Meteorological Services Division
National Environment Agency
P.O. Box 8, Changi Airport
Singapore 918141
Tel: +65 654 29024

Fax: +65 6542 9020
Email: Yap_Chui_Wah@nea.gov.sg

SOMALIA

Mr Abdulkadir NUR ARALE
Deputy Minister of Fisheries and Marine Resources
Mogadishu
Tel: +254 722 19496
Email: arraleh05@yahoo.com

Mr Omer HAMUD
Secretary
Ministry of Fisheries and Marine Resources
Mogadishu
Tel: +2521 655 223
Email: a.nur@planet.nl

SRI LANKA

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

Mr Sarath WEERAWARNAKULA
Director
Geol. Survey & Mines Bureau
No. 4 Senanayaka Building,
Dehiwala
Tel. +94 11 2725 745
Fax +94 11 5723 752
Email gsmb@slt.lk

Mr G.H.P. DHARMARATNA
Director-General, Dept. of Meteorology, 383,
Buddhaloka Mawatha, Colombo 7.
Tel: +94 11 2694 104
Fax: +94 11 2698 311
E-mail : gdharmaratna@yahoo.com,
Meteo1@sltnet.lk

Prof Charitha PATTIARATCHI
Centre for Water Res.
Univ. of WA,
Nedlands, W.A.
Australia
Tel: +61 8 6488 3179
Fax: +61 8 6488 1015
Email: pattiara@cwr.uwa.edu.au

TANZANIA

Mr Philbert TIBAIJUKA
Director of Forecasting,
Tanzania Meteorological Agency
P.O. Box 3056
Dar es Salaam
Tel: +255 22 2460706
Fax: +255 22 246 0718
Email: tibaijukap@meteo.go.tz

Mr Shigalla MAHONGO
Senior Research Officer
Tanzania Fisheries Research Institute
P.O. Box 9750
Dar es Salaam
Tanzania
Telephone: +255 22 2650045
Fax: +255 22 2650043/2110215
Email: shigalla@yahoo.co.uk

THAILAND

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

Mr Thongchai SIMKING
Chief of Administration Division, GISTDA
196 Phahonyothin Road
Chatuchak, Bangkok 10900
Tel: +662 326 4427
Fax: +662 326 4290
Email: thongchai@gistda.or.th

Prof Absornsuda SIRIPONG
Marine Science Department, Faculty of Science
Chulalongkorn University
Khet Pathumwan
Phya Thai Road
Bangkok 10330
Tel: +662 218 5405
Fax: +662 218 5405, +662 255 0780
Email: sabsorns@chula.ac.th

II. MEMBER STATES OF IOC OBSERVERS TO ICG

GERMANY

Mr Reinhold OLLIG (Head of Delegation)
Head of Division
Ministry for Education and Research
Heinemannstrasse 2

53175 Bonn
Tel: +4 91888 573469
Fax: +49 1888 57 83469
Email: reinhold.ollig@bmbf.bund.de

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

Dr Joachim SAUL
Geophysicist
GFZ Potsdam
Telegrafenberg
14473 Potsdam
Tel: +49 331-288-1267
Fax: +49 331 288-1277
Email: saul@gfz-potsdam.de

Dr Harald MEHL
Head of Division
Environment and Geo-Information
German Aerospace Center
D-82234 Wessling.
Tel: +49 8153 28 1137
Fax: +49 8153 28 1445
Email: harald.mehl@dlr.de

PD Dr Torsten SCHLURMANN
Academic Officer
United Nations University
Institute for Environment and Human Security
UNU-EHS
Goerresstr. 15
D-53113, Bonn
Germany
Tel: +49 (0) 228 42285518
Fax: +49 (0) 228 42285599
Email: schlurmann@ehs.unu.edu

Mr Torsten RIEDLINGER
Scientist, Natural Hazard and Crisis Information
German Aerospace Centre
Oberpfaffenhofen
82234 Wessling
Germany
Tel: +49 8153283674
Fax: +49 8 153 28 1445
Email: Torsten.Riedlinger@dlr.de

Mr Wil DORAN
EUMETSAT
Am Kavalleriesand 31
64295 Darmstadt
Germany
Tel: 0049 6151 807 361
Fax: 0049 6151 807 304
Email: wil.doran@eumetsat.int

