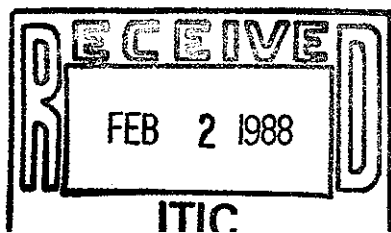


International Co-ordination Group for the Tsunami Warning System in the Pacific

Eleventh Session

Beijing, People's Republic of China, 8-12 September 1987



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
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*This document has been printed
in English, French, Spanish and Russian
except for the annexes, which appear in English only*

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1. ORGANIZATION OF THE SESSION

In the absence of the Acting Chairman of the Group, Eng. Eddy H. Sanchez B, the International Co-ordination Group for the Tsunami Warning System in the Pacific invited the Director ITIC, Dr. G. Pararas-Carayannis to chair the Session. 1

He called on the participants to stand for a minute's silence to mark the death of the Chairman of the Group, Mr. Norman Ridgway, who passed away during the intersessional period and who was among those prominent figures whose role in promoting the Tsunami Warning System in the Pacific will never be forgotten. 2

Dr. G. Pararas-Carayannis opened the Eleventh Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific at 10.00 on Tuesday, 8 September 1987 at the National Research Center on Marine Environment Forecasts (NRCMEF). 3

In his welcoming address the Chairman thanked the Government of the People's Republic of China and particularly the Director-General of the State Oceanic Administration (SOA) and the Director of NRCMEF for hosting the Meeting and for their continuous support to the Tsunami Warning System. He emphasized that the purpose of the Eleventh Session is to co-ordinate the many interesting and exciting activities that have been taking place and which will result in further improvements of the Tsunami Warning System. He noted that though the intersessional period from August 1985 to September 1987 has been remarkable in terms of activities for the improvement of the Tsunami Warning System, and of accomplishments, many more improvements can be made and will be made. 4

He then called on the Deputy Director-General of SOA, Mr. Yang Wenhe to address the Session. 5

Mr. Yang Wenhe extended a warm welcome to the Member States of the IOC/ITSU and to the participants of the Session. 6

He referred to the importance of tsunami studies and mitigation for China and gave some examples of the loss of life and heavy destruction caused by tsunamis in his country. 7

He noted a number of principles that are considered and observed by China in determining the set-up of the National Tsunami Warning System, among them: the establishment of an integrated system in China for both tsunami and storm surge warnings, the full utilization of existing network of oceanographic and seismological observation stations and the importance of close co-ordination with other relevant international regional and national programmes. 8

Mr. Yang Wenhe expressed his appreciation for the efforts made by 9

the IOC/ITSU for the development of national or regional tsunami warning systems, in training and assistance for tsunami preparedness and in many other fields within the responsibility of the Group.

10 In closing he wished the Session every success and expressed a strong belief that the achievements of this Session will play an important role in the advancement of the Tsunami Warning Service.

11 The full text of the Deputy Director-General's statement is given in Annex V.

12 Speaking of behalf of Professor Chao Jiping, Director of NRCMEF, the Deputy Director of the Center, Prof. Chenglan Bao, expressed a cordial welcome to the participants and his pleasure in hosting the Eleventh Session of ITSU.

13 He informed the participants on the activities of the Center which is a research institute engaged in marine environmental forecasting services. Different laboratories of the Center are responsible for operation and research activities in the areas of ocean waves, sea ice, seawater temperature, currents, storm surges, tsunamis, marine meteorology, etc. In addition to operational and research activities, the NRCMEF is active in training. Prof. Changlan Bao emphasized that the Center's staff members are looking forward to further co-operation with various international organizations and scientists abroad in the field of marine environmental forecasting, marine hazards, warning and prevention.

14 The Chairman of the Session then invited Dr. I. Oliounine, Senior Assistant Secretary IOC in charge of Ocean Services, to address a welcome to the Session on behalf of the Chairman and Secretary IOC.

15 In his statement, Dr. I. Oliounine noted the success achieved by the Group after 20 years of existence and stressed that the Tsunami Warning System is now about to embark on a new phase in which special emphasis should be laid on the development of regional warning centers, on the building-up of knowledge, and on broad operational dissemination of tsunami warnings.

16 He expressed a strong belief that this Session will provide a good opportunity to exchange views and to find ways to further development of the system, that the recommendations of the Session will provide a basis for evolving a sound and workable strategy to guide IOC activities in mitigation of tsunamis and that these recommendations will be noted more widely than before and will ultimately be of use to many nations and organizations concerned.

17 Dr. Oliounine further stated that the IOC will always be attentive to the efforts of the Group and will remain receptive to its aspirations and needs and that the IOC places great hopes in the Group. He joined the Chairman of the Session in expressing sincere thanks to the Government of the People's Republic of China and wished the Group's proceedings every possible success.

The Chairman of the Session thanked all speakers for their most interesting remarks and information, valuable advice and kind and encouraging words. He then asked the representative of the local Organizing Committee to inform the Session on local arrangements.

18

The Group was invited to consider the Provisional Agenda as presented in Doc.IOC/TTSU-XI/1 Prov. for adoption. The Agenda was adopted as presented in Annex I.

19

Mr. T. Sokolowsky (USA) was unanimously designated Rapporteur for the Session.

