Intergovernmental Oceanographic Commission
Reports of Governing and Major Subsidiary Bodies

Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS)

First Session

Rome, Italy
21-22 November 2005

UNESCO

In this Series *Languages*

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

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

CONTINUED ON INSIDE OF BACK COVER

Intergovernmental Oceanographic Commission
Reports of Governing and Major Subsidiary Bodies

Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS)

First Session

Rome, Italy
21-22 November 2005

UNESCO 2006

Abstract

The First Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and connected Seas (ICG/NEAMTWS), established by the IOC Assembly during its 23rd Session in June 2005, through Resolution XXIII-14, took place in Rome on 21st and 22nd November 2005, at Palazzo Taverna.

The Meeting, kindly hosted by the by the Government of Italy (Italian Ministry of Foreign Affairs and Ministry for Environment and Protection of the Territory), was attended by more than 150 participants from 24 countries, 13 organizations and numerous observers.

Reports from national, regional and international organizations were presented on the development of a tsunami and multi-hazard regional early warning system and provided the basis for working group discussions on the establishment of such a system in the North Eastern Atlantic, the Mediterranean and connected seas.

The Tsunami Warning System will be based on existing seismographic and sea-level networks, with appropriate upgrade to real time operation. Several national and local warning systems under development will be fully integrated into this initiative. Nations committed themselves to work towards upgrading legislation and existing detection systems, and to develop integrated national emergency preparedness and awareness plans.

The ICG nominated Italy as Chair of the Intergovernmental Coordination Group, position that will be served by Professor Stefano Tinti, University of Bologna, for two years assisted by two Vice-chairs, Morocco and Greece, positions that will be served by Dr Azelbarab El Mouraouah, Coordinator, Centre Euro-Méditerranéen pour l'Evaluation et la Prévention du Risque Sismique —CEPRIS of Rabat, and Dr Gerassimos Papadopoulos, National Observatory of Athens.

During the intersessional period four working groups will address issues concerning the formulation and operationalization of a multi-hazard early warning system for the North Eastern Atlantic, the Mediterranean and connected seas:

1. Hazard assessment, risk and modelling
2. Seismic and geophysical measurements
3. Sea level measurements
4. Advisory, mitigation and public awareness

The ICG will work towards the formulation of a complete plan of action by December 2006, including the implementation of an initial operational system by December 2007.

The next session of the ICG/NEAMTWS will take place in May 2006.

(SC-2006/WS/4)

TABLE OF CONTENTS

ANNEXES

1. OPENING

1 On behalf of the Italian Ministry for the Protection of the Environment and Territory (MATT), Professor Ezio Bussoletti, Scientific Attaché of the Italian Permanent Delegation to UNESCO, opened the First Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS-I) at 09:30 on Monday 21 November 2005. Professor Bussoletti invited the representatives of the Government of Italy and the Assistant Director-General of UNESCO/Executive Secretary of the IOC to make their welcoming addresses and statements.

2 Dr Patricio Bernal, Executive Secretary of the IOC, thanked the Italian Government for the hospitality and delivered a statement on behalf of Mr Koïchiro Matsuura, Director-General of UNESCO (the full speech is available in Annex IV). In his statement Mr Matsuura reminded the catastrophic consequences of the tsunami that took place in the Indian Ocean on 26 December 2004 and emphasized the increasing degree of vulnerability to natural disasters to which large numbers of population are exposed due to population increase, unplanned growth of inadequate coastal settlements and poverty. While a tsunami early warning system exists for the Pacific Ocean since 1965, the Indian Ocean, the Caribbean Sea, the Mediterranean and the North-Eastern Atlantic are not equipped with such a system. UNESCO, through the IOC, is taking the lead for the establishment of early warning systems in those regions, based on the enhancement of existing capabilities for measuring seismic activities and the sea level and the information provided by the Global Ocean Observing System (GOOS). Given the particular geological structure and size of the Mediterranean and the Black Sea, the technical requirements are very demanding and quite different from other regions. Mediterranean-rim countries, particularly Greece, Italy and Turkey, are exposed to seismic activity generated by the collision zone between the Eurasian and African crustal plates. Historically, there are records of important tsunamis originating in this region. The First Session of the ICG/NEAMTWS lays the foundation for the establishment of such a system in the North-Eastern Atlantic, the Mediterranean and connected seas, based on existing national and regional observation networks and centres such as EuroGOOS, MedGOOS, the Euro-Mediterranean Centre on Evaluation and Prevention of Seismic Risk, in Rabat, Morocco, the European Mediterranean Seismological Centre (EMSC) at Bruyères-le-Châtel, France, the European Centre on Prevention and Forecasting Earthquakes, in Athens, Greece, and the European Centre for Geodynamics and Seismology, in Luxemburg. The goal of establishing a tsunami and multi-hazard warning system in the North-Eastern Atlantic, the Mediterranean and connected seas is challenging and UNESCO/IOC stand ready to assume the coordination role for which have been called upon by the international community.

3 Dr Aldo Cosentino, Head of Directorate-General for Nature Protection, Ministry for the Protection of the Environment and Territory, welcomed the participants on behalf of the Ministry for the Protection of the Environment and Territory. In his speech, Dr Cosentino emphasized how the catastrophic events occurred in the Indian Ocean have placed tsunamis on the global agenda. He stated that the Italian Government and MATT have readily responded to such catastrophe by providing the affected countries with resources, technologies and methodologies. He underlined how the impact has been proportionate to the level of protection of the natural environment: in some cases, the fishermen villages built inland and protected by natural vegetation have better resisted than tourist resorts built with non-traditional technologies; in addition, if the comparison is possible, the loss of animals in vegetated areas has been inferior than that of human lives in areas not protected by vegetation. The adoption of integrated coastal zone management (ICZM) approaches and the creation of building setbacks can help maintain the equilibrium of coastal morphodynamics, in particular sedimentary budgets and erosive

processes. On the one hand, the extensive processes of coastal urbanization and alteration of river flows have led to extensive erosive processes worldwide. On the other hand, the protection of coastal ecosystems —e.g., vegetation of the dune systems and seagrass meadows— leads to stability and resilience of the littoral and mitigation of such negative effects. The reflux of waves produced by tsunami lead to the transport of debris and noxious substances —chemicals and petroleum— to the sea, with consequent damage to the ecosystem on the long-term. The protection of coastal ecosystems through ICZM and marine protected areas can provide an essential context for an early warning system by raising principles of public awareness and building criteria. In this context, the Italian Government has signed an agreement with UNESCO/IOC for the provision of resources, technologies and methodologies to improve knowledge of coastal and ocean bathymetry in the Indian Ocean. The Italian Government has also signed an agreement with the U.S. National Oceanic and Atmospheric Administration (NOAA) for the development of coastal sensitivity maps in marine protected areas. Such approaches and experiences could be positively transferred to the countries of the Mediterranean, particularly in North Africa. In closing, Dr Cosentino emphasized the role of UNESCO in developing a regional early warning system in the Mediterranean and confirmed the support of the Italian Government to the process.

4 Mr Eugenio Campo, Deputy Director of Directorate General for Development Cooperation, Ministry of Foreign Affairs, welcomed the participants on behalf of the Ministry of Foreign Affairs. He reminded that this event is part of the series of “Giornate della Cooperazione” (Cooperation Days), organized by the Italian Government to enhance development cooperation in support to the Millennium Development Goals. While reminding that Italy has been ready to support the countries of the Indian Ocean affected by the December 2004 tsunami, Mr Campo emphasized the importance of going beyond emergencies, improving reconstruction and prevention. He also delivered a message from Mr Deodato, Director-General of Directorate General for Development Cooperation, Ministry of Foreign Affairs. The creation of an early warning system is important for all countries. Italy has actively mobilized on the occasion of the tragedy of the December 2004 tsunami: the collective contribution from the Government and citizens, provided through the United Nations, the European Union and bilaterally amounted to 160 million euros of which 10 million for immediate aid and 72.5 million through the Ministries of Foreign Affairs, Environment and Finance for reconstruction and economic development through the medium and long-term strategies agreed upon in Kobe, Phuket, Paris and Mauritius. An early warning system for the Mediterranean is important: the tragic event of December 2004 would have been reduced by the existence of such a system and there is awareness that the Northeast Atlantic, the Mediterranean, the Marmara Sea and the Black Sea have been exposed to tsunami in the past (particularly Portugal, Spain and Morocco). Tsunamis cannot be avoided but mitigated and Italy is among the countries that support IOC Assembly Resolution XXIII-14. This meeting is the first step in the creation of a regional early warning system and Italy is ready to make available resources, technologies and methodologies to support this process.

5 Dr Enzo Boschi from the National Institute for Geophysics and Volcanology (INGV) congratulated UNESCO/IOC and the Ministries of Foreign Affairs and the Environment for organizing the meeting. He informed about the activities the INGV is carrying out on early warning since 1982 and in particular the monitoring of the earthquakes and tsunamis that took place in 2001 in Augusta and Syracuse and in 2002 in Stromboli. Through the Civil Protection and the Ministry of Education, University and Research (MIUR), the Government of Italy is actively engaged in supporting monitoring seismic activities on the seabed in collaboration with all the countries of the Mediterranean, in particular in North Africa and the Adriatic region. Dr Boschi underlined that the Meeting provided an important opportunity for launching a tsunami warning system for the Mediterranean, which will have to be more sophisticated than in other regions due to the limited size of the basin and the speed at which tsunami waves would travel. The INGV has standing scientific collaborations with France, Greece and Portugal, in particular on the occasion of the 250th anniversary of the Lisbon tsunami. He expressed appreciation for the statements made by Dr Bernal and Dr Cosentino and expressed satisfaction for the opportunity to start working towards the establishment of a global tsunami warning system.

6 Dr Alexander Tenenbaum, Director-General of Strategies and Internationalization of Scientific and Technological Research, Ministry of Education, University and Research, Italy expressed the wishes for a successful meeting to the plenary on behalf of the Minister of Education, University and Research, Ms Letizia Moratti. In his presentation Dr Tenenbaum suggested that an early warning system being established through the ICG/NEAMTWS should be directed at multiple hazards and it should be developed under the leadership of UNESCO. He presented the spectrum of hazards to be addressed by the system, distinguishing among very fast processes (earthquakes, land slides, volcanic explosions), fast processes (tsunamis, floods, fires, extreme weather and sea conditions, volcanic eruptions, oil spills, marine and air short-term pollution) and slow processes (droughts, desertification, marine and air long-term pollution). He outlined the components of an early warning system, including sensors, data transmission, archiving and analysis, parameters and models for evaluation, and alerting. He mentioned the four satellites planned and being developed by the European Space Agency (ESA) to monitor natural and artificial hazards and highlighted the need to support not only research but also applications. In this context, the Italian participation to the Global Monitoring for Environment and Security (GMES) initiative, developed by the European Commission and ESA and a contribution to the Group on Earth Observations (GEO), could help generate most of the information needed for the Mediterranean. He also underlined some of the critical tasks of a global early warning system, namely to: (i) improve theoretical models both for the genesis of phenomena and for their temporal/spatial evolution; (ii) extend the monitored areas by increasing the number of detecting stations; (iii) provide an open data base with well-established international standards; (iv) integrate existing regional systems in a global network by defining common formats and procedures for data acquisition, transmission, and evaluation; (v) fill the gaps in the global network by supporting the use of a common standard for instruments and technologies, for both acquisition and management of data; and ensure efficiency and rapidity of information exchange in a global integrated early warning system, and the adoption of shared action procedures.

2. ORGANIZATION OF THE SESSION

7 Dr Patricio Bernal, Assistant Director-General of UNESCO and Executive Secretary of the IOC, introduced this agenda item. He thanked the Government of Italy for the choice of the magnificent location of Palazzo Taverna as the venue of the Meeting and the logistical arrangements provided.

2.1 ADOPTION OF THE AGENDA AND TIMETABLE

8 **The ICG approved** the Agenda as in Annex I.

2.2 ELECTION OF THE CHAIR FOR THE SESSION

9 Portugal, seconded by Germany, proposed to the plenary that Professor Ezio Bussoletti, Scientific Attaché of the Italian Permanent Delegation to UNESCO acted as Chairman for the

Session. **The ICG approved** his nomination by acclamation. The Chairman thanked the plenary. Professor Bussoletti underlined that the offer of the Government of Italy to host the meeting reflects its commitment to the process of establishing a regional early warning system for tsunamis and other marine hazards.

2.3 DESIGNATION OF RAPPORTEURS

10 The Executive Secretary informed the plenary that they had received offers from Greece, Germany, Italy, Portugal and Turkey to volunteer for the roles of the chairs and rapporteurs of the sessional working groups. **The ICG accepted** the following proposals:

- Working Group 1 on Hazard Assessment: Professor Stefano Tinti (Italy) as Chair and Dr Gerassimos Papadopoulos (Greece) as rapporteur;
- Working Group 2 on Warning Guidance: Dr Peter Koltermann (Germany) as Chair and Professor Emin Özsoy (Turkey) as Rapporteur; and
- Working Group 3 on Mitigation and Public Awareness: Professor Professor Luís Mendes-Victor (Portugal) as Chair and Dr Paolo Favali (Italy) as Rapporteur.

2.4 SESSION DOCUMENTATION

11 The Executive Secretary introduced the documentation for the Session (Annex V), including the Provisional Annotated Agenda and the Provisional Timetable. All the documentation prepared for the meeting and after the meeting is available on the ICG/NEAMTWS website (http://ioc3.unesco.org/neamtws/index.htm).

2.5 LOCAL ARRANGEMENTS

12 The Chairman provided the participants with practical information on local arrangements.

2.6 ESTABLISHMENT OF SESSIONAL WORKING GROUPS

13 The Executive Secretary introduced the three sessional working groups:

- Sessional Working Group 1 on *Hazard Assessment*, addressing issues concerning collecting information on local and distant tsunami inundation maps for coastal communities using internationally accepted numerical model methodology. Estimates of coastal areas susceptible to tsunami flooding will be available from a network of modellers and data managers who will be sharing community modelling tools via the Internet;
- Sessional Working Group 2 on *Warning Guidance*, addressing issues concerning the developing and deploying of a network of early warning tsunami detection instruments, based on existing organizations and functions, in seismically active coastal areas of the Northeastern Atlantic, the Mediterranean and connected seas to complement the global network of real-time sea level networks and broadband seismometers for the international tsunami warning system and to supplement regional tsunami warning centres; and
- Sessional Working Group 3 on *Mitigation and Public Awareness*, addressing issues concerning promoting coastal hazards consideration into spatial planning and developing response plans for emergency managers, universally accepted tsunami information signs in accordance with local plans/procedures, and maintaining a

tsunami education programme for disaster management personnel, local residents and school systems.

The Executive Secretary declared that the sessional working groups were open to all the participants to the session. **The ICG approved** the proposal.

14 Israel and the USA recommended to reorganize the working groups on the successful model of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning System (ICG/IOTWS), namely four working groups concerned with (i) Seismic measurements, data collection, and exchange; (ii) Sea level data collection and exchange, including deep-ocean tsunami detection instruments; (iii) Tsunami hazard identification and characterization, including modelling, prediction and scenario development; and (iv) The establishment of a system of interoperable advisory and warning centres. Portugal and Norway supported this proposal. Greece and Italy noted that, given the particular physiographic characteristics of the Mediterranean, integration rather than separation of warning systems were required. The Executive Secretary suggested that in this Session of the ICG/NEAMTWS, due also to logistic constraints, the warning guidance issues should be addressed by Working Group 2, which, for the intersessional period, should be divided into two working groups dealing primarily with seismic and sea level information respectively. The USA felt that this was a reasonable proposal. France commented that the working group dealing with seismic information should also incorporate geophysical aspects, particularly in relation to volcanic eruptions and landslides. UN/ISDR suggested that risk assessment should also include vulnerability aspects. Following the suggestion from the USA that risk assessment and modelling should also be included into Working Group 1, the Executive Secretary proposed that the three sessional working groups were renamed as follows:

- Sessional Working Group 1: **Hazard assessment, risk and modelling**;
- Sessional Working Group 2: **Warning guidance, including seismic, geophysical and sea level information**; and
- Sessional Working Group 3: **Advisory, mitigation and public awareness**.

3. BACKGROUND AND REPORTS

3.1 THE ESTABLISHMENT OF THE ICG/NEAMTWS

15 The Executive Secretary provided background on the establishment of the ICG/NEAMTWS and outlined its expected role in fulfilling the objectives of IOC Resolution XXIII-14. The ICG is intended to provide oversight and technical guidance to the Tsunami Early Warning and Mitigation System in the Northeastern Atlantic, the Mediterranean and Connected Seas and ensure the integrity of the system servicing all the nations of the region and operated through their concerted action. It will also provide effective coordination amongst countries, technical and operational planning and adequate resources, sharing of data and information, promotion of research, implementation of capacity building and other objectives as stated in the ICG's terms of reference.

