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)

Third Session

Bonn, Germany
7–9 February 2007

UNESCO

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ICG/NEAMTWS-III/3
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Abstract

The Third 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-III) was held in Bonn, Germany, on 7 - 9 February 2007 under the Chairmanship of Prof. Stefano Tinti. It was attended by 92 participants from 16 ICG/NEAMTWS Member States, representatives from 9 organizations, and 19 observers.

The ICG reviewed the progress made during the intersessional period from June 2006 to January 2007 and adopted the NEAMTWS Implementation Plan for the period 2007 – 2011. The Implementation Plan will be executed in two phases. The first phase, to be completed in 2007, will focus on (i) support to the continued work of the intersessional Working Groups for the completion of their respective tasks; (ii) nomination of national Tsunami Warning Focal Points (TWFP) and Tsunami National Contacts (TNC); (iii) implementation of the initial architecture and functions of the tsunami warning system through regional and subregional watch centres; (iv) the conduct of assessments of national capacities to address tsunamis and other ocean-related hazards, when requested, both through expert missions and a Country Assessment Questionnaire on tsunami warning and mitigation activities for ICG/NEAMTWS Member States; (v) the preparation of a Communication Plan. The second phase, covering the period 2008 - 2011, will focus on the establishment of regional tsunami watch centres and national tsunami warning centres and the implementation of the full TWS.

The four intersessional Working Groups on (i) hazard and risk assessment and modelling; (ii) seismic and geophysical measurements; (iii) sea level measurements; and (iv) advisory, mitigation and public awareness each met immediately prior to and during the Session and provided the ICG with a summary of the existing activities and the requested infrastructure, functionalities and architecture of the TWS. The ICG confirmed the four intersessional working groups and encouraged them to continue their work in the context of the implementation plan.

Italy announced that it would provide 24/7 processing and watch coverage of seismic data from the seas around Europe. These data are essential for the detection of offshore earthquakes that potentially generate tsunamis, and could significantly boost protection of Europe's heavily developed and populated coastlines. The tsunami information bulletins will be provided by the Istituto Nazionale di Geofisica e Vulcanologia (INGV), one of Europe's largest research institutions in the field of geophysics, seismology and vulcanology. The INGV will thus serve as the system's first hub for immediate data delivery and tsunami watch dissemination. The ICG adopted a preliminary list of facilities that can assist or qualify as regional tsunami watch centres.

The ICG expressed its support for the establishment of a framework for a global tsunami and other ocean-related hazards early warning system.

The ICG decided to organize its Fourth Session in November 2007 and accepted the offer of Portugal to host it.

* An executive summary of this report (ICG/NEAMTWS-III/3S) is also available in French, Russian and Spanish on http://unesdoc.unesco.org

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1. OPENING

1 The Chairman, Prof. Stefano Tinti from Italy, opened the Third 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-III) on 7 February 2007 at 09:30 at the United Nations Campus in Bonn, Germany. He thanked the German Government for having hosted the Session and the United Nations University for their administrative, logistical and organizational support.

2 Dr Frieder Meyer-Krahmer, State Secretary, Federal Ministry of Education and Research, Germany, welcomed the delegates. He recalled that the city of Bonn had previously hosted other meetings concerning disaster prevention and early warning, among these were the German Committee for Disaster Reduction (DKKV), which is the national platform for disaster prevention, the Platform for the Promotion of Early Warning (PPEW), of the United Nations International Strategy for Disaster Reduction (UN/ISDR), and the Institute for Environment and Human Security of the United Nations University (UNU-EHS). He thanked the Director of the Institute, Prof. Bogardi, for his support of this event. He emphasized that while after the 2004 Indian Ocean tsunami the international community understood that effective early warning systems are the only way to mitigate such unavoidable extreme natural events, until that date, the only existing tsunami early warning system was in the Pacific and that a similar system is needed for the Mediterranean and European regions and is being realized under the coordination of the IOC. The previous session in Rome (2005) and in Nice (2006) advanced this work and the Bonn meeting was going to focus on the definition of the requirements of the seismological warning system to cover Europe and the Mediterranean in order to provide fast and reliable warnings. Such systems would rely on the structures which exist in the different countries, such as the European Mediterranean Seismological Centre (EMSC). The full speech of Dr Meyer-Krahmer is available in

3 Prof. Janos J. Bogardi, Director, UNU-EHS, provided a presentation on “Tsunamis in Europe”. He emphasized that there was no tsunamis awareness in the general public before 2004. This was surprising when looking at statistics indicating that the Mediterranean was in greater danger than the Indian or the Atlantic Oceans, with 10% of world tsunamis between 1901 and 2000 and 25% of all tsunamis including paleo-tsunamis. Europe has approximately 185,000 km of shoreline and therefore 560,000 km^2 of coastal area, covering 13% of the European territory and hosting 140 million people or 47% of the European population. While German coastal lowlands are exposed to coastal inundation, in 1908, in Messina, Italy, a tsunami caused 75,000 casualties, but it is not manifested in the collective mind. Almost fifty years later, in 1956, 56 people were killed in the area of the South Aegean Sea by a tsunami of intensity 4 that was generated by an earthquake of magnitude 7.5 and caused waves of more than 20 meters. Whereas, the earthquake in Algeria in 2003 damaged approximately 100 boats. The challenge remains for Europe to be prepared in case of a tsunami. Since 1628 B.C. 41 tsunamis were observed in the Mediterranean and a destructive tsunami can be expected every 100 years.

2. ORGANIZATION OF THE SESSION

4 The Chairman of the ICG/NEAMTWS introduced this agenda item.

2.1 ADOPTION OF THE AGENDA

5 The Chairman of the ICG/NEAMTWS introduced the provisional Agenda prepared by the Secretariat (ICG/NEAMTWS-III/1 Prov.) and its annotation (ICG/NEAMTWS-III/2).

6 Israel suggested a brief plenary discussion preceding the Working Group breakout session under agenda item 4 because not all delegations are sufficiently strong to participate in all Working Group's discussing the questionnaire. Finland seconded the proposal.

7 **The ICG adopted** the Agenda as in Annex I.

2.2 DESIGNATION OF THE RAPPORTEUR

8 According to Rule of Procedure no. 25.4, France proposed Germany as rapporteur and Greece and the United Kingdom endorsed the proposal. **The ICG then elected** Dr Anna von Glydenfeldt from Germany as Rapporteur of the Session to work with the Secretariat for the preparation of the Draft Summary Report (this document, ICG/NEAMTWS-II/3 Prov.)

2.3 CONDUCT OF THE SESSION, TIMETABLE AND DOCUMENTATION

9 The Chairman of the ICG/NEAMTWS explained that the meeting would include plenary sessions and working group sessions. The four Working Groups would meet in three breakout sessions, each followed by a plenary session. **The Meeting adopted** the provisional Timetable (ICG/NEAMTWS-III/1 Prov. add.)

10 The Secretariat introduced the documentation for the meeting All the documentation, including the report of ICG/NEAMTWS-I and ICG/NEAMTWS-II and the terms of reference for the working groups, is available on the ICG/NEAMTWS website (http://ioc3.unesco.org/neamtws/).

3. REPORT ON ICG/NEAMTWS INTERSESSIONAL ACTIVITIES

11 The Chairman of the ICG/NEAMTWS introduced this agenda item.

3.1 OVERVIEW OF THE ACTIVITIES OF THE ICG/NEAMTWS

12 The Chairman provided a summary of the activities developed before ICG/NEAMTWS-III. The Chairman emphasized that the ICG, as an IOC subsidiary body, has to report to the IOC Assembly on its progress. He emphasized that while no solid statistics exist according to expert evaluations, the Mediterranean is at risk for tsunamis, especially in the Aegean Sea and in the Ionian Sea, which requires urgent action for the development of an early warning system. Concerning the elements and functions of the initial tsunami warning system (ITWS), the Chairman suggested that the ITWS should address large tsunamis, prioritizing regions that are most vulnerable to such large events, especially the Hellenic Arc. The Chairman underlined the need to define the general architecture of the ITWS, in particular the number, characteristics and location of a regional tsunami watch centre (RTWC). The need for sub-regional tsunami warning centres should be considered as well. In any event, the RTWC is provided with data from national tsunami warning centres (NTWCs), which are also in charge of issuing the warnings. The Chairman also emphasized the need to complete the list of national tsunami warning focal points (TWFP's) as well as the need to draft a Communication Plan.

3.2 REPORT ON THE ACTIVITIES OF THE WORKING GROUPS

13 The Co-chairs of the Working Groups reported on progress achieved during the intersessional period and based on discussions held just prior to the Session.

14 For Working Group 1 on Hazard Assessment, Risk and Modelling, Co-chair Dr François Schindelé from France detailed the progress on the different tasks agreed upon at the Second Session. The development of the database of tsunami events was ongoing. A decision matrix for classifying local, regional and basin-wide tsunamis was tested for the Eastern Mediterranean, while a different decision matrix should be taken into account for the Western Mediterranean and the North-eastern Atlantic. A review of different numerical models for tsunami events was carried out, including numerical description and technical description.

15 For Working Group 2 on Seismic and Geophysical Measurements, Co-chair Dr Alessandro Amato from Italy reported progress on the tasks decided upon at the Second Session. An inventory of real-time data networks was carried out; in particular, the inventory of the seismic stations revealed a certain density. A Memorandum of Understanding concerning the exchange of seismic data was signed by all Western Mediterranean countries. “Best practices” for locating earthquakes and determining their magnitude were explored but not all countries submitted their reports and there is a need to improve the coverage. He emphasized the need to involve North African countries as well as to better define the role of national centres vs. regional centres. He suggested that the IOC could play a role in stimulating national commitments and financial support. In this perspective, it would be important to identify a few priorities for action.

16 For Working Group 3 on Sea Level Measurements, Co-chair Dr Begoña Pérez from Spain provided a review of the accomplishments concerning sea level measurement. She reported on a list of possible sea level stations for the initial system, based on already existing stations or stations with existing upgrade plans, emphasizing that the distribution was not optimal and no information was received on stations in North Africa. She detailed the user requirements, namely, data sampling of 15 s or 30 s with transmission every 60 s to stations within an hour or 100 km from the source. Concerning a survey on data transmission, she reported that only a few countries replied and suggested that an official request from IOC may be needed. Regarding the upgrading of sea level stations, she reported that there were no tsunami-fit stations in operation yet. Ten sea level stations in critical locations could be selected for the initial system. As for the buoy network, she noted that most of the buoys were in the vicinity of the coast, thus not being useful for tsunami detection; to this purpose, a possible collaboration with EuroGOOS, BOOS or NOOS should be initiated.

17 For Working Group 4 on Advisory, Mitigation and Public Awareness, Co-chair Mr Russell Arthurton from the UK reported that Working Group 4 had coordinated with Working Group 1 on the subject of assessment of socioeconomic impacts in the coastal zone. He reported on a meeting with the Environment Directorate-General of the European Commission, which expressed the wish that the recommendations from the Working Group be in line with the new Community initiative on floods and storm surges, especially in the North Sea. Concerning education and public awareness, the Working Group could not report progress. Finally, he informed the Session of the establishment of a dedicated website at IOC for the Working Group and acknowledged the contribution of cooperating organizations such as United Nations Environment Programme’s Mediterranean Action Plan (UNEP/MAP), but emphasized the low participation from Member States.

18 The detailed reports from the intersessional Working Groups are contained in Annex VI.

19 Member States then commented on the reports by the Co-chairs of the four Working Groups.

20 Israel commented that in the report of Working Group 1 it was not clear how the sources of the numerical models would be made available to all Member States of the region. Furthermore, coastal bathymetric data within the 100 m depth were generally classified and regarding topographic data buildings versus plain terrain determine different propagations of a tsunami wave, which require high resolution data.

21 Slovenia supported the view that the ICG/NEAMTWS should address multiple hazards, as only 16% to 23% of marine-related hazards are connected to tsunamis, while the rest are due to other events, such as storm surges. Climate change impacts such as sea level rise provide another point of interest, considering, for example, Small Island States that could be flooded. The instrumentation for tsunami monitoring should be connected to that for monitoring sea level rise.

22 The United Kingdom, supported by Finland, commented that the IOC Governing Bodies have emphasized the need to expand the scope of the NEAMTWS to different kinds of hazards, such as storm surges. This had also a great importance in terms of the sustainability of the monitoring system; possibly, the Global Ocean Observing System (GOOS) could provide an important operational framework. He underlined that the United Kingdom would like to see the broadening of the scope of the Working Groups to include marine hazards other than tsunamis as this could also provide opportunities for more sustainable funding from Member States.

23 **The ICG commended** the Co-chairs of the Working Groups for their intersessional activities and encouraged them to continue their work.

3.3 REPORTS FROM OTHER INTERGOVERNMENTAL ORGANIZATIONS

24 Mr Edgar Cabrera, WMO, expressed, on behalf of the Executive Secretary of the World Meteorological Organization (WMO), Mr Michel J.P. Jarraud, the wishes of the WMO for the success of the meeting. He commented that 90% of hazards are of a meteorological nature and that while hazards cannot be avoided, disasters can be prevented. He reported on the upgrade of the Global Telecommunication System (GTS), linking National Meteorological Services as the backbone for exchange of tsunami related information and warnings in the Indian Ocean, the offered support of WMO's Global Data Processing and Forecasting Centres to the Indian Ocean Tsunami Early Warning and Mitigation System (IOTWS), and participation in the missions for assessing national capacities for the TWS. WMO cooperates through JCOMM with IOC to ensure early warning systems for ocean-related hazards, particularly tropical cyclones and associated phenomena such as storm surges, high sea and swells. Six regional centres designated by the WMO provide advisories for countries in the region. Technical guidelines on wind waves and storm surge forecasting, capacity building, and warning for enhanced coastal risk management complete the group of activities.

25 Mr Yuchi Ono, ISDR-PPEW, provided a statement on the coordinating role of ISDR on disaster reduction efforts and expressed the willingness of ISDR to cooperate with ICG/NEAMTWS. He provided examples of the cooperation between ISDR and IOC in other regions such as the Indian Ocean, especially in terms of addressing the needs of affected communities. He stated that ISDR supported the multi-hazard approach promoted for ICG/NEAMTWS and its availability for bridging the gap between the scientific level and vulnerable communities.

26 Mr François Gérard, Chairman, I-GOOS, and Chairman, ad hoc working group on the Global Ocean-related Hazards Warning and Mitigation System (GOHWMS) presented the views of the GOHWMS in terms of addressing multiple ocean-related hazards in the coastal zone. He recalled the formation of GOHWMS at the 23rd Assembly of the IOC. The first meeting, held during the 39th Executive Council of the IOC, tasked the GOHWMS to prepare a framework document. As an example he outlined the coordination among I-GOOS, JCOMM and others on storm surges and gave an outline of the framework document for GOHWMS. He considered whether the structure of I-GOOS could be applied to NEAMTWS, that is, (i) a general policy and requirements component, (ii) a scientific planning and advice component, and (iii) an implementation component. For ocean observation and geophysical observations, (i) the tsunami warning is composed of Advisory Providers (regional watch centres) providing data and information to Warning Providers (national warning centres), (ii) alert providers providing warnings that are then distributed to the concerned populations. Among the themes suggested there are coastal inundations, due to tsunamis, storm surges, extreme waves, and sea level rise. Sea level observations could be done through the Global Sea Level Observing System (GLOSS). An additional information system for ocean pollution, particularly harmful algal blooms, could be devised. Elements that are common to all the themes are sea level information, alert dissemination and real data concentration, as well as bathymetry and coastal modelling studies, while propagation models are useful for tsunamis and storm surges.

27 France commented on the need to better define the meaning of “early warning” (mitigation of the disasters before the event) and “warning” (management of the disasters before the impact).

28 The Head of the Tsunami Unit informed that primary and secondary data streams for tsunami will be available to Member States from the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) upon request, with the IOC verifying the appropriateness of the requesting agency. Concerning the definition of terms, he informed that the United States National Oceanic and Atmospheric Administration (NOAA) had aligned its nomenclature with tsunami warning but that the need to verify English terms in other national languages remained.

29 The Chairman commented that NEAMTWS should be multi-hazard, as underlined in all other ICG documents. The current seismic network was conceived to detect and monitor earthquakes on land and the same applies to tidal gauges and other devises. A warning system devised only for tsunamis would not be sustainable; therefore, the TWS should be conceived as part of a system composed of other systems targeting other ocean-related hazards. This applied also to the characteristics of national agencies, which were not conceived to address only tsunamis.