20

The Secretary briefly introduced the time schedule, identified changes in the List of Documents (Doc.IOC/TTSU-XI/4, see Annex IV) and reviewed the documentation.

21

The Group agreed with the proposed changes and with the suggested working arrangements and recognized that though the work will basically be carried out in plenary sessions there might be a need to establish drafting groups to deal with specific problems in order to facilitate the work of the Group.

22

The List of Participants is Annex III.

23

2. INTERSESSIONAL ACTIVITIES

The Director ITIC briefly summarized his report on intersessional activities which covers the period since the Tenth Session of the ICG/TTSU, for 1985-1987 (Doc.IOC/TTSU-XI/7). He gave some examples of progress made in implementing the programme during this period, as well as of difficulties encountered.

24

Approximately 40 events were investigated during these years, reports on large earthquakes and other tsunamigenic events as well as on tsunamis themselves have been published in the ITIC Newsletter. Four Regional Tsunami Watchers and one Tsunami Warning for the 7 May 1986 earthquake were issued.

25

All actions taken by the Pacific Tsunami Warning Center (PTWC) were in accordance with established procedures. However, although the actions taken by PTWC for the 19 September 1985 and 7 May 1986 events were correct these 2 events focussed attention on the need for additional tsunami stations and for better ways of communication.

26

A number of operational improvements have been made to the Tsunami Warning System. In addition to the established international seismic stations exchanging seismic data with PTWC, seismic data was received in real-time at PTWC from a total of 14 stations in the northern hemisphere in addition to the 9 seismic stations located in the Hawaiian Islands. Remarkable progress has been made in establishing sea level measuring instrumentation. Twenty additional sea level data collection platforms (DCP) have been installed in South America and in the Southwest Pacific bringing the total number of such platforms to 27. These stations have the ability to

27

telemeter sea level data in real-time via satellite. Progress has been made in improving the computer software for epicenter determination and in improving the determination of earthquake size.

28 Numerous visitors were received at ITIC from different ITSU countries and specific problems were resolved during these visits. Through correspondence, there was co-ordination with individual scientists and government officials of more than 20 IOC Member States. ITIC effectively fulfilled its mandate of training experts from developing countries and assisting them with the planning of necessary action in order to improve national tsunami warning capabilities.

29 Installation of microcomputers at ITIC helped significantly in facilitating the activities of the Center. Implementation of a number of projects supported by the IOC has been started: compilation of existing catalogs of historical tsunami, development of an atlas of tsunami marigrams and a glossary of tsunami related terms, organization of different archive files, upgrading the annotated tsunami bibliography, etc. The direct financial support from IOC has permitted the hiring of clerical staff to keypunch the data. ITIC assisted in the organization and publicity for several scientific symposia and conferences and provided historical data to numerous governmental and non-governmental agencies, institutions and individuals.

30 Finally, the Director ITIC expressed hope that the close co-operation and co-ordination between IOC and ITIC achieved during the last years will continue.

31 The Senior Assistant Secretary IOC reported on the actions taken by the IOC to implement the decisions of the Tenth Session of the IOG/ITSU and those of the IOC Governing Bodies relevant to the Group's activities (Doc.IOC/ITSU-XI/6). He stressed that the implementation of the decisions of the Group depends on active support from all participating Member States.

32 He called attention to those decisions of ITSU-X the implementation of which has been strongly hampered for various reasons: absence of nominations for Associate Director of ITIC; slow reaction of potential donor agencies for funding of the project proposal for a Regional Tsunami Warning System in South-East Asia; delay in the finalization of the Tsunami Workshop Report and Proceedings; delay in submission of reports on national intersessional activities for distribution to ITSU Member States well in advance of the Session of the Group.

33 The Group noted with interest and appreciation the reports of the Director ITIC and the Senior Assistant Secretary IOC and agreed that information contained in the reports will be taken up under relevant Agenda Items. The Group expressed its full satisfaction with the work accomplished by the IOC Secretariat and ITIC during the intersessional period and strongly supported the efforts made by the Commission in providing direct support to ITIC activities in spite of heavy financial constraints. The Group reiterated the importance of the role of ITSU National Contacts in persuading their national authorities to increase support to the programme.

The Chairman of the Session called on all Delegates present to submit reports on their national intersessional activities. 34

The complete text of national reports will be published in the ITSU Newsletter. 35

The Group noted the progress achieved by Member States in the development of their national warning systems and urged them to increase their efforts to develop better bilateral and regional co-operation. The Group expressed concern over the delay or lack of submission of National Reports on intersessional activities. In spite of numerous efforts by the IOC Secretariat only 4 Member States out of 24 kept the deadline for report submission and only 16 reports were submitted to the Session. The Group requested the Director ITIC jointly with the IOC Secretariat to carry out a survey on the reasons for such a situation and to report on the results to the next Session of the Group. 36

3. IMPLEMENTATION OF RESOLUTIONS AND RECOMMENDATIONS OF THE TENTH SESSION OF THE IOC/ITSU (1-3 August 1985, Sidney, Canada)