16 In his presentation, Dr Bernal reviewed historic tsunami events that had occurred in the Mediterranean and North Eastern Atlantic (the pre-historic Storega slide in Norway, Santorini—1650 B.C., Lisbon—1750, Norwegian fjords and the recent Algerian earthquake in 2003) and showed the relationship among tsunamigenic potential, magnitude of earthquake, location of earthquake and depth of earthquake. Based on the historical tsunami data in the Pacific region, the Pacific Tsunami Warning Center (PTWC) has developed tentative criteria for tsunami evaluation in Tsunami Advisory Information for the Indian Ocean provided both by PTWC and the Japan Meteorological Agency (JMA), in which the accuracy of evaluation of tsunamigenic potential depends on that of magnitude, location and depth of earthquake. In the case of tsunamigenic earthquakes, tsunamis propagate very fast towards coasts but seismic waves propagate much faster, making it possible to evaluate tsunami potential using seismic wave data and to issue a Tsunami Warning before tsunami reaches coastal areas. Therefore, it is essential for tsunami warning centres to obtain seismic data of good quality on a real time basis. To illustrate the need for improving existing monitoring and modelling capabilities, Dr Bernal illustrated an experiment carried out by JMA in cooperation with the International Monitoring System, Comprehensive Nuclear Test-ban Treaty Organisation (CTBTO/IMS). JMA received information from a number of primary stations, auxiliary stations and hydroacoustic stations: to determine the epicentre and focal depth of earthquake, it is necessary to read arrival times of primary wave and/or secondary wave at several stations and to read maximum amplitudes of seismic waveform at several stations for evaluation of magnitude of the earthquake; this means that it is important for earthquake analysis to obtain complete seismic waveform data. He compared waveforms of LISS/IRIS data and CTBTO/IMS data concerning an earthquake with M7.8 occurred in Chile on 13 June 2005. There were some “data losses” in the waveforms and under these conditions there are difficulties in determining the hypocenter and magnitude—there were about 20-30% stations JMA could not use for seismic waveform data for earthquake analysis. While LISS and IRIS data are transmitted through the Internet with delay of 100 and 180 seconds on average, respectively, CTBTO/IMS data is transmitted in 30 seconds via the VSAT communication. In the case of the earthquake occurred in Chile on 13 June 2005, JMA could receive data from CTBTO LPAZ station 180 seconds earlier than the earliest LISS station. To estimate a tsuanmigenic potential correctly, focal depth estimation is essential. And it is also important for Tsunami Warning to determine accurately whether the epicentre is in an oceanic area or in a land area when an earthquake took place near a coast. Generally, the accuracy of estimated earthquake parameters increases if we can use seismic data from more stations.

17 In concluding his presentation, Dr Bernal emphasized the need for a multi-hazard platform to address coastal hazards beyond immediate emergencies: the platform would include storm surges (IOC, WMO, JCOMM), tropical storms (WMO, JCOMM), improving storm and cyclones track forecasts (IOC, WMO, JCOMM), ice hazard (IOC, WMO, JCOMM), and oil spills (IOC, WMO, UNEP). Following the remarks made by Namibia on behalf of the Africa Group at UNESCO and the G77 about the need to develop an Integrated Multi-Hazards Early Warning System in the Central, Equatorial and Southern Atlantic Ocean as part of a Integrated Global System, Dr Bernal emphasized that such multi-hazard platform should be developed and implemented including the whole Atlantic coast of Africa.

3.2 TECHNICAL REPORTS FROM MEMBER STATES AND REGIONAL ORGANIZATIONS PROVIDING CAPABILITY TO THE ICG/NEAMTWS

18 Member States contributing major systems and technology to the NEAMTWS reported briefly on their commitments and progress in establishing the systems. The presentations included national plans for observing instrumentation, communications equipment and systems, data systems and national and local warning centres. The same subjects were the focus of discussion in the working groups carried out in the Session.

19 Professor Stefano Tinti from the University of Bologna gave a presentation on tsunami research and preparedness in Italy. The 26 December 2004 Indian Ocean event raised worldwide awareness that tsunamis occur in all the oceans and that they may hit disastrously also the coasts of countries that are in areas outside the Pacific and the Indian oceans. Europe and especially the

Mediterranean coasts were attacked by great tsunamis according to historical records. The European tsunami catalogue prepared by the GITEC-TWO project in the 90s and the recent updates show that tsunamis were observed in all parts of the Mediterranean, including also the Marmara and the Black Sea. Italy is one of the European countries with the highest number of known tsunami occurrences. The recent Italian tsunami catalogue (available on line at http://www.ingv.it/italiantsunamis/tsun.html) contains 67 events most of which were due to coastal and submarine earthquakes. Several events were associated with the volcanic activity of Vesuvius and of the Aeolian Islands volcanoes: the last Italian tsunamis in 1988 and in 2002 were caused by slides triggered by volcanic unrest and eruptions. The most affected Italian zone is the region embracing southern Calabria and north-east Sicily: the highest concentration of events and some of the largest tsunamis were registered there, such as the eastern Sicily 1693 tsunami, the western Calabria 1783 case and the big 1908 Messina Straits tsunami.

20 The data base of the seismic active faults in Italy (DISS: Database of Individual Seismogenic Sources, INGV) assembled by the DISS Working Group shows that some active faults have been identified in the coastal areas where historical tsunamis occurred, but the precise association between seismic faults and tsunamis is problematic in most cases, and most importantly, it is problematic for the major Italian tsunami events: a paradigmatic case is the 1693 tsunami produced by a big destructive earthquake causing more than 60,000 fatalities. In the DISS the fault is placed some 20-30 km onshore, parallel to the eastern Sicily coast, in a position that is incompatible with tsunami generation. In addition to earthquakes, possible local sources of tsunamis are volcanoes and also unstable submarine masses (underwater flanks of volcanic edifices, canyon heads, etc.) —which can be mobilised either by mere gravitational load or by seismic load or even by anthropic activity. Italian coasts may be affected also by remote sources, such as the North Africa faults from where tsunami can reach Sardinia and Liguria (see e.g. the 2003 Algerian tsunami that was recorded as a few-centimetre perturbation by the Genoa harbour tide-gauge) and the Hellenic Arc sources. These are especially relevant not only for Italy, but also for the whole eastern and central Mediterranean Sea. The 365 A.D. earthquake (with an estimated M8.3) and tsunami, though its precise source is still unknown, is to be attributed to the western Hellenic arc subduction zone: the tsunami travelled across the Mediterranean basin, entered the Adriatic sea and attacked the eastern Sicily coast.

21 The seismic monitoring system of Italy is managed and operated by the Istituto Nazionale di Geofisica and Vulcanologia (INGV, Rome) and consists of a national short-period seismometer network and of some local networks. The Centro Nazionale Terremoti (INGV) manages the national network (RSNC: Rete Sismica Nazionale Centralizzata) covering the whole Italian territory with capability of detecting and locating earthquakes, and launching alerts to the Civil Protection Service within a few minutes on a 24 h x 7 day basis. The MEDNET network is a broadband seismometer network covering the Mediterranean area and operated by the INGV with capability for a quick source-mechanism determination of intermediate- to large-size earthquakes. MEDNET shares its data with other European broadband seismic network within the Virtual European Broadband Seismograph Network (VEBSN) real-time project, with data collected from as many as 18 European data contributors at the ORFEUS Data Centre (ODC) in the Netherlands. The Italian tide-gauge network (Rete Mareografica Nazionale) is operated real-time by the APAT (Agenzia per la Protezione dell'Ambiente e per i Servizi Tecnici) in Rome. It consists of 26 digital stations suitable for tide recording and for meteorological variables monitoring (e.g. atmospheric pressure, wind speed, etc.) and usually located within harbour areas, whose data are available also on the web. Sea monitoring is completed by a network of 14 wave-buoy stations (Rete Ondametrica Nazionale) to measure marine wave height and direction in the wind-wave spectral window, in addition to the sea temperature. Deployment of ocean floor observatories with real-time capabilities is a tool whose potential is under investigation in Italy by INGV in the framework of national and international collaborations, and that is believed to provide important integration to on-land based observational networks, as is proven by the example of the SN-1 station installed offshore Catania, southern Italy. Since most of the sources of Italian tsunamis are very close to the coast and tsunami travel time to the nearest piece of coast is very short, which is a common feature of the whole Mediterranean, the tsunami warning system has to be designed in such a way that the alert can be launched almost immediately. In this context the implementation of local tsunami warning systems based on automatic detection of tsunami generation and adequate policies of education and preparation of vulnerable coastal communities are needed. A project is in progress for the implementation of a network for the early detection of tsunami waves in southern Italy with priority given to the eastern Sicily coasts and the Messina Straits, where the tsunami potential is the highest. The network called TSUNET is a joint effort of the INGV and of the University of Bologna in cooperation with the Civil Protection Service of Sicily and is designed on the idea of community-based local systems connected together in a higher-level network.

22 Large tsunamis are a danger also for remote coasts and a Tsunami Warning System based on the traditional approach (i.e. the one currently considered in the Pacific and in the Indian Ocean) is also needed for the Mediterranean. This system is the natural complement of the local automatic TWSs, but it has to be remarked that in the Euro-Mediterranean seas the distances are less than in the vast oceans, and that in this area a 'remote' coast is attacked within about 40-50 minutes. Numerical simulations show that great tsunamis produced in the western Hellenic Arc region may attack the local coasts of Crete and Greece mainland within 20 minutes and the remote north-Africa coasts, and the Italian coasts of Apulia and Sicily in less than 45 minutes.

23 This shows clearly that great efforts should be made to reduce as much as possible the time needed for the determination of the relevant characteristic of the tsunami source (e.g. source mechanism and fault parameters in case of a seismic source) and for the detection of the generated tsunami. Fully aware that its coasts are under the threat of tsunamis, Italy is ready to exploit and improve its scientific and technological know-how to defend the coastal communities and the coastal environment and ecosystem from future tsunami attacks. Professor Tinti concluded in declaring that Italy is ready to cooperate to build a Tsunami Warning System to cover the North-East Atlantic, the Mediterranean and the connected seas, according to Resolution XXIII-14, adopted by the IOC Assembly in June 2005.

24 Mr Emilio Carreño, National Geographical Institute (IGN), Spain, gave a brief presentation on the state of the art of the tsunami warning system in Spain. In Spain, no specific network to monitor the possible occurrence of tsunamis exists. Besides, no official institution has the legal mandate to carry out this duty. In 2004 (and before the Indonesian tsunami) the Minister of Civil Defence ordered a group of experts from the Spanish Central Administration to prepare a report on the need of a Tsunami Warning System for the country. By the time this report was almost finished, and coinciding with the Indonesian tsunami and other catastrophic events in the world, the Spanish Government began to organise a specific Network for the Coordination of the Alert System for Natural Catastrophes in Spain. One of the groups of the network was precisely the Tsunami Alert group. The Spanish coast is exposed to two different areas of tsunamigenic sources: the Atlantic Ocean and the Mediterranean Sea. The Atlantic tsunamigenic zone runs along the Azores-Gibraltar fracture. Tsunamis generated in this area are not frequent, but they can be really disastrous and have a huge impact on the Spanish coasts. The biggest and most famous tsunami generated in this area was the 1755 Lisbon earthquake that left some 1,000 deaths in the South of Spain. The other tsunamigenic area is the Mediterranean Sea. This zone presents a moderate seismic activity in the Alboran Sea and on the North-African coast. The last tsunami recorded on the Spanish coasts was generated by the Boumerdes earthquake (Algeria) in 2003. It showed once again the great importance of the Algerian tsunamigenic source region for Spain. For tsunamis with a seismic source, the Spanish group for the study of the Tsunami Alert Network, has considered that the system should be based on four processes: (i) Recording and analysing the seismic information; (ii) Numerical simulation of the possible tsunami; (iii) Confirmation of the sea level change; and (iv) Alert-spreading.

(i) Recording and analysing the seismic information. This step consists of a quickly computation of the focal parameters of the earthquakes, including the seismic tensor moment. It should be a 24 h attention service that could be carried out by the National Seismic Network. In Spain several seismic networks work in real time. Some of them are run by the Central Administration, as the Army Network (Real Observatorio de la Armada), and some of them are run by other institutions, such as the Servei Geologic de Catalunya (Geological Service). There is, at the moment, no special coordination established among these networks. A very big and close earthquake that would saturate the records would pose a real problem if it occurred today. In such a case it would be necessary to compute the focal mechanism with records from other countries, which is almost impossible to be done in a short time. This is a very general problem, which happened in the case of the Indonesian tsunami in 2004.

(ii) Numerical simulation of the possible tsunami. Several institutions in the country, especially the University of Cantabria, can carry out the numerical modelling. The starting point would be a database containing tsunamis previously simulated with a numerical model. With the epicentral localization and the seismic moment tensor provided by the National Seismic Network in real time, the Tsunami Simulations Data Bank would be used to obtain the possible affected areas and the arrival time of the tsunami. Another possibility is to establish a 24 h real-time link between the institution modelling and the institution in charge of the seismic alert.

(iii) Confirmation of the sea level change. In order to avoid false alarms as much as possible and have a better prediction, it is necessary to have sensors in the vicinity of the tsunamigenic sources. Two kinds of sensors can be used: pressure sensors and tide-gauges. Pressure sensors are located on the sea floor. When a change in pressure is detected, they transmit the data to a buoy located on the sea surface that sends the information to the warning centre via satellite. Nowadays, no pressure sensor is working along the Spanish coast. A tide-gauge network is not as useful as a pressure sensor network, but it is much easier to maintain. In Spain several institutions run such networks along the peninsular and Balearic coasts. None of them has been designed for tsunami alert purposes; therefore a densification of the network and an improvement of the communication system would be necessary.

(iv) Alert-spreading. Because of the short response time, the alert spreading should be directly made from the Tsunami Alert Centre to the possible affected areas. Therefore, it would be a non-hierarchical response. Also, and due to this necessary urgency, the possibility of spreading a pre-alert from the seismic data alone can be studied. The warning and alert spreading should be a municipality task. Moreover, Civil Protection must prepare an official document showing the different risk areas and which local and regional plans should be elaborated. Additionally, it is necessary to ensure an efficient response from the population, and consequently, a self-protection programme should be carried out/put into effect. In conclusion, the Spanish working group for the Tsunami Warning System established the need to carry out the following improvements:

- a legal mandate establishing the institution responsible for the tsunami alert in Spain;

- to complete the seismic and oceanographic instrumentation focusing on the tsunami alert;
- to create a data base of tsunami scenarios; and
- to design the mechanism of the alert spreading.

25 Dr François Schindelé (ICG/PTWS Past-Chairman) presented the tsunami and earthquake monitoring activities performed by the "Département Analyse Surveillance Environnement" (DASE) of the "Commissariat à l'Energie Atomique" (CEA) in France and Europe during the last decades. The DASE has implemented a network composed of 40 seismic stations (short and long period) in French territories (France and Corsica). The data are transmitted by VSAT to the DASE facilities close to Paris. DASE is responsible of the Earthquake Alert for the French Civil Defence authorities: bulletins are sent for all events above magnitude 4.0 located in France or close to France, less than 1 hour after the earthquake occurrence. DASE is hosting the European-Mediterranean Seismological Centre (EMSC) which is responsible of the earthquake monitoring and warning in Europe and Mediterranean region. In contribution to the European projects GITEC and GITEC-TWO, DASE and Portugal have implemented a pilot tsunami warning system consisting of several broad-band seismic stations processed with the TREMORS ® software. The tsunami hazard assessment for the French coasts has been investigated using numerical modelling methods. Specific events have been analysed. Dr Schindelé presented detailed analysis of the 2003 Algerian earthquake and tsunami, in particular the phenomena of directivity that explains clearly the impact of the according tsunami in the Balearic Islands, where the tsunami destroyed several boats and the amplitude recorded was higher than 2 m. There was a small effect on the French coasts where the tsunami amplitude did not exceed 20 cm. In closing Dr Schindelé also underlined the usefulness of modelling studies in designing an expanded sea level monitoring network.

26 Dr Remy Bossu, European-Mediterranean Seismological Centre (EMSC), presented the activities of the EMSC, an international NGO created in 1975 to rapidly locate earthquakes in the Euro-Mediterranean region. The EMSC is based on a membership of 73 observatories and institutes from 46 countries, with the aim to provide real time information on seismic activities, implement an operational alert system, publish a Euro-Mediterranean bulletin and improve data availability. Currently the EMSC alert system is based on 56 networks and 1,200 stations. The EMSC has a specific mandate to inform the Council of Europe on major hazards (EUR-OPA agreement) and is currently engaged in a number of European projects in the Mediterranean (concerning the improvement of network coordination and data exchange in the western and eastern basins and reducing earthquake losses in the eastern basin). Dr Bossu emphasized that in the Euro-Mediterranean region, sources of tsunamis are very close to the coasts and thus are a specific problem due to travel times of tsunami waves which are much shorter than in the Pacific. Therefore, the performance of the current system has to be improved. Significant expertise is also required to avoid false alarms, as tsunamis are less frequent than in the Pacific, and it is necessary to maintain long-term awareness and funding. In order to rapidly determine the location of earthquakes and their magnitude, a number of broadband monitoring systems are available (Virtual Earthquake Broad-band Seismic Network [VEBSN, ORFEUS], for research purposes; GEOFON [GFZ, Germany]; MedNet [INGV, Italy]; IMS [CTBTO]). Additional stations in the southern Mediterranean region, however, would be required as well as ocean bottom seismometers (OBS). The experience of the EMSC can be useful for a Euro-Mediterranean tsunami warning system.

3.3 PROGRESS REPORT ON ITIC, THE ICG/PTWS (FORMERLY ICG/ITSU), ICG/IOTWS, AND THE INTERGOVERNMENTAL COORDINATION GROUP FOR TSUNAMI AND OTHER COASTAL HAZARDS WARNING SYSTEM FOR THE CARIBBEAN AND ADJACENT REGIONS (ICG/CARTWS)

27 Dr Laura Kong (ITIC Director) presented information on the mission of the IOC International Tsunami Information Centre (ITIC), its role in the implementation of the global tsunami warning system, and the day-to-day activity carried out as part of the IOC Tsunami Coordination Unit. The ITIC has been in operation since 1965 and has been hosted since its inception by the USA. The activities include monitoring and recommending improvements to the existing Tsunami Warning System in the Pacific and assisting in the establishment of new regional and national tsunami warning systems and the implementation of comprehensive mitigation programmes. These intend to reduce tsunami risks, facilitating technology transfer through expert missions and to conduct the Hawaii-based training programme in tsunamis and tsunami warning systems. Last but not least the development and creation of educational and awareness materials in local contexts and acting as a clearinghouse for the distribution of these materials globally in multiple languages as well as gathering and documenting information on tsunami events and working with the World Data Centre for Solid Earth Geophysics to archive and quality control these data completes ITIC's focus. She emphasized that encouraging the conduct of research that can improve the detection and analysis of tsunamis thereby reducing damage and saving lives is an important part of her duties. Through its programmes, ITIC cooperates directly with the International Tsunami Coordination Groups and interested stakeholders to increase awareness and facilitate the coordination required to implement regional tsunami warning centres. At the same time, the ITIC is very active internationally in the delivery of safety preparedness materials and in working with governments and other non-government partners to increase community level engagement and empowerment that is essential for an effective response to tsunami warnings, and perhaps more importantly, the immediate response to a local tsunami which can arrive in minutes and for which no official tsunami warning will be available.