3.4 NATIONAL ASSESSMENT MISSIONS

30 The Chairman presented a concept note on the organization of national assessment missions to assess national capacities for the establishment and operation of national tsunami early warning and mitigation systems, including scope, modalities, schedule, and financing (ICG/NEAMTWS-III/9). He stated that nearly twenty assessment missions were carried out in the Indian Ocean in the aftermath of the 2004 tsunami event to assess the existing capacity in establishing tsunami warning systems and functions in individual countries. The Chairman emphasized the importance of establishing national warning focal points in each region and stated that the experience of the Indian Ocean could be repeated in the NEAMTWS region as the assessment missions have been instrumental in developing an Implementation Plan. The Chairman then presented the questionnaire used in the Indian Ocean for evaluating national capacities, addressing contact information, authority and coordination, tsunami warning and

mitigation, tsunami warning response and emergency preparedness, tsunami hazards and risks, tsunami public awareness and preparedness and community level activities (ICG/NEAMTWS-III Inf. 5).

31 Finland warmly supported the usefulness of the questionnaire and commented that it would be practical to identify the required players. It underlined again the need for adopting a multi-hazard approach.

32 France warmly supported the initiative of assessment missions and a questionnaire survey. It suggested examining methods for administering the questionnaire. It also proposed devising a strategy for the regional warning functions, possibly without creating new structures. This aspect should be examined by the ICG itself.

33 Greece commented that for Europe the expertise required for the national assessment missions may involve a very broad variety of stakeholders and require holding national workshops. The Chairman commented that the missions should first address developing countries.

34 Israel mentioned that a similar experience in the Mediterranean concerning the Mediterranean Network to Assess and Upgrade Monitoring and Forecasting Activity in the Region (MAMA), involving all countries of the region and including warning issues. The countries invited a broad range of stakeholders in oceanography and this experience could be repeated even with limited delegations.

35 The United Kingdom approved of the questionnaire and suggested that questions concerning multiple hazards be addressed earlier in it.

36 The ISDR confirmed that the missions were requested by the countries of the Indian Ocean region and commented that the questionnaire was also a tool for exchanging information at the national level and that it balanced technical and information aspects.

37 The European Sea Level Service (ESEAS) welcomed the questionnaire and supported the intervention of the United Kingdom that the questionnaire should incorporate multi-hazard issues. ESEAS has undertaken a similar initiative in cooperation with JCOMM concerning sea level aspects.

38 The Head of the Tsunami Unit confirmed that the assessment missions are offered to Member States but, to be carried out, have to be requested by the countries. The assessment missions allow the creation of a common ground for the NEAMTWS.

4. WORKING GROUP MEETINGS

39 The Chairman of the ICG/NEAMTWS introduced this agenda item.

4.1 BREAK OUT SESSIONS

40 The four Working Groups met separately in three sessions, with a view to elaborate on proposals for concrete actions and recommendations in line with the elements of the ICG Implementation Plan.

4.2 REPORTING IN PLENARY

41 Discussions, results, proposals and recommendations from the working group sessions were presented in three instances to the plenary session by the respective Chairs. The detailed reports from the Working Groups, including recommendations and elements for the Implementation Plan and the Questionnaire, are contained in Annex VII.

42 Working Group 1 on Hazard Assessment and Modelling, presented by Dr François Schindelé from France, examined sections 5 and 4 of the Questionnaire and agreed that they were useful to the purpose of the assessment of national capacities in tsunami warning and mitigation systems. Based on presentations by Greece and Italy, Working Group 1 had examined a preliminary Decision Matrix for assessing tsunami risk and issuing related warnings, recommending that a final Decision Matrix be adopted at NEAMTWS-IV. The first study done by Greece and Italy did not cover other important areas of the basin.

43 Working Group 2 on Seismic and Geophysical Measurements, presented by Dr Alessandro Amato from Italy, revised a few elements of the Questionnaire regarding the seismic network. Concerning the possible architecture of the monitoring system, the Working Group proposed an open list of seismological centres (Istituto Nazionale di Geofisica e Vulcanologia – INGV, Italy, in cooperation with national institutions and under the supervision of the National Focal Point; the United Kingdom including the British Geological Survey – BGS; GeoForschungsZentrum – GFZ, Germany, for data collection and processing as a backup to regional centres; Commissariat à l'Energie Atomique, Département analyse, surveillance, environnement – CEA/DASE, France; Bogazici University Kandilli Observatory and Earthquake Research Institute – KOERI, Turkey; National Observatory of Athens – NOA, Greece) that could act as regional or subregional watch centres. The terms of reference and requirements of such regional watch centres are based on those adopted at ICG/NEAMTWS-II. These include full 24/7 service (staff on watch), data mirroring, watch redundancy (between 2009 and 2011), sufficient communication facilities and backup, earthquake and tsunami watch information, full waveform data openly available to all Member States, and sharing competence (advise and training).

44 Working Group 3 on Sea Level Measurements, presented by Dr Begona Perez from Spain, stated that the rather lengthy and detailed Questionnaire should be especially used during assessment missions to countries where no information is available. The Working Group addressed aspects contained in the Implementation Plan and received information on priority sites for upgrading sea level stations suggested by Working Group 1 for 2007 (e.g., Lagos in Portugal and Shetland Islands in the United Kingdom). A specific proposal for the stations in North Africa will be developed later in cooperation with North African countries (e.g., Algeria and Lebanon). The Working Group also discussed the standard format for sea level transmission.

45 Working Group 4 on Advisory, Mitigation and Public Awareness, presented by Mr Russell Arthurton from the United Kingdom, discussed harmonization and standardization of warnings. He informed the Session that the Working Group would like to see a broadening of the Questionnaire to other hazards such as storm surges. And, for sections 4, 5 and 6, he proposed small changes concerning mitigation and adaptation. He stated that overall the questionnaire could contribute to the enhancement of national capabilities to address tsunamis.

46 Member States made observations about the presentations of the Working Groups in plenary.

47 France commented that the map of sea level stations, referring to the current year, could be expanded to include targets for upgrading sea level stations in the mid-term.

48 Greece confirmed that it would be willing to contribute to the regional tsunami watch function through the NOA, which is competent for tsunamis; however, it requested to clarify whether the centres would address tsunamis or only seismic information.

49 Israel commented that it had submitted a list of study areas that could be considered for the determination of the tsunami Decision Matrix for the Mediterranean. It stated that it would like to join the network of watch centres and that it would confirm within a month. It recommended that facilities should be robust enough to face an earthquake. Concerning the questionnaire, it stated that it could include a section on modelling and forecasting.

50 The Head of the Tsunami Unit appreciated the results of Working Group 2 and asked whether the proposed tsunami watch centres could confirm their willingness to provide information to the ICG/NEAMTWS. Other partners would be invited to contribute to the tsunami watch function. Concerning data sharing policy the reference was the IOC data sharing policy framework.

51 In this regard, I-GOOS reminded the Plenary that within the context of the IOC the data sharing policy is mandatory. It also proposed to organize a sea level meeting in conjunction with the IOC Assembly in June 2007, where these issues could be addressed.

5. IMPLEMENTATION PLAN

52 The Chairman introduced this agenda item.

5.1 PRESENTATION BY THE CHAIRMAN

53 The Chairman presented the draft Implementation Plan, emphasizing that it was a draft based on the contributions of the Working Groups and according to the format of the Implementation Plan of the IOTWS. The Implementation Plan is organized in two phases. The first phase refers to the Initial TWS, covering the period until the end of 2007. The second phase would be completed in four years, from 2008 to 2011. The timing and roadmap of the second phase were to be discussed. The Chairman underlined the specificity of the ocean basin geometry of the Mediterranean and Black Sea, including the Marmara Sea, the western and Levantine basins of the Mediterranean, and the natural barriers provided by the Strait of Gibraltar and the Strait of Messina. This might lead to the establishment of subregional watch centres. The Chairman suggested the Working Groups provide a roadmap, clear responsibilities and budget for the implementation of the relevant actions in the Plan. The current draft of the Implementation Plan focused on tsunamis and did not address multiple hazards.

54 France noted that in the Pacific and the Indian Oceans there were at least two focal points per country.

55 Israel commented on the definition of Regional Tsunami Watch Centres and a possibility to distribute their information also on the internet for the general public and suggesting they be called Regional Tsunami Watch and Signalling Centres.

56 Portugal informed the Session that after the Second Session in Nice a number of capacity building activities concerning tsunamis and other marine hazards had been conducted in Portugal

thanks to the aid of GFZ. Portugal would present the status of its tsunami warning systems at a later stage and would offer a regional tsunami watch centre for the North-eastern Atlantic.

57 ISDR asked to clarify the difference between the TWFP, valid for individual countries, and the Regional Tsunami Watch Centre, which can provide information to an entire region.

58 The Chairman commented that the Tsunami Contact and Focal Points should be regarded as institutions or services rather than individuals.

59 The Head of the Tsunami Unit clarified the difference between the governmental contacts for the IOC, mainly referred to the ICG, and the 24x7 national focal points, in charge of receiving the tsunami information from RTWCs. The letter from the Director-General of UNESCO to the Ministries of Foreign Affairs of the ICG/NEAMTWS included the request to nominate both.

60 The Co-chair of the Tsunami Programme of the Group on Earth Observation (GEO) commented that the line of transmission of the RTWC should be clearer.

61 The Head of the Tsunami Unit clarified that the RTWC simply issue a description of the geophysical phenomena but not advisories. To issue warnings is the responsibility and sovereign decision of governments and the national centres.

62 The Chairman of I-GOOS suggested a better definition of the terminology and a clarification of the authoritative source of the information.

63 In this regard, the Chairman underlined the need to establish relationships with the press so that no ambiguous messages would be released, given that the news may repeat the warnings but not the cancellation of the warnings. Media and people need to be educated to interpret the information correctly and the national focal points could play an important role in this.

5.2 DRAFT OF THE IMPLEMENTATION PLAN

64 The Session discussed the Draft Implementation Plan for the NEAMTWS prepared by the Chairman and the Co-chairs of the Working Groups. In the perspective of the operationalization of the plan, the appropriateness of the geographical coverage of the NEAMTWS was reviewed.

65 Member States provided comments based on the presentation of the Implementation Plan by the Chairman as well as the revisions elaborated by the working groups during the breakout session.

66 Finland, seconded by the United Kingdom, noted that the current Implementation Plan focused primarily on the Mediterranean and expressed concern that the NEAMTWS adopted a sub-regional implementation.

67 France emphasized that the start of the initial TWS in December 2007 should not be postponed and urged all Member States to participate actively to ensure cooperation among the candidate regional watch centres. It also noted the need to promote the NEAMTWS among decision-makers and media.

68 Greece observed that in this initial phase sub-regional implementation of the TWS could represent an advantage, also from the perspective of addressing and resolving technical issues.

69 Israel noted the need to identify what kind of data should be made publicly available through the network of regional tsunami watch centres.

70 Lebanon supported the statement of France, noting that in December 2007, after four sessions of the ICG, there would be expectation for the TWS to be operational. It suggested that this phase be devoted to start a basic TWS, and then activate the watch functions at the end of 2007.

71 Portugal expressed its willingness to contribute to the network of regional and sub-regional watch centres, in particular providing waveform subset data.

72 Spain informed of its willingness to contribute to the network of regional and sub-regional watch centres seismic data from the National Oceanographic Institute.

73 **The ICG adopted** the revised version of the Implementation Plan (ICG/NEAMTWS-III/8).

6. OTHER BUSINESS

74 There was no other business to discuss at the Session.

7. PROGRAMME AND BUDGET FOR 2007–2008

75 **The ICG adopted** a list of priority activities for 2007 (attached to Annex II) concerning the governance of the ICG/NEAMTWS and the Secretariat, hazard assessment and modelling, seismic and geophysical measurements, sea level measurements, and advisory, mitigation and public awareness. Due to the difficulty of the working groups in costing the activities foreseen in the Implementation Plan, the meeting decided to postpone any discussion on financial implications, leaving the Working Groups to make concrete proposals that could be examined at the next Session.

8. DATES AND PLACE FOR ICG/NEAMTWS-IV

76 The meeting received an offer by Portugal to host the next Session of the ICG/NEAMTWS.

77 **The ICG accepted** the offer of Portugal to host the next meeting in November 2007.

9. ADOPTION OF DECISIONS AND RECOMMENDATIONS

78 Based on the reports of the Working Groups and the discussions at the plenary sessions, **the ICG adopted** Recommendation ICG/NEAMTWS-III.1 (Annex II).

10. CLOSING

79 The Chairman of the ICG/NEAMTWS thanked the Government of Germany and the United Nations University for hosting the meeting and the excellent organization. He closed the meeting on Friday, 9 February 2007, at 15:00.

ANNEX I

AGENDA

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ANNEX II

RECOMMENDATION

ICG/NEAMTWS-III.1

DEVELOPMENT AND IMPLEMENTATION OF THE NEAMTWS

The Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas,

Having met in Bonn from 7 to 9 February 2007 at its Third Session,

Expressing its gratitude to the German Government for hosting the ICG,

Expressing its gratitude to the United Nations University for hosting the Session,

Emphasizing the need to ensure full and active participation of all Member States concerned with the North-eastern Atlantic, the Mediterranean and Connected Seas and relevant organizations to establish the tsunami warning system, in the area,

Committed to the establishment of an initial tsunami warning system for the North-eastern Atlantic, the Mediterranean and Connected Seas by the end of 2007,

Calling for the definition of technical requirements and standards for the availability of the relevant data and the formulation of policies for sharing these data and the information to support the operation of the NEAMTWS,

Recalling therefore IOC Resolution XXII-6 on the IOC Oceanographic Data Exchange Policy, the IOC Sea Level Manual and the IASPEI Manual as a basis for the operation of the NEAMTWS activities,

Having reviewed Recommendation NEAMTWS-II.1,

Having discussed the draft of the Implementation Plan (ICG/NEAMTWS-III/7) and **having agreed** on a list of priority activities for 2007,

Having reviewed the geographical coverage of NEAMTWS in the context of other TWSs,

Recalling that the NEAMTWS is conceived as part of a global coordination process of IOC for tsunamis and other ocean-related hazards,

Taking note of a number of research projects relevant to NEAMTWS objectives being funded by the European Commission,

Adopts:

(i) the Implementation Plan for NEAMTWS as a guiding document for the development, implementation and performance monitoring of the NEAMTWS;

(ii) the definition and the establishment of tsunami watch centres covering parts of or the entire region (Annex 1 to this Recommendation);

(iii) the priority activities for 2007 (Annex 2 to this Recommendation);

Confirms the four intersessional working groups and **encourages** them to continue their work in the context of the implementation plan;

Invites the IOC Assembly at its 24th Session to endorse this Recommendation and its Annexes;

Urges Member States:

(i) to complete the nomination of national ICG Tsunami Warning Focal Points in response of the letter of the Director-General of UNESCO of 2005;

(ii) to provide continuous support to the intersessional activities of the Working Groups and to the Secretariat for coordinating the implementation of NEAMTWS, through direct contributions to the IOC Trust Fund or in-kind contributions;

Instructs the Executive Secretary to update the Implementation Plan as needed, based on the continuous contributions of the Working Groups;

Instructs the Executive Secretary to further explore funding opportunities with the European Commission for ICG/NEAMTWS activities;

Instructs the Executive Secretary to explore opportunities for, and modalities of, cooperation with other UN and relevant organizations involved in aspects relevant to the ICG/NEAMTWS;

Welcomes the organization of a meeting on sea level matters by relevant organizations;

Accepts the kind offer of Portugal to host the Fourth Session in Lisbon, in November 2007.

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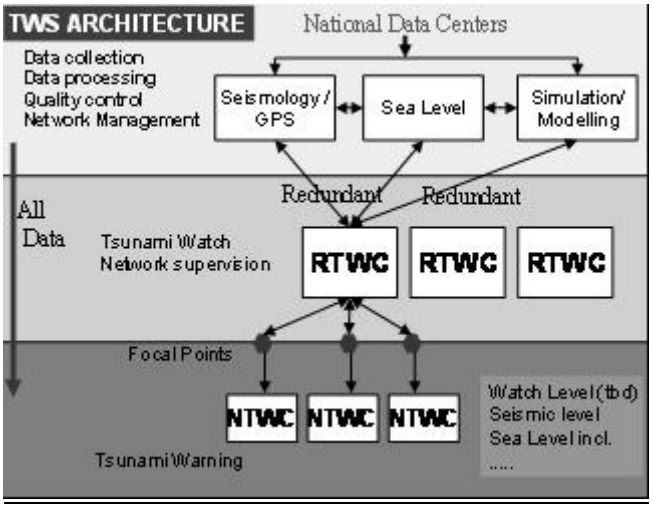
Financial implications: none

Annex 1 to Recommendation ICG/NEAMTWS-III.1

Regional Tsunami Watch Centres



Architecture of the TWS

Adopted an open list of regional/subregional centres:

- Istituto Nazionale di Geofisica e Vulcanologia – INGV, Italy (in cooperation with national institutions and under the supervision of the National Focal Point)
- UK including the British Geological Survey – BGS
- GeoForschungsZentrum – GFZ, Germany (data collection and processing, backup to regional centres)
- Commissariat à l'Energie Atomique, Département analyse, surveillance, environnement – CEA/DASE, France
- Bogazici University Kandilli Observatory and Earthquake Research Institute – KOERI, Turkey
- National Observatory of Athens – NOA, Greece

With Portugal and Spain contributing to the NEAMTWS seismic network by providing access to real-time data.