3.1 MASTER PLAN FOR INTERNATIONAL TSUNAMI WARNING SYSTEM

The Group adopted the Master Plan for the Tsunami Warning System in the Pacific (Doc. IOC/ITSU-XI/9) with the amendments as suggested by Member States of ITSU. The Delegate of Canada offered to prepare the final type-written copy of the Plan and submit it to the IOC before the end of October 1987 for final assembly, publication and wide distribution. 37

The Group expressed its most grateful appreciation to Mr. G. Dohler for his considerable efforts and his unflagging determination to bring the Master Plan to completion. The Group pointed out that the Plan will be an essential working document for future ITSU meetings with the aim of reviewing and updating it in the light of new technology and new membership. The Group recommended that the author of the Plan should present it to the next International Conference on Natural and Man-Made Hazards to be held, San Diego, USA and Ensenada, Mexico, August 14-21, 1988. 38

The Group supported the offer made by the Editor of the Natural Hazard Journal, Prof. M. El-Sabh, Canada, to use the publications of other international bodies for wide advertizing of the Master Plan and its objectives. 39

3.2 TSUNAMI TRAVEL TIME CHARTS

The IOC Senior Assistant Secretary informed the Session on the successful implementation of Recommendation ITSU-X.1. Tsunami Travel Time Charts for 25 locations of the Pacific have been produced in the Soviet Union and distributed by the IOC to all ITSU Member States and participants of the Session. There are more sets of charts available on request at the ITIC. Professor Y. Shokin presented a paper "Calculation of Tsunami Travel Time Charts in the Pacific Ocean" which contains the description of the models, algorithms and techniques which were used for the development of charts. The complete text of the paper will be published in the coming issue 40

of the ITSU Newsletter.

41 The participants of the Editorial Group Meeting held in Honolulu
in April, 1986 recommended that work on the production of tsunami travel-
time charts should be continued and proposed 10 additional locations. This
recommendation was supported by the IOC Assembly at its Fourteenth Session.

42 The Group expressed appreciation to the Soviet Union for the
quality of the new charts. The Group strongly supported the view expressed
by the participants of the Session on the need to construct charts for all
locations specified in the ITSU Communication Plan, and agreed that the
preparation of a loose-leaf Atlas with a complete set of tsunami travel-time
charts will be of great interest and importance to all IOC Member States of
the Pacific affected by tsunamis. The Group recommended that the Secretary
IOC will consider ways of supporting the implementation of this project.

43 The Group adopted Recommendation ITSU-XI.1.

44 The Group reiterated its strong desire to obtain more bathymetric
data for the preparation of new tsunami travel time charts so as to change
the grid of calculations from one square degree to 5 square minutes. This
will increase their accuracy. The Group urged its Chairman, Director ITIC
and the Secretary IOC to make all possible efforts to provide the Computer
Center responsible for charts production with this data.

45 The Group recommended further that the possibility of the
development of tsunami travel time charts for boundary seas of the Pacific
Ocean should be investigated and the results of the investigation reported
to the next Session of the Group.

3.3 GLOSSARY OF TSUNAMI-RELATED TERMS

46 The Director ITIC introduced this Agenda Item and presented a
preliminary glossary of tsunami-related terms proposed by the Center to the
Group for their review. This draft was circulated for comments but because
of the voluminous nature of the document an ad hoc review group was
appointed by the Chairman to prepare recommendations to the Group relevant
to the issue. The ad hoc Group consisted of Dr. Pararas-Carayannis, ITIC,
Prof. S. L. Soloviev, USSR, Dr. T. S. Murty, IOC Consultant, Mr. H. Soldi,
Peru and Mr. E. Lorca, Chile. The following procedure for finalizing the
glossary was recommended to the Session:

- (i) Dr. Pararas-Carayannis is to provide an updated copy of the glossary to
Prof. Soloviev within 6 months from the day of the closure of the
Session.
- (ii) Prof. Soloviev with the help of his colleagues will prepare the
revision of the draft glossary, as needed, within a period of 8 months
after receiving an updated copy of the glossary from Dr. Pararas-
Carayannis and he will then pass the revised version to the IOC.
- (iii) IOC will circulate copies to the Member States of ITSU as well as to
scientists for comments so as to incorporate these comments in the

final draft during the first quarter of 1989.

- (iv) An ad hoc Editorial Meeting will review the final draft in mid-1989 and make draft recommendations to ITSU-XII on the publication of the glossary.

The Group recommended that the participants of the Editorial Meeting should be those who served in an ad hoc review group mentioned in the first paragraph of item 3.3 and requested the Secretary IOC to allocate funds for this meeting and to make all the arrangements necessary.

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3.4 DATABASE FORMAT

In meeting the directives of its mandate, the ITIC has made considerable progress in developing a complete and thorough historical tsunami database to serve the needs of PIWC as well as of other IOC Member States seeking to mitigate the tsunami hazard. The database was compiled from many sources including previous ITIC databases, World Data Center A, USSR and Japan. It was noted that existing databases are varied in format which does not permit easy accessibility of the data.

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The Group agreed that the draft of the ITIC standard format, submitted to the Group for comments and acceptance would permit historical tsunami data to be easily cross-referenced, to be available for statistical manipulations, and to be used to facilitate decision-making in operational problems. Software has also been created by the ITIC using this format for processing the data.

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The Group requested that the ITIC implement this format and associated software which performs rapid data processing for operational and non-operational uses and send it to ITSU National Contacts and to the scientific community for comments as soon as possible.