28 Dr François Schindelé, former chairman of the International Coordination Group for the Tsunami Warning System in the Pacific provided an overview of the historic background, governance mechanisms and progress on intergovernmental tsunami coordination activities in the Pacific, the Indian Ocean and the Caribbean. The International Pacific coordination group was set up in 1965 through a resolution at the 3rd Assembly of the IOC. The most recent session of the Coordinating Group (ICG/ITSU-XX) was held in Viña del Mar, Chile, from 3 to7 September 2005. Highlights of the meeting were: (a) Renaming of the group (ICG/PTWS) and deciding to held the next session within six months; (b) A task team has been established to convene a tsunami exercise in May 2006; (c) Working groups have been set up on: Seismic measurements including data Collection and exchange; Sea-level measurements including data collection and exchange; Tsunami hazard identification and characterization, including modelling, prediction and scenario development; Resilience building and emergency management; Interoperability of regional, sub-regional and national tsunami warning systems in the Pacific.

29 The Indian Ocean Intergovernmental Coordination Group was set up in 2005 through IOC Assembly Resolution XXIII-12 (June 2005) following international preparatory coordination meetings in Paris (3–8 March 2005; IOC Workshop Report 196) and Grand Baie, Mauritius (14–16 April 2005; IOC Workshop Report 198). The first session of ICG/IOTWS was held in Perth, Australia, from 3 to 5 August 2005. The meeting addressed the topics of and established intersessional working groups on: (a) Seismic measurement, data collection and exchange; (b) Sea level data collection and exchange, including deep-sea tsunami detection instruments; (c) Tsunami hazard identification and characterization, including modelling; (d) Prediction and scenario development; and (e) The establishment of a system of interoperable operational centres. The second ICG/IOTWS will be held in Hyderabad, India, from 14 to 16 December 2005.

30 The Caribbean intergovernmental coordination group was set up in 2005 through IOC Assembly Resolution XXIII-14 (June 2005). Preparatory meetings had been convened including the IOCARIBE Tsunami Steering Committee on Tsunamis (Puerto Rico in December 2000) and the International Conference for the Establishment of a Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (1–3 June 2005, Mexico City, Mexico; IOC Workshop Report 199). In 2002 ICG/ITSU had provided to the Seventh Session of IOCARIBE a proposal for a tsunami warning system in the Intra-America Seas. The proposal had been strongly endorsed by some delegations but no funding was identified. The first meeting of the ICG/CARTWS will be held in Barbados from 10 to 12 January 2006.

3.4 PROGRESS REPORTS ON OTHER PROGRAMMES AND ACTIVITIES RELATED TO TSUNAMI (GEO, ISDR, WMO, ITU)

31 On behalf of Dr Guy Duchossois, Dr Alexia Massacand provided background on the Group of Earth Observations (GEO) and reported on the GEO Working Group on Tsunami Activities. The development of the GEO started at the first Earth Observations Summit (31 July 2003, Washington DC) where thirty-three nations plus the European Commission and 21 international organizations adopted a Declaration that signified political commitment to move towards the development of a comprehensive, coordinated, and sustained Earth observation system(s). The GEO group has now grown to 58 nations, the European Commission and 43 participating organizations. GEO has adopted a ten-year implementation plan for a Global Earth Observation System of Systems (GEOSS). This plan entails the coordination of a wide range of space-based, air-based, land-based, and ocean-based environmental monitoring platforms, resources and networks to address nine societal benefits areas. More information on GEO is available at http://earthobservations.org/. The GEO Working Group on Tsunami Activities held two formal meetings at IOC (Paris, 7–8 September 2005) and at WMO (Geneva, 3–4 November 2005). The meetings provided recommendations on GEO's Role and Actions for 2006. The envisioned role for GEO is to: (a) In collaboration with international operational agencies, identify gaps, accelerate processes without interfering or duplicating efforts; (b) Team-up directly with IOC on relevant issues; (c) Facilitate the development of high-level commitments; (d) Promote a multi-hazard multi-purpose approach; (e) Involve users (cf. GEO Committee on User Interface); (f) Help bridge *in situ*, airborne and space communities; (g) Help ensure sustainability of infrastructure and know-how. The proposed actions for 2006 would include: (i) Encourage *in situ* and space agencies to: (a) Systematically record data over regions subject to tsunami risk; and (b) Archive data in a form easily accessible to all countries; (ii) Promote free and unrestricted exchange of all data relevant to tsunami early warning systems; and (iii) Create a project plan for the production of high-resolution near-shore bathymetric maps and the development of digital elevation models in coastal zones. These proposed actions are open for review and subsequently included in the consolidated GEO work plan for 2006 that is expected to be adopted at the GEO-2 meeting in Geneva (12–14 December 2005).

32 Mr Reid Basher gave a brief introduction to the United Nations' International Strategy for Disaster Reduction (ISDR; www.unisdr.org) including the Platform for the Promotion of Early Warning (PPEW; www.unisdr-earlywarning.org). Mr Basher also drew attention to the Hyogo Framework for Action 2005–2015 which was agreed through an open-ended intergovernmental process concluded at the World Conference on Disaster Reduction, Kobe, Hyogo, Japan, 18–22 January 2005 (http://www.unisdr.org/eng/hfa/hfa.htm). The aims of the Hyogo Framework are to embed disaster reduction as part of sustainable development; to strengthen institutions (especially in communities) to build resilience; and build risk reduction into emergency management and recovery. Mr Reid Basher also provided an update of the UN Flash Appeal concerning the Indian Ocean Tsunami early warning system. This appeal was initiated by ISDR and UNESCO/IOC and has generated multi-donor support on the order of $1 M. It is implemented through multiple partnerships including UNESCO, WMO, UNDP, UNU, UNEP, ADPC, ADRC, ABU, and others. UNESCO/IOC leads the intergovernmental process for the establishment of the IOTWS including some technical elements like sea level observations. WMO is working on regional strengthening of the Global Telecommunication System (GTS) and met service support. ISDR facilitates/coordinates, including through Africa and Asia offices, mainly linkages to disaster reduction/management, public awareness, all-hazard approaches, etc. In closing M. Basher emphasized that (i) the ISDR mechanisms can help link tsunami early warning systems into disaster reduction and management; and (ii) a broader view on early warning should be applied in tsunami early warning systems (including risk assessment; warning service; communication and preparedness).

33 Dr Edgard Cabrera, World Meteorological Organization (WMO) gave a presentation and delivered a statement on the contribution of WMO to the ICG/NEAMTWS on behalf of Dr Michel Jarraud, Secretary-General, WMO (the full speech is available in Annex IV). After bringing the salutations of Dr Jarraud, Dr Cabrera described WMO's global network including the national meteorological and hydrological services of its 187 Member States (NMHS), 10 international scientific and technical programmes on weather, climate and water, three World Meteorological Centres and 40 Regional Specialised Meteorological Centres, coordinated by the Secretariat based in Geneva. The network operates with the NMHS contributing daily information to the Global Observing System, 24 hours a day and 365 days a year. The NMHS are responsible for monitoring, detecting, developing and disseminating early warnings for natural hazards related to weather, climate and water (including severe storms, tropical cyclones such as hurricanes and typhoons, storm surges, floods, cold spells, heat waves, droughts, forest fires, locust swarms, etc.). The potential for WMO contribution to the ICG/NEAMTWS is great, as WMO, in partnership with UNESCO/IOC, UN/ISDR, and other agencies is contributing its infrastructure and relevant expertise to the establishment of a WMO Tsunami Task Team. WMO is currently supporting the establishment of a tsunami early warning system in the Indian Ocean through its Global Telecommunication System (GTS), including support of the Regional Tsunami Centres, enhancement of multi-hazard national warning alert and response mechanisms, identification of user-requirements for utilization of Satellites for Indian Ocean EWS, enhancement of Maritime safety, and integration of TWS within a multi-hazard framework (e.g., tropical cyclones, storm surges, etc.). The GTS, which is currently being updated, includes systems via satellite, covering all regions, based on digital data-casting techniques (e.g. Digital Video Broadcasting DVB-S) for distributing large volume of information. It also integrates data-collection services, in particular the IDCS from meteorological satellites. The WMO is also engaged to (i) ensure interoperability among its specialized regional centres; (ii) enhance national capabilities for multi-hazard warning alerts and responses; and (iii) enhance maritime safety through observation networks. WMO continues to promote the benefits of end-to-end multi-hazard early warning systems. Together with IOC and other partners, WMO works on the implementation of multi-hazard approach to include other hazards that pose a more frequent risk, such as tropical cyclones and storm surges, and floods. Reflecting Dr Jarraud's statement, Dr Cabrera emphasized the need for the government authorities, risk managers and the public at large to fully understand and utilize warning information as it arrives. Only the development of an end-to-end tsunami early warning system, encompassing from observations to community-level responses, can be effective to address multiple hazards in the coastal zone. The main synergistic advantage of such approach is the multipurpose use of observational and telecommunication systems, including for meteorological and hydrological information, exploiting the routine operational facilities and services to provide accurate and timely emergency information to decision makers and the public, down to the village and household levels. More specifically in relation to the NEAMTWS, WMO is willing to contribute through the following actions:

- the WMO Global Telecommunication System is being upgraded, where needed, to address the requirements for tsunami-related information exchange, for the interim period and the longer term;
- WMO is working towards the enhancement of multi-hazard national warning alert mechanisms through the NMHSs, to support the around-the-clock dissemination of tsunami warnings and to raise public risk awareness, through the development of educational and community outreach programmes;
- in partnership with the space agencies and its partner organizations, WMO is working towards the development of user requirements for optimal utilization of space technologies in enhancing multi-hazard early warnings, including tsunami; and
- with a strong support for the implementation of the Hyogo Framework for Action, WMO will continue to promote the benefits of a multi-hazard approach to early warning systems and to contribute to its implementation.

In concluding his presentation, Dr Cabrera wished to assure of WMO's commitment to continue working in partnership towards a safer world and reducing the magnitude of catastrophic events in the future.

34 Dr Simão Ferraz de Campos Neto, International Telecommunication Union (ITU) presented the role of ITU as the United Nations Specialized Agency concerned with the development of telecommunication networks and services worldwide, active in many areas applicable to early warning and disaster relief, in operational aspects, capacity building and infrastructure development. Earlier examples include the Morse code, which is an ITU standard, and the Global Maritime Distress and Safety System (GMDSS). Some of the more recent activities include drafting of the Tampere Convention, numerous resolutions passed at several ITU Conferences ranging from telecommunication resources in the service of humanitarian assistance (Resolution 34, World Telecommunication Development Conference, 2002; Resolution 36, ITU Plenipotentiary Conference, 2002), to consideration of disaster telecommunication needs in telecommunication development activities (Recommendation 12, WTDC-02) to the definition of reserved spectrum for emergency communications (Resolution 646, World Radio Conference, 2003). Its Radiocommunications Sector developed Recommendations on global circulation of equipment (M.1637, and M.1579), a report on the needs of future systems for public protection and disaster relief (ITU-R Report M.2033), Recommendations on disaster communications in the amateur and amateur-satellite services (ITU-R Rec. M.1042-2), and on the use of transportable fixed radiocommunications equipment for relief operations (ITU-R Rec.F.1105). ITU's Telecommunications Standardization Sector, ITU-T, has produced technical standards, called "Recommendations," for call preference schemes in the PSTN (E.106) and in systems based on Internet Protocol (IP) (H.460.4 and H.460.14 in H.323 system and J.260 in IP-Cablecom), it has approved a telecommunication security architectural framework that applies to TDR/EW systems (ITU-T Rec.X.805), and a Supplement on emergency services for third-generation mobile networks. It is also developing a message broadcasting specification using IP technologies, and is paying special attention to support of emergency and alert services in Next Generation Networks. ITU-T has prepared an

Action Plan to accelerate the standardization work of its technical groups in support for Telecommunications for Disaster Relief and Early Warning, and has appointed one of the groups to act as focal point for the activities. The Telecommunication Development Sector of ITU, ITU-D, has a co-financing arrangement between Inmarsat and ITU aimed at helping countries respond more effectively to disasters through the use of satellite terminals. For capacity building, ITU-D published in 2005 a revised *Handbook on Emergency Telecommunications*, and infrastructure rebuilding projects are being run in the Indian Ocean, under request from the member countries. ITU reassured its commitment to continue fulfilling its role as the specialized agency of the United Nations for telecommunications, and willingness to cooperate with all partners needed to get this essential work done. Given the critical role of information and communication technologies (ICTs) in disaster prevention and relief, ITU is ready to contribute with its technical expertise, which goes beyond an early warning system for tsunamis.

4. INTRODUCTION TO THE SESSIONAL WORKING GROUPS

4.1 WORKING GROUP 1 – HAZARD ASSESSMENT, RISK AND MODELLING

35 Dr Gerassimos Papadopoulos, Research Director, National Observatory of Athens (NOA) gave an introductory presentation to the Sessional Working Group on Hazard Assessment, Risk and Modelling. He defined tsunami hazard in a particular area as a function that describes the tsunami wave occurrence in the time-space-size domain and that can be estimated by statistical means, simple probabilities or conditional probabilities. He then defined tsunami vulnerability as a function that describes the degree of resistance of the anthropogenic environment to a given level of tsunami hazard. Tsunami risk is a convolution of the tsunami hazard, the tsunami vulnerability and the value exposed to the risk, expressed by the formula: $R = H * Vu * Va$. Dr Papadopoulos presented an overview of seismicity in the world and in Europe and defined requirements for hazard assessment, namely, (a) distribution of tsunami sources; (b) tsunami generation mechanisms; (c) repeat time of tsunamis; (d) tsunami propagation laws; and (e) tsunami inundation. He also provided a historical overview of tsunami research in Europe, which includes a historical period (before the 20th century), an early scientific period (up to mid 20th century), an advanced scientific period (up to 80s), and a modern period (~ 1990- …) (GITEC, GITEC-TWO, European-Japanese project). The basis of historical data is currently provided by documentary sources, field geological observations, and field archaeological observations, while instrumental data basis is provided by seismic records, tide-gauge records, and optical materials (pictures and videos). A new European tsunami catalogue is being built by GITEC, GITEC-TWO and more recent efforts that provide a quick-look table, accounts files, and a reference list. Dr Papadopoulos them provided example of tsunami events, both historic and contemporary, from the Mediterranean and connected seas (Cyclades, Corinth Gulf, Hellenic Arc, Levantine Sea, Marmara Sea, South Italy) discussing tsunami generation mechanisms (co-seismic fault displacement, seismic and aseismic earth slumps, volcanic eruptions, combined) and measurement methods (instrumental, field observations, numerical modelling). Concerning data collection and exchange, seismic and sea level data for concerned areas are being recorded and stored in both analogical and digital form on a near real-time basis in data banks at local, national (as in the case of the Greek national seismographic centre), European and global level. In summary, in the Mediterranean tsunami events are generated and propagated through complex mechanisms and, despite rapid attenuation, may have a damaging (every 1 to 10 years) or destructive effect (every 1 to 30 years).

4.2 WORKING GROUP 2 – WARNING GUIDANCE, INCLUDING SEISMIC, GEOPHYSICAL AND SEA LEVEL INFORMATION

36 Professor Luís Mendes-Victor, Director of the European Centre on Urban Risks (CERU), gave an introductory presentation to the Sessional Working Group 2 on Warning Guidance. His presentation focused on the opportunity to establish a European Tsunami Early Warning Institute. The amount of knowledge on tsunami events generated around the North Atlantic and the Euro-Mediterranean areas thanks to dedicated projects implemented in the last fifteen years, partly funded by the EU, justifies the consideration and opportunity to design a European Tsunami Early Warning Institute (ETEWI). It was possible to identify the seismic, volcanic and landslides sources of tsunamis on different zones, where hazard assessments were performed. The modelling of tsunami propagation was developed in order to allow along coastal areas: (a) the simulation of the run up and (b) the mapping of inundations. Even if more intensive research on the related tsunami matters has to be developed, at this stage, it is important to attempt the organization of an operational network under the responsibility of the participant States assuring not only the diffusion of early warning messages, but also the source areas being monitored, the implementation of the prevention regulations and the emergency plans to mitigate the tsunami impacts. Essential conditions have to be fulfilled to establish a viable institute: (a) the idea of a close cooperation between the Member States have to be fostered; (b) the scientific and technical conditions have to be met; (c) scientists and technicians who are capable of carrying out the necessary duties have to be found; (d) an outstanding and particularly energetic scientist has to be found and appointed director of this institute. The coordinating body of the operational network in the central headquarters (ETEWI) would be continuously connected with each one of the Regional Tsunami Early Warning Centres (RTEWCs) responsible for the three areas: North Atlantic (NARTEWC); Western Mediterranean (WMRTEWC); Eastern Mediterranean (EMRTEWC). In all the regional centres, the 7-day 24-hour duty would be assured by national hosting institutions, where dedicated specialists should be able to prepare the warning messages, to be validated by direct dialog with the headquarters institute, in almost real-time (1 minute), thanks to real-time communication facility (videoconference). The regional centres should collect the fast flow of observational data, coming from the sensors used in the regional network deployed to assure the continuous monitoring of the region. The concept of operational centre must be similar for all the network structure but moreover, the regional centres should be in direct connection (real time) with civil protection authorities and with the national and regional centres in charge of monitoring seismic or volcano activities, in order to guarantee almost real-time warning. Although the regional centres will play the most important activities, the ETEWI headquarters must assure the ultimate validation of the warning; for that specific responsibility, adequate operational staffs have to be selected. The following steps have to be envisaged for the establishment of this network: (a) identification of the source areas and elaboration of generic scenarios; (b) selection and installation of seismic and pressure sensors, GPS, pressure gauges, etc.; (c) real-time (RT) communications capacity in the network, including RT videoconference linkage with civil protection, seismic or volcano centres and decision-makers; (d) analysis in RT of detected phenomena, using automatic procedures; (e) elaboration of the alert concept. The States integrating the ETEWI network will take the appropriate measures to facilitate the housing of the headquarters and of the RTEWC buildings, located in the three regions. The RTEWC communications and the maintenance of the regional system have to be supported by the States integrating the region. Satellite or any other very fast communication linkage and automatic local data processing will be designed through a specific project developed as soon as possible. In order to characterize the organization of the North Atlantic Regional Tsunami Early Warning Centre (NARTEWC), it is necessary to take into account: (a) the geodynamic sector; (b) the location of the equipment to be installed; (c) the regional watching structure. The reception of the income data from the sensors, validation, preliminary processing and diffusion of the

resulting messages, throughout the participating institutions, are fundamental to assure the local and regional dialogue, before calling the Headquarters of the ETEWI. The Member States of the RTEWC have to maintain local very fast communications with the seismic authority and the civil protection institution and be prepared to work on almost real time with the policy decision makers.