The following was agreed as criteria for providing the services of a RTWC:

Functions of Regional Tsunami Watch Centres (RTWC)

– Collection, recording, processing and analysis of earthquake data for rapid initial assessment (locate the earthquake, the depth, the magnitude, the origin time) as a basis for the alert system.

– Computing the arrival time of the tsunami in the forecasting points listed in the Communication Plan.

– Collection, recording, processing and analysis of sea level data for confirming and monitoring the tsunami or for cancelling elements of the alert system.

– A decision making process in accordance with the Communication Plan to elaborate messages.

– Dissemination to the Member States focal points (and national warning centres) of the messages in accordance with the Communication Plan, included the tsunami travel time, the amplitude and period of tsunami measured, and cancellation messages.

Annex 2 to Recommendation ICG/NEAMTWS-III.1

Priority Activities for 2007

A. Governance and secretariat of the ICG/NEAMTWS

1. Finalization, publication and dissemination of the Implementation Plan.
2. Preparation, publication and dissemination of the Communication Plan.
3. Organization of ICG/NEAMTWS-IV in November 2007.
4. Dissemination and analysis of the Assessment Questionnaire on tsunami warning and mitigation capacities of ICG/NEAMTWS Member States.
5. Conduct of two missions to assess national capacity in tsunami warning and mitigation in NEAMTWS Member States.
6. Support to the Secretariat.

B. Hazard assessment, risk and modelling

7. Compilation of risk assessment databases and references.
8. Definition of a decision matrix for classifying local, regional, and basin-wide tsunamis.
9. List of island, submarine and coastal volcanoes in activity, with their characteristics of activity.
10. Provision of data of historical seismic and tsunami events.
11. Inventory and dissemination of available bathymetric and topographic information.

C. Seismic and geophysical measurements

12. Technical coordination meeting for regional centre procedures.
13. Network inventory and check of real-time data availability.
14. Identification of key backbone stations upgrade proposed.
15. Exploring possibilities and best practices for earthquake location and magnitude
16. Technical scheme for VSAT backbone and required budget.

D. Sea level measurements

17. Completion of survey on data transmission of existing sea level stations

18. Installation and upgrade of an initial backbone network of coastal sea level stations for the ITWS.

19. Report on existing offshore instrumentation.

20. Standard format for the description of sea level other than CREX.

21. Test of the GTS new codes for real time transmission of sea level data.

22. Selection of deep-ocean tsunami buoy sites to be part of the final TWS.

E. Advisory, mitigation and public awareness

23. Make recommendations on harmonization of warnings nomenclature and standards by consultation between all TWS and in consultation with Barcelona Convention and European Commission.

24. Make recommendations on communications, including standards, authentication and spectrum requisition, in consultation between all TWS, with the European Commission and its JRC, and the WMO in respect of output messages from RTWCs.

25. Make recommendations for the establishment of guidelines for best practice and standards for emergency preparedness and response for national and local authorities, in consultation with civil protection agencies including coastal cities and European Commission.

26. Make recommendations for the development of guidelines for coastal planning and marine-related hazards and vulnerability mitigation.

ANNEX III

OPENING ADDRESSES AND STATEMENTS

Prof. Dr Frieder Meyer-Krahmer
State Secretary, Federal Ministry of Education and Research, Germany

Distinguished Delegates,
Ladies and Gentlemen,

A cordial welcome to Germany, Bonn and the UN Campus

I am pleased to welcome you here in the former German capital Bonn to the 3rd meeting of the IOC working group to establish a tsunami early warning system in the Mediterranean and the neighbouring seas.

The city of Bonn is closely linked to the topic of early warning. In March last year, the Federal Foreign Office had been invited to the third Early Warning Conference here in Bonn. So you can see that the city is familiar with this topic. In recent years, Bonn has attracted numerous institutions dealing with the topics of disaster prevention and early warning, among them

- the German Committee for Disaster Reduction (DKKV), which is the national platform for disaster prevention, its international counterpart PPEW,
- the Platform for the Promotion of Early Warning, which is an institution of the UNISDR (International Strategy for Disaster Reduction),
- and the Institute for Environment and Human Security of the United Nations University (UNU-EHS), whose guests we are for the next three days. I would like to sincerely thank the Director of the Institute, Prof. Bogardi, for his extensive support of this event.

After the terrible tsunami disaster on 26 December 2004, the international community immediately understood that effective early warning systems are the only way to mitigate such unavoidable extreme natural events. Up until that date, the only existing tsunami early warning system was in the Pacific. There was none in the Indian Ocean, so that no warning could reach the people affected.

However, in spite of known tsunami threats, there are no early warning systems in the Mediterranean with its neighbouring seas and in other regions, either. The international community therefore commissioned the Intergovernmental Oceanographic Commission of UNESCO to initially coordinate the development of regional early warning systems in the regions I mentioned. Eventually, they are to provide global coverage.

As a European country directly concerned, Italy took the initiative and hosted the first tsunami conference in Rome in November 2005. Working groups were established there in which experts identified the different aspects of a future tsunami early warning system for the Mediterranean and the Northern Atlantic. In May last year, France hosted a meeting in Nice in order to continue this work. The Nice meeting adopted a preliminary Plan of Actions and recommended an architecture for a possible warning structure in Europe.

The results of the first two conferences in Rome and Nice provide the basis for today's third meeting in Bonn. We must elaborate these ideas and complete the Plan of Actions. I would like to

take this opportunity to thank the IOC which tackled these big challenges with great energy and can present notable results by now. German experts at the IOC and UNESCO have helped to ensure progress with this task.

The individual working groups must develop the appropriate solutions for an early warning system adapted to their specific region. This system will depend, on the one hand, on geological and geographical conditions. For Indonesia, for example, a particularly sophisticated system must be developed because of the coastline's proximity to the seismically very active Sunda Arc, which means that we must be fast, precise and reliable to be able to issue a relevant warning. The other Indian Ocean rim countries have much more time to issue a warning and can therefore use this extra time to verify whether an earthquake has actually triggered a tsunami. The situation is entirely different for the Pacific and equally unique in the Mediterranean region.

We have a highly differentiated geographic situation in the Mediterranean, so that all coastal regions must reckon with very short warning periods. The seismological component which quickly localizes and analyses earthquakes and derives a tsunami threat will therefore be particularly important. One objective of this third tsunami meeting in Bonn should therefore be a definition of the requirements which such a seismological warning system must meet in Europe in order to provide fast and reliable warnings. As a result, the structures which exist in the different countries should be used and enhanced. In Europe, the EMSC (European Mediterranean Seismological Center) is already working very successfully. As one result of the conference in this respect, we should in the end have more than the sum total of the individual national contributions.

The European Union will also have to play an important role. The topic has already been anchored in the 7th EU Research Framework Programme in the field of environmental research.

In the area of marine measuring systems, we need, above all, improvements for rapid and uncomplicated exchanges of real-time data. This will help early tsunami warnings as well as bring about enormous improvements for coastal protection and storm warnings in coastal regions.

Ladies and Gentlemen,

In Germany we are not threatened by tsunamis. However, German research can rely on years of experience in seismology, marine research and the modelling of geo-hazards. Due to our commitment in establishing a tsunami early warning system in Indonesia, the German science community has already gathered precious experience. Together with the Indonesian partners we are developing a complete functioning tsunami early warning system which is to be fully operational by the end of 2008. It covers all components from land- and sea-based measuring stations to the establishment of a decision-making and warning centre and also provides technology to disseminate warnings on land. We can provide all this know-how.

I wish all delegates and participants as well as the IOC three hard-working and, above-all, successful days. It will be my honour to invite you tonight to a dinner on the Petersberg.

ANNEX IV

LIST OF DOCUMENTS

Working Documents

Doc. no.	Document title
ICG/NEAMTWS-III/1 Prov.	Provisional agenda
ICG/NEAMTWS-III/1 Prov. Add.	Provisional timetable
ICG/NEAMTWS-III/2 Prov.	Provisional annotated agenda
ICG/NEAMTWS-III/3 Prov.	Draft Summary Report (prepared during the Session)
ICG/NEAMTWS-III/4 Prov.	Provisional list of documents (this document)
ICG/NEAMTWS-III/5 Prov.	Provisional list of participants (*to be provided at the meeting*)
ICG/NEAMTWS-III/6	Report of the Chairman on the intersessional activities of the ICG/NEAMTWS
ICG/NEAMTWS-III/7	Reports of the Co-chairs of the working groups on the intersessional activities
ICG/NEAMTWS-III/8	Draft implementation plan for the NEAMTWS
ICG/NEAMTWS-III/9	Concept note for national assessment missions
ICG/NEAMTWS-III/10	Draft questionnaire for the assessment of national capacities

Information Documents

Doc. No.	Document title
ICG/NEAMTWS-III/Inf. 1	Information for participants (venue, hotels, airport bus) (http://ioc3.unesco.org/neamtws/neamtws-iii/index.htm)
ICG/NEAMTWS-III/Inf. 2	IOC Assembly Resolution XXIII-14
ICG/NEAMTWS-III/Inf. 3	List of NEAMTWS National Contacts (*to be provided*)
ICG/NEAMTWS-III/Inf. 4	Template for sessional working group reports
CL 2214	Letter of invitation to ICG/NEAMTWS-III
ICG/NEAMTWS-I/3	Summary Report of ICG/NEAMTWS-I
ICG/NEAMTWS-II/3	Summary Report of ICG/NEAMTWS-II
IOC Manuals and Guides, 14 Vol. IV	Manual on Sea Level Measurement and Interpretation; Volume IV: An Update to 2006 (IOC Manuals and Guides 14)
--	Summary of IASPEI, New Manual of Seismological Observatory Practice (NMSOP), GeoForschungsZentrum Potsdam, 2002

ANNEX V

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ANNEX VI

REPORTS FROM THE INTER-SESSIONAL WORKING GROUPS

Working Group 1 – Hazard Assessment and Modelling

Progress on inter-sessionnal actions of WG1 – Hazard Assessment, Risk and Modelling - established at NEAMTWS II in Nice

Introduction

During the plenary session of ICG/NEAMTWS, it was decided that Working Group 1 would be responsible for collecting and exchanging information on local and distant tsunamis 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 scenario 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.

The Action Plan proposed by the WG1 was adopted by the ICG/NEAMTWS-II. The Action Plan includes the list of actions, timelines and responsibilities. For several actions all Members States must provide to the Chairman of the Group information and data related to these.

Several issues and actions have been performed during the inter-sessionnal period. Most of the Database will be completed in 2007 and 2008. Member States (MS) are requested to provide additional information during the next months.

One of the main issues for the implementation of the preliminary warning system by the end of 2007 is the definition of the Decision Matrix. A first Decision Matrix is provided, considering essentially data of the eastern part of the Mediterranean region. This matrix must be completed by data from the western part and also from the Atlantic Ocean.

The list of available documents and reports will be provided during ICG/NEAMTWS-III.

Data base

Actions: 1, 3, 4, 5, 7, 9

Several documents have been provided. Member States must complete these databases before ICG/NEAMTWS-IV.

The database must be considered as a “living” product. The format and distribution of the database must be considered during the next inter-sessional period.

2 Decision Matrix

A first document on the decision matrix for tsunami warning was available for the Chairman and the Vice chairman on January 29. This document was established with the data from the eastern part

of the Mediterranean sea. This decision matrix must be completed by the data of the western part of the Mediterranean Sea and the North-East Atlantic region. The classification of local, regional and basin tsunamis must be taken into account.

During the WG1 meeting and ICG/NEAMTWS-III, Member States must provide their comments on that document.

A draft decision matrix must be finalized and accepted during ICG/NEAMTWS-IV.

This will be the priority action for WG1 during the next couple of months. WG1's Chairman will discuss the provision of information about all the parameters of the decision matrix with representatives of Member States.

3 Model review and collection

This task has been performed: a questionnaire was distributed worldwide by Internet. Information was collected about tsunami numerical models and four tables have been elaborated (1 Identification and scientific contact, 2 Numerical description, 3 Technical description, 4 Documentation).

Member States are requested to review this collection and to provide additional information before June 1, 2007 to publish the tables before July 1, 2007.

Plan of Action

No.	***Action***	***Timeline***	***Responsibility***	***Status***
1	Compilation of Database	December 2006	G. Papadopoulos (Greece) A. Maramai (Italy) F. Schindelé (France)	In progress
2	Decision Matrix to classify local, regional and basin tsunamis (criteria in magnitude, depth, focal mechanism)	December 2006	G. Papadopoulos (Greece) A. Maramai (Italy) F. Schindelé (France)	Must be discussed during NEATWS III
3	Research on seismic sources 363 1693 1856	 End of 2008 End of 2006 End of 2007	 Greece Italy Algeria Israel	New data found
4	Compilation of references and Database Stromboli,Vulcano, Izmit 1999 Corinth Gulf 1963, 1956 Balearic Islands, Canary	 September 2006 September 2006 September 2006	 A. Maramai (Italy), S. Tinti (Italy) G. Papadopoulos (Greece) Spain	Done Spain, partly done for Balearic Islands
5	List of island, submarine and coastal volcanoes in activity, with their characteristics of activity (effusive, explosive, etc.)	ICG/NEAMTWS-III January 2007	Member States (Italy, Spain, Greece, Portugal)	In progress
6	Model review and collection			

No.	*Action*	*Timeline*	*Responsibility*	*Status*
6.1	Design template for questionnaire and distribution	End June 2006	M. Gonzalez (Spain) J. Behrens (Germany)	Done
6.2	Model collection and assessment of documentation	1 Month before ICG/NEAMTWS-III	Whole community National Representatives	Done
6.3	Define a standard output (kinds of data) for a model that goes into NEAMTWS system – proposal for next meeting	ICG/NEAMTWS-III	Chair of intersessional WG1	Discuss during the WG1 Session
7	Input data requirements			
7.1	Provision of data of the historical seismic and tsunami events (seismic parameters, topo-bathymetry, sea level data, run-up....) Portugal 1755, Messina 1908, Greece 1956, Izmit 1999, Algeria – Balearic 2003	End of September 2006	WG3 (Sea level) Portugal, Italy, Greece, Turkey, France, Algeria, Spain	Seismic parameters for Izmit 1999, Algeria 2003. Several sources are supposed for the other events.
7.2	Credible scenario for all other areas	ICG/NEAMTWS-IV	Member States F. Schindelé (France) M. Gonzalez (Spain)	Tectonic Studies must be performed => NEAMTWS-V
7.3	Inventory of available bathymetries (emphasis on shallow water < 100 m)	ICG/NEAMTWS-III	Ifremer	
7.4	Inventory of available topographies and land usage maps	ICG/NEAMTWS-III	Member states, IGN	
7.5	Make topo-bathymetric data available	ICG/NEAMTWS-IV	National Authorities National representatives	
8	Model simulation			
8.1	Benchmarks case computation	ICG/NEAMTWS-III	B. Feignier (France)	Done for Algeria 2003, Lisbon 1755 In process for Messina 1908, Izmit 1999
8.2	Sensitivity analysis	ICG/NEAMTWS-III	G. Bellotti (Italy)	
8.3	Preliminary hazard assessment (examples, priority regions, etc.)	ICG/NEAMTWS-III	WG1 Member States	
8.4	Define sea level data measurement locations (based on model sensitivity)	After October 2006		

No.	*Action*	*Timeline*	*Responsibility*	*Status*
9	Provision of Impact and damages input for database Portugal 1755 Messina 1908 Greece 1956 Izmit 1999 Algeria – Balearic 2003	December 2006	 Portugal Italy Greece Turkey France, Algeria, Spain	Italy provided a report that must be completed by MS
10	Methodology of coastal vulnerability assessment	December 2006	A. Cavalletti (Italy)	

Working Group 2 – Seismic and Geophysical Measurements

Prepared by A. Amato and W. Hanka (with contributions of R. Bossu, I. Papadopoulos, C. Gurbuz, J. Virieux)

Terms of reference

The working group is responsible for defining, based on existing organizations and functions, a transnational seismic network as part of early warning tsunami detection instruments in seismically active coastal areas and providing recommendations on the data processing and analysis.

Task 1 - Networks inventory and check of real time data availability: invite countries contributing to the backbone

Many regional networks operate in the area. The coverage of seismic stations is extremely inhomogeneous, both in the number of seismic stations and in the type of seismometers installed. The most critical region in terms of data availability is North Africa, where broad band stations have been or are being installed but data are not yet available.