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3.5 COMMUNICATION PLAN

At the Tenth Session of the ICG/ITSU, the Group decided that the form of "the communication plan for the tsunami warning system in the Pacific (prepared regularly by the USA) adequately satisfies the Member States' requirements". Consequently, the USA produced an updated edition of the Plan.

51

Mr. Gordon Burton of the Pacific Tsunami Warning Center (PTWC) provided summary comments on the final draft to the Group. The proposed Eleventh Edition has been updated to reflect the most recent communication methods of member agencies and expanded to include the participation of new Member States. The structure and format of this new edition has been revised and organized on a country to country basis so that the respective dissemination agency, seismological stations, and tidal stations are grouped together for each country.

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In addition to restructuring the Plan, a significant change was included in the format of messages to be issued by PTWC so that the message content could be clearly understood. Each message includes a header which

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clearly identifies the type of message and the appropriate actions to be taken. Three basic types of messages will be issued by PIWC: a Tsunami Information Bulletin to advise of the occurrence of a non-tsunamigenic earthquake; a Tsunami Watch Bulletin to advise of the probability of generation of a tsunami and a Tsunami Warning Bulletin to advise of the generation of a potentially destructive tsunami. The Tsunami Watch Bulletin represents a significant change in text and form from the previous Regional Tsunami Watch Bulletin to minimize possible confusion and misinterpretation, although operational procedures remain the same and in conformance with IOC/TTSU procedures for the issue of a Regional Tsunami Watch. Countries within a 6-hour tsunami travel time from the source region will be placed in watch status with those countries within a 3-hour travel-time being designated for possible urgent action.

54 The restructuring of the communication plan and the revision of message texts are intended to make the plan a more useful and flexible document and to make messages more meaningful and clearly understood.

55 The final draft of the eleventh edition of the Communication Plan for the Tsunami Warning System was distributed to all TTSU National Contacts prior to convening the Eleventh Session of the Group in order to provide time for review (Doc. IOC/TTSU-XI/11).

56 The Group accepted the Plan and requested the Director of PIWC to incorporate comments made during the Session and received from Member States in the final version of the Plan. The Group requested further the Director of PIWC to finalize the document before the end of 1987 and recommended that the IOC logo should be printed on the cover page in order to reflect the international nature of this Plan and thus, contribute to promote the use of this document.

3.6 GUIDE ON WAVE REPORTING PROCEDURES

57 In accordance with the decision of the Tenth Session of IOC/TTSU, the United States were to explore the possibility of revising the Guide on Wave Reporting Procedures, the first version of which was issued by IOC/Unesco in 1975. The USA had volunteered to produce a revised version which was presented to the Group for comments and acceptance (Doc. IOC/TTSU-XI/12).

58 The Group considered that this version was adequate to meet present needs, thanked the USA for preparing it, and accepted it for publication. The Group requested the Secretary IOC to publish the Guide as soon as possible but no later than the middle of 1988. The Group further requested that this Guide also be made available in the other working languages of the Commission: French, Spanish and Russian.

4. OPERATIONAL IMPROVEMENTS TO THE TSUNAMI SYSTEM

59 Mr. Gordon Burton of the Pacific Tsunami Warning Center provided a summary presentation to the Group on the present operational status of the Pacific Satellite Sea Level Network. At present a total of 27 tide stations have been instrumented with satellite Data Collection Platforms (DCP's)

providing communication of sea level data via NOAA's Geostationary Operational Environmental Satellite (GOES). These stations are located along the coast of Central and South America and at island stations in the South, Southwest, and Central Pacific. A description of DCP instrumentation was provided followed by examples of sea level data transmitted to PIWC for the Adak tsunami of 7-8 May 1986 and the Antofagasta tsunami of 5 March 1987. Other applications of GOES sea level data included monitoring of station instrumentation operations, monitoring of sea level activity relating to storm surge, and determination of variations in mean sea level.

Though the Pacific Satellite Sea Level Network was initiated by Dr. Klaus Wyrtki of the University of Hawaii in 1982, it presently is a reflection of the international efforts of many participating IOC/ITSU Member States. This represents a major operational improvement to the Tsunami Warning System in making critical sea level data available to the Pacific Tsunami Warning Center from automated remote locations throughout the Pacific. By utilizing GOES transmission, sea level data are received at PIWC within a few minutes for utilization in the detection and evaluation of tsunamis.

Future applications of GOES technology were presented, including the satellite transmission of seismic data from remote locations and the transmission of tsunami data from PIWC to local ground station receivers where other communication facilities do not exist. It is recognized that seismic data transmitted via GOES can be received at PIWC within 3-5 minutes to provide a more rapid epicenter and magnitude determination. The Group recognized that with additional development efforts, critical earthquake parameters, including origin time, epicenter, and size, can be transmitted from PIWC for re-transmission by NESDIS and receipt by any user throughout the Pacific equipped with a small inexpensive satellite ground station, provided that the station is within the range of the transmitting satellite. The Group appreciated the efforts made by ITIC and PIWC in the development of the concept for the operational basis of the next generation tsunami warning system.