4.3 WORKING GROUP 3 – ADVISORY, MITIGATION AND PUBLIC AWARENESS

37 Mr Russell Scott Arthurton, Coastal Geoscience, gave an introductory presentation to the Sessional Working Group 3 focusing on mitigation and public awareness. He focused on different approaches to respond to coastal hazards and risks, namely, by assessing the risk, constraining the hazard (e.g., by dissipating wave energy offshore), and reducing vulnerability to hazards (e.g., through effective warning systems and emergency responses, enhancing the standard of onshore protection, and strategic land-use planning and implementation). Constraining tsunami hazards can be achieved through the installation of sub-tidal and shoreface wave breaks and beach-plain wave foils, while storm surges can be mitigated by the maintenance and promotion of natural defences like salt marshes and sand dunes. Vulnerability to hazards can be reduced through emergency measures, such as procedures that address impending or actual extreme event hazard impacts (e.g., warning systems) and more strategic measures such as long-term urban planning to reduce vulnerability (e.g., restriction of development in vulnerable areas and setbacks), relocation of vulnerable communities and infrastructure (or enhancing standards of protection where relocation is not viable), and regulation of human activities which exacerbate hazards in vulnerable areas (such as the removal or disruption of natural protection). Mr Arthurton also underlined the human factors that contribute to vulnerability, such as socio-economic drivers (e.g., poverty or commercial opportunity) versus vulnerability to hazard, community isolation leading to indifference or lack of awareness to risk, belief in individual invulnerability, fear of being homeless on evacuation, fear of lawlessness, and fading memories of catastrophes and forgetting the risk. Mr Arthurton discussed the importance of emergency plans and their implementation, through preparedness (national, municipal, community action plans and the responsibilities of individuals), communication (early warning systems, municipal and community warning networks, evacuation transportation plans tried and tested), and resources (national and municipal funding and supplies for implementation of emergency plans). Responsibility and authority are needed to address catastrophic events through emergency procedures and strategic planning and adaptation, including to incremental impacts and their threats. Mr Arthurton concluded his presentation with a series of global lessons learned from the coastal catastrophic events of the last year: coastal populations are vulnerable to storm surges and extreme waves; surge and extreme wave events have recurrent costs on country economies; developed countries do not necessarily have effective emergency responses; strategic planning and development are key responses in reducing vulnerability, especially coastal cities and megacities; standards of protection need continual monitoring and maintenance; warning systems must be in place at global to local scales; and emergency plans must be tested and resourced, and need to be implemented.

5. WORKING GROUP MEETINGS

38 Reports and recommendations from the three sessional working groups were presented to the plenary by the respective chairs or rapporteurs, namely: Agenda Item 5.1, Working Group 1 on Hazard Assessment, Risk and Modelling, by Dr Papadopoulos; Agenda Item 5.2, Working Group 2 on Warning Guidance, Including Seismic, Geophysical and Sea Level Information, by Dr Koltermann; and Agenda Item 5.3, Working Group 3 on Advisory, Mitigation and Public

Awareness, by Dr Favali. The full reports of the three sessional working groups established under agenda item 4 are given in Annex II.

6. SECRETARIAT ARRANGEMENTS FOR THE ICG/NEAMTWS

39 The Executive Secretary reminded the Meeting that IOC Assembly Resolution XXIII-14, adopted in June 2005, mandated IOC to act as the Secretariat of the ICG/NEAMTWS with the tasks to: (i) support meetings of the Intergovernmental Coordination Group; (ii) facilitate the liaison among the various national contact points and national tsunami warning centres; (iii) maintain a current list of operational national contact points and facilities and make it available on request to all Member States; (iv) organize the liaison of the ICG/NEAMTWS with the PTWC and with other tsunami warning centres to facilitate best practices in tsunami warning; and (v) initiate and support, in consultation with ITIC, training activities and enhance and enrich warning in the north-eastern Atlantic and the Mediterranean and connected seas.

7. PROGRAMME AND BUDGET FOR THE NEXT INTER-SESSIONAL PERIOD

40 The Executive Secretary clarified that one of the tasks of the ICG/NEAMTWS following the Meeting would be to initiate a process for defining a programme of work and identify initial resources. In response to the recommendation by Portugal that the IOC Secretariat should be strengthened, he underlined the opportunities provided by the secondment of government officials and scientific experts by the Member States, as well as the possibility to open at the IOC a special account for tsunami-related activities, including for the hiring of specialists on a limited-duration base. He estimated financial needs to hold two meetings a year in US$ 350,000-400,000, excluded additional posts at the Secretariat.

8. OTHER BUSINESS

41 There was not other business to address.

9. DATE AND PLACE FOR ICG/NEAMTWS-II

42 Portugal and France offered to host the next sessions of the ICG/NEAMTWS and recommended that it be held in May 2006, before the IOC Executive Council, and in February 2007, before the IOC Assembly scheduled end of June. Greece also offered to host one of the next three sessions. **The ICG adopted** May 2006 as the period to hold the Second Session. The venue will be discussed in the near future with the IOC Secretariat.

10. ELECTION OF THE CHAIR AND VICE-CHAIRPERSONS

43 Portugal, France and Germany proposed Italy as Chair of the ICG/NEAMTWS. **The ICG elected** Professor Stefano Tinti, University of Bologna, as Chairman for two years and Dr Azelbarab El Mouraouah (Morocco), Coordinator, “Centre Euro-Méditerranéen pour l’Evaluation et la Prévention du Risque Sismique” —CEPRIS of Rabat and Dr Gerassimos Papadopoulos (Greece), National Observatory of Athens, as Vice-chairmen.

11. ADOPTION OF THE REPORT

44 **The ICG approved** the reports and recommendations of the working groups. **The ICG recognized** that the working groups achieved substantial work during the session but that much still remain to be done in order to fully define the necessary technical specifications of the NEAMTWS. One particular point concerned the need to achieve consistency, to the extent possible, with the working group structure of other ICGs. Therefore, it was **agreed** that for the intersessional period Working Group 2 would be divided into two groups dealing primarily with (i) seismic and geophysical information and (ii) sea level information. **The ICG decided** that the four intersessional working groups would then be as follows:

- Working group 1: Hazard Assessment, Risk and Modelling;
- Working group 2: Seismic and Geophysical Measurements;
- Working group 3: Sea Level Measurements; and
- Working group 4: Advisory, Mitigation and Public Awareness.

45 **The ICG nominated** France and Spain as co-chairs of Working Group 1. Portugal and Italy will co-chair Working Group 4. As no agreement emerged for Working Groups 2 and 3, **the ICG left the decision** to the ICG Chairman and the IOC Secretariat to consult with Member States on the nomination of the chairs and co-chairs of those two working groups. For the working groups to continue to work during the intersessional period, **the ICG agreed** that the IOC Secretariat, in consultation with the ICG Chairman would expand their terms of reference. The revised terms of reference are given in Annex III.

12. CLOSURE

46 Hon. Roberto Tortoli, Secretary of State, Ministry for the Protection of Environment and Territory, delivered a closing statement on behalf of Hon. Altero Matteoli, Minister of Environment. Hon. Tortoli brought the salutations of the Government of Italy to the participants and confirmed the attention of Italy to marine environmental issues. He reminded the prompt support of Italy to the populations affected by the catastrophe of 26 December 2004, including through technical and scientific cooperation with UNESCO. For this reason the Government of Italy had offered to host the First Session of the ICG/NEAMTWS in Rome with a view to strengthen cooperation among the countries of the Mediterranean and Europe. For the regional multi-hazard mitigation and warning system to be effective, different dimensions have to be integrated such as monitoring and prevention, coastal planning, sensitisation of the populations and creation of integrated warning systems. On behalf of Hon. Matteoli and the Government of Italy, Hon. Tortoli reiterated the support to a regional monitoring and control system for marine hazards to be developed under the coordination of UNESCO/IOC.

47 Dr Aldo Cosentino, Director-General of Directorate-General for Nature Protection, Ministry for the Protection of the Environment and Territory, expressed satisfaction for the consideration of the role of long-term coastal planning and public awareness in support of early warning system for coastal hazards. He emphasized the need for developing research to understand the dynamics that generate tsunamis and for standardizing systems for data collection and elaboration as well as for disseminating best practices and technologies, including those most accessible. He reiterated the interest of his Government of Italy in participating in the ICG/NEAMTWS process, both through scientific and technical support and, if needed, in logistical and organizational terms.

48 Dr Angelo Guerrini, Director-General of the Italian National Research Council (CNR), briefly presented the activities of CNR related to tsunamis, currently involving 10 institutes and 150 researchers and substantial financial support, and emphasized the need to develop practical applications from research.

49 The Executive Secretary thanked the Italian authorities for the support to the Meeting and underlined the opportunity for the ICG/NEAMTWS and the IOC to develop an effective multi-hazard warning system in Europe and the Mediterranean on the model of the Pacific, avoiding the institutional failure that characterized the catastrophe of the Indian Ocean.

50 The Chair of the Session thanked the IOC Secretariat for the work undertaken and the Italian authorities that made possible the conditions for such a productive First Session of the ICG/NEAMTWS. The Chair closed the Session at 18:45, on Tuesday 22 November 2005.

ANNEX I

AGENDA

1. OPENING

2. ORGANIZATION OF THE SESSION

2.1 Adoption of the Agenda and Timetable
2.2 Election of Chair of the Session
2.3 Designation of rapporteur(s)
2.4 Session documentation
2.5 Local arrangements
2.6 Establishment of sessional working groups

3. BACKGROUND AND REPORTS

3.1 The establishment of the ICG/NEAMTWS
3.2 Technical Reports from Member States and regional organizations providing capability to the ICG/NEAMTWS
3.3 Progress report on ITIC, the ICG/PTWS (formerly ICG/ITSU), ICG/IOTWS, and the Intergovernmental Coordination Group for tsunami and other coastal hazards warning system for the Caribbean and adjacent regions
3.4 Progress reports on other programmes and activities related to tsunami (GEO, ISDR, WMO, ITU).

4. INTRODUCTION TO THE SESSIONAL WORKING GROUPS

4.1 Keynote presentation on Sessional Working Group 1
4.2 Keynote presentation on Sessional Working Group 2
4.3 Keynote presentation on Sessional Working Group 3

5. WORKING GROUP MEETINGS

5.1 Hazard assessment
5.2 Warning Guidance
5.3 Mitigation & Public Awareness

6. SECRETARIAT ARRANGEMENTS FOR THE ICG/NEAMTWS

7. PROGRAMME AND BUDGET FOR NEXT INTER-SESSIONAL PERIOD

8. OTHER BUSINESS

9. DATES AND PLACE FOR ICG/NEAMTWS-II

10. ELECTION OF CHAIR AND VICE-CHAIR(S)

11. ADOPTION OF THE DECISIONS OF THE MEETING (INCLUDING RESOLUTIONS AND RECOMMENDATIONS)

12. CLOSURE

ANNEX II

REPORTS FROM THE SESSIONAL WORKING GROUPS

Sessional Working Group 1 – Hazard Assessment, Risk and Modelling

Chairman: Stefano Tinti
(University of Bologna, Italy)
Rapporteur: Gerassimos Papadopoulos
(Institute of Geodynamics, National Observatory of Athens, Greece)

Introduction

During the plenary session of the meeting it was decided that the Working Group 1 would be responsible for collecting and exchanging information on local and distant tsunami from existing historical data, including seismic data, sea level data, and deep-sea pressure measurements, in view of assessing tsunami hazard, vulnerability and risk. This would also comprise tsunami modelling, including bathymetry and inundation mapping and prediction and scenarios development using internationally accepted numerical model methodologies. Estimates of coastal areas susceptible to tsunami flooding will be available from a network of modellers and data managers who will be sharing community-modelling tools via the Internet.

Discussion

The Working Group 1 (WG1) focused on the main topics of 1) assessment of hazard, vulnerability and risk associated with tsunamis and 2) of tsunami modelling, with the main purpose to identify the needs and requirements to support the implementation of an efficient tsunami warning and mitigation system in the area of the interest (AOI) of the ICG/NEAMTWS. A number of questions were posed on these subjects aiming at clarifying what is part of the accepted knowledge and what is still unknown and needs further research and/or technological development.

The WG1 addressed the problem of the identification and characterization of the tsunamigenic sources. It has been stressed that most tsunamis are induced by earthquakes, but that also landslides (either submarine or subaerial) and volcanic activity may contribute to tsunami generation, and that it is not negligible the case of combined or multiple sources, such as the occurrence of an earthquake that triggers a landslide, both being tsunamigenic. It has also been stressed that almost all the tsunamigenic sources of the AOI are located in the near-shore belt with the relevant consequence that tsunamis hit the nearest segment of coast within a very short time. There has been much progress in the understanding of seismicity and of the seismotectonic processes of the AOI, thanks to the advancement of seismology and the implementation of local, national and international seismic and geodetic networks. In spite of these efforts a lot of uncertainty persists in the identification of the seismic faults that were responsible for the major tsunami occurrences in the AOI, such as the 1755 "Lisbon" earthquake, the 1693 eastern Sicily earthquake, the 1627 south Adriatic shock, the 365 and the 1303 Hellenic Arc earthquakes, to name a few.

As regards the tsunami potential of submarine or coastal origin, it has been observed that marine geology and geophysics contributed to identify several areas in the AOI where sliding processes took place with high probability of having excited tsunami waves. But, it was further recognized that no systematic studies or surveys covering homogeneously the coastal margins and the volcanic submarine or island edifices have been conducted so far. The aim of the study would be to make an inventory and a classification of the potential sources in terms of their stability, volume, possible run-out, potential for tsunami excitation, etc. It has been further observed that the landslide-generated tsunamis represent a very common phenomenon, ranging some order of magnitudes in volume and in the repeat time. It is recognised that in the AOI the landslide generation problem has specific features as far as hazard, vulnerability and risk assessment are concerned, due to the specific active tectonic setting, to the jagged coastline, to the existence of many sub-basins and to the high density of population and infrastructures on the coasts.

The WG1 considered further that all present-day operational TWSs use a decision matrix that is only based on earthquake occurrences, and more specifically 1) on the epicentre position with respect to the coastline, 2) on focal depth and 3) on earthquake magnitude. The operational practice is that after an earthquake the three needed elements are evaluated and fit into the decision matrix in order to decide which kind of warning is to be launched. The marine sensor network is then used to validate or to disprove the tsunami occurrence, leading to an updated warning or to a warning cancellation. This practice proved to be appropriate for very many cases of tsunamigenic earthquakes in the Pacific, but it has relevant limitations that require corrections and improvements for its efficient implementation in the AOI, with two main drawbacks delineated as follows:

- The first consideration concerns the coastal sources. Very local tsunamis hit in a short time and do not leave time for a precise determination of the decision matrix parameters, which calls for different criteria to identify local tsunami generation.
- Second, for very large tsunamigenic earthquakes, which pose the highest level of threat, knowledge of the fault geometry (and especially length, position and strike) and kinematics is needed in order to characterize the tsunami generation and propagation, taking into account the typical tsunami directivity.
- In order to cover the case of non-seismic sources, presently, the decision matrix is extended in such a way that an alert is launched also in the absence of seismic signals, provided that an anomalous, large and sudden, change of the sea level is detected by some marine sensors. The efficiency of the method is not proven, since no warning has ever been launched so far only based on this condition. What can be observed, however, is that today's marine sensor networks are not configured with the scope of capturing tsunamis produced by landslides, which means that very probably a tsunami induced by a landslide (associated either with gravitational instability or with instability due to seismic loading) either would pass totally undetected or would be detected too late. This underlines the importance of testing and deploying observational systems capable of detecting the landslide itself, and the quick determination of those parameters that are relevant for tsunami generation. In a sense, there is a need to specify a second type of decision matrix specific for the landslide generation mechanism. The set of parameters (landslide volume, thickness, front extension, acceleration, etc) is still to be identified, since the knowledge of the tsunami generation process by underwater body motion is not yet completely understood.