JAPAN

Mr Hiroshi TAJIHI
Deputy Director, International Office for
Disaster Management, Cabinet Office
1-2-2 Kasumigaseki Chiyoda-ku
Tokyo 1008969
Tel: +81 3 3503 9394
Fax: +81 3 3581 8933
Email: hiroshi.tajihi@cao.go.jp

Mr Yuji NISHIMAE
Scientific Officer
Earthquake and Tsunami Observations Division
Seismological and Volcanological Department
Japan Meteorological Agency
1-3-4 Otemachi, Chiyoda-ku
Tokyo 100-8122
Tel: +81 3 3212 8341
Fax: +81-3-3215 2963
Email: nishimae@met.kishou.go.jp

Mr Yuji OKADA
Consulate General of Japan
No. 12/1 Cenetoph Road 1st Street
Teynampet, Chennai 600 018
India
Tel: +91 44 2432 3859
Fax: +91 44 2432 3859

UNITED KINGDOM

Mr David RADCLIFFE
Senior Livelihoods Adviser
DFID India
c/o British High Commission
B 28 Tara Crescent
Qutab Institutional Area
New Delhi 110 016
India
Telephone : +91 5279 3354
Fax : +91 (11) 2652 9296
Email: d-radcliffe@dfid.gov.uk

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 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
NOAA
Assistant Regional Director
NWS Pacific Region
Grosvenor Center, Mauka Tower
737 Bishop Street, Suite #2200
Honolulu, HI 95813
Tel: +1 808 532 6412
Fax: +1 808 532 5569
Email: Edward.young@noaa.gov

Mr Orestes ANASTASIA
USAID
US IOTWS Program Manager
Regional Environment Office
Diethelm Towers A, 10th Floor
93/I Wireless Road
Bangkok 10330
Thailand
Tel: +66 2 263 7468
Fax: +66 2 263 7499
Email: oanastasia@usaid.gov

Dr Vasily TITOV
PMEL/NOAA
7600 Sand Point Way NE
Seattle, WA 98115
Tel: +1 206 526 4536
Fax: +1 206 526 4576
Email: vasily.titov@noaa.gov

Dr Walter MOONEY
USGS
Geophysicist
Lead Coordinator USGS Program for an Indian Ocean Tsunami Warning System (IOTWS)
345 Middlefield Road, M/S 977
Menlo Park, CA 94025
Tel: +1 650 329 4764
Fax: +1 650 329 5163
Email: mooney@usgs.gov

III. ORGANIZATIONS / INSTITUTIONS

Asian Disaster Reduction Center (ADRC)

Ms Akiko NAKAMURA
Researcher
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, CRM
AIT Campus
Bangkok
Tel: +66 2 516 5900
Email: subbiah@adpc.net

Dr Pennung WARNITCHAI
Asian Institute of Technology
School of Engineering and Technology
PO Box 4, Klong Luang
Pathumthani 12120
Thailand
Tel: +66 2 524 5530
Fax: +66 2 524 6059

International Coordination Group/ Pacific Tsunami Warning 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 Telecommunication Union (ITU) Regional Office for Asia and the Pacific

Mr Wisit ATIPAYAKOON
ITU regional Office for Asia and the Pacific
89/2 Chaengwattana Rd, Laksi
Bangkok 10210 Thailand
Tel: +66 2 574 8565

Fax: +66 2 574 9328
Email: wisit.atipayakoon@itu.int

University of Hawaii Sea Level Center/ Global Sea Level Observing. System (UHSLC/GLOSS)

Dr Bernie KILONSKY
Department of Oceanography
Univ. of Hawaii,
1000 Pope Road, MSB 317
Hawaii HI 96822
USA
Tel: +1 808 956 6574
Fax +1 808 956 2352
Email: kilonsky@hawaii.edu

United Nations International Strategy for Disaster Reduction (UN/ISDR)

Mr Reid BASHER
Coordinator
Platform for the Promotion of Early Warning (PPEW)
UN ISDR Secretariat
Görresstrasse 30
Bonn, 53113
Germany
Tel +49 228 249 8810
fax +49 228 249 8888.
E-mail: reid.basher@un.org