Mr. J. Talandier (France) spoke of improvements made in the operational assessment of tsunami generation using a long period seismometer and the use of seismic moment. He informed the Group of the proposed installation of a new Harbour Platform for sea level data collection at Niue, to be implemented in co-ordination with the PIWC. This station is of strategic importance for the early detection of tsunamis from the Tonga-Kermadec Trench.

Mr. Emilio Lorca (Chile) briefed the Group on the operational improvements that have taken place in his country which enhance also the overall efficiency of the Tsunami Warning System. He spoke of specific improvements, such as the seismic trigger and the water level measuring instrumentation, installed in Chile under the THRUST program. Additional improvements include the preparation of numerical models, historical tsunami data collection, the preparation of a standard operational plan and other such activities that have resulted in establishing a more efficient tsunami warning service.

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The Group acknowledged the efforts made by Chile in the preparation of its national operational plan. The Group noted that the Chilean Operational Plan which satisfies the Chilean requirements, has not been tested to enable it to be applied directly to the requirements of the early warning system improvements presented by the Chilean representative.

Significant test results of the system's performance are required before any concrete proposal on dissemination of the experiences can be recommended. The Group requested Chile to test the Plan and to report on the results of this testing at the next Session.

5. CO-OPERATION WITH IUGG TSUNAMI COMMISSION AND OTHER INTERNATIONAL BODIES INVOLVED IN TSUNAMI MITIGATION AND RESEARCH

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Representatives of international bodies involved in tsunami research or other activities which might be of interest to the Group reported on the activities of their bodies and expressed views on the ways to improve co-operation. Dr. T. Murty, the past President of the IUGG Tsunami Commission, reported on several conferences concerning the mitigation of the tsunami hazard. He emphasized the importance of these collaborative conferences with other international bodies and expressed appreciation for IOC financial support to them. Dr. M. El-Sabh reported on the first International Symposium on Natural and Man-Made Hazards, Rimouski, Canada, August 1986. This Symposium was attended by participants from 34 countries. The papers presented covered an extraordinarily diverse range of hazards including tsunamis. During the final summing-up session of the Symposium, resolutions were proposed by various participants and presented to the plenary session. Dr. El-Sabh invited the Group to consider and endorse Resolutions I-III (Annex VI) related to tsunamis which were adopted during the international symposium. He recommended the IOC to co-sponsor the forthcoming second International Symposium on Natural and Man-Made Hazards in Coastal Zones, San Diego, USA/Ensenada, Mexico, August 1988.

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The Group endorsed Resolutions II through V of the Rimouski Symposium and stressed the importance of continued financial support from the IOC for experts to attend conferences concerning the protection of mankind from the tsunami hazard. The Group felt that the interaction of IOC/ITSU Sessions with related tsunami conferences was very beneficial and important for improving the Tsunami Warning System.

67

The Group recommended that the IOC should support, in order of priority, the following international meetings at which there will be an extensive discussion of matters relevant to tsunami operations and research:

- IUGG Tsunami Symposium, Novosibirsk, USSR, August 1989
- International Conference on Natural and Man-made Hazards in Coastal Zones, San Diego, California, USA and Ensenada, Mexico, August 14-21, 1988
- PACOM 88
- Tsunami Symposium of the European Geophysical Union, Bologna, Italy, March 1988

Mr. Kilonsky, an observer from the IGOSS Special Oceanographic Center for Sea Level (SOC), presented to the Group, the IOC Global Sea-Level Observing System (GLOSS) Programme which serves many purposes. It covers the entire spectrum in time and space from short-lived tsunami to the changes related to tectonic processes. He pointed out that at present 26 GLOSS stations are being used for both sea-level research at the University of Hawaii and for tsunami warning at PIWC. He emphasized that the establishment of near-real time sea level and tsunami warning systems usually entails a useful transfer of technology. Due to the fact that it is not unusual for a hydrological service to become more interested in sea level and tsunami warning systems after satellite transmitters are installed on their gauges, Mr. Kilonsky suggested that using GLOSS sea level stations for tsunami warning purposes is a mutually beneficial project and the experience gained should be used on a broader geographical scale. The Special Oceanographic Center for Sea Level would like to obtain the basic sea level and tidal information from all tsunami warning system tide stations. Currently under the IGOSS Sea Level Pilot Project (ISLPP) SOC is receiving data from 63 stations located in 34 different countries of the Pacific. He further suggested that depositing the sea level and tidal data collected from tsunami warning gauges at SOC would be an excellent way to show the multiple applications of the data and to further document the excellent spirit of international co-operation enjoyed by this Group.

The Group agreed with the proposals and requested its Chairman to prepare jointly with the Director of IGOSS SOC for Sea Level, a plan of action required to bring these proposals alive so that ICG/ITS Member States could start more effectively to meet the identified requirements. The Group expressed its thanks to Prof. Wyrteki, Prof. Enfield and their colleagues for their devotion and efforts in promoting the Sea Level Programme.

The Group noted with interest the written report of the Director of the WDC-A for Solid Earth Geophysics and expressed regret that the representative of the WDC-A was not able to attend the Session.

The Group noted also the need to improve links of beneficial co-operation with UNDRO and urged its Chairman, the Director ITIC and the Secretary IOC to take the necessary action.

6. TRAINING AND ASSISTANCE IN TSUNAMI PREPAREDNESS

Three types of activities were considered by the Group under this Agenda Item.