In view of the above considerations, the Working Group 1 agrees in providing the following set of recommendations.

Recommendations for Source Assessment

Earthquakes

– The high seismotectonic complexity of the AOI calls for the need to classify in a simple data base the potential tsunamigenic seismic sources on the basis of their geographical distribution, focal mechanism and distance from the closest coastal segments.

– For coastal segments threatened by earthquake generated "regional" tsunamis with travel times of no less than about 20 min, the same criteria as those implemented in the Pacific and the Indian Ocean could be applied. However, the magnitude threshold should be selected on the basis of the past tsunami history. In order to increase the efficiency of future early warning systems responding to regional tsunamis there is a need to intensify seismic and sea level instrumental networks, particularly along the North Africa and Middle East coastal zones of the Mediterranean Sea.

– For tsunamis caused by "local" seismic sources, wave travel times range from a few minutes up to less than 20 minutes and, therefore, a timely very rapid warning has to rely on automated systems. In these cases, particular effort should be made to identify the best instrumentation that is the most appropriate to meet such a specific need.

– More research effort is needed for seismic sources, whose tsunamigenic mechanism remains unknown or is little known or is still controversial, like, among others, the tsunamis observed in the Levantine Sea caused by strong earthquakes of strike-slip faulting occurring on land in association with the Dead Sea Fault System, the 1755 "Lisbon" earthquake, the 1693 eastern Sicily earthquake, the 1627 south Adriatic shock, the 365 and the 1303 Hellenic Arc earthquakes. Further research is also needed to understand why in a particular region (e.g. Rhodes in the east Hellenic Arc) some earthquakes cause tsunamis, but others of the same size do not.

– Given the many different approaches that are in use for the determination of earthquake magnitude, a general recommendation that regards local and regional tsunamigenic seismic sources is that an effort should be made to standardize the procedure of earthquake magnitude determinations.

Landslides

– Given that no international experience exists for the early warning as regards landslide generated tsunamis, there is a need to identify the most characteristic and best studied tsunamigenic landslide sources in the AOI, like the west Corinth Gulf, the Stromboli volcano, the Marmara Sea, the Balearic islands, the Canary islands and the Norwegian coasts, and on the basis of their features to investigate possible innovative ideas for the design of appropriate warning approaches.

– A parallel activity should focus on the better identification of potentially tsunamigenic submarine slumps that generated tsunamis in the past or that bear the potential to produce tsunamis in the future, with priority given to selected test-sites. Great advantage to the identification of past mass wasting will derive from detailed seafloor mapping.

– The classification and the characterisation of landslide mechanics are needed to infer the behaviour and the tsunamigenic potential of mass wasting.

– Given the smaller extent of the segment of coast affected by destructive tsunami waves, compared to the case of earthquake tsunami generation, hazard micro-zoning (based on the modelling of the wave approaching to the coast) will be extremely important.

– Restriction for coastal zone use and management will be a very effective means to reduce tsunami vulnerability.

– Monitoring of unstable masses (by OBH or other sensors) would detect possible precursors.

Volcanic Activity

Due to the several types of volcanic generation mechanisms, it is recognized that the application of an early warning system is directly dependent on the volcano activation and, therefore, on the capability of monitoring the volcanic activity. It is recommended that a few test-sites should be selected with the aim of developing possible scenarios of volcanic tsunami generation and in view also of designing and implementing local tsunami warning systems.

Recommendations for Modelling

– Numerical modelling simulation of possible tsunami waves is certainly useful, as the experience in the Pacific Ocean indicates, but much effort should be made in order to improve simulation codes used in such pre-computations because of propagation complexity.

– Particular attention should be given to the improvement of our knowledge about the earthquake fault dislocation as well as the bathymetry especially in shallow water. The efforts such as the compilation of the IOC-IHO-IBCM international bathymetric chart of the Mediterranean are to be encouraged until the resolution needed for tsunami simulation is attained.

– Particular attention should be also given to the identification of the role of coastal topography and to the identification of the requirements needed for Digital Elevation Models (DEMs) to make them useful for pre-computation purposes.

– Tsunami generation mechanism by landslides and pyroclastic flows is very complex and as yet not fully understood and this reflects in non-standardization of numerical models, and in the difficulty in ascertaining their reliability and accuracy.

– There is a need of validation for numerical models used in tsunami simulation against the available observational data, such as coastal and open ocean sea-level observations, experimental data of coastal impact (run-up heights) and, when appropriate, physical model data.

Recommendations for Vulnerability and Risk Assessment

– The existing experience in Europe, Japan and the USA indicates that it is absolutely realistic to proceed towards the establishment of standardizing the methodology needed for the pre-determination of tsunami damage zones by combining experience from past cases, numerical modelling and inundation results with socioeconomic parameters, to be collected through ground-based, airborne-based and space-based techniques.

– Of crucial importance is the time-dependence of tsunami risk on a particular coastal segment because of the seasonality of human activities (e.g. tourism) and of the daily variation of activities.

– In view of the above, it is recommended that an effort should be made for the step-by- step production of a tsunami resistance “Eurocode”.

Sessional Working Group 2 – Warning Guidance, Including Seismic, Geophysical and Sea Level Information

Chairman: Klaus Peter Koltermann
(Federal Maritime and Hydrographic Agency – BSH, Germany)
Rapporteur: Emin Özsoy
(Middle East Technical University, Turkey)

Introduction

The NE Atlantic and Mediterranean Seas are very diverse as high-risk tsunamigenic areas. Highly variable geographic areas and a specific distribution of strong tsunamigenic sources have distinct socioeconomic implications. Due to the proximity of highly active seismic zones to coasts and islands and mostly ocean basins of great depths, any tsunami will travel very fast and subsequently arrival and implied warning times are extremely short.

Europe has a rich and highly developed infrastructure able to monitor and observe both causes for and effects of tsunamis around Europe. This infrastructure needs to be reviewed, developed and optimised in the particular context of the highly diverse regional requirements and their appropriateness and effectiveness.

Any warning system needs to take these constraints into account. It also will incorporate existing national systems and contributions. These need to be made compatible, coherent and adapted to the specific requirements of a fast and reliable observing, information and warning system.

The Working Group considered details of existing and planned observing systems including telecommunications and back-up facilities, the available information on tsunamigenic sources and types of sources, the bathymetric information required to calculate travel and arrival times, and inundation effects. The Working Group identified deficiencies and suggests, where possible, ways and means to overcome these.

Taking into account also these very stringent requirements for this warning system as to its short warning times of less than one hour in the Mediterranean, its diverse regional particularities provide important challenges to Europe.

The NEAMTWS system will be based on existing structures and programmes and use available technology and work within the UN system (including the long experience and knowledge of IOC and WMO).

It also should adhere where possible to Pacific principles (i.e., one basin scale observing system composed of national and regional networks and with national warning systems) as discussed and modified within the context of developing the IOTWS for the Indian Ocean.

The NEAMTWS region suggests focusing on subregional networks in order to adequately address the tsunami detection and warning. Details are to be defined by the intersessional task teams.

Plans need to be developed within 12 months so that a pilot system can be made fully operational to address the needs of the NEAMTWS Ocean region in the interim and on longer-term periods.

Detailed Requirements

Seismic and Geophysical Measurements

Existing international, regional and national seismic networks in the region are very well developed and provide a sound basis. They are to be considered as essential components of a tsunami warning system. These networks need to be evaluated, upgraded, expanded to fill in the observation gaps and strengthened to address all requirements for monitoring and for the NEAMTWS. In detail these are:

- International seismic observing system (Federation of Digital Seismic Network);
- The regional Mediterranean Seismic System EMSC;
- CTBTO;
- National networks (several countries);
- The existence of broadband seismic networks such as GEOFON and GEOSCOPE.

Action

– Needs for upgrades must be identified and prioritised. Broadband seismic sensors are recommended to correctly measure large earthquakes. The critical need is availability of real-time data transmission. Suitable experts (international and national) must be identified to carry out this task;

– Data must be made available in real-time to all national warning centres and centres designated for processing and analysis;

Ocean Measurements

For the Mediterranean region, MedGOOS is active in the coordination of deep-sea observation networks for a variety of purposes and in operational oceanography for the region. It provides opportunities for cooperation and sharing of infrastructure and logistics. This should be further explored.

In the Atlantic Ocean similar GOOS bodies, such as IBI-ROOS, NOOS and BOOS, provide the basis for implementation and integration. Those components that provide information on the sources and existence of tsunamis need to be reviewed and where required up-dated.

Sea Level Gauges

For sea level data MedGLOSS, as a regional component of GLOSS, can provide an adequate operational platform for the Mediterranean. For the Atlantic Ocean coast mechanisms such as ESEAS should be explored as a co-ordinating facility.

The Group acknowledges the need for a new standard to enhance the value of new tidal stations to operate in real-time, and with the possibility of a mode that triggers high-sampling rates under certain circumstances.

Upgrading of all required tide gauges is required in order to meet measurement and telecommunication requirements and standards. There is immediate need for specific gauges (at-least 10 sites) to become fully operational. All other gauges must be fully operational in medium term.

A more comprehensive network of tide gauges to be designed and implemented with consideration for at-risk areas to complement the existing system (an immediate action item).

<u>Deep Ocean Network</u>

There are national ocean buoy networks in the Mediterranean and the Atlantic Ocean operated by coastal states, and in part linked to GOOS activities. These are multi-purpose oceanographic buoys collecting meteorological and standard oceanographic parameter. Some are coastal and some are deep ocean buoys. These are transmitting every hour, and have two-way communication capabilities for intelligence training of the system. Some could be equipped with bottom-pressure sensors to measure tsunami heights in the open ocean;

It has been demonstrated that bottom-pressure sensors installed in buoy and/or cable system arrays offshore (100-200 km from the coast) could detect tsunami waves in advance of their arrival at the coast.

Action

– Buoy systems must be reviewed and evaluated with respect to their potential for contributing to a tsunami early warning system and, as necessary, upgraded to address the needs for tsunami monitoring and tsunami early warning;

– There is need for the establishment of deep ocean buoys specifically designed for tsunami monitoring;

– Cable-based systems should also be assessed;

– It was noted that these measurements are important for slumping events and other events that are not seen in seismic measurements;

– Data must be made available in real-time to all national warning centres and centres designated for processing and analysis.

<u>Other Observations in the Coastal Zone</u>

– High resolution coastal and open ocean bathymetry and land mapping are essential and must be carried out and the data be made available in high resolution format for all at-risk national coastal regions;

– Bathymetric data are essential for pre-tsunami mitigation planning. Knowledge of the near-shore seafloor depth allows and improves tsunami wave height predictions, storm surge calculation and facilitates response strategies.

Telecommunication

Telecommunication requirements need to meet three different objectives:

- The secure and redundant transfer of seismic, sea-level and other relevant observations (data) from the field to the operators.
- The exchange of these data within the components of the TWS
- The dissemination and exchange of warnings on national, regional and global levels as required and agreed.

The following systems and their general specifications are identified:

- Use of geostationary communication satellites operating in the Mediterranean Sea and the Northern Atlantic Ocean region;
- Use of the Global Telecommunication System (GTS) of WMO, which is currently operational, for the collection and distribution of sea-level observations and distribution of bulletins and warnings is strongly advised and should be upgraded.;
- Use of satellite systems should be fully explored and a consolidated plan for telecommunication needs should be developed for use by the space agencies for coordination of their activities in this area (see above comments on new technologies). It was noted that data-collection systems of geostationary meteorological satellites were integrated within the WMO GTS to ensure distribution of collected data;
- The use of IP-based networks should be explored, including the possibilities of, for example, VPN, to complement and enhance the GTS;
- – The use of ad hoc mobile telecommunications systems could significantly improve warning/alert communications between authorities as well as rescue operations;
- All-media all-hazard citizen alert systems should be explored to identify which GSM cell broadcasting systems could help reaching a large number of exposed citizens in the shortest amount of time;
- There is a need for broadband facilities for the real-time distribution of seismic data. Available telecommunication systems that meet these requirements should be identified and utilized;
- There is a need to distribute other data such as sea level data, analysis and warning messages. Appropriate telecommunication systems need to be identified and utilized for this purpose;
- Reliable systems should be put in place to address all needs for data collection and distribution.

Advantage should be taken of existing and evolving systems. These specifically may include for communication requirements:

(i) WMO GTS consisting of leased lines, IP networks, satellite communications, and the next generation of the Future WMO Information System (FWIS);

(ii) the international SafetyNET System/IMO/IHO/WMO (reference is also made to COMSAR/Circ.36 of 18 February 2005);

(iii) RANET;

(iv) leased lines, satellite communications, VPN internet, direct broadcasts; and

(v) mobile methods such as SMS, cell broadcasts and dedicated TETRA-like networks for authorities.

The following conclusions are drawn:

– Redundancy is a prime requirement to ensure that communication links remain operational after earthquakes, floods etc;

– Best use should be made of existing dissemination and communications infrastructure to minimize overall cost;

– There is a need to identify best practices in different countries that could be applicable;

– There is a need for an inventory of existing standards and protocols;

– There is a need to identify requirements on delivering emergency and distress messages and information to end users for incorporation in existing and future communication systems such as mobile, IP –based technology etc.;

– There is a need to communicate such requirements to telecommunication standards development organizations such as ITU.

Analysis and processing centres

The Working Group did not discuss, due to time constraints, issues such as Tsunami analysis and simulation or the analysis and processing of geophysical data. The ICG need to address the establishment of centres that process, validate, analyse and interpret the incoming data. The appropriate nomenclature for advisories and warning should be developed and harmonized across the entire NEAMTWS.

With respect to Warning system elements, there is an urgent need to identify interim contact information from each country to receive information such as advisories and bulletins. These contacts

- Should be operational with 24/7 capabilities;
- Should be part of an established national mitigation system or civil defense, rescue coordination centre, etc.;
- Need to take into consideration down-stream limitations of use of communication methods (fax, email, etc.).

It was noted that the WMO GTS has the potential to provide for the international distribution of tsunami advisories and information in the immediate future, through National Meteorological and Hydrological Services (NMHSs).

Conclusions

The discussion addressed also generalities of the individual components of the NEAMTWS. This developed for the entire system into a

General Strategy

– Immediate, free and open distribution of raw data from the observing systems in real-time must be acknowledged as a founding principle for all national, regional and global tsunami warning systems. Without such, both the timeliness and effectiveness of the system may be severely compromised and the risk may be greater than would otherwise be the case;

– Any network planning should start with identifying and mapping the tsunami prone areas. This should be based upon a historical study of earthquake and tsunami occurrences;

– Many of the standards that underlie the systems for open data collection and exchange can be adopted (or adapted) from already established international systems;

– A sustained and reliable NEAMTWS network will require responsible national and international actions and cooperation, including sustained investment and commitments;

– There is need to develop the networks within a consistent integrated framework for system of systems;

– In terms of the technological implementation, the tsunami warning system as a whole should build on and be a part of a multi-purpose system. It should address several hazards where possible, and be able to deliver many types of routine operational products including warnings both to authorities as well as the public. The sustainability of the observing system including cost effectiveness and efficiency are also enhanced with such an approach;

– National and international agencies need to invest in a coordinated centralization approach to build an integrated tool for earthquake and tsunami surveillance and scientific research;

– Robustness and durability of the instruments and the system as a whole to the impacts of the earthquakes needs to be addressed.

Actions for ICG and Parent Bodies

– Identify primary national agencies mandated for seismic, geophysical and sea level services;

– Nominate national focal contact points for tsunami information (as set out in CL) and consider establishing national TWS;

– Identify priority list of sea level sites meeting high frequency and real time requirements in the seas around Europe;

– Nations are invited to offer their services to host regional warning centres with the functions of monitoring seismic and sea level data, assessing anomalies indicating tsunamigenic events and distributing respective information to all national focal points.

Tasks for ICG

– The ICG to communicate to the European region GOOS networks the requirements and the opportunity to contribute to and be part of NEATMWS;

– The ICG to organize a workshop at IOC Headquarters to review the existing components, commitments and arrangements;

– The ICG to promote the IOC marine data policy in order to implement a common data policy for the free exchange of all data on real-time basis to enable efficient flow of information within the NEAMTWS.

– Implementation issues of data policy are:

- Data standards, formats are required to enable data sharing in exchange for effective warnings that are secure, accurate, timely, extensible and sustainable;
- Data standards are required for existing operational observing systems that can be made interoperable including tide gauges, seismic stations and buoys/pressure sensors;
- Data standards are required to facilitate upgrading and developments of observing systems that do not currently meet warning requirements;
- Data standards are required for common architecture infrastructure for dissemination and archiving.

– In order to support the ICG a Working Group on Technical Requirements of the NEAMTWS should be set up. This Working Group should on the intermediate time frame:

- Review existing components of NEAMTWS and identify gaps and deficiencies, upgrading needs and suggest actions and time frames to be considered;
- Review organizational arrangements of providing a warning system at local, regional and European scales;
- Develop an implementation plan to remedy deficiencies and promote up-grades of technical components where required;
- Oversee the implementation process;
- Consider integration into and compatibility with global systems;
- Report to the ICG on a regular basis.

Working Group 3 – Advisory, Mitigation and Public Awareness

Chairman: Luis Mendes Victor (Portugal), European Centre on Urban Risks (CERU)
Rapporteur: Paolo Favali (Italy), National Institute of Geophysics and Volcanology (INGV)

The objectives of the working group on Advisory, Mitigation and Public Awareness were discussed and many issues of the utmost importance and urgency were emphasised.

This group was mostly concerned with:

- Marine-related hazards including tsunamis and storm surges within a multi-hazard framework;
- Mitigation activities covering two approaches: long-term strategic planning and management of the coastal zone in a context of sea-level rises; and preparedness for emergency and crisis management.