Mr Yuichi ONO
Programme Officer
Platform for the Promotion of Early Warning (PPEW)
UN ISDR Secretariat
Görresstrasse 30
Bonn, 53113
Germany
Tel:+ 49 228 249 8810
Fax: +49 228 249 8888
E-mail: onoy@un.org

World Agency of Planetary Monitoring & Earthquake Risk Reduction (WAPMERR)

Mr Adel KARAS
Post Box No. 33280
Dubai
UAE
Tel: +9714 332 2299
Fax: +9714 332 9988
Email: akaras@wapmerr.org

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

World Meteorololgical Organization (WMO)

Dr Dieter SCHIESSL
Director, WWW Dept.
CP 2300
CH-1211 Geneva 2
Switzerland
Tel: +41 22 730 8369
Fax: +41 22 730 8021
Email: dschiessl@wmo.int

IV. SECRETARIAT

IOC/UNESCO

Dr 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

Mr William ERB
IOC Perth Regional Office
C/- Bureau of Meteorology
P.O. Box
Perth W.A. 6019
Australia
Tel: +61 8 9226 2899
Fax: +61 8 9226 0599
E-mail: W.Erb@bom.gov.au

Dr Laura KONG
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

Mr 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
m.yamamoto@unesco.org

Dr 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

Ms Forest COLLINS
Tsunami Activity Coordinator
1 rue Miollis
Paris 75015
France
Tel : +33 (0)1 45 68 39 74
Fax : +33 (0) 1 45 68 58 10
Email: f.collins@unesco.org

Mr Mika ODIDO
UNESCO Nairobi Office
PO Box 30592
Kenya
Tel: +254 20 623830
Fax: +254 20 622750
Email: m.odido@unesco.org

Dr Jane CUNNEEN
Perth Secretariat ICG/IOTWS
P.O. Box 1370,
West Perth WA 6872
Australia
Tel: +61 8 9226 0191
Fax: +61 8 9263 2211
Email: j.cunneen@bom.gov.au

Mr Len BROADBRIDGE
IOC Perth Secretariat ICG/IOTWS,
P.O. Box 1370
West Perth WA 6872
Tel: +61 8 9226 0191
Fax: +61 8 9263 2211
Email: l.broadbridge@bom.gov.au

V. OBSERVERS

Mr Tony ELLIOTT
Fugro OCEANOR
Pir-Senteret
N-7462 Trondheim
Norway
Tel: +47 7354 5200
Fax: +47 7354 5201
Email: t.elliott@geos.com

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

Prof John WEBB
Counsellor
Australian High Commission1/50 G, Shantipath
Chanakyapuri
New Delhi 110021
India
Tel: +11 5139 9900
Fax: +11 2687 3172
Email: john.webb@aei.gov.au

ANNEX XI

LIST OF ACRONYMS

AUD	Australian Dollars
ADPC	Asian Disaster Preparedness Center
AFTN	Aeronautical Fixed Telecommunications Network
ASEAN	Association of Southeast Asian Nations
ATWS	Australian Tsunami Warning System
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
DIPECHO	Directorate General (European Commission) for Humanitarian Aid
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/ITSU	International Coordination Group for the Tsunami Warning System in the Pacific
IFRC	International Federation of Red Cross & Red Crescent Societies
IMO	International Maritime Organization
INCOIS	Indian Centre for Ocean Information Services
IO	Indian Ocean
IOC	Intergovernmental Oceanographic Commission (of UNESCO)
IOGOOS	Indian Ocean GOOS
IOTEWS	Indian Ocean Tsunami Early Warning System
IOTWS	Indian Ocean Tsunami Warning System
ISDR	International Strategy for Disaster Reduction
ITSU	Tsunami Warning System in the Pacific
ITIC	International Tsunami Information Center (USA)
ITU	International Telecommunications Union

JMA	Japan Meteorological Agency
LIPI	Indonesian Institute of Sciences
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
RTCI	Regional Tsunami Information Centre
RTH	Regional Telecommunication Hub
RTWP	Regional Tsunami Watch Provider
TEWS	Tsunami Early Warning System
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

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