- The Director ITIC reported that in 1985-1986 4 experts from the Republic of Korea, Colombia, Indonesia and Guatemala received comprehensive training at the ITIC and PIWC. The experts were thoroughly familiarized with the operation of the Tsunami Warning System, worked on specific problems related to tsunami warning in their own country and on improvement of communications. Reports by visiting experts were prepared and submitted to the IOC Secretariat.

The Group felt that the training was a rewarding experience for the experts and for the ITIC and PIWC staff who worked with them. The Group

noted with satisfaction that the training these scientists received, and the exchange of ideas, have already resulted in positive benefits to the Tsunami Warning System through enhancing working ties and a spirit of co-operation among the ITSU Member States. The general view of the Group was that the visiting experts programme should be continued. The Group expressed its appreciation to the Directors of ITIC and PIWC for their generous efforts and to the Secretary IOC for his continuous interest and for making this programme possible through financial support.

74 The Group shared the concern expressed with regard to a long delay in nomination of candidates for this year's training course which is being planned for 26 October to 5 December 1987 due to the lack of response from Member States to the IOC invitation letter.

75 The Group recommended the following actions to improve the preparation of the course in the future:

- (i) information dissemination should be improved by wide usage of the ITIC Newsletter for advanced announcements;
- (ii) international organizations involved in tsunami mitigation and research should use their own channels to advertize the course;
- (iii) the list of ITSU Contact Points should be updated.

76 The Group requested the Secretary IOC to approach the IOC Action Addresses and ITSU Contact Points urgently in order to finalize the updating of the list before the coming session of the Executive Council.

77 Taking into account requests made by some participants of the Session, the Group requested the Secretary IOC to investigate the possibility of providing assistance to 2-3 participants of the visiting experts programme from the same country at a time, by covering their travel expenses.

78 The Group received information about the IOC co-sponsored mission to Mexico undertaken by the Director ITIC from 3-11 December 1985 in order to investigate and survey the effects of the tsunami generated by the earthquake of 19 and 21 September 1985 and to assist the authorities in Mexico with necessary planning to mitigate them (Doc. IOC/ITSU-XI/10). The mission was successfully implemented and gave positive benefits to Mexico and the Tsunami Warning System in the Pacific in general.

79 The Group reiterated the importance of arranging missions to Member States and called on the Secretary IOC to continue support for this important mechanism of assistance to Member States in tsunami preparedness and mitigation.

80 The Senior Assistant Secretary IOC then drew the attention of the Group to a long-awaited project proposal for the Regional Tsunami Warning Center for South-East Asia. He recalled the efforts made by the IOC Governing Bodies to try to persuade UNDP to change the priority of the project. He considered, and the Group concurred, that the Member States

concerned need to show initiative in making a contribution to the project which has long-term socio-economic benefits as a disaster-prevention measure and to give the required priority to this.

The Group adopted Recommendation ITSU-XI.2 on this subject.

81

7. MANDATE AND FUNCTIONS OF THE INTERNATIONAL TSUNAMI INFORMATION CENTER

Though this matter was discussed at length during the Ninth and Tenth Sessions of the IOG/ITSU, the Group felt that it would be appropriate to reflect more explicitly the relationship between the IOC and ITIC. The Group noted with satisfaction and strongly supported actions taken by the Secretary IOC in promoting ITIC activities. The increase of financial support from the IOC had made it possible for the Center to implement the preparation of the first draft of the Glossary of Tsunami Related Terms, the development of the historical tsunami data base, the automation of ITIC library holdings and the support of the ITIC visiting experts programme. The Group emphasized that the support should be continued and extended. The Group appreciated the work of the Director ITIC who despite the absence of adequate staff carries out his duties so efficiently and effectively.

82

The Group agreed that at the present time which is marked by an increased co-operation between the IOC and ITIC, there is a need to have an amendment to Resolution X-23, Mandate and Functions of the International Tsunami Information Center (ITIC) and recommended the following text to be added to the Annex of this Resolution under the description of the Mandate of the Center:

83

"The International Tsunami Information Centre (ITIC) operates with the support of the USA, the IOC and all IOC Member States. The Director ITIC should consult with the Secretary IOC on all policy issues which may have political or financial implications to the IOC."

The Group accepted Recommendation ITSU-XI.3.

84

The Group expressed concern that in spite of numerous calls on the IOC Member States, none of them had responded positively to the request to forward to the Secretary IOC, the names of candidates for the post of Associate Director of ITIC. The Group welcomed the decision of the IOC to provide support to the ITIC. The Group stressed that this type of assistance is supplementary to and not in lieu of the Associate Director and reiterated the need to continue efforts to fill the Associate Director's position.

85

8. PLANS FOR THE FUTURE

The IOC Senior Assistant Secretary informed the Group of the implementation of Recommendation ITSU-X.2 of the Tenth Session of the IOG/ITSU. In spite of the attempt made by the Group to urge Member States of ITSU to raise their voices at the Unesco General Conference in support of the IOC Tsunami Programme, no Member States present at the Conference expressed strong support for the Programme. As a result, second priority was

86

given to a few ITSU projects and funds have been cut off. That hampered the successful implementation of the minimum level of activities specified in Recommendation ITSU-X.2. The lack of funds did not permit the IOC to give major assistance to developing Member States of the Pacific for the improvement of their national warning centers; no funds had been allocated for the organization of ITSU-XI; the number of missions implemented during 1986-1987 was limited to one, etc.