Strategic Dimension

The working group noted that capacity building is required at all levels to ensure the effective implementation of mitigation strategies. Any such strategies should be developed in the context of ICZM/ICAM.

Long-term planning strategies should focus on minimizing the vulnerability of coastal communities and their infrastructure. Such strategies may include relocation of vulnerable communities, the protection of essential infrastructure, and the maintenance or strengthening of natural protection.

The working group recognized the need for the behaviour of coastal communities under stress from expected or actual tsunami or storm surge impacts to be better understood in the development of emergency responses.

Hazard awareness about tsunami and storm surges has to be set up on a long-term basis, making permanent links between scientists, civil protection authorities, politicians and other relevant stakeholders. Systems for the communication of reliable and relevant information to emergency managers should be established as a priority.

Society is aware that a “zero-risk” of marine hazard impact is unrealistic, and politicians should respond accordingly.

Assessment of the vulnerability of coastal communities and infrastructure to tsunami and storm surge hazard is another priority task, with particular attention to changing demographic and environmental conditions. Tools such as GIS can be used for the construction of vulnerability assessments.

Knowledge of marine hazards and of the actions to be taken in case of disasters should include information on human behaviour.

Communication

Regarding communication, an important issue is to explore best practice both from the warning centre to national authorities (where the ICG can decide on the methods used) and from national authorities to citizens (where the ICG role will be limited to providing information on best practices). The use of tools such as sirens, radio, television and internet, mobile phones (e.g., SMS) as means to declare alarms, messages and info, has to be considered (Italy has already used SMS on particular occasions, e.g., 2004 tsunami and papal funeral, however it is essential not to ignore other media, even in countries with high mobile penetration). Despite popular use and apparent widespread availability, SMS text messaging should be viewed as only one part of the solution. Additionally, efficient handling of early warning and disaster mitigation communications should be built into new technologies (e.g., “next generation networks” which use packet-switching) as they emerge. In any case a diffuse use of Internet and related possibilities has to be considered to transmit information to the media, to inform society on the improvements achieved, and to circulate correct updates.

In case of emergencies, the process for sending information on upcoming events to the national “authorities” that have the responsibility for disseminating alarms and taking consequent actions must be defined within strict and rigid protocols, avoiding as much as possible misunderstandings (e.g., poorly written messages) and false information (e.g., hoaxes).

Education and Training

The working group recognized the need for education, through programme like EDUSEIS, in order to ensure better knowledge and awareness of tsunami risks.

The main goals are to: 1) upgrade information on marine-related hazards and vulnerability; 2) render hazard-awareness activities fashionable; 3) have accessibility to generate interest.

Higher education can be reached through programmes dedicated to the implementation of awareness. Training in Science with different approaches built on different capabilities and different cultural levels of groups, such as scholars and students, teachers, media, decision makers, political people, making the marine-related risks understandable to the general public. In an area like the Mediterranean, different community cultures need to be taken into account.

In the plans of countries a MSK Managements Chapter have to be taken into consideration how planners should be educated in order to incorporate risks in the legislation.

Constitutional right do have the life of people protected should be emphasized; this right should not be only on paper but should become reality through improving awareness exercises and providing education training.

In training, education and awareness, the important role of NGOs should also be widely recognized. Another feasible way to enhance awareness is using dedicated workshops and exercises. Specific actions would be needed for training coastal communities, not necessarily interested to workshops. To enhance public awareness, the use of existing maritime museums, oceanarium networks, and marine protected areas as permanent vehicles to convey relevant information on tsunami and storm surges and mitigation measures was suggested.

Recognising what has been set forth above, the working group recognizes that the IOC has an important role in facilitating and/or achieving the following:

- Hazard warning systems and procedures in Member States at regional to community levels in respect of tsunamis and storm surge events

- Vulnerability assessments for coastal communities and infrastructure in the context of ICZM/ICAM

- Strategic planning in the coastal zone in the context of ICZM/ICAM with a view to minimizing vulnerability of coastal communities and infrastructure

- Developing an effective capacity building framework for assisting Member States in the North Eastern Atlantic, the Mediterranean and connected seas with limited national capabilities in technology through the implementation of IOC criteria and guidelines on the transfer of marine technology (CGTMT, document IOC/INF-1203);

- Immediate implementation of short- and long-term planning at regional and national levels to ensure interventions at the appropriate scale.

- Promoting research required to better understand the human factors related to communities under stress from marine related hazard impacts.

– Promoting national education curricula to encompass natural disaster causes and responses following guidelines prepared by the IOC and other international bodies related to different aspects of disaster reduction.

– Inviting ITU, as it develops the specifications for the Next Generation Networks, to consider the needs of tsunami warning systems, and in particular the timing requirements for delivery of warnings in the NEAM area.

ANNEX III

TERMS OF REFERENCE FOR THE INTERSESSIONAL WORKING GROUPS

The intersessional working groups have the task to developed the elements of an operational system for tsunami early warning based on existing national and regional capabilities in (1) hazard assessment, risk and modelling, (2) warning guidance, and (3) mitigation and public awareness. As part of the assessment, the working groups will consider the requirements to fully develop the capacity in each component, including associated costs, and develop elements for an implementation plan.

Working Group 1 – Hazard Assessment, Risk and Modelling

The working group will be responsible for collecting information on local and distant tsunami inundation maps for coastal communities using internationally accepted numerical model methodology. Estimates of coastal areas susceptible to tsunami flooding will be available from a network of modellers and data managers who will be sharing community-modelling tools via the Internet.

Working Group 2 – Seismic and Geophysical Measurements

The working group will be responsible for developing and deploying, based on existing organizations and functions, a network of early warning tsunami detection instruments in seismically active coastal areas.

Working Group 3 – Sea Level Measurements

The working group will be responsible for developing and deploying a network of real-time sea level networks for the international tsunami warning system and to supplement regional tsunami warning centres.

Working Group 4 – Advisory, Mitigation and Public Awareness

The working group will be responsible for promoting coastal hazards consideration into spatial planning and developing response plans for emergency managers, universally accepted tsunami information signs in accordance with local plans/procedures, and maintaining a tsunami education programme for disaster management personnel, local residents and school systems.

ANNEX IV

OPENING ADDRESSES AND STATEMENTS

Opening Address

by Mr Koïchiro Matsuura
Director-General of the United Nations Educational, Scientific and Cultural Organization (UNESCO)[1]

Ladies and Gentlemen,

Almost one year ago, the devastating tsunami that took place in the Indian Ocean on 26 December 2004 claimed the lives of nearly 200,000 people.

It destroyed the livelihoods of many more. It will take a number of years for the countries of the region to fully recover from the impact of this major disaster.

In the days that followed, UNESCO's long-standing association with tsunami-related actions became more widely known, particularly through its Intergovernmental Oceanographic Commission (IOC) which had established and operated the Tsunami Warning System in the Pacific Ocean since 1965. The unspoken question, however, was why, if a Tsunami Warning System existed in the Pacific Ocean, a similar system did not exist in the Indian Ocean?

When confronted by such a huge catastrophic event, a deep sense of insecurity grows among people and very basic questions begin to be asked. Worldwide statistics show that the losses from natural disasters are increasing, not so much because there is an increase in their frequency and severity but because the human population has dramatically increased, leading to the establishment of human settlements in less than optimal territories that are exposed to increased levels of danger. For example, unplanned urban sprawl in coastal cities with less than adequate infrastructure, along with poor socio-economic conditions, dramatically increases the vulnerability of large numbers of people to the effects of natural disasters.

UNESCO has long been advocating in favour of an early warning system in the Indian Ocean and other regions of the world since the risk of tsunamis exists in varying degrees in all oceans and coastal seas. Given the knowledge and technology available, it is unacceptable that at the dawn of the twenty-first century, humanity still has not been able to utilize this knowledge and technology to protect the people of the Earth and to mitigate the effects of natural disasters.

This is why, last January, UNESCO called for the establishment of early warning systems not only in the Indian Ocean but also in the Caribbean and Mediterranean seas and for their reinforcement in the Pacific. Indeed, we are actively promoting the setting up of a global early warning system for tsunamis that would provide an integrated international framework for establishing regional systems and responsible national centres and facilities.

In a historic meeting in July, the IOC General Assembly approved the creation of three tsunami warning and mitigation systems in the Indian Ocean, the Caribbean Sea, and the Mediterranean Sea and North-Eastern Atlantic. Effectively, when added to the existing Pacific Ocean system and when

[1] Delivered on behalf of the Director-General by Dr Patricio Bernal, Assistant Director-General of UNESCO and Executive Secretary of the IOC.

fully operational, these new systems will provide global coverage to protect coastal populations from tsunami hazards.

UNESCO through its IOC is leading this initiative as part of the ongoing effort to complete the building the Global Ocean Observing System (GOOS). Although the earliest signals that give warning about the possibility of an impending strong and distant tsunami draw upon the monitoring of seismic activity, the observational backbone of the tsunami warning system consists of measurements of sea-level already being made under the auspices of the Global Ocean Observing System. The central task is not to develop a new capability to measure sea-level but to harness the system that already exists for the purposes of tsunami warning.

This strategic approach is essential, since the long-term sustainability of the warning systems depends on the multiple uses of detection networks.

Ladies and Gentlemen,

The actual danger posed by tsunamis is specific to a given region. Local tsunamis can be generated by small earthquakes, a landslide or lava flow and affect areas less than 200 kilometres away. On the opposite extreme, a huge shallow earthquake, like the one off the coast of Sumatra on 26 December, can generate a distant tsunami (or teletsunami) that can travel thousands of kilometres over the deep ocean before hitting the coastline. In the case of local tsunamis or in regions where the centre of seismic activity is close to the coastline, the time for issuing an alert is very limited. In the case of both local tsunamis and teletsunamis, a single country cannot adequately protect itself from tsunami risks without a regional network composed of hundreds of observation stations.

Given the particular geological structure and size of the Mediterranean and the Black Sea, the technical requirements are very demanding and quite different from other regions. Mediterranean-rim countries, particularly Greece, Italy and Turkey, are exposed to seismic activity generated by the collision zone between the Eurasian and African crustal plates. Historically, there are records of important tsunamis originating in this region.

At the core of the warning systems are the National Tsunami Warning Centres, designed to respond to the most frequent types of events occurring in their regions and fully interlinked with the National Emergency Authorities, so that long-term preparedness plans can be implemented and timely warnings can be issued by responsible agencies.

Ladies and Gentlemen,

This first meeting of the Intergovernmental Coordination Group for the Tsunami Early Warning System for the North-Eastern Atlantic, the Mediterranean and Connected Seas, hosted by the Government of Italy, will lay the foundations for the establishment of an effective system.

European countries and the European Commission have been developing and supporting observation networks through several initiatives. Several institutions do exist in support of the work that we are initiating in this meeting. For ocean observations, the EuroGOOS alliance and the MedGOOS project are important regional components of GOOS.

In seismology, the Euro-Mediterranean Centre on Evaluation and Prevention of Seismic Risk, in Rabat, Morocco, with its rich experience linking research centres from Southern Europe and Northern Africa, aims to develop a unified strategy and a common framework for co-coordinating and correlating activities relating to regional seismotectonic zoning and assessment of seismic hazards and risks in the Mediterranean region.

In Southern Europe, the European Mediterranean Seismological Centre (EMSC) at Bruyères-le-Châtel, France, has set up an operational alert system responsive to any earthquake whose magnitude is greater than 5.0 on the Richter Scale over the European-Mediterranean region. The EMSC maintains a 24h/24 and 7d/7 operation. These networks are important assets that need to be fully exploited internationally in the context of establishing a tsunami warning system.

To these centres, we could add several others such as the European Centre on Prevention and Forecasting Earthquakes, in Athens, Greece, and the European Centre for Geodynamics and Seismology, in Luxemburg.

Ladies and Gentlemen,

In response to the tsunami in the Indian Ocean, European countries reacted very positively, offering humanitarian help and technical assistance to the affected countries. Now these same countries need to engage in an international process that will enable the protection of part of their own territories and help others to do the same in their immediate neighbourhood.

In Nice last February, in closing an international seminar assessing the tsunami hazard in the Mediterranean region, M. Lepelletier, then Minister of Environment of France, called upon UNESCO to assume the important international coordination role to achieve this goal. We are extremely happy today to offer to all countries of these regions this mechanism to do just that.

Thank you.

Statement

by Mr Michel Jarraud
Secretary-General, World Meteorological Organization[2]

Excellencies, Ladies and Gentlemen,

On behalf of the World Meteorological Organization (WMO) and my own, I wish to express our appreciation for the invitation to address the First Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and connected Seas (ICG/NEAMTWS). I am grateful to the Government of Italy, through the Ministry of Foreign Affairs and the Ministry for Environment and Protection of the Territory, for its support to WMO and its Programmes, particularly to its activities related to disaster reduction.

The unprecedented tragic tsunami that hit the Indian Ocean countries on 26 December 2004 has demonstrated, in tragic proportions, the need for a tsunami early warning system in this region as well as in other regions at-risk. Over the period since this awful event, WMO has reinforced its partnerships with UNESCO's Intergovernmental Oceanographic Commission (IOC), the UN International Strategy for Disaster Reduction (ISDR) and other concerned organizations, to ensure that our respective expertise and capabilities can be utilized and built upon to accelerate efforts in strengthening pre-disaster strategies, including the development of the tsunami early warning system. WMO is therefore very supportive of the initiative to develop the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and connected Seas.

---

[2] Delivered on his behalf by Mr Edgard Cabrera, Chief Ocean Affairs Division Applications Programme Department, WMO.

Excellencies, Ladies and Gentlemen,

As we consider the development of such a system, I wish to draw your attention to a number of issues. In this respect, I would like to stress that a fundamental precondition for national disaster preparedness is a well-functioning "end-to-end early warning system", capable of delivering accurate information to the population at risk, dependably and in a timely manner.

While we must indeed raise political commitment and funds to develop the technical infrastructure and institutional mechanisms for development of tsunami warnings, one of our most challenging tasks is also to ensure that, as the warnings arrive, the government authorities, risk managers and the public at risk can fully understand and utilize this information. This is particularly important whenever the warning period will be short, so that close regional cooperation and coordination, national legislation and related organizational coordination and collaboration, mechanisms for communicating the warnings to the communities at risk, and public education and outreach are among the key issues to be addressed.

The development of an end-to-end tsunami early warning system, encompassing from observations to community-level responses, should therefore be carried out following a multi-hazard, multi-purpose approach. The main synergistic advantage of such approach is the multipurpose use of observational and telecommunication systems, exploiting the routine operational facilities and services to provide accurate and timely emergency information to decision makers and the general public, down to the village and household levels. Successful national meteorological and hydrological experiences with early warning systems, such as those for severe weather, tropical cyclones, storm surges and flood warnings, can be applied to accelerate the development of an integrated, multi-hazard, early warning approach. Regular activation of the multi-hazard national alert systems can help to ensure their sustainability and effectiveness for less frequent events, such as tsunami. The regular use of multi-hazard, multi-purpose alert systems also allows the public to understand the warnings and to repeatedly exercise the specific actions that they should take for each type of hazard.

As the specialized agency of the United Nations competent in weather, climate and water, WMO works through National Meteorological and Hydrological Services (NMHSs) of its 187 Members to ensure that, among their other responsibilities, all early warning for hydro-meteorological disasters can be addressed effectively 24 hours a day, 365 days a year, regardless of political boundaries. WMO's Global Telecommunication System (GTS) links all the NMHSs and constitutes a reliable asset to the international community, in their efforts to deal with emergency situations. The WMO GTS is already utilized as the backbone for exchange of tsunami related information and warnings in the Pacific Ocean and is being adapted to this use for the Indian Ocean Tsunami Warning System and for other regions at risk.

Currently, nearly 60 NMHSs in the world have their governments' mandate to provide seismic and/or tsunami early warnings. In the Indian Ocean, most of the 27 concerned countries have designated their NMHSs to act as their national tsunami focal points. However, the capabilities and resources of the NMHSs vary significantly from country to country. By enhancing these capabilities, and establishing a stronger link between NMHSs and the risk management authorities, we can be more effective and contribute to saving more lives. In this respect, in the Indian-Ocean Rim countries, WMO has taken proactive action and is contributing to the development of the end-to-end tsunami early warning system in four areas:

First: The WMO Global Telecommunication System is being upgraded, where needed, to address the requirements for tsunami-related information exchange, for the interim period and the longer term.

Second: WMO is working towards the enhancement of multi-hazard national warning alert mechanisms through the NMHSs, to support the around-the-clock dissemination of tsunami warnings and to raise public risk awareness, through the development of educational and community outreach programmes.

Third: In partnership with the space agencies and its partner organizations, WMO is working towards the development of user requirements for optimal utilization of space technologies in enhancing multi-hazard early warnings, including tsunami.

Fourth: With a strong support for the implementation of the Hyogo Framework for Action, WMO will continue to promote the benefits of a multi-hazard approach to early warning systems and to contribute to its implementation. To this end, WMO will hold a multi-agency, multi-disciplinary symposium on multi-hazard, multi-purpose early warning systems in Geneva, from 1 - 2 March, 2006, in order to develop recommendations contributing to a framework for the implementation of this concept.

Excellencies, Ladies and Gentlemen,

Before closing, I wish to thank you again for your invitation. Your presence speaks of your deep commitment to the development of the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and connected Seas.

I wish to assure you of WMO's commitment to continue working together towards a safer world and reducing the magnitude of such tragic disasters in the future.

Thank you.

Remarks

by H.E. Wilfried I. Emvula
Ambassador of Namibia and Chairperson of the Africa Group at UNESCO

Mr Chairperson,
Hon. Ministers,
Mr ADG and Executive Secretary,
Delegates,

May I take this opportunity to congratulate the organizers of this meeting and the government of Italy for hosting it. While my presence here if to represent my Minster who, due to other commitments cannot attend, I have been requested to speak on behalf of the Africa Group at UNESCO, which I chair and the G77, of which I am a member of the Bureau.