For the western Mediterranean, in the framework of the EC-Project EERWEM (Earthquake monitoring and Earthquake Risk in Western Mediterranean), led by EMSC, ORFEUS and ROA, a workshop was organised in June 2006 in San Fernando with the network operators from Morocco, Algeria, Tunisia, Libya, Malta, Italy, France, Monaco, Spain and Portugal, experts in data exchange from INGV/Mednet and GFZ/GEOFON, the President of the Federation of the Digital Seismic Network (FDSN) and a member of the International Oceanographic Commission (IOC) to raise awareness on the issues associated with the establishment of a tsunami warning system in the area.

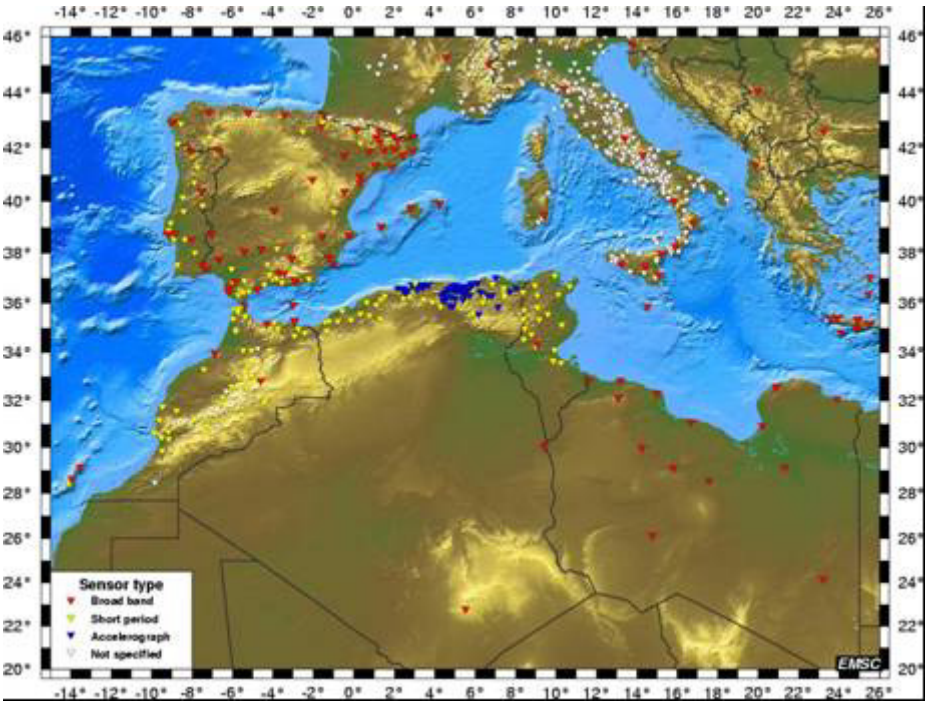

Figure 1. Seismic stations locations and type. Note that for Italy most of the stations have broad band seismometers together with accelerometers and GPS.

The inventory of seismic stations coming out of this workshop shows the high potential for a dense BB network surrounding the Western Mediterranean (figure 1), but the present real data availability from these networks is extremely lower.

A Memorandum of Understanding *for the Establishment of a Cooperation Framework on Earthquake Surveillance in the Western Mediterranean Region* was signed by most of the countries involved in the seismic monitoring of Western Mediterranean. The full text is available at www.roa.es/eerwem. Unfortunately Libya, one of the largest countries of Northern Africa with a real-time BB network in place, did not sign the MOU yet.

Several bilateral or multilateral agreements among different regional monitoring institutions have been signed and are in progress. Possibly they will lead to increased real-time data availability useful for a TWS. Different projects like NERIES, SAFER, TRANSFER, GITEWS, ESONET, MarmESONET and others are going on. They will provide results useful for the NEAMTWS.

Task 2 - Define the backbone network of real-time linked BB stations - priority: North-Africa

A first draft of the backbone seismic network has been attached already to the NEAMTWS-II WG 2 report. Fine tuning is required, namely to increase the density of the network in the earthquake prone areas. But planning remains difficult when important national seismic networks are not contributing to the NEAMTWS process. Namely the representation from Northern Africa is still poor; the EERWEM initiative did not change this significantly. Also several national networks in Europe and Near East are not yet represented. Many committed GEOFON and MedNet stations still have insufficient or even no real-time access. GFZ tries to overcome this problem by planning its own VSAT system, analogue to the one installed recently for SE Asia (see below). INGV is still improving the BB network in Italy, with special emphasis on the islands, where new BB stations have recently been installed using VSAT connections. Also in Greece several ongoing projects will improve the seismic network. NOA is leading EU and regional projects for earthquake and tsunami warning systems in Crete, the Ionian Islands and the Hellenic arc. In Turkey, KOERI will install ten BB stations around the Marmara Sea. As said before, North African countries are also improving their national networks, although the issue of data availability has not been solved yet. Many other countries are improving their BB networks. Additional participants and users of this infrastructure are very welcome. Figure 2 shows an updated map of a possible backbone network.

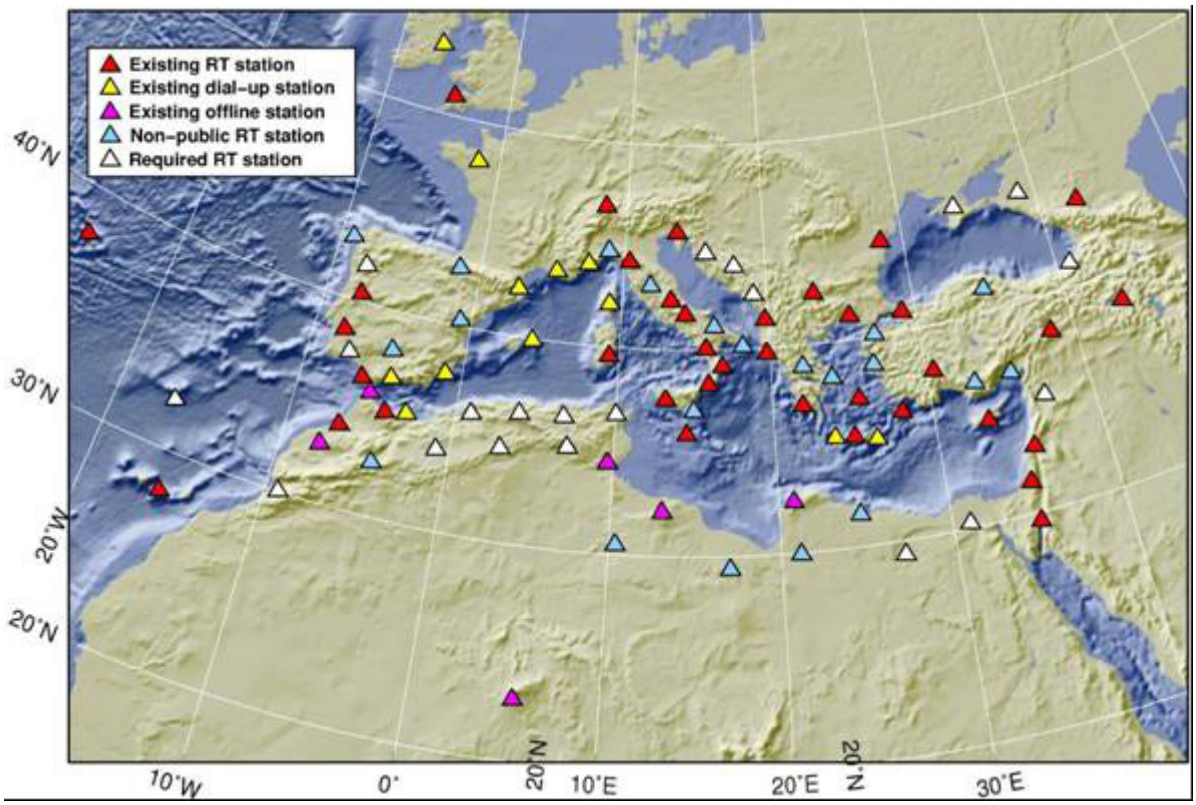

Figure 2. An updated "backbone" network envisaged for the Mediterranean and northeast Atlantic.

Task 3 - Possible implementation of data exchange through internet or other links

Task 4 - Any additional seismological real-time data available will be considered

As stated in the Report of the second session, while VSAT connections are encouraged, possible alternative free (or leased) connections through the Internet can be accepted as a first step. Some of the stations presently used for rapid earthquake locations and magnitudes in the Euro-Med region have public Internet links and show good performance, with latencies compatible with a TWS. At national level, dedicated telephone lines are broadly and efficiently used for real time data transmission (as in Italy for instance). These connections are more expensive than VSAT, but have very low latency and are robust.

Task 5 - Exploring possibilities and "best practice" for earthquake location and magnitude determination

Different new quick teleseismic broadband magnitudes like mB, mBc and Mwp have been implemented in the GEOFON earthquake information system. At INGV, both the Mwp and a newly derived M_{ED} are presently under test. These magnitudes are not supposed to saturate as early as the conventional quick magnitudes mb and Ml. Namely, both mBc and M_{ED} seem to give excellent results even for the strongest (M>8.5) events. Automatic near real-time tools are developed and operational and presently tested parallel to the standard GEOFON processing system. The results are promising and the new magnitudes are already routinely distributed for all larger events. In addition, during the mBc processing, the earthquake's rupture length is routinely and automatically determined. It is envisaged to extend the different magnitude concepts to regional distances to make them even more valuable for rapid warning. M_{ED}, presently under test at INGV, also provides an estimate of the tsunami potential based on the ratio between radiated energy and seismic moment.

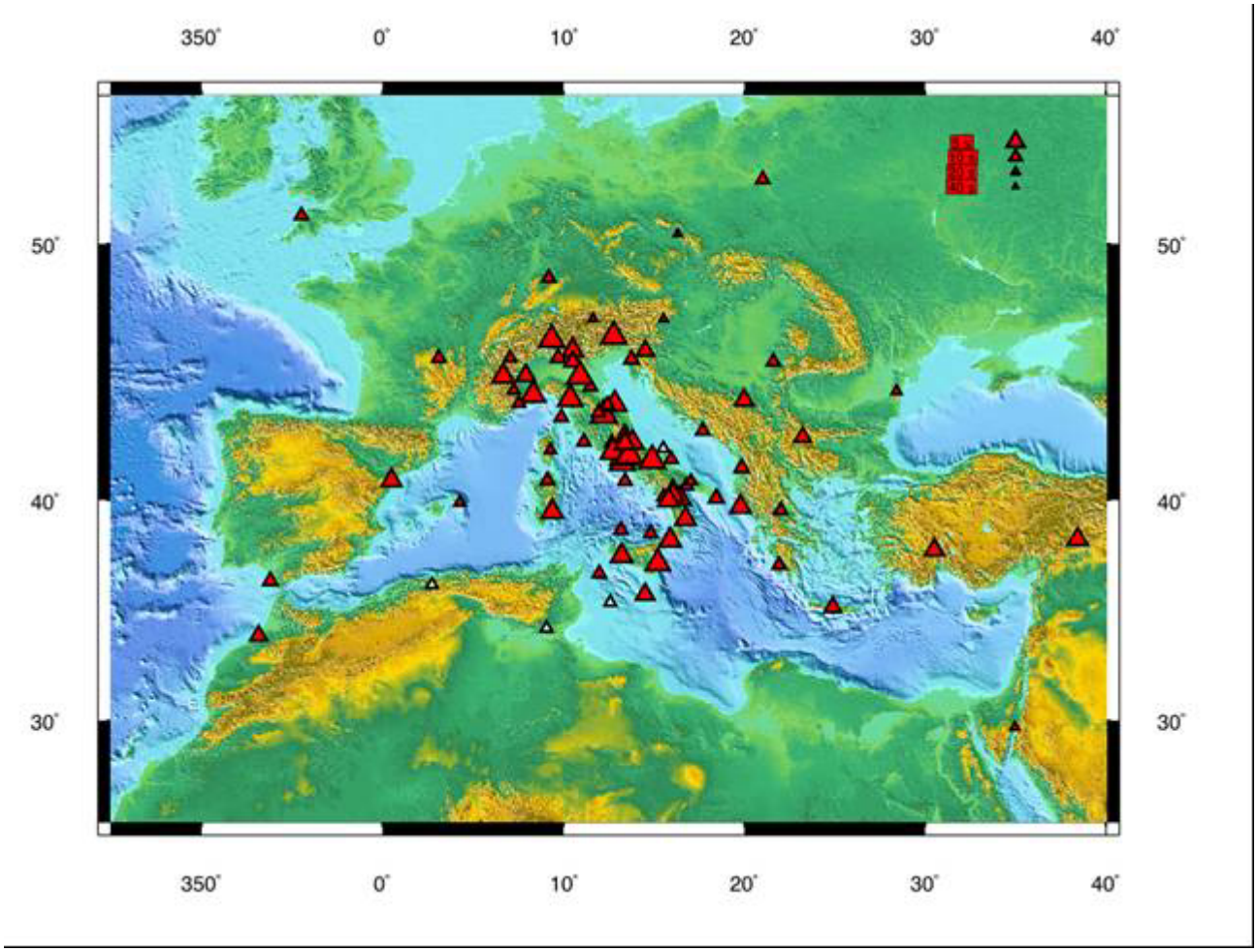

Figure 3. Map of Broad Band stations presently acquired in real-time at INGV. The symbol size is inversely proportional to the data latency (largest symbols: delays lower than 5 seconds)

Task 6 - Technical scheme for the VSAT backbone and required budget

The NEAMTWS VSAT backbone may gain from the experience of the GITEWS project in the Indian Ocean and by the broad experience of INGV and other institutions which use VSAT communications for their national networks. In particular, INGV has presently about 120 BB real-time stations in operation in Italy and surrounding countries.

The GFZ VSAT experience in Indonesia.

A private VSAT system was recently installed for real-time data communication from seismic, GPS and tide gauge stations in Indonesia and other parts of SE Asia. Its basic features are:

- no prefixed acquisition hardware
- full IP network transparency
- star like topology for basic data collection
- point-to-point (SCPC) topology for inter-data centre communication (integrated data streams)
- multiple fully independent sub-networks

- multiple satellite support (one hub, multiple antennas)
- full redundancy achievable with an optional second hub (master and slave functionality exchangeable)
- relatively high hub investment costs
- low investment costs for the remote terminals
- low operational costs

The operational experience after 3 months is very promising. The uptime for the seismic data streams is close to 100% and the data loss extremely low.

The VSAT experience at INGV.

Since 2002, INGV for part of its National Network and for volcano monitoring, adopted a VSAT technology using the Nanometrics Libra equipment. Today more than 100 Libra stations are installed and are continuously sending data to 3 hubs (Roma, Grottaminarda and Catania). Recently, also MedNet has adopted the same technology for some of the remote sites in other countries of the Mediterranean. The same technology is also used in other countries of the Mediterranean, like Spain, Libya and some others.
The main characteristics of the system can be summarized as follows:

- use of VSAT technology with high efficiency of compression (QPSK modulation)
- use of high efficiency of seismic data compression
- use of TDMA scheme, allowing to share the same transmission channel for many stations (reduced transmission costs)
- transparent transport of serial fluxes (e.g. geodetic GPS)
- optimized power management (the SSPB is powered just during the transmission cycle of each station, high efficiency antennas are used), that allows to maintain the station with autonomous power systems (solar cells)
- reliable retransmission scheme via UPD, that allows to maintain a high amount of real time data and a delayed continuity of the data (as far as possible)
- autonomous and reliable management of multiple hubs (one master and one backup for each channel): in case of failure of the master hub, the backup hub takes immediately care of the transmission management. The data continuity is assured in each centre via internet connections.

Since 2006, INGV started to test other VSAT IP connections: in particular the SatLink system was chosen, and 3 connections are today operational, with INGV-made “GAIA2” digitizers, which are efficient and inexpensive. With respect to the Libra system, the main differences are:

- use of a “provider”, with some loss of flexibility (and maybe of reliability)
- use of continuous connections and of less efficient antennas, which means higher power consumption (AC power needed), and higher transmission costs
- on the other side, smaller antennas and cheaper transmission instruments (less critical installations, use of different acquisition instruments)

As regards the Libra system, our experience demonstrates that the transmission mechanism is very robust and reliable: we observed some phases of higher retransmission rates in case of heavy snow

falls or thunderstorms, but usually without loss of data. In normal conditions, the retransmission rate is lower than 0.1%. The two satellite providers in use (Intelsat and HellaSat) up to now were completely reliable, without any interruption of the service.

The main cause of data loss is power problems (snow on solar cells, faults in the AC-DC converters in case of AC-powered systems). We had few faults on the instruments (mainly on the AC-powered ones), but in most cases the same instrument has been continuously working since the installation.

The system has an intrinsic delay on the data, linked to the TDMA mechanism: at the moment, most channels are working with a 10s TDMA frame, which means that each station sends data every 10 seconds (or that data can be delayed up to 10 seconds). On some channels we are now testing a 3s TDMA, which reduces the delay time but increases the system overhead (i.e. less stations can be packed up in the same channel).