87 The Group noted that the funds from Unesco budget in support of the ITSU programme which are now planned for the next biennium will not be sufficient to cover the wide spectrum of the activities agreed upon by the Group for 1988-1989.

88 After reviewing proposed activities for 1988-1989, the Group adopted Recommendation ITSU-XI.4.

89 The Group called on ITSU Member States to consider making contributions to the IOC Trust Fund for the implementation of the ITSU programme.

9. OTHER BUSINESS

 - Tsunami Brochure

90 The Director ITIC presented a draft of the updated version of the of the brochure on the Tsunami Warning System in the Pacific where there is an attempt to take into account the latest developments of the System.

91 The Group reviewed and adopted the brochure with minor editorial modifications. The Group requested its Chairman, jointly with the Director ITIC to prepare the final version with graphs and photos and to pass it to the Secretary IOC for publication before the end of 1987.

 - Tsunami Danger in Areas Outside the Pacific Basin

92 Professor S. Soloviev (USSR) expressed his concern to the Group on the necessity to estimate potential tsunami danger along different coast lines outside the Pacific Basin in particular, the coast lines of the Atlantic and Indian Oceans, and the Mediterranean and Caribbean Seas.

93 The Group noted the importance of studying tsunami hazards in these areas.

 - New Magnitude Scale

94 Dr. J. Talandier (France), proposed a new magnitude scale that can be used in the Tsunami Warning System for determining the magnitude of great earthquakes and tsunamigenesis.

95 The Group commented actively on the proposal and encouraged scientists and others to investigate the proposal in order to determine the capabilities for its particular uses. The Group advised that this issue should be included in the agenda of the next Symposium of the IUGG Tsunami

Commission. Future discussions should include the review of all commonly used magnitude scales for earthquakes and tsunamis. Dr. Talandier's proposal is annexed to the Summary Report of this Session (see Annex VII).

- Second IOC/ITSU Workshop

The Group discussed the possibility of holding another Workshop on Technical Aspects of the Tsunami Warning System in conjunction with the IOC/ITSU-XII. The Group noted the development of the Tsunami Warning System and the progress made by the IOC Member States in tsunami research and operations during the last few years and concluded that holding the Workshop would be desirable.

96

10. DATE AND PLACE OF THE NEXT SESSION

The Delegate of the Soviet Union, on behalf of his Government, proposed that his country host the Twelfth Session of the IOC/ITSU in August 1989, in Novosibirsk, in conjunction with the IUGG Tsunami Symposium. As in 1985, the conjunction of these meetings will allow maximum interaction between those engaged in tsunami operations and research and will increase attendance at both meetings.

97

The Group accepted this invitation with thanks and appreciation and requested the Director ITIC and its Chairman to establish close co-operation with the IUGG Tsunami Commission and the IOC for the preparation of these meetings. Noting the views expressed under Agenda Item 9 on the desire to organize the next workshop, the Group recommended that the Soviet Union should consider the possibility of joining the Second Workshop on Technical Aspects of the Tsunami Warning System with the IOC/ITSU-XII and the IUGG Tsunami Symposium, provided that IOC and Unesco are in a position to support the Workshop financially.

98

11. ELECTION OF THE CHAIRMAN AND VICE-CHAIRMAN

The Senior Assistant Secretary IOC explained to the participants the election procedures as presented in the IOC Manual.

99

The Group was of the general opinion that although the term of service of the Vice-Chairman has not been terminated as yet, it would be most desirable to have a new Vice-Chairman from the scientific community in order to improve interconnections between operational and research groups.

100

The Group unanimously elected Mr. R.H. Hagemeyer from the United States of America as Chairman of the IOC/ITSU and Prof. S.L. Soloviev from the Soviet Union as Vice-Chairman.

101

12. ADOPTION OF THE SUMMARY REPORT AND RECOMMENDATIONS

The Group adopted the draft Summary Report of the present Session and the four Recommendations (Annex II). The Group requested the Secretary IOC to make the necessary editorial corrections and improvements in the final version.

102

13. CLOSURE

103 The Chairman of the Session briefly addressed the Group and summarized the findings of the Session. He paid tribute to the constructive spirit of the Delegates, Representatives and Observers. He particularly thanked the Technical Secretary and the local staff for their devotion and hard work.

104 Prof. Chenlgan Bao expressed, on behalf of local organizers, his thanks to all present and invited them to participate at the Symposium on Storm Surges which would be held in the same hall from 15-17 September.

105 The Chairman of the Session then informed the Group that this was the last session at which Dr. I. Oliounine would be participating as the IOC Technical Secretary, and wished him on behalf of the Group, all the best in his future work. He stressed that much of the success achieved by the Group was due to his energy, experience and knowledge and that the Group will remember his friendliness, kindness and good humour. Following this, the Chairman of the Session presented Dr. I. Oliounine with a token of their esteem. Dr. I. Oliounine thanked the participants for their kindness and assured them that he will always remember the good co-operation and friendly atmosphere which was created by the former Chairmen of the Group with whom he worked and that he will always be thankful to the assistance and understanding he received from all ITSU experts.