I am further delighted to be at this meeting, to express our full support to this important initiative which is in line with the preventive approach of the United Nations to mitigate the impacts of natural disasters on our societies.

The G77 and the Africa Group have extensively reflected on the subject matter at our Plenary meeting a few weeks ago and I would like to bring some of the key points of this reflection to your kind attention.

Both the Secretary General of the United Nations and the Director General of UNESCO called for the establishment of an Integrated Multi-Hazards Early Warning and Mitigation Systems in ALL REGIONS of the World. The World Community of Nations including the G77 and the Africa Group supported this vision, based on the fact that we are all sailors on the same boat. Tsunamis can potentially hit any part of the World at varying degrees. The G77 and the Africa Group are glad that UNESCO supports the establishment of this very important Working Group that will take forward the development of the Tsunami Early Warning and Mitigation System in the Northeast Atlantic, the Mediterranean and Connected Seas.

Again, I would like to reiterate, that we are very supportive to the main purpose of this meeting and this laudable initiative. My own country borders a long coastline of about one thousand kilometres, making it equally vulnerable to a disaster of this nature.

As such, distinguished experts, I have two questions to you and I hope that you will help breaking my little ignorance as I am neither a geographer, nor a marine scientist. I am a politician and Diplomat by training.

1. Does the Northeast Atlantic cover Central, Equatorial and Southern Africa?

2. If the Atlantic as a whole is considered as an OCEAN BASIN, is there any scientific explanation to consider that the Central, Equatorial and the Southern parts of this Basin represent its CONNECTED SEAS?

It is my humble understanding at least, that the Mediterranean is a connected sea to the Atlantic Ocean, as is the Black Sea to the Mediterranean.

At the First International Tsunami Coordination Meeting at the UNESCO Headquarters in Paris, 3-8 March 2005, the Africa Group submitted a Concern and Position paper. Subsequently we wrote to the Director General of UNESCO on 21 June 2005 on the development of an Integrated Multi-Hazards Early Warning Systems in the Central, Equatorial and Southern Atlantic Ocean, as we believe that an Integrated Global System will work in the better interest of us all.

Distinguished experts,
Honourable Representative of Members States,

You may agree with me, that Human society is a single community. We ALL are on this same boat. We believe that it is imperative, that either we take an Integrated or rather a Global approach or establish a similar Group, to take consideration of the concerns of the countries bordering the Central, Equatorial and Southern Atlantic.

It is my hope that our plight, is worth your consideration and will be fully integrated in the report of this meeting.

Thank you for you kind attention.

ANNEX V

LIST OF DOCUMENTS

Document code	**Title**	**Agenda item**	**Language**
Working Documents			
IOC/ICG-NEAMTWS-I/1 Prov.	Provisional Agenda		E F
IOC/ICG-NEAMTWS-I/1 Prov. Add.	Provisional Timetable		E F
IOC/ICG-NEAMTWS-I/2 Prov.	Provisional Annotated Agenda		E
IOC/ICG-NEAMTWS-I/3	Summary Report		E
ICG-NEAMTWS-I/4	Draft Guidance for Working Groups		E
IOC/ICG-NEAMTWS-I/5	List of Participants		E
IOC/ICG-NEAMTWS-I/6	Provisional List of Speakers		E
Information documents			
Resolution XXIII-14	Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-eastern Atlantic, the Mediterranean and Connected Seas		E
IOC Circular Letter 2171	Letter of invitation to the session		E
IOC Workshop Report No. 196	International Coordination Meeting for the Development of a Tsunami Warning and Mitigation System for the Indian Ocean within a Global Framework UNESCO Headquarters, France, 3–8 March 2005		E
IOC Workshop Report No. 198	Second International Coordination Meeting for the Development of a Tsunami Warning and Mitigation System for the Indian Ocean Grand Baie, Mauritius, 14–16 April 2005		E

Document code	Title	Agenda item	Language
ICG/IOTWS-I/3	First Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS), Perth, Western Australia, 3–5 August 2005		E
UNEP publication	Annotated Guiding Principles for Post-tsunami Rehabilitation and Reconstruction		E
IHO publication	Areas of Co-operation between IHO and ITSU (Twentieth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific (ITSU-XX), Valparaiso, Chile, 3-7 October 2005, Agenda Item: 9.3 “Cooperation with IHO”)		
--	List of Tsunami meetings		E

ANNEX VI

LIST OF PARTICIPANTS

MEMBER STATES OF ICG/NEAMTWS

Bulgaria

Mr Hristo Dimitrov SLABAKOV
Institute of Oceanology Bulgaria
P.O. Box 152
Varna 9000
Tel.: 00359 52 370 484
Fax: 00359 52 370 483
Email: office@io-bas.bg

Croatia

Mr Ivica VILIBIC
Intitute of Oceanography and Fisheries
Setaliste Ivana Mestrovica, 63
Split 21000
Croatia
Tel.: 00385 21 358 688
Fax: 00385 21 358 650
Email: vilibic@izor.hr

Egypt

Mr Hatem ABDELKADA
First Secretary
Embassy of the Arab Republic of Egypt
Rome
Tel.: 39 06 844 01964
Fax: 39 06 855 4424
Email: hatemabd@gmail.com

Finland

Dr Tapani STIPA
Scientist, Docent, Ph.D.
Finnish Institute of Marine Research
P.O. Box 33
FI-00931 Helsinki
Tel: 358 9 613 941
Fax: 358 40 605 8090
E-mail: tapani.stipa@fiMrfi

France

Mr Jean VIRIEUX
Université de Nice
UMR Géosciences Azur
250, rue Albert Einstein
06560 Valbonne
Tel.: 33 (0)4 92 94 26 51
Fax: 33 (0)4 92 94 26 10
Email: virieux@geoazur.unice.fr

Mr François SCHINDELÉ
Assistant Director
Département Analyse et Surveillance de l'Environnement
Laboratoire de Géophysique
B.P. 12
91680 Bruyères-le-Châtel
Tel: 33 1 69 26 50 63
Fax: 33 1 69 26 70 23
E-mail: schindel@ldg.bruyeres.cea.fr

Germany

Dr Peter KOLTERMANN
Head of Division
Marine Sciences, Co-ordination
Bundesamt für Seeschifffahrt und Hydrographie
Bernhard-Nocht-Strasse 78
D-20359 Hamburg
Tel.: (49 40) 31 90 35 00
Fax: (49 40) 31 90 50 35
E-mail: koltermann@bsh.de

Greece

Mr V. LYKOUSIS
National Hellenic Centre for Maritime Research
P.O. Box 712
Anavissos 19013
Tel.: 30 22910 76380
Fax: 30 22910 76347
Email: vlikou@ncmr.gr

Dr Gerassimos A. PAPADOPOULOS
Research Director
Institute of Geodynamics
National Observatory of Athens
11810 Athens
Tel: 30-210-3490165

Fax: 30-210-3490180
E-mail: g.papad@gein.noa.gr

Dr Costas SYNOLAKIS
Technical University of Crete
Tsunami Research Center
Biegler Hall,
University of Southern California
Los Angeles, CA 90089-2531
Tel.: 1 213 740 5129
Fax: 1 213 744 1426
Email: costas@usc.edu

Israel

Mr Dov S. ROSEN
National Institute of Oceanography, IOLR
P.O. Box 8030
Haifa, 31080
Tel.: 972 4 856 5241
Fax: 972 4 851 1911
Email: rosen@ocean.org.il

Italy

Mr Stefano CACCIAGUERRA RANGHIERI
Ministry of Foreign Affairs
Piazzale della Farnesina, 1
Rome 194
Tel.: 039 3691 5801
Fax: 039 06 32 42 524
Email: stefano.cacciaguerra@esteri.it

Mr Eugenio CAMPO
Ministry of Foreign Affairs
Piazzale della Farnesina, 1
Rome
Tel.: 0039 06 36 91 51 95/6
Fax: 0039 06 32 42 52 4
Email: eugenio.campo@esteri.it

Mr Federico CINQUEPALMI
Italian Ministry for the Environment and Territory
Via Capitan Bavastro, 174
Rome 154
Tel.: 39 06 5722 3450
fax. 39 06 5722 3486
Email: cinquepalmi.federico@minambiente.it

Mr Stefano TINTI
University of Bologna
Viale Carlo Berti Pichat, 8
40127 Bologna
Tel.: 39 051 2095025
Fax: 39 051 2095058
Email: steve@ibogfs.df.unibo.it

Mr Aldo COSENTINO
MATT - Italian Ministry for the Environment and Territory
Via Capitan Bavastro 174
00154 Rome
Tel.: 39 06 57228277
Fax: 39 06 57228390
Email: dpn-dg@minambiente.it

Mr Damiano LUCHETTI
MATT - Italian Ministry for the Environment and Territory
Via Capitan Bavastro 174
00154 Rome
Tel.: 39 06 57228377
Fax: 39 06 57228390
Email: luchetti.damiano@minambiente.it

Mr Ezio BUSSOLETTI
Italian Permanent Delegation UNESCO
MR3.17
1 rue Miollis
75 015 Paris
France
Tel.: 33 45 68 31 21
Email: e.bussoletti@unesco.org

Lebanon

Mr Alexandre SURSOCK
CNRS - Conseil National de la Recherche Scientifique
Achrafieh 1100
Liban 2040
Tel.: 00961 4 981 885
Fax: 00961 4 981 886
Email : asursock@cnrs.edu.lb

Monaco

Mr Michel BOISSON
Centre Scientifique de Monaco
Boulevard de Suisse, 16 - "Villa Girasole"
Monaco 98000

Tel.: 00377 93 15 85 96
Fax: 00377 93 15 86 74
Email: mboisson@gouv.mc

Morocco

Azelarab EL MOURAOUAH
CEPRIS
52, Av. Omar Ibn Khattab, BP: 8027
Agdal Nations Unies
Rabat
Tel.: 212 37 77 28 03
Fax: 212 37 77 12 88
Email: elmouraouah@cnr.ac.ma

Norway

Bente Lilji BYE
Norvegian Mapping Authority
Geodetic Institute
Kartverksveien, 21
Honefoss 3511
Tel.: 0047 32 11 81 00/303
Fax: 0047 32 11 81 01
Email : bente-lilja.bye@statkart.no

Portugal

Prof. Mario RUIVO
National Commission for the IOC
Av. Infante Santo, 42-4°
1350-179 Lisboa
Tel.: 351 21 390 4330
Fax: 351 21 395 2212
Email: cointersec.presid@fct.mces.pt

Romania

Ms Ruxandra BALAET
Ministry of the Environment
12 Libertatii Blvd
Bucharest Sector 5
Tel.: 0040 21 41 05 386
Fax: 0040 21 41 02 032
Email: bruxandra@mappm.ro

Ms Silvia Ana VARGA
Ministry of Environment
12 Libertatii Blvd
Bucharest Sector 5
Tel.: 0040 21 41 05 386
Fax: 0040 21 41 02 032
Email: varga@mappm.ro

Spain

Mr Juan ACOSTA-YEPES
IEO - Instituto Español de Oceanografía
c/coazon de Maria 8, 28002 Madrid
Tel: 34 91 3473618
Fax: 34 91 4135597
Email: juan.acosta@md.ieo.es

Emilio CARREÑO HERRERO
Jefe del Servicio de Ingenieria Sismica
Instituto Geografico Nacional
General Ibanez Ibero, 3
28003 Madrid, Spain
Tel: (34-1) 533-3800 x 303, 309
Fax: (34-1) 533-1158
Email: emilio@ign.es; emilio@geo.ign.es

Mr José COLOMER
Cartographic Institute of Catalonia
Parc de Montjuïc 08038 Barcelona
Tel.: 93 567 15 00
Fax.: 93 567 15 67
Email: colomer@icc.es

Tunisia

Mr Mourad BEDIR
National Scientific and Technical Institute
of Tunisia/Borj Cédria Technopark
B.P. 95, Borj Cedria
Hammam lif 2050
Tel.: 216 71 431 122
Fax: 216 71 430 934
Email: bedmour@yahoo.fr

Mr Cherif SAMMARI
National Scientific and Technical Institute
28 rue 2 mars 1934,
2025 Salammbô
Tel.: 216. 71. 730 420
Fax: 216. 71. 732 622
Email: cherif.sammari@instm.rnrt.tn

Turkey

Mr Cimil GURBUTZ
Kandilli Observatory and Earthquake
Institute

Prof. Emin Özsoy
Middle East Technical University

PK 28 Erdemli
Mersin 33730
Tel.: 90 324 521 21 50
Fax: 90 324 521 23 27
Email: ozsoy@ims.metu.edu.tr

MEMBER STATES OF IOC OBSERVERS TO ICG/NEAMTWS

Cameroon

Mr Charles ASSAMBA ONGODO
Permanent Delegation to UNESCO
UNESCO House
1 rue Miollis
75 015 Paris
France
Tel.: 33 (0)1 45 68 30 79
Fax: 33 (0)1 45 68 30 34
Email: C.Assamba@unesco.org

Mexico

Mr Francisco BRIZUELA-VENEGAS
Secretaría de Educación Pública-SEMS
Viaducto Miguel Alernan, 806
Col. Napoles del Benito, Juàres 3810
Tel.: 55 23 19 13/33
Fax: 55 23 19 134
Email: brizuela@sep.gob.mx

Namibia

Mr Wilfried EMVULA
Ambassade de la République de Namibie
17 Square de l'Avenue Foch, 17
75 016 Paris
Tel.: 0033 01 44 17 32 65
Fax: 0033 01 44 17 32 73
Email : namparis@club-internet.fr

Pakistan

Mr Ghulam RASUL
Pakistan Meteorological Department
Post Box 1214
Islamabad H-8/2
Tel.: 0092 51 9250 369
Fax: 0092 51 9250 368
Email: grmet@yahoo.com

USA

Mr David GREEN
NOAA
SSMC-2 Rm-15426
1325 East West Highway
Silver Spring, Maryland 20910
Tel.: (301) 713 3557 x 172
Fax: (301) 713 0173
Email : David.Green@noaa.gov

ORGANIZATIONS / INSTITUTIONS

CJ SIEP-EPT-PER

Mr Christopher SHAW
Shell
Postbus 60 2280
AB Rijswijk
The Netherlands
Tel.: 31 70447 3560
Fax: 31 70447 7980
Email: Christopher.Shaw@SHELL.com

European Commission - Directorate-General for Information Society & Media

Mr Guy WEETS
Deputy Head of Unit
Information Society Directorate-General
European Commission
Av. de Beaulieu 31
BE-1160 Brussels
Belgium
Tel: 32 2 296 35 05
Fax: 32 2 296 95 48
E-mail: guy.weets@cec.eu.int

European Commission DG Research, Environment & Sustainable Development

Ms Karen FABBRI
Scientific Officer in Risk Management
ICT for Environment
Information Society & Media Directorate-General
Av. de Beaulieu 31
BE-1160 Brussels
Belgium
Tel: 32 2 299 5185
Fax: 32 2 296 9548
E-mail: karen.fabbri@cec.eu.int

International Geographical Union (IGO)

Mr Giuliano BELLEZZA
Home of Geography
Via della Navicella, 12 (Villa Celimontana)
Rome 184
Italy
Tel.: 0039 06 77 59 11 83
Fax: 0039 06 77 07 88 27
Email : g.bellezza@homeofgeography.org

International Ocean Institute (IOI)

Dr Iouri OLIOUNINE
Executive Director
P.O. Box 5
Gzira GZR 01
Malta
Tel: 356 2134 6528 / 6529
Fax: 356 2134 6502
E-mail: ioihq@ioihq.org.mt

UN International Strategy for Disaster Reduction (ISDR)

Mr Reid BASHER
PPEW Coordinator, ISDR Secretariat
Gorresstrasse 30
Bonn 53113
Germany
Tel: 49 228 249 8810
Fax: 49 228 249 8888
E-mail: reid.basher@un.org

International Telecommunications Union (ITU)

Mr Simao CAMPOS
TSB Counselor for Network Services & Multimedia Terminal Technologies,
Palais des Nations
CH-1211 Geneva 20
Switzerland
Tel: 41 22 730 51 11
Fax: 41 22 733 72 56
E-mail: s.campos@itu.int

GSM

Mr Robert CLARKE
GSM Associates
SFR Tour Sequoia
1 place Carpeaux
92915 Paris La Défense cedex
France
Tel.: 33 (0)1 71 08 20 03
Fax: 33 (0)1 71 08 20 03
Email: robert.clarke@fr.sfr.com

National Oceanic and Attmospheric Administration (NOAA)

Mr. William BRENNAN
Tel.: (202)482-6076
Fax: (202)482-6000
E-mail: bill.brennan@noaa.gov

United Nations Institute for Training and Research (UNITAR)

Mr Alain RETIERE
UNOSAT/UNITAR
International Environment House 2
7-9Chemin des Anémones
CH - 1219 Châtelaine, Geneva
Switzerland
Tel.: 909-793-2853
Email: Alain.Retiere@cern.ch

United Nations Environment Programme (UNEP)

Ms Teresa BORELLI
ERS/RAC
Via Cagliari n. 40
00198 Roma
France
Tel.: 39.06.85305147
Fax: 39.06.8542475
Email: tborelli@inforac.org

Mr Paul MIFSUD
48, Vassileos Konstantinou Ave
Athens 116 35
Greece
Tel.: 0030 210 7273123/101
Fax: 0030 210 7253196/7
Email : paul.mifsud@unepmap.gr

Mr Ivica TRUMBIC
MAP PAP/RAC
Kraj Sv. Ivana 11 HR-21000 Split
Croatia
Tel.: (385) (21) 34 04 70