The SatLink system has been in use for too short a time for a true comparison. The first feeling is that the system works well, and that it could represent a good alternative for installations in sites with AC power and in which a smaller antenna could reduce installation problems.

A technical meeting on this topic is possible and encouraged.

Task 7 - Description and demonstrations of near real-time OBS

Both in Italy (SN-1, offshore eastern Sicily; the gulf of Pozzuoli, near Naples) and in France (off-shore Toulon, in southern France) some sea-bottom seismometers have been connected to land in real time. These installations took advantage of previous projects and existing infrastructures (sea-bottom observatories) and are cable connected. For a TWS, a higher flexibility is needed to be able to cover large marine areas, where no cable connections are available.

Some advances have been made in the design of a sea-floor instrument able to transmit pre-processed data (either from a seismometer or a DPG sensor) to a buoy and then to land. However, no real instruments are operational at the moment. INGV built some new OBS/H's on which a system of acoustic transmission will be implemented. Italy and Turkey have also developed a feasibility study for a deep OBS connected via cable to a buoy and then radio-linked to land. Both countries are waiting for political decisions and national fundings to proceed.

Software development at GFZ

A prototype of the GITEWS seismological control centre software is almost finished. It is based on the well-known SeisComP package and relies on its de-facto world standard SeedLink for data acquisition from arbitrary data loggers and acquisition systems. Its proven automatic real-time processing tools are connected to a completely new state-of-the art distributed software architecture, providing many libraries and wrappers for easy connectivity also for foreign processing modules. Sophisticated graphical user interfaces allow quick and easy verification and correction of automatic event processing results and supervision of station status and communication links. A new standard for seismological XML and database structures (QuakeML) has been developed jointly with ETH Zürich both for internal and external exchange of seismological parametric data. This concept allows easy distribution of data processing and automatic near real-time data exchange among different processing and warning centres without the need to transfer the raw data streams.

Working Group 3 – Sea Level Measurements

Working Group 3: Sea level data collection and Exchange, including offshore tsunami detection instruments

Intersessional Report

Prepared by: Begoña Pérez

Terms of reference: the working group will be responsible for defining, based on existing organizations and functions, a transnational sea level and marine network that can be integrated in an early warning tsunami detection system, as well as for providing recommendations on the data processing and analysis.

Tasks 1, 4 and 5: First list of possible sea level stations for the ITWS, report on status and needs of upgrade, and final requirements on priority of site.

A large and heterogeneous number of tide gauges exist in the region, and an increasing number have the possibility of some kind of automatic data transmission for less demanding warning systems, such as the storm surge forecast. Nevertheless, we are far from having this information from the North African countries, something that has been tried during last years within GLOSS and MedGLOSS networks. A complete survey on the status on data transmission was initiated by ESEAS (European Sea Level Service). The use of existing infrastructure, whenever possible, was the basis for the selection of stations, taking into account the need to convince the national governments and institutions that no large extra funding would be needed.

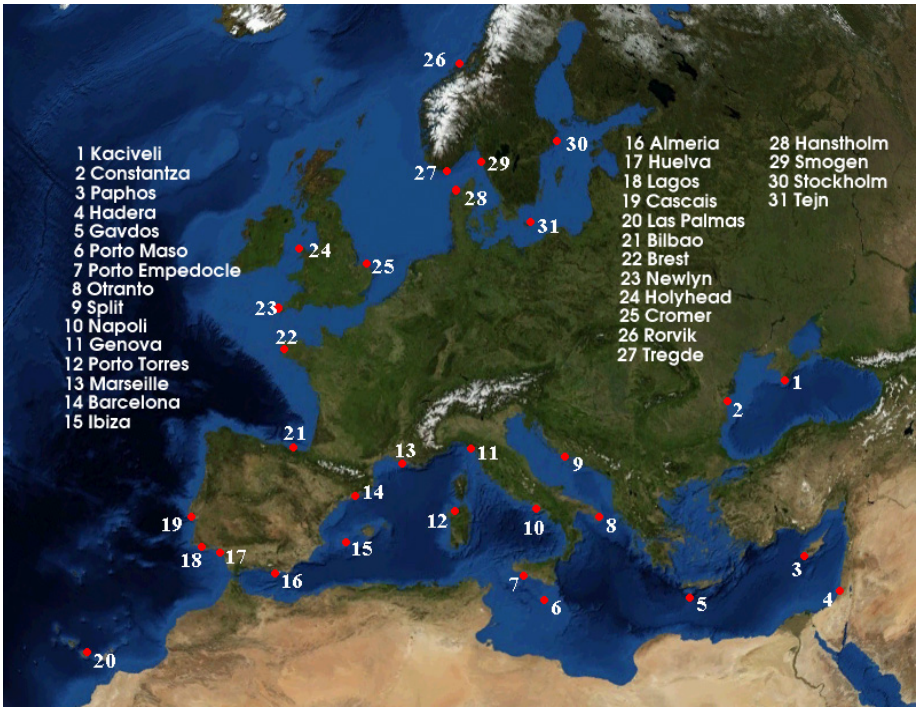

Figure 1: Preliminary selection of possible stations for the core initial tsunami alert system. June 2006.

This first task aimed to establish the starting point for the implementation of a sea level network for the initial tsunami warning system, to be operational in December 2007. This is a very short time taking into account that there is no sea level stations in Europe which completely fulfil the requirements of tsunami alert at this moment. So, mainly focusing first in those sea level stations with some kind of automatic data transmission (near real time), an initial set was defined, considering in principle those with better conditions to be upgraded in the near future, and following the recommendations of WG1 about optimal location (Figure 1). The next step was asking the institutions in charge of the selected stations about the actual status, plans of upgrading and availability of data, as well as their agreement with the selection. Next there is a review of the answers received during the intersessional period:

SPAIN:(Begoña Pérez, Spanish Harbours Authority)
Initial proposed stations: Barcelona, Ibiza, Almería, Huelva, Bilbao (Spanish Harbours stations).
Changes: Ferrol instead of Bilbao (in the Northwest corner of Spain), better position for detecting events coming from Portugal or North Atlantic. In the Canary Islands, La Gomera station instead of Las Palmas, because a radar gauge with high frequency sampling is already in place there. A station in the North of Africa (Melilla harbour) is foreseen to be established during 2007.
Status and plans:

- Barcelona: acoustic sensor to be upgraded during the next 6 months to a new FMCW radar sensor.
- Ibiza/Mahón: (Balearic Islands) there is a pressure sensor already in place in Ibiza, to be upgraded to a new FMCW radar sensor. No plans of when, however. Conversations with the Harbour Authority are taking place, it could be that a FMCW radar sensor (new station) would be established in Menorca Island (Mahon) first (Mahon would then be selected for the system).
- Almería: FMCW radar sensor already in place (installed January 2006).
- Huelva: acoustic sensor to be upgraded during this year to a FMCW radar.
- Ferrol: FMCW radar sensor already in place (installed November 2006).
- La Gomera: FMCW radar sensor already in place (installed November 2006).
- Melilla: planned new FMCW radar station for 2007.

Data transmission is mainly by Internet in all the stations, although other alternatives such as VSAT or BGAN will be explored in the future.
Other Spanish Institutions: no information yet about plans of other institutions in Spain about the upgrade of their stations for tsunami applications. Their plans could in the future add or change some of the Spanish contribution to the system.

UK: (David Smith and Philip Woodworth, Proudmann Oceanographic Laboratory)
Initial proposed stations: Holyhead, Newlyn and Cromer.
Changes: Gibraltar could be added if it is thought of interest for the system.
Status and plans: three systems for tsunami applications will be operational by April 2008, with the following programme of work:

- Holyhead: site survey August 2006, system installation March 2007
- Newlyn: site survey November 2006, system installation June 2007
- Cromer: site survey March 2007, system installation September 2007

- Gibraltar: a FMCW radar sensor is already in place. An additional pressure sensor will be installed during 2007.

The three stations will be based on pressure sensors mounted close to the seabed with vented cables to the data logging system. At Holyhead, sampling periods of 1-10 seconds will be tested. Final decision of the measuring system will be done after checking these data with a bubbler gauge for the first site. Communications: broadband (phone). BGAN direct text messages is being tested for future communications.

FRANCE: (Ronan Creach-SHOM)
Initial proposed stations: Brest and Marseille
Changes: Le Conquet will replace Brest. No funds available yet for upgrading of Marseille.
Status and plans: at the moment SHOM has no funds to upgrade stations in the Mediterranean. Currently, the planning of upgrading (radar sensors and real time transmission) applies only to the Atlantic and the Channel.

- Le Conquet (Brest): these two very close stations in the Atlantic coast will be upgraded to real time data transmission in 2007. The reason to choose Le Conquet is that it is in a more open ocean site (Brest is inside a bay).
- Marseille: MORS acoustic sensor without real time transmission, it needs to be totally upgraded, and no funds available. To the West, two new stations at Sète and Port-Vendres are planned to be installed between 2007 and 2008. SHOM suggests, due to the location, to focus on Toulon or Ajaccio, instead of Marseille, although these stations would also need to be upgraded.
- Monaco: Monaco Authorities have confirmed interest to SHOM in upgrading their tide gauge (waiting for news).

GREECE: (Prof. Stelios P. Mertikas, Techn. Univ. of Crete and A. Mavraeidopoulos, HNHS)
Initial proposed stations: Gavdos
Changes: more stations could be added by HNHS
Status and plans: Currently, Gavdos is under the responsibility of the Technical University of Crete, but the final responsibility and decision for data transmission will correspond to the Hellenic Navy Hydrographic Service (HNHS). On the other hand, the Observatory of Athens is planning new tide gauges in Ionian Sea for tsunami applications, although no contact with them has been established yet.
HNHS is responsible for operating the Hellenic Network (21 stations). All of them are float gauges in stilling wells, and only 7 are now digital with a GSM connection for data transmission (Alexandroupolis, Chios, Siros, Samos, Peiraeus, Lefkas and Katakolo). HNHS is interested in participating in the project and in knowing the exact requirements for sampling interval and data transmission.

CYPRUS:(George Zodiatis, Oceanography Centre, University of Cyprus)
Initial proposed stations: Paphos
Changes: none
Status and plans: The Oceanography Centre (University of Cyprus) is looking for funds to upgrade the sea level station of Paphos, operating in the framework of MedGLOSS and ESEAS, in order to be included in a Mediterranean tsunami warning system. They also plan to do so with their open sea station, SW of Cyprus.

ISRAEL: (Dov S. Rosen, Israel Oceanographic & Limnological Research)
Initial proposed stations: Hadera

Changes: Ashdod station has been proposed also.
Status and plans: both stations can provide 30 sec averaged data and in the coming months with new software also 5, 10 or 15 sec averaged data. Data transmission by means of a triggering mechanism from the station will be established in the coming months.

ITALY: (Stefano Corsini, APAT)
Initial proposed stations: Napoli, Genova, Porto Empedocle, Otranto and Porto Torres.
Changes: new list proposed by APAT, changing two of the stations: Napoli, Imperia, Porto Empedocle, Otranto and Carloforte.
Status and plans: at this moment APAT has asked for availability of the data for the NEAMTWS system. Not confirmed yet. All the stations seem to be acoustic, not more details about the status.

NORTH OF AFRICA
ALGERIA:
CRAAG director (A.K. Yelles), contacted the Algerian Hydrographic Service. They have two old stations, not digital. CRAAG will provide three new stations adequate for tsunami applications in the next few months.

EGYPT:
ODINAFRICA and IOC have recently selected a site in Alexandria for a new ODINAFRICA location with a radar and pressure gauge, that could be a possible station contributing to the tsunami warning system. (Philip Woodworth communication)

MOROCCO:
Possibly one station in Morocco (Atlantic coast) also within ODINAFRICA. (Philip Woodworth and Thorkild Aarup communication)

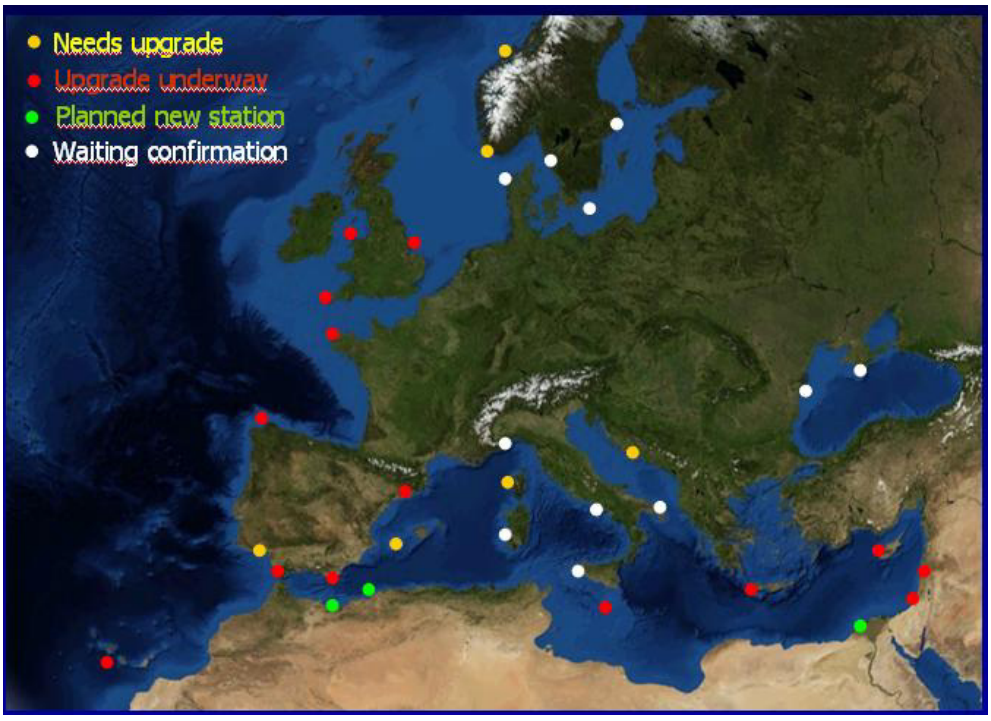

Figure 2: Sea Level Stations: core initial network. Status February 2007.

The updated status of the sea level stations to be included in the core initial system is shown in Figure 2. More detailed information on the status of each tide gauge can be found in the table at the end of the document.

Task 2: Technical Description of user requirements for NEAMTWS tide gauges:
The requirements of the tide gauges for the NEAMTWS system will be by now the ones adopted for the Indian Ocean, although it is agreed that it could be necessary to adapt these requirements to the particular difficulties of the Mediterranean area in the future. Based on the Implementation Plan of the Indian Ocean Tsunami Warning and Mitigation System (IOTWS), 31 July-2 August 2006, Bali, Indonesia, the requirements for sea level data sampling and transmission would be, for stations within 1 hour travel time and/or 100 km of tsunami generation areas, a sampling of 1 min averages and a continuous transmission cycle of 1 minute. Apart from the following are recommended:

- Immediate retransmission via WMO's GTS to the appropriate warning centres
- Configuration if possible as a multi-purpose coastal sea level station
- IOC/GLOSS or equivalent proven equipment in the field (accuracy better than 1 cm for each measurement)

Concerning the data sampling, it could be considered the convenience of reduction of the time interval to 15 seconds, if small tsunamis are to be detected. This has been shown in a Technical Paper on Sampling Frequency of Sea Level Measurements for Tsunami Detection, of the Japan Meteorological Agency (personal communication, October 2006).

Task 3: Completion of survey on data transmission of existing sea level stations in NEAMTWS region:

Task 6: Existing offshore instrumentation report:
A significant number of offshore or open sea stations exist in Europe that could also potentially be used for tsunami detection purposes. The instrumentation includes both meteorological-oceanographic buoys and OBS systems (seismic sensors on the seafloor). The objective of this task is to have available a detailed inventory of the existing open sea stations around the NEAMTWS region and information about the possibilities and costs of upgrading. This upgrading normally will refer to the inclusion of bottom pressure sensors and adequate data processing and transmission for tsunami applications.

Apart from the national buoy networks (Spanish Harbours, APAT – Italy, POSEIDON - Greece), a European Sea Floor Observatory Network (ESONET) is planned. All these positions should be explored.

National plans concerning open sea stations for tsunami applications:

Italy:
A deep sea station with a bottom pressure recorder has been installed close to the Marsili Volcano, North of Messina Strait, at a depth of about 2,000 m.

Cyprus:
The Oceanography Centre is planning to upgrade their open ocean observatory (70 km SW of Cyprus) for tsunami applications, but funds are not yet available.

Greece:
A deep sea station at a depth of 2,000 will be established within POSEIDON project for tsunami detection.

NEAREST project:
A seafloor multiparameter observatory (GEOSTAR class), including bottom pressure sensor and innovative software will be operational in the Gulf of Cádiz. Previous ESONET station (?). (Laura Beranzoli communication).