106 The Chairman closed the Eleventh Session of the IOC/ITSU at 17.00 on 12 September 1987.

ANNEX I

AGENDA

1. Organization of the Session
2. Intersessional Activities
3. Implementation of Resolutions and Recommendations of the Tenth Session of the ICG/ITSU (1-3 August 1985, Sydney, Canada)
 - 3.1 Master Plan for the International Tsunami Warning System in the Pacific
 - 3.2 Tsunami Travel-time Charts
 - 3.3 Glossary of Tsunami-related terms
 - 3.4 Data Base Format
 - 3.5 Communication Plan
 - 3.6 Guide on Wave Reporting Procedures in Tsunami Warning Systems
4. Operational Improvements to the Tsunami System
 - 4.1 Standard Operating Plan for the National Tsunami Warning System in the Pacific
5. Co-operation with IUGG Tsunami Commission and other International Bodies involved in Tsunami Mitigation and Research
6. Training and Assistance in Tsunami Preparedness
7. Mandate and Functions of the International Tsunami Information Centre
8. Plans for the Future
9. Other Business
10. Date and Place of the next Session
11. Election of the Chairman and Vice-Chairman
12. Adoption of the Summary Report and Recommendations
13. Closure

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ANNEX II

RECOMMENDATIONS

Recommendation ITSU-XI.1

PREPARATION OF ADDITIONAL TRAVEL TIME CHARTS

The International Co-ordination Group for the Tsunami Warning Group in the Pacific,

Recognizing and appreciating the work carried out by the Academy of Sciences of the USSR, Siberian Branch Computer Centre, Krasnojarsk, in providing Tsunami Travel Time Charts for 25 tidal stations in the Pacific,

Noting the usefulness of these charts in assisting the proper functioning of local emergency preparedness and warning dissemination activities,

Requests the preparation of Tsunami Travel Time Charts for all tidal stations as shown in the Communication Plan,

Further requests the preparation of a loose leaf atlas containing all Tsunami Travel Time Charts,

Further requests the Secretary IOC to provide financial support to carry out this work by the Academy of Sciences of the USSR.

Recommendation ITSU.XI.2

REGIONAL TSUNAMI WARNING CENTRES

The International Co-ordination Group for the Tsunami Warning System in the Pacific,

Noting that the Report on the Mission to South East Asia has been submitted to UNDP with a request for funding, a considerable time ago,

Being concerned that the IOC has not been informed on any actions taken by the Member States concerned, to convince UNDP of the necessity of such a system in the region,

Recognizing that the Master Plan for the Tsunami Warning System in the Pacific adopted at ITSU-XI presents the strategy for the development and improvements of the Tsunami Warning System in the Pacific,

Requests that IOC continues its efforts in approaching UNDP and other appropriate international funding agencies to support the long standing project to establish a Regional Tsunami Warning Centre in South East Asia,

Urges all Member States concerned to actively support the proposal by direct contribution to the project in cash or in kind.

Recommendation ITSU-XI.3

AMENDMENT TO THE MANDATE OF THE INTERNATIONAL
TSUNAMI INFORMATION CENTRE

The International Co-ordination Group for the Tsunami Warning System in the Pacific,

Considering that the International Tsunami Information Centre (ITIC) has made considerable progress in providing support to Tsunami related research and operational efforts and in co-ordinating the activities of the Tsunami Warning System in the Pacific,

Noting with appreciation assistance provided by the USA for effective operating of the ITIC and especially an increase of direct support from the IOC,

Recalling Resolution X.23 on Mandate and Functions of the ITIC,

Realizing that there is a need to modify the Mandate of the ITIC in order to improve the mechanism of co-ordination between the Secretary IOC and the Director ITIC,

Recommends that the following text be added to the Annex of Resolution X.23 under the description of the Mandate of the Centre:

"The International Tsunami Information Centre (ITIC) operates with the support of the USA, the IOC and all IOC Member States. The Director ITIC should consult with the Secretary IOC on all policy issues which may have political or financial implications to the IOC."

Recommendation ITSU-XI.4

PROGRAMME AND PRIORITIES FOR 1988-1989

The International Co-ordination Group for the Tsunami Warning System in the Pacific,

Being informed of the plans of the IOC for budget and programme of the ICG/ITSU for 1988-1989,

Taking into account the proposed activities of the ICG/ITSU as they were adopted by the Tenth Session of the Group (Recommendation ITSU-X.2),

Expressing its satisfaction with the policy of Unesco to give high priority to the promotion of the development of scientific and technical knowledge of the mechanisms involved in natural hazards, such as droughts, floods and particularly tsunamis and plans to encourage multidisciplinary studies and their application for the purpose of developing warning systems for natural hazards,

Considering the greater demands of members of ICG/ITSU for the Tsunami Warning Service and for enhancement of their capabilities to combat against tsunami, including the major steps that need to be taken to cope with these demands as recommended by the Master Plan for the Tsunami Warning System in the Pacific adopted at the Session,

Noting, however, with grave concern, that notwithstanding what is mentioned above, Unesco in its Draft Programme and Budget for 1988-1989 proposes not to provide an increase above current levels for the support of the activities of the Group,

Urges, that the