Fax: (385) (21) 34 04 90
Email : ivica.trumbic@ppa.htnet.hr

United Nations University/ Environment & Human Security (UNU/EHS)

Dr. Juan Carlos VILLAGRAN de LEON
UNU-EHS
Goerresstr 15
D-53113 Bonn
Germany
Tel: 49 (0)2 28 4228 5513
Fax: 49 (0)2 28 4228 5599
Email: villagran@ehs.unu.edu

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

Mr Kartlos EDILASVILI
WAPMERR
Route de Jargonnant, 2
Geneva 1207
Switzerland
Tel.: 0041 22 700 5544
Fax: 0041 22 700 0044
Email : k_edilasvili@wapmerr.org

Dr David KHIDASHELI
Operations Director
Member of the Coordination Council
Route de Jargonnant 2
CH-1207 Geneva
SWITZERLAND
Tel: 41 79 433 0448
E-mail: d_khidasheli@wapmerr.org

Prof. Max WYSS
Director WAPMERR
Route de Malagnou 36A
P.O. Box 104
CH-1208 Geneva 17
Switzerland
Tel: 41 79 749 4894
Fax: 41 22 735 2050
E-mail: wapmerr@maxwyss.com

World Meteorological Organization (WMO)

Mr Edgard CABRERA
Chief, Oceans Affairs Division
Applications Programme Dept.
7bis, av. De la paix
C.P. 2300
CH-1211 Geneva 2
Switzerland
Tel: 41 22 730 82 37
Fax: 41 22 730 81 28
E-mail: ecabrera@wmo.int

Mr Guy DUCHOSSOIS
7bis, av. De la paix
C.P. 2300
CH-1211 Geneva 2
Switzerland
Email: GDuchossois@geosec.org

INVITED SPEAKERS

Mr Russell Scott ARTHURTON
Formerly British Geological Survey
5A Church Lane
Grimston Melton Mowbray
Leics LE14 3BY
UK
Tel.: 0044 (0) 1664 810024
Fax: 0044 (0) 1664 810024
Email: r.arthurton@btinternet.com

Mr Remy BOSSU
CSEM (EMSC) Secretary General
C/o CEA, Bat. Sables
B.P. 12 91680 Bruyères le Châtel
France
Tel.: 33 1 69 26 78 14
Fax: 33 1 69 26 70 00
Email: bossu@emsc-csem.org

Ms Alexia MASSACAND
GEO
7, bis avenue de la Paix
Case Postale 2300
CH-1211 Geneva 2
Switzerland
Tel: 41 22 730 8382
Fax: 41 22 730 8520
Email: AMassacand@geosec.org

Dr Luís MENDES-VICTOR
CERU-Centro Europeu de Riscos Urbanos
Av. Elias Garcia, n. 7, 2 Andar
1000-146 Lisboa

Portugal
Tel.: 351 21 3021 871
Fax: 351 21 395 3327
Email: lavictor@fc.ul.pt

Dr François SCHINDELÉ
Scientific Advisor
Département Analyse, Surveillance Environnement
Laboratoire de Géophysique
B.P. 12
91680 Bruyères-le-Châtel
France
Tel: 33 1 69 26 50 63
Fax: 33 1 69 26 71 30
E-mail: francois.schindele@cea.fr

Mr Alexander TENENBAUM
MIUR - Ministry of Education Universities and Research
Piazza Kennedy, 20
Rome 144 Italy
Tel.: 0039 06 58 49 78 85
Fax: 0039 06 58 49 75 22
Email: tenenbaum@miur.it

OBSERVERS

Mr Giovanni ADDAMO
APAT- Agenzia per la Protezione dell'Ambiente e Servizi Tecnici
Via Curtatone, 3
Rome 185
Italy

Mr Franco ANDALORO
ICRAM
Via di Casalotti 300
00166 Roma
Tel: 06 615701
Fax: 06 61561906
Email: f.andaloro@icram.org

Mr Giovanni ARENA
APAT- Agenzia per la Protezione dell'Ambiente e Servizi Tecnici
Via Curtatone, 3
Rome 185
Italy

Ms Barbara BELFIORE
Ministry of Foreign Affairs
Piazzale della Farnesina, 1
Rome 194
Email: barbara.belfiore@fastwebnet.it

Mr Mauro BENCIVENGA
APAT- Agenzia per la Protezione dell'Ambiente e Servizi Tecnici
Via Curtatone, 3
Rome 185
Italy

Mr Ugo BERGAMO
Italian State Senate
Italy
Email: u.bergamo@senato.it

Ms Viviana BIANCO
Italian Ministry for the Environment and Territory
Via Capitan Bavastro 174
00154 Rome
Italy

Mr Enzo BOSCHI
INGV
Via di Vigna Murata, 605
00143 Rome
Italy
Tel.: 39 06 51 86 06
Fax: 39 06 50 41 181
Email: presidente@ingv.it

Ms Nina BUVANG VAAJA
Ambasciata di Norvegia
Via delle Terme Deciane, 7
Rome 153
Italy
Tel.: 0039 06 57 17 031
Fax: 0039 06 57 17 03 26
Email: nbv@mfa.no

Mr Daniele CALORE
Envirtech SpA
37, Via XX Settembre
16121 Genoa
Italy
Tel.: (+39) 0182 - 55 96 43
Fax: (+39) 0182 - 57 09 76

Mr Luigi CAVALERI
ISMAR-CNR
San Polo 1364
Venice 30125
Italy
Tel.: 0039 041 5216 810
Fax: 0039 041 2602 340
Email : luigi.cavaleri@ismar.cnr.it

Ms Alessandra CAVALLETTI
MATT - Italian Ministry for the Environment and Territory
Via Capitan Bavastro 174
00154 Rome
Italy
Tel.: 39 06 57228377
Fax: 39 06 57228390
Email: acavalletti@gmail.com

Ms Anna Maria CICERO
ICRAM
Italy
Email: Am.cicero@icram.org

Mr Antonio CIRILLO
Telecom
Via Parco De' Medici, 61
Rome 148
Italy
Tel.: 0039 06 36 89 09 24
Fax: 0039 06 36 87 02 50
Email : antonio.cirillo@telecomitalia.it

Mr Goffredo CORTESI
Ministry of Foreign Affairs
Piazzale della Farnesina, 1
Rome 194
Italy
Email: Goffredo.cortesi@esteri.it

Mr Stefano COSINI
APAT- Agenzia per la Protezione dell'Ambiente e Servizi Tecnici
Via Curtatone, 3
Rome 185
Italy
Tel.: 0039 06 44 44 22 48
Fax: 0039 06 49 10 54
Email : stefano.corsini@apat.it

Mr Fabrizio CUMO
University La Sapienza
Italy
Email: fabrizio.cumo@uniroma1.it

Mr Maurizio CUMO
University La Sapienza
Italy
Email: maurizio.cumo@uniroma1.it

Mr Paolo DE GIROLAMO
University of L'Aquila
Laboratorio di Ingegneria ambientale e marittima
Monteluco di Roio L'Aquila
67040 Italy
Tel.: 0039 08 62 43 45 44/550
Fax: 0039 08 62 43 45 20
Email : p.degirolamo@modimar.it; padegi@ing.univaq.it

Mr Costante DE SIMONE
Aeronautica Militare
Via di Centocelle, 301
Rome175 Italy
Tel.: 0039 06 24 00 25 16
Fax: 0039 06 24 40 13 59
Email: desimone@meteoam.it

Mr Paolo FAVALI
INGV - Istituto Nazionale di Geofisica e Vulcanologia
Italy
Email: paolofa@ingv.it

Mr Paolo GASPARINI
AMRA
Italy
Email: gasparini@na.infn.it

Mr Giuseppe GIORDANO
ENI S.p.A.
Piazzale Enrico Mattei, 1
Rome 144
Italy
Tel.: 0039 06 59 82 56 77
Fax: 0039 06 59 82 28 19
Email : giuseppe.giordano@eni.it

Mr Stefano GOMES
Ministero dell'Ambiente e della Tutela del Territorio
Via Capitan Bavastro, 174
Rome 154

Italy
Tel.: 0039 06 57 22 34 00
Fax: 0039 06 57 22 34 86
Email : gomes.stefano@minambiente.it

Mr Marco GONELLA
MATT - Italian Ministry for the Environment and Territory
Via Capitan Bavastro 174 Rome 154
Tel.: 039 06 57 22 34 00
Fax: 039 06 57 22 34 86
Email: gonella@tin.it

Mr Giovanni GRAVINA
Italian Coast Guard
Via dell'Arte, 16
Rome 100
Italy
Tel.: 0039 06 59 08 47 68
Fax: 0039 06 59 22 737
Email: eg3rep1@infrastrutturetrasporti.it

Ms Arianna GRAZIOLI
Ministry of Foreign in Affairs
Piazzale della Farnesina, 1
Rome 194
Italy
Email: stefano.cacciaguerra@esteri.it

Mr Roberto INGHILESI
APAT- Agenzia per la Protezione dell'Ambiente e Servizi Tecnici
Via Curtatone, 3
Rome 185
Italy
Email: roberto.inghilesi@apat.it

Mr. Agostino IZZO
MATT - Italian Ministry for the Environment and Territory
Via Capitan Bavastro 174
00154 Rome
Italy
Tel.: 39 06 57228377
Fax: 39 06 57228290
Email: izzo.agostino@minambiente.it

Mr Andrea LAZZARI
Ministero dell'Ambiente e della Tutela del Territorio
Via Cristoforo Colombo, 44
Rome 00147
Italy
Tel.: 0039 06 57 22 38 19
Fax: 0039 06 57 22 38 05
Email : lazzari.andrea@minambiente.it

Mr Pierre LOYER
Alcatel Alenia Space
Email: Pierre.loyer@alcatelaleniaspace.com

Ms Alessandra MARAMAI
INGV
Via di Vigna Murata, 605
Rome 143 Italy
Tel.: 0039 06 51 86 02 10
Fax: 0039 06 51 86 03 38
Email: maramai@ingv.it

Mr Carlo MORELLI
University of Trieste
Italy

Mr Michele MORRIONE
Regione Sicilia
Via Abele, 5
Palermo 90100
Italy
Tel.: 0039 091 70 71 912
Fax: 0039 091 70 71 901

Mr Renzo MOSETTI
OCS-Istituto Nazionale Oceanografia e Geofisica Sperimentale
Borgo Grotta Gigante, 42/c
Sgonico (TRIESTE) 34010
Italy
Tel.: 0039 040 21 401
Fax: 0039 040 32 73 07
Email : rmosetti@inogs.trieste.it

Mr Gabriele NARDONE
APAT- Agenzia per la Protezione dell'Ambiente e Servizi Tecnici
Via Curtatone, 3
Rome 185
Italy
Email: gabriele.nardone@apat.it

Ms Viviana PALANCA
Italian Ministry for the Environment and Territory
Via Capitan Bavastro, 174
Rome 154

Italy

Ms. Immacolata PANNONE
Ministry of Foreign Affair
Direzione Generale per la Culture
Piazzale della Farnesina, 1
Roma 19
Italy

Mr Andrea PERUGINI
Ministry of Foreign Affairs
Piazzale della Farnesina, 1
Rome 19 Italy
Email: andrea_perugini@hotmail.com

Ms Francesca POLLA MATTIOT
ENI S.p.A.
Via Laurentina, 449
Rome 142 Italy
Tel.: 0039 06 59 88 60 67
Fax: 0039 06 59 85 52 4
Email :francesca.pollamattiot@eni.it

Mr Giuseppe PORCELLA
Telecom
Viale Parco De' Medici, 61
Rome 148
Italy
Tel.: 0039 06 36 88 00 29
Fax: 0039 06 36 87 28 99
Email : giuseppe.porcella@telecomitalia.it

Mr Antoni ROCA
Cartographic Institute of Catalonia
Spain
Email: colomer@icc.es

Mr Giancarlo RICCIO
Ministry of Foreign Affair
Piazzale della Farnesina, 1
Roma 19
Italy

Mr Giuseppe ROSSI
Ministry of Foreign Affair
Piazzale della Farnesina, 1
Roma 19
Italy

Mr Furio RUGGIERIO
Envirtech SpA
37, Via XX Settembre
16121 Genoa
Italy
Tel.: (+39) 0182 - 55 96 43
Fax: (+39) 0182 - 57 09 76
Email : furio@envirtech.org

Mr Leonardo SANTORO
Civil Protection
Italy
Email: serviziosismico@regione.sicilia.it

Mr. Valter SECA
Envirtech SpA
37, Via XX Settembre
16121 Genoa
Italy
Tel.: (+39) 0182 - 55 96 43
Fax: (+39) 0182 - 57 09 76

Mr Mauro SELLITTO
The Abdus Salam Center for Theoretical Physics (ICTP)
Strada Costiera 11
34014 Trieste
Italy

Mr Sergio SILENZI
ICRAM
Via di Casalotti 300
00166 Roma
Italy
Tel: 06 615701
Fax: 06 61561906
Email: s.silenzi@icram.org

Mr Chiara SPEGNI
MATT - Italian Ministry for the Environment and Territory
Rome Italy
Email: chiara@sensible.it

Mr Ermanno VECCIA
CNMCA- Italian National Center for Meteorology and Climate

Mr Silvio VETRANO
MATT - Italian Ministry for the Environment and Territory
Via Capitan Bavastro 174
00154 Rome
Tel.: 39 06 57228377
Fax: 39 06 57228390
Email: vetrano.silvio@minambiente.it

SECRETARIAT

Dr Patricio BERNAL
Executive Secretary, IOC/ADG, UNESCO
1, rue Miollis
Paris 75 015
France
Tel : 33 1 45 68 39 83
Fax : 331 45 68 58 12
Email : p.bernal@unesco.org

Dr Thorkild AARUP
Programme Specialist
IOC of UNESCO
1, rue Miollis
Paris 75 015
France
Tel: 33 1 45 68 39 76
Fax: 33 1 45 68 58 12
Email: t.aarup@unesco.org

Ms Tosin ANIMASHAWUN
Liaison Officer
Office of the Director-General
UNESCO
7 Place de Fontenoy
75 007 Paris
France
Tel.: 33 1 45 68 13 93
Email: t.animashawun@unesco.org

Dr Stefano BELFIORE
Programme Specialist
IOC of UNESCO
1, rue Miollis
Paris 75 015
France
Tel.: 33 1 45 68 40 68
Fax: 33 1 45 68 58 12
Email: s.belfiore@unesco.org

Ms Forest COLLINS
Secretary
IOC of UNESCO
1, rue Miollis
Paris 75 015
France
Tel: 33 1 45 68 39 74
Fax: 33 1 45 68 58 12
Email: f.collins@unesco.org

Dr Laura KONG
Director, ITIC - International Tsunami Information Centre
737 Bishop Street, Suite 2200
Honolulu, Hawaii 96813
USA
Tel.: 001 808 532 6423
Fax: 001 808 532 5576
Email : l.kong@unesco.org

Dr Uli WOLF
Programme Specialist
IOC of UNESCO
1, rue Miollis
Paris 75 015
France
Tel.: 33 1 45 68 39 29
Fax: 33 1 45 68 58 12
Email: u.wolf@unesco.org

ANNEX VII

LIST OF ACRONYMS

CEA	Commissariat à l'Energie Atomique (France)
CEPRIS	Centre Euro-Méditerranéenne pour l'Evaluation et la Prévention du Risque Sismique / Euro-Mediterranean Centre for the Evaluation and Prevention of seismic risk
CNR	Consiglio Nazionale delle Ricerche / Italian National Research Council (Italy)
CTBTO	Comprehensive (Nuclear) Test Ban Treaty Organization
DASE	Département Analyse Surveillance Environnement / French Department of Analysis and Surveillance of the Environment
DVB-S	Digital Video Broadcasting
EMSC	European-Mediterranean Seismological Centre / Centre Sismologique Euro-Méditerranéen
ESA	European Space Agency
EuroGOOS	European Global Ocean Observation System (GOOS)
GEO	Group on Earth Observation
GEOFON	German seismological network
GTS	Global Telecommunication System
GFZ	GeoForschungsZentrum (German seismological program)
GMES	Global Monitoring for Environment and Security
GOOS	Global Ocean Observing System
ICG	Intergovernmental Coordination Group
ITSU	International Tsunami Warning System
ICZM	Integrated Coastal Zone Management
IDCS	International Data Collection System
IMS	International Monitoring System
INGV	Italian Institute of Geology and Vulcanology / Istituto Nazionale di Geofisica e Vulcanologia (Italy)
IO-EWS	Indian Ocean Early Warning System

IOC	Intergovernmental Oceanographic Commission (UNESCO)
IOTWS	Indian Ocean Tsunami Warning System
IOCARIBE	IOC Sub-commission for the Caribbean and Adjacent Regions
ISDR	International Strategy for Disaster Reduction (UN)
ITIC	International Tsunami Information Center (UNESCO-IOC)
MATT	Italian Ministry for the Protection of the Environment and Territory (Ministero dell'Ambiente e della Tutela del Territorio)
MDG	Millennium Development Goals
MedGOOS	Mediterranean Global Ocean Observation System
MedNet	Italian telemetered seismic network
MIUR	Civil Protection and the Ministry of Education University and Research
NEAMTWS	Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas
NGO	Non-Governmental Organization
NMHS	National Meteorological and Hydrological Services
NOAA	United States National Oceanic and Atmospheric Administration
OBS	Ocean Bottom Seismometers
ORFEUS	Observatories and Research Facilities for European Seismology
PTWS	Pacific Tsunami Warning System
TWS	Tsunami Warning System
UN	United Nations
UNESCO	United Nations Educational Scientific and Cultural Organisation
VEBSN	Virtual Earthquake Broadband Seismic Network
VSAT	Very Small Aperture Terminal (reference to a type of satellite network)
WMO	World Meteorological Organization

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