Status of Sea Level Proposed Stations Based on Best Available Information (January 2007)

	Station Name	Coordinates	Country	Basin/Sea	Current status	Type of sensor	Current Sample (min)	Transmission interval (min)	Type of transmission	Network
1	Kacively	44º.42N,34º.05E	Ukrania	Black Sea	3	Pressure				MedGLOSS
2	Constantza	44º.17N,28º.67E	Romania	Black Sea	3	Pressure				MedGLOSS
3	Paphos	34º.78N,32º.40E	Cyprus	E. Mediterr.	3	Pressure				MedGLOSS-ESEAS
4	Hadera	32º.47N, 34º.86E	Israel	E. Mediterr.	2	Pressure	0.5			MedGLOSS-ESEAS
5	Ashdod	31º48'N,34º38'E	Israel	E. Mediterr.	2	Pressure	0.5			
6	Gavdos	34º.85N, 24º.12E	Greece	E. Medterr.	2					
7	Porto Maso	35º.91N, 14º.52E	Malta	C. Mediterr.		Pressure				MedGLOSS-ESEAS
8	Split	43º.51N, 16º.44E	Croatia	Adriatic	3	Pressure	10	10		MedGLOSS-ESEAS
9	Napoli	40º50'N, 14º16'E	Italy	C. Mediterr.	3					
10	Imperia	43º53'N, 08º01'E	Italy	C. Mediterr.	3					
11	Carloforte	39º09'N, 08º 18'E	Italy	C. Mediterr.	3					
12	Porto Empedocle	37°17'N, 13°31'E	Italy	C. Mediterr.	3					
13	Otranto	40º 09'N, 18º30'E	Italy	Adriatic	3					
14	Ajaccio	41º56'N, 08º46'E	France	W. Mediterr.	3	Acoustic				
15	Le Conquet	48º22'N,04º46'W	France	Atlantic	2	Radar			ADSL	
16	Barcelona	41º21'N,02º10'E	Spain	W. Mediterr.	2	Acoustic	5	60	GSM	MedGLOSS-ESEAS
17	Ibiza	38º55'N,01º27'E	Spain	W. Mediterr.	3	Pressure	5	60	GSM	MedGLOSS-ESEAS
18	Almería	36º50'N,02º29'W	Spain	W. Mediterr.	2	Radar	5	5	Internet	
19	Huelva	37º08'N,06º50'W	Spain	S. Atlantic	3	Acoustic	5	60	PSTN-modem	ESEAS
20	Ferrol	43º17'N,08º08'W	Spain	S. Atlantic	2	Radar	5	5	Internet	

	Station Name	Coordinates	Country	Basin/Sea	Current status	Type of sensor	Current Sample (min)	Transmission interval (min)	Type of transmission	Network
21	La Gomera	28º03'N,17º05'W	Spain	S. Atlantic	2	Radar	5	5	Internet	
22	Melilla	35º17'N,02º56'W	Spain	W. Mediterr.	4	Radar	1	1	Internet	
23	Lagos	37º07'N,08º34'W	Portugal	S. Atlantic	3	Float	60			GLOSS
24	Cascais	38º41'N,09º25'W	Portugal	S. Atlantic	3	Float	60			GLOSS
25	Newlyn	50º06'N,05º33'W	U.K.	Atlantic	2	Bubbler	15		Internet	
26	Holyhead	53º19'N,04º37'W	U.K.	Irish Sea	2	Bubbler	15		Internet	
27	Cromer	52º56'N,01º18'E	U.K.	North Sea	2	Bubbler	15		Internet	
28	Gibraltar	36º09'N,05º22'W	U.K.	Gibral. St.	2	Radar	15	60	GSM	
29	Rorvik	64º52'N,11º15'E	Norway	N. Atlantic	3	Float	10			
30	Tregde	58º00'N,07º34'E	Norway	North Sea	3	Float	10			
31	Hanstholm	57º07'N,08º36'E	Denmark	North Sea	3		10	10	Internet	
32	Tejn	55º19'N,15º11'E	Denmark	Baltic Sea	3		10	10	Internet	
33	Smogen	58º22'N,11º13'E	Sweden	North Sea	3	Float	10	60	PSTN modem	
34	Stockholm	59º19'N,18º05'E	Sweden	Baltic Sea	3	Float	10	60	PSTN modem	
35	Alexandria		Egypt	E. Mediterr	4					

Notes:
Current status: 1-upgrade completed, 2- upgrade underway, 3- requires upgrade, 4- planned new installation
Coloured: new proposed stations after the national survey

Working Group 4 – Advisory, Mitigation and Public Awareness

Progress on inter-sessional activities agreed at ICG/NEAMTWS-II in Nice**:**

Prepared by Russell Arthurton, Chair

Establish a website to facilitate interactions amongst WG4 members to develop its activities, hosted by IOC

- An NEAMTWS web space has been established by IOC for the project as a whole.

Establish contacts with potential partners (e.g. Barcelona Convention, MAP/UNEP, WB/METAP, ISO)

- During this inter-sessional period, the WG has consulted with representatives of the European Commission's DG Environment in respect of coastal flooding, civil protection and coastal planning, as well as opportunities for the funding of project implementation by Member States. The DG units concerned have supported the aims of the project and recognize the impetus that this IOC-led project will give to their implementation of the Floods Directive. The DG Environment Water Unit has requested a continuing dialogue with the aim of achieving compatibility between the ICG's output and the new Floods Directive. The WG has also consulted with UNEP/MAP in respect of the Barcelona Convention, in particular for issues of ICAM protocol for the (Mediterranean) region.

Undertake reviews of emergency response procedures and technologies, including communication, advisory messaging, and strategic planning procedures

- Selected existing national, regional and international procedures, including recommended ISDR procedures, have been reviewed. There is a need for a more extensive coverage for this review, also for dialogue with Civil Protection agencies at regional and national levels.
- A compilation of emergency preparedness and response procedures has been prepared, to be reviewed following dialogue with Civil Protection agencies.
- Existing TWS communications systems have been reviewed and elaboration of the NEAMTWS II draft architecture for tsunami emergency communications systems has been proposed. Opportunities for synergies with other EWS need further investigation.
- The format and content of advisory messages have been reviewed; advice has been sought from NOAA and other TWS websites in respect of tsunamis, and from UK in respect of Storm Tide Forecasting procedures. Further work is required in consultation with the other TWS projects and storm surge warning agencies, and regional institutions with a view to achieving harmonization and standards.
- Existing strategic planning response practices have been reviewed in the context of ICZM/ICAM. Case examples from Alexandria (tsunami risk) and Thames Estuary (storm surge risk) are in preparation. Procedures for vulnerability assessment and for minimizing vulnerability have been reviewed with the assistance of UNU EHS. Relevant EU recent and current research projects (EUROSION; FLOODsite; TRANSFER) are also under review. This activity has covered the use of regulatory instruments to reduce risk in the context of ICAM/ICZM, including the issue of setback lines for coastal development.

Assessment of user needs (national and local authorities, individuals), including perceptions of risks, through a questionnaire sent to MS focal points

- There has been no progress on this item. The task objective has been superseded by the proposal by IOC to issue a questionnaire to MS seeking responses to a wide range of issues relating to the setting up of a TWS, and followed up as appropriate with visits to MS by expert groups.

Education a) Critical review of existing educational materials developed in other ICGs and ITIC to the needs of the region, and b) Adaptation of these materials to the needs of the region and MS

- Recommendations for good practice in education and awareness programmes are in preparation, with assistance from UNU-EHS and ISDR, amended to suit the particular conditions of the region and adapted to tsunami and storm surge relevance.

Organize a workshop on stakeholder participation in marine-related hazards mitigation programmes

- No progress is reported on the proposed workshop on stakeholder participation. [It has been suggested that the workshop should span a wider range of issues related to the TWS.]

Develop IOC guidelines for mainstreaming consideration of tsunamis and other marine-related hazards into ICAM plans and programmes

- Terms of Reference for proceeding with this venture – "Guidelines for Mainstreaming Awareness and Mitigation of Marine-related Hazards and Risks in Integrated Coastal Area Management (ICAM)" - have been finalized by IOC and experts are being identified for implementation.

Compilation of case studies on human behaviour in the event of tsunamis and other extreme events in the coastal are

- This item has not been addressed

Testing and training for the operation of the pilot component of the TWS

- Pilot TWS testing and training have not been appropriate in this inter-sessional period.

ANNEX VII

REPORTS FROM THE SESSIONAL WORKING GROUPS

Sessional Working Group 1 – Hazard Assessment, Risk and Modelling

Chair: François Schindelé
(CEA-DASE, France)
Co-chair: Mauricio Gonzalez
(Universidad de Cantabria, Spain)

Participants: Ana V Baptista (Portugal)
Giorgio Bellotti (Switzerland)
Volodymyr Belokopytov (Ukraine)
Utku Kanoglu (Middle East Technical University)
Vlado Malacic (Slovenia)
Alexander Rudloff (Germany)
Ahmet Cevdet Yalciner (Turkey)

Introduction

The Action Plan proposed by the WG1 was adopted by the ICG/NEAMTWS-II. The Action Plan includes the list of actions, timelines and responsibilities. For several actions all Members States must provide to the Chairman of the Group information and data related to these.

Most of the Database will be completed in 2007 and 2008. Member States (MS) are requested to provide additional information during the next months. One of the main issues for the implementation of the preliminary warning system by the end of 2007 is the definition of the Decision Matrix. A first Decision Matrix was provided and discussed, considering essentially data of the eastern part of the Mediterranean region, and of Italy. This matrix must be completed by data from the western part and also from the Atlantic Ocean.

The list of available documents and reports will be provided in the ICG/NEAMTWS web page.

1. Data base

Actions : 1, 3, 4, 5, 7, 9

MS must complete these databases before NEAMTWS IV and provide these data to Italy. The database must be considered as a "living" product. The format and distribution of the database must be considered during the next inter-sessional period.

2. Decision Matrix

A first document on the Decision Matrix for tsunami warning was available. During the WG1 meeting and ICG/NEAMTWS-III, Member States provided their comments on the presentation and on the document.

A first Decision Matrix must be finalized before and accepted during ICG/NEAMTWS-IV.

First study: Italy and Greece

Some areas of the NEAM region were not covered by the first study.

- Portugal, Spain and Morocco will study the region of the 1755, 1969 and 1975 earthquakes
- Turkey is performing studies in Marmara sea and will provide the results
- The Black sea must also be studied (Ukraine, Turkey, etc)
- The North Algeria, North Tunisia region (Spain, Algeria, France)
- Eastern Mediterranean region (Israel, Lebanon, Syria)

Results will be provided to all WG1 participants — End of June 2007

Synthesized document — September 2007
(G. Papadopoulos, S. Tinti, M. Gonzales, F. Schindelé)

Mw thresholds — September 2007

How many ranges for each basin (local, regional and basin-wide or local and basin wide)?

Reviewed Decision Matrix 2009 – 2011 — September 2007

3. Questionnaire

Questions related to Tsunami Hazard Assessment and Risk, and Modelling (66 to 84). No specific modifications were requested.

This will be the priority action for WG1 during the next couple of month. WG1 Chairman will discuss with representative of MS to provide information about all the parameters of the decision matrix.

Implementation Plan for Hazard Assessment and Modelling

No.	*Action*	*Timeline*	*Responsibility*	*Status*
1	Compilation of Data Base	April 2007 2009 2011	Contribute : MS Greece Italy France	INEAMTC Review TRANSFER Review 2
2	Decision Matrix to classify local, regional and basin tsunamis (criteria in magnitude, depth, focal mechanism)	NEAMTWS-IV	Greece Italy, Portugal, Spain France	Details provided in chapter 2
3	Research on seismic sources 365 1693 1856 (2events)	2009 ??	Greece Italy	Done
4	Compilation of references and Data Base Stromboli,Vulcano, Izmit 1999 Corinth Gulf 1963, 1956 Balearic Islands, Canary	NEAMTWS-IV	Italy Greece Spain	Done – (*doc.)*
5	List of island, submarine and coastal volcanoes in activity, with their characteristics of activity (effusive, explosive, etc.)	NEAMTWS-IV	Italy, Greece Spain, Portugal	Done – (*doc.)*

No.	*Action*	*Timeline*	*Responsibility*	*Status*
6	Model review and collection			
6.1	Design template for questionnaire and distribution		Spain / Germany	Done – *doc*.
6.2	Model collection and assessment of documentation		Whole community / National Representatives	Done – *doc*.
6.3	Define a standard output (kinds of data) for a model that goes into NEAMTWS system – proposal for next meeting	NEAMTWS-IV	Germany	
7	Input data requirements			
7.1	Provision of data of the historical seismic and tsunami events (seismic parameters, topo-bathymetry, sea level data, run-up....) Portugal 1755, Messina 1908, Greece 1956, Izmit 1999, Algeria – Balearic 2003	NEAMTWS-IV 2011	WG3 (Sea level) Portugal, Italy, Greece, Turkey, France, Algeria, Spain	Seismic parameters for Izmit 1999, Algeria 2003. Several sources are supposed for the other events. Spain (Balearic)
7.2	Credible scenario for all other areas	2010	Member States TRANSFER	Seismotectonic Studies will be performed
7.3	Inventory of available bathymetries (emphasis on shallow water < 100 m)	NEAMTWS-IV	Contribution : MS IOC – IHO	MS must complete 2 maps
7.4	Inventory of available topographies and land usage maps	2009	Member states	
7.5	Make topo-bathymetric data available	NEAMTWS-IV	National Authorities/National representatives	NEAMTWS-IV
8	Model simulation			
8.1	Benchmarks case computation	NEAMTWS-IV		Lisbon 1755 Messina 1908
8.2	Sensitivity analysis	2009	TRANSFER	
8.3	Tsunami source and hazard assessment (examples, priority regions, etc.)	2009	TRANSFER Member States	
8.4	Define tidal gages locations (based on model sensitivity)	NEAMTWS-III		Done
9	Provision of Impact and damages input for data base Portugal 1755 Messina 1908 Greece 1956 Izmit 1999 Algeria – Balearic 2003	April 2007	Contribution . Member States Italy	Initial report NEAMTC
10	Methodology of coastal vulnerability assessment		A. Cavalletti (Italy)	*Doc* available WG4 will take into account that issue

Sessional Working Group 2 – Seismic and Geophysical Measurements

Chair: Alessandro Amato (INGV, Italy)
Co-chair: Winfried Hanka (GFZ, Germany)

Participants: Rémy Bossu (CSEM)
Domenico Giardini (ETH/CH)
Cemil Gurbuz (Turkey)
Jörn Lauterjung (Germany)
Salvatore Mazza (Italy)
Lars Ottemoller (United Kingdom)
Christian Reichert (Germany)
Andreas Rosenberger (Germany)
Stefano Tinti (ICG Chairman)
Jean Virieux (France)
Uli Wolf (IOC/UNESCO)

Terms of reference

The working group is responsible for defining, based on existing organizations and functions, a transnational seismic network as part of early warning tsunami detection instruments in seismically active coastal areas and providing recommendations on the according data processing and analysis.

Summary of discussion during the breakout sessions

The working group concentrated in their discussion on three major issues:

- The network of Regional Tsunami Watch Centres (RTWC) and their terms of reference
- The update of the seismic monitoring task list of the Implementation Plan
- Modifications to the seismic monitoring part of the assessment questionnaire

1) Regional Tsunami Watch Centres (RTWC)

The group extensively discussed and summarized the requirements for providing a continuous operational availability of and appropriate regional coverage for seismic data for the NEAMTWS region in order to provide the basis for adequate and appropriate tsunami information products. The Working Group discussed and decided that regional centres will have to meet the following objectives:

- full 24/7 service (staff on watch)

- data mirroring, watch redundancy (by 2011)

- sufficient communication facilities and backup with other regional centres

- earthquake and tsunami watch information to be provided to all partners

- full waveform data will be available to all member states (open access)

- sharing competence (advice and training)

In view of the capabilities and facilities presented at the meeting, the following institutions expressed interest to perform – at least partly - functions of a regional centre: INGV (Italy), BGS (UK), GFZ (Germany), DAS (France), KOERI (Turkey), NOA (Greece) while the group invited the expression of interest of other institutions. The WG 2 urged member states to address the issue of establishing one or more operational regional seismic data centres meeting all of the above mentioned requirements. Portugal and Spain (IGN) announced that they will make data available. Following a first appraisal on how these requirements are being met the WG2 will develop an organizational concept for the NEAMTWS.

Italy announced that INGV, in close cooperation with other relevant national institutions will provide as of today the full operationality of its facility as a Regional Tsunami Watch Centre.

WG 2 recommends using results and findings from ongoing projects like SAFER, NERIES, TRANSFER, GITEWS for the implementation of the initial and upcoming regional watch centre(s).

Availability and real-time transmission of data is essential for timely warnings.

The working group decides to set up an implementing sub-group with one representative from each of the institutions which signed up for regional centres. This group will be chaired by INGV and will address the following issues:

- Communication/bandwidth and coordination between centres
- software standardisation
- data sharing structure
- best practice, QC, -> SOP's
- standardisation of messages
- additional instrumentation (e.g. OBS, Differential GPS,…)
- data transmission to upgrade existing and new stations (VSAT)

2) Updated WG task list for the NEAMTWS Implementation Plan

Task	responsible	Timeline	required budget	Status
Technical decisions for RTWC links (organizational concept to be defined in the next week - items as described above)	Italy (coord), Germany, EMSC, other RC's	Next meeting	(10k)	O
Network inventory and check of real time data availability – open list of RT-BB stations availability including network code, country, location, instruments, latency	Italy, Germany EMSC	Continuous	None	O
Identification of key backbone stations – upgrade proposed	Germany, Italy	ICG/NEA MTWS- IV	none	O
Possible implementation of data exchange through internet or other links	France	June 2007	none	O

Exploring possibilities and "best practice" for earthquake location and magnitude determination (link with other projects)	All partners	Continuous	none	P
Technical scheme for the VSAT backbone and required budget	Germany, Italy	January 08	Not defined	P
Time table for progressive earthquake locations and (different) magnitudes in the main source regions	Italy	Continuous	none	P
Simulations of network performance with estimates of errors in location and depth				
First estimate of Earthquake location and magnitude				
Web page (restricted access) with basic information	IOC Secretariat	March 2007	covered	C

1 Note: – Status: P – Planned, C – Completed, O – Ongoing

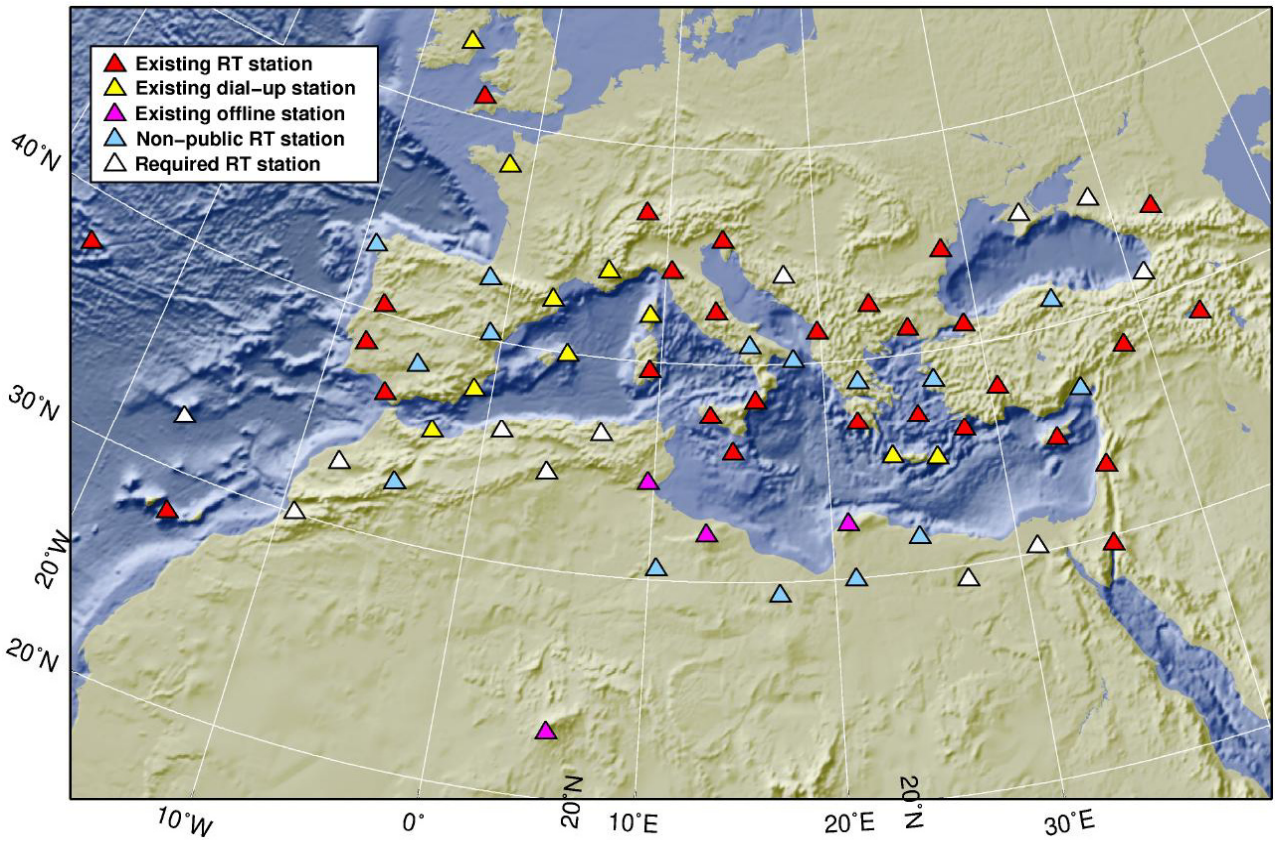

Fig.: Possible NEAMTWS Backbone Seismic Network (70 Stations)

3.) Revised Questionnaire

d. <u>SEISMIC NETWORK</u>

Question 28: Does your country operate any seismic stations or seismograph networks within your country or other countries?

Question 29: If yes, please describe the monitoring system including location, instrumentation and telecommunications and analysis procedures.

Question 30: Does your country have more than one institution committed for earthquake monitoring information?

Question 31: Are the waveform data available in real-time in your center? If yes, please specify and how in practice?

Question 32: Does your country operate or plan to operate any OBS stations for permanent monitoring? If yes, please specify?

Sessional Working Group 3 – Sea Level Measurements

Chair: Begoña Pérez
(Harbours Authority, Spain)
Co-chair: Karim Yelles (CRAAG, Algeria)

Participants: Laura Beranzoli (Italy)
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Sea Level Monitoring

Real time sea level data are a basic component of the tsunami warning systems, and they are used first of all as a validation tool, that is to confirm that a major tsunami was generated by an earthquake or, on the contrary, to cancel alert messages in case of no tsunami observations. Traditionally, such observations are carried out through tide gauges typically placed in harbours, and through pressure gauges on the sea floor deployed offshore far from the coast. Tide-gauge stations are operated in the NEAM region by a number of national agencies and of research institutions that usually process their own data. Data transmission and exchange in real-time with the characteristics required by the TWS are rarely met.

There is a recognised need to establish new standards to enhance sea level stations to operate in real-time, with higher frequency sampling rates (possibly in the range of 30-60 sec or less). There is an immediate need for specific gauges (at least 10 sites) to become fully operational at the end of 2007 for the ITWS. All other required sea level gauges must be fully operational during the second phase of the implementation process (end 2011). A possible list of sea-level gauges as proposed by the WG3 is displayed in the map of Figures 5 and 6. The technical selection criteria of these stations was based mainly on relevance, gauge availability and data access, so most of them are already existing stations, that need to be upgraded. In many cases they are part of global or regional networks such as GLOSS, MedGLOSS, ESEAS or ODINAFRICA, multi-user/multi-purpose sea level observing networks that serve both research and operational purposes (i.e. monitoring long-term sea level change, storm surge and port operations). This multi-purpose nature guarantees the sustainability of the system, and should be also the nature of the new stations that are proposed to be installed in the North of Africa, where sea level data availability becomes crucial for other applications such as sea level rise, storm surge forecast and coastal inundation.

To complement this core network, denser networks are required in the areas of the NEAM region that are close to the tsunamigenic zones and may be hit by dangerous waves soon after the

earthquake occurrence. Network densification is a task to be designed in the first phase and accomplished in the second phase of the TWS implementation.

Deep ocean buoys are considered useful to record tsunamis as they travelled in the open ocean and tsunami signal is not affected by the amplification and other interaction known to take place in coastal areas. They can intercept the tsunami along its propagation path to distant coasts and their records can be used, in conjunction with modelling tools, for forecast purposes, as has been shown by recent cases of tsunamis in the Pacific Ocean. Usually they are installed on the open sea-side in positions between the tsunami sources and the distant coasts to protect. Examples of installation in the NEAM region are related to test experiments. Experience gained in the Pacific Ocean and in the Indian Ocean where such instruments have been deployed and used in TWS operations also by European countries (see f.i. the GITEWS project) can be usefully transferred to the NEAM region to integrate the tide-gauge sea-level network especially in view of recording major basin-wide tsunamis.

The regional components of GLOSS in the area, MedGLOSS and ESEAS, may give relevant contributions to the TWS tide-gauge monitoring, and likewise valuable is considered the collaboration with existing bodies active in the coordination of deep-sea observation networks mostly for operational oceanography, such as MOON/MedGOOS for the Mediterranean, NOOS for the North Sea, BOOS for the Baltic sea and BlackSea GOOS, all regional components of GOOS.

Reliable and efficient data transmission links should be used for the real time systems. Secure and redundant transfer of data from the instrument to the operators should be guaranteed to ensure that communication links remain operational after earthquakes, floods, etc. Advantage should be taken of existing and evolving systems. This is especially the case of WMO GTS, which the WMO even has offered to upgrade to account with the requirements of the system, and others as IP networks, satellite communications, VPN internet, etc. There is a need to communicate such requirements to telecommunications standards development organizations such as ITU. Standards on data format and data transmission protocols should be adopted from already existing systems (ex. XML, GTS).

Rapid detection of tsunamis in the records of the sea level sensors is essential to validate the tsunami occurrence. Time constraint is very demanding in the NEAM region where tsunami travel times are short and is even more demanding than for seismic detection algorithms, since normally the time available between the tsunami arrival at the sea-level gauges and the tsunami attack on the coasts is less (or considerably less) than the corresponding time available for earthquake parameters assessment.

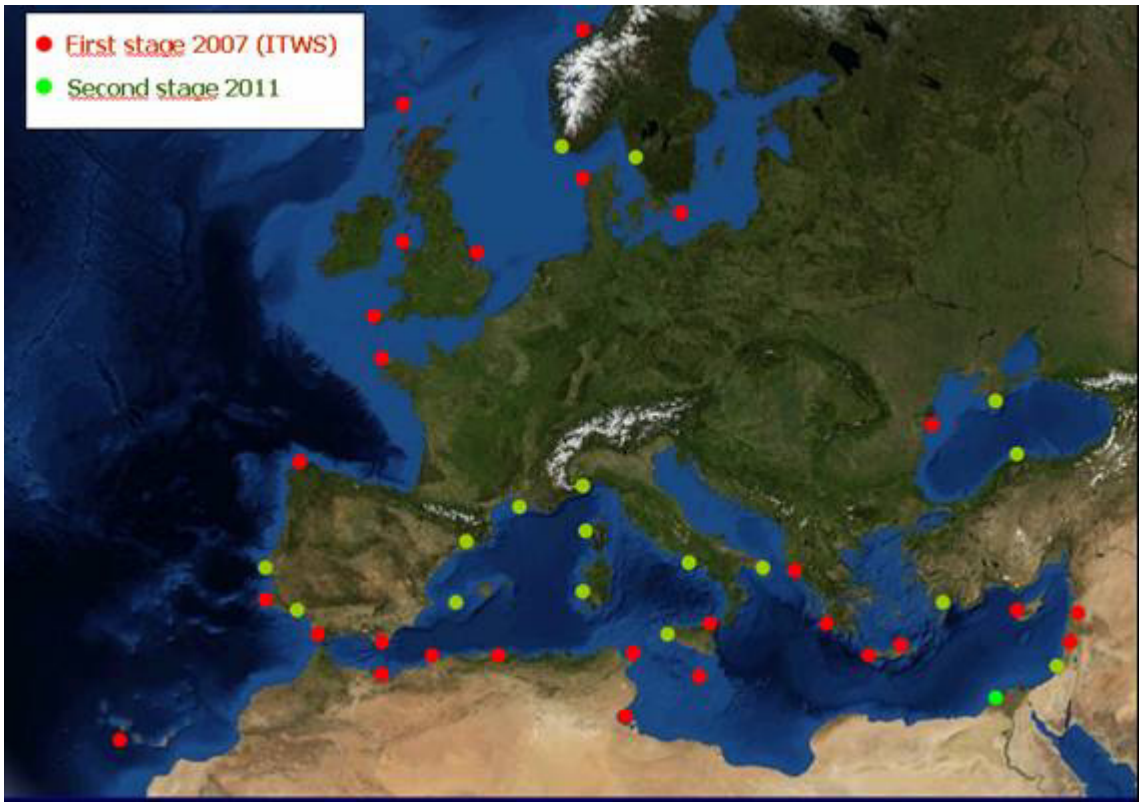

Figure 5: plan of implementation of the sea level stations (red: to be upgraded/installed by December 2007)

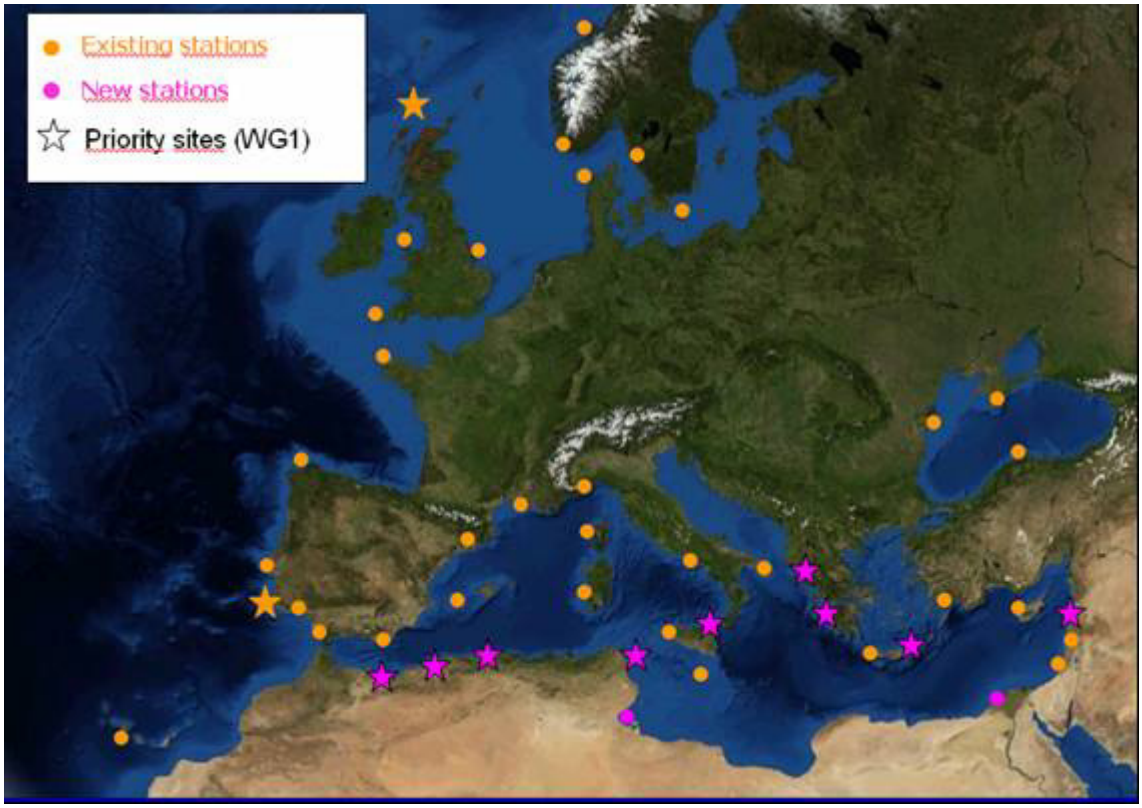

Figure 6: status of the stations to be part of the system during NEAMTWS III

WG3 regional goal for the implementation of stations

An initial prototype system based on a minimum number of sea level stations, meeting the established requirements and standards, should become operational by December 2007: this minimum number will be based both on already available and upgraded sea level stations and the priority sites defined by WG1. The rest of sea level stations proposed by this working group in Figures 5 and 6, as well as the selection/proposal of deep ocean stations to be done during 2007, should be incorporated to the system during the second stage, to be fully operational by 2011.

Instrumentation Requirements and Standards

The instrumentation and stations that will be part of the sea level monitoring with application for tsunami detection should fulfil the requirements established by the working group, which are based on the experience of the corresponding sea level working group for the Indian Ocean, with small modifications.

Core Network of Coastal Sea Level Stations

Equipment: IOC/GLOSS or equivalent proven equipment (accuracy and resolution should be equal or better than 1 cm for multipurpose stations), with possibility of data sampling below 1 min (seconds). In situ data storage capacity. Redundancy of equipment is desirable, especially in cases where the existing tide gauge do not fulfil the multi-purpose condition.

Data sampling and transmission: 1 min (maximum, better 15 or 30 seconds) averages and a continuous transmission cycle of 1 min, for stations within 1 hour of travel and/or 100 km from the tsunami generation areas.

Communications: redundancy systems of data transmission via WMO's GTS to the corresponding regional data centres (to be defined), after the new codes of GTS for real time data transmission are tested. BGAN or IP-based systems are strongly recommended.

Power supply: redundancy of systems (batteries, solar panels, UPS, etc).

Core Network of Offshore/Deep Ocean Stations

Equipment: main sensor for tsunami detection should be a bottom pressure sensor that is able to determine the tsunami amplitude before it arrives to the coast. Measurement accuracy of water column pressure should be 0.5 cm.

Data sampling and transmission: 1 min or less averages data sampling, measurement processing within 2 minutes and measurement availability within 5 minutes.

Communications: a reliable data transmission should be used (following the experience of existing deep ocean stations in other regions) and data must be placed on GTS operated by the WMO.

Gaps and Deficiencies

Several countries are already making efforts to upgrade their national sea level networks, most of the times as part of a multi-purpose/multi-hazard system approach. This is the case especially for countries from the Atlantic coast and North of Europe, where besides data are normally available and open to be included in the system. The situation is completely different in the Mediterranean, where the most at risk areas are found: tide gauges here are not being upgraded now, and if they are, the availability of the data is not confirmed sometimes. In this part of the region there are more difficulties to get the funds, and countries sometimes have no adequate mechanisms to carry out this task. In the North of Africa the problem is enhanced, as even there are no news of the existence of operational stations with data that can become available to the community, so there is a need of installation of completely new stations. Funds for these new

stations may be provided sometimes by ODINAFRICA, but are not available in other cases, such as the new station to be established at Lebanon. For the already existing stations, smaller amount of funds can be needed for upgrading to tsunami requirements, such is the case of several MedGLOSS stations. In any case, the Member States should make the commitment to provide the data and maintain the stations on a permanent basis for the stations proposed by WG3.

Action Plan

The planned, ongoing and new proposed actions concerning sea level monitoring for the NEAM region are included in Table 3.6.1. The main and key activities are:

- Installation and upgrade of an initial backbone network of coastal sea level stations to be operational by the end of 2007
- Upgrade of additional sea level stations to the system based on the WG3 proposed list and national needs during the second stage of the implementation plan (end of 2011).
- Design and implementation of the network of deep ocean sea level monitoring stations to be also in operation by the end of 2011.
- Agreement on data format standards before the end of 2007, and test of GTS real time codes for sea level
- Proposal on Regional Data Centres for reception and quality control of sea level data

A detailed estimate of the required budget for the implementation of each station remains to be done, but a rough estimate for completely new stations would be of the order of 20.000 Euros of investment and 6000-9000 Euros/per year for maintenance and communications, although this last item will be vary from one place to other. For the first year up to 12 completely new stations will have to be installed according to the last recommendation of WG1 about priority of sites. Some of them have already funds available, for others funds need to be allocated.

Implementation Plan for Sea Level Measurements

Task/Milestone	Country/ Location	Responsibility	Timeline	Required budget	Status 1
Final selection of initial stations to be upgraded/installed within 2007	Regional	Member States	NEAMTWS-III		C
Completion of survey on data transmission of existing sea level stations in NEAMTWS region	Regional	ESEAS	2007		O
Report on initial sea level stations status and needs of upgrade	Regional	Spain	NEAMTWS-III		C
Final requirements on the priority of the sites	Regional		NEAMTWS-III		C
Existing offshore instrumentation report	Regional	Israel, France	2007		O
Standard format description for sea level (based on Indian and Pacific warning systems)	Member States		May 2007 (before G.A. meeting in June)		P
Test of the GTS new codes for real time transmission of sea level data	Regional	Spain	September 2007		P

Task/Milestone	Country/ Location	Responsibility	Timeline	Required budget	Status 1
Upgrade / install backbone network sea level sensors for the ITWS	Member States	Member States	December 2007		P
Selection of deep ocean stations to be part of the final TWS (2011)	Regional	Italy	2007		P
Organization of a meeting of existing sea level organizations (GLOSS, MedGLOSS, ESEAS, EuroGOOS...) for proposals on the RTWC for sea level data			April 2007 (before General Assembly in June)		P
Upgrade national sea level networks for the NEAMTWS	Member States	Member States	2011		P
Upgrade national (enhanced) sea level networks tailored to specific national needs.	Member States	Member States	2011		P
Establish deep ocean sea level monitoring stations in the TWS network	Member States	Member States	2011		P

1 Notes: Status: P-Planned, C-Completed, O-Ongoing

Sessional Working Group 4 – Advisory, Mitigation and Public Awareness

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Loyer Pierre (AAS)
Ivica Trumbic (MAP)
Juan Carlos Villagrán De León (UNU-EHS)

Implementation plan

The impact of a tsunami can be substantially reduced if timely warnings are issued to population by the TWS and if coastal communities are prepared to the tsunami impact through appropriate programmes of preparedness and education, leading to effective response in the emergency and to the reduction of vulnerability and risk. Proper advisory schemes tailored to the local communities, mitigation measures and public awareness sustained and maintained over the long term are essential components of an end-to-end tsunami warning system for the NEAM region. If the issues of mitigation and population response are key points for tsunami warning systems in all the oceans, these are even more crucial in the NEAM region where tsunami travel times are very short, and there is a possibility that a tsunami will impact either before the population can be properly alerted by the TWS or soon after the TWS has issued warnings. It is important, therefore, that national and local emergency response plans be prepared for coastal regions, that regular preparedness exercises and drills be undertaken, starting with those coastal areas identified as the most exposed to the potential tsunamis, and that coastal communities undertake sustained efforts to reduce risks from tsunamis by mitigation and adaptation. Education and outreach campaigns, including preparation of ad-hoc educational material, have to be undertaken specifically on tsunami and storm surge risks, warning systems, and emergency response in coastal regions.

As a key part of this Implementation Plan, recommendations for guidance to authorities will be prepared that relate in general to coastal flood risk management in the context of ICAM (ICZM). They will concern the well-being coastal communities that are threatened by inundation not only from tsunamis, but also from other catastrophic marine physical hazards including storm tidal surges and unusually large, wind-induced waves (Table 1). For completeness, the guidance will also cover the implications for coastal flood risk management of the progressive impacts of sea-level rise and predicted climate change over the long term. It is emphasized that the implementation of responses within individual Member States is the responsibility of those MS, and is outside the scope of the operational parts of NEAMTWS such as seismic detection and sea-level monitoring.

Implementation will be carried out in consultation with other TWS, regional bodies including the European Commission and Barcelona Convention, and the UN agencies dedicated to disaster reduction and risk management.

The guidance will be presented in four sections:

The first covers information on hazard events received from Regional Tsunami Watch Centres by National Tsunami Warning Centres, and their dissemination via local authorities as warnings or alerts to vulnerable communities. A priority task will be to make recommendations for the harmonization and standardization of the nomenclature used for the various advisory and warning messages delivered in the event of a tsunami incident or a developing storm surge.

The second section deals with emergency responses of MS, and particularly local authorities, for coping with marine inundation and determining the priorities of designated authorities for emergency response preparedness.

The third relates to communication systems, both for the transmission of event-related information and warnings, and for use in emergency response operations. A priority will be to make recommendations for standards covering the communications systems used in end-to-end information and warning networks.

The fourth section will deal with the mitigation of, and adaptation to, the impacts both of extreme marine hazard events and of long-term, progressive sea-level rise which will exacerbate the impacts of extreme events. This latter section will include recommendations for assessing vulnerability, reducing or minimizing human and economic vulnerability through public awareness and education, strategic planning and flood risk management, taking into account environmental and demographic changes within the planning timescale. The activities of this section will include the development by IOC of "Guidelines for Mainstreaming Awareness and Mitigation of Marine-related Hazards and Risks in Integrated Coastal Area Management (ICAM)". These guidelines will be global in their scope.

Characteristics of, and responses to, marine physical hazards

MARINE HAZARD →	***Tsunami***	***Storm surge****	***Extreme wind-forced waves****	***Long-term sea-level rise***
Likely frequency of event	Decades to millennia, depending on regional tectonic regime	Months to decades, depending on regional climate regime	Months to decades, depending on regional climate regime	On-going, a consequence of global warming and local factors
Type of impact	Initial sea-recession; catastrophic inundation and drainage surges, may be multiple	Catastrophic, single-event inundation	Multiple, localized inundation and drainage surges	Progressive rise of mean high (tidal) water level
Limits of area likely to be affected	Local run-up limit for specified wave amplitudes predicted by modelling	Flood limit for specified surge level predicted by terrain modelling	Flood limit for specified wave heights predicted by terrain modelling	Mean high water mark predicted by terrain modelling with allowance for extreme events
Potential warning time	Minutes to hours, depending on proximity of source location	Hours to days, depending on climatic factors	Hours to days, depending on climatic factors	Decades to centennial
Action by Regional Watch Centre(s)	Issuance of Watches and event information to National Warning Centres			No action
Action by National Warning Centre(s)	Issuance of Warnings to appropriate Local Authorities			No action
Emergency actions by Local Authorities	Launch of emergency response action on receipt of Warning			No action
Mitigation and adaptation by Local and National Authorities	Vulnerability assessment of coastal populations and infrastructure; Strategic spatial planning and regulation to minimize vulnerability; Public awareness campaigns, including emergency response exercises (coping) and education (coping and adaptation)			

*Risks of inundation are greatest when surge and wave events coincide

Mainstreaming tsunami and other marine-related hazard warning, mitigation and adaptation practices into development planning for coastal areas through ICAM will ensure sustainability of development through adequate prevention programmes and through mitigation measures, such as the establishment of coastal buffer zones and protection of coastal vegetation and habitat. Coordination among national and international agencies responsible for disaster risk reduction and disaster management to lead, monitor, and coordinate the emergency response in countries throughout the NEAM region will identify gaps, avoid duplications, rationalise resources, harmonise plans and initiatives in the interest of the local communities. With particular regard to tsunamis, building the capacity of national and local agencies and institutions to prepare for, and respond to, emergencies is a priority for many countries of the NEAM region. Developing national and local emergency response plans including assessment of critical infrastructure and production of evacuation maps is an objective that is still far from being accomplished.

The implementation will recognize the diversity of the region and accept that flexibility is needed in order to accommodate the circumstances and requirements of individual countries. The guidance therefore will aim to highlight principles of good practice that may be generally applicable, illustrated by examples chosen from within this TWS region and, where appropriate, other regions. A key consideration in the preparation of these guidelines will be the assessment of the risk of flooding and its consequences, geographically, socio-economically and temporally. Within the region, the Mediterranean Sea coasts – and especially the eastern Mediterranean – have the greatest incidence of tsunami impact, while Northern Europe's coasts have the greater risk of storm surge events – southern North Sea coasts and estuaries being most prone. In particular, it is important that implementing national and local authorities understand the levels of vulnerability of coastal communities and infrastructure, as well as the nature of the hazard impacts, including the likely warning time for potential emergency response, the possible return periods of tsunami and storm surge events, and the timescales over which significant sea-level rise may occur (Table 1). Such information should form the basis for any response, whether for early warning, for emergency preparedness and response, or for mitigation and adaptation, so that the response arrangements are credible, sustainable and appropriate to the risk.

Implementation Plan for Advisory, Mitigation and Public Awareness

Activity	*Country/Location*	*Responsibility*	*Timeline*	*Required Budget*	*Status*
Make recommendations on harmonization of warnings nomenclature and standards by consultation between all TWS and in consultation with Barcelona Convention and European Commission	Regional	IOC TWS Member States	Phase 1 Oct 2007 Continued output to 2009	$ 15 000	O
Make recommendations for best practice and standards for emergency preparedness and response for national and local authorities; consultation with civil protection agencies (including coastal cities) and the European Commission	Regional	IOC assisted by UNU EHS and ISDR	Phase 1 Oct 2007 Continued output to 2009	$ 15 000	O
Make recommendations on communications, including standards, authentication and spectrum requisition; consultation between all TWS; also with	Regional	IOC TWS	Phase 1 Oct 2007 Continued output to	$ 20 000	O

Activity	*Country/Location*	*Responsibility*	*Timeline*	*Required Budget*	*Status*
European Commission; liaison with WG1 and WMO in respect of output messages from RTWCs			2009		
Develop IOC Guidelines for mainstreaming consideration of tsunamis and other marine-related hazards into ICAM plans and programmes; taking account of on going research (TRANSFER; FLOODSITE, etc) inclusion of vulnerability assessment, mitigation and adaptation.	Global	IOC Member States	End 2008	tba	P
Workshop on stakeholder participation in marine-related hazards mitigation processes	Regional	Portugal	End 2007	tba	P

1 Notes: – Status: P – Planned, C – Completed, O – Ongoing

ANNEX VIII

LIST OF ACRONYMS

BGS	British Geological Survey
BOOS	Baltic Operational Observing System
CEA/DASE	Commissariat à l'Energie Atomique, Département analyse, surveillance, environnement
CTBTO	Comprehensive Nuclear-Test-Ban Treaty Organization
DKKV	German Committee for Disaster Reduction
EMSC	European Mediterranean Seismological Center
ESEAS	European Sea-Level Service
EUROGOOS	Global Ocean Observing System in the European Seas and Adjacent Oceans
GEO	Group on Earth Observation
GFZ	GeoForschungsZentrum/National Research Centre for Geosciences
GLOSS	Global sea level Observing System
GOHWMS	Global Ocean-related Hazards Warning and Mitigation System
GOOS	Global Ocean Observing System
GTS	Global Telecommunication System
ICG	Intergovernmental Coordination Group
I-GOOS	Intergovernmental IOC-WMO-UNEP Committee for GOOS
INGV	Italian Institute of Geology and Vulcanology/Istituto Nazionale di Geofiscia e Vulcanologia
IOC	Intergovernmental Oceanographic Commission
IOTWS	Indian Ocean Tsunami Warning System
ITWS	Initial Tsunami Warning System
JCOMM	Joint Technical Commission for Oceanography and Marine Meteorology
KOERI	Kandilli Observatory and Earthquake Research Institute
MAMA	Mediterranean Network to Assess and Upgrade Monitoring and Forecasting Activity in the Region
MedGLOSS	Mediterranean Network for Systematic Sea-level Monitoring in the Mediterranean and Black Seas - regional subsystem of Global Sea Level Observing System
NEAMTWS	Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas
NOA	National Observatory of Athens
NOAA	United States National Oceanic and Atmospheric Administration

NOOS	North West Shelf Operational Oceanographic System
NTWC	National Tsunami Warning Centre
PPEW	Platform for Promotion of Early Warning
RTWC	Regional Tsunami Watch Centre
TWS	Tsunami Warning System
UNEP	United Nations Environmental Programme
UNEP/MAP	United Nations Environment Programme's Mediterranean Action Plan
UNESCO	United Nations Educational Scientific and Cultural Organisation
UN/ISDR	United Nations International Strategy for Disaster Reduction
UNU/EHS	Institute for Environment and Human Security of the United Nations University
WMO	World Meteorological Organization

In this Series *Languages*

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

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

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

114.	Second Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS), Hyderabad, India, 14–16 December 2005	E only
115.	Second Session of the WMO-IOC Joint Technical Commission for Oceanography and Marine Meteorology, Halifax, Canada, 19–27 September 2005 (Abridged final report with resolutions and recommendations)	E, F, R, S
116.	Sixth Session of the IOC Regional Committee for the Western Indian Ocean (IOCWIO), Maputo, Mozambique, 2–4 November 2005 (* Executive Summary available separately in E, F, S & R)	E*
117.	Fourth Session of the IOC Regional Committee for the Central Indian Ocean, Colombo, Sri Lanka 8–10 December 2005 (* Executive Summary available separately in E, F, S & R)	E*
118.	Thirty-eighth Session of the Executive Council, Paris, 20 June 2005 (Electronic copy only)	E, F, R, S
119.	Thirty-ninth Session of the Executive Council, Paris, 21–28 June 2006	E, F, R, S
120.	Third Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS), Bali, Indonesia, 31 July–2 August 2006 (*Executive Summary available separately in E,F,S & R)	E*
121.	Second 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), Nice, France, 22–24 May 2006	E only
122.	Seventh Session of the IOC Intergovernmental Panel on Harmful Algal Blooms, Paris, France, 16–18 March 2005 (* Executive Summary available separately in E, F, S & R)	E*
123.	Fourth Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS-IV), Mombassa, Kenya, 30 February-2 March 2007 (* Executive Summary available separately in E, F, S & R)	E*
124.	Nineteenth Session of the IOC Committee on International Oceanographic Data and Information Exchange, Trieste, Italy, 12–16 March 2007 (* Executive Summary available separately in E, F, S & R)	E*
125.	Third Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas, Bonn, Germany, 7–9 February 2007 (* Executive Summary available separately in E, F, S & R)	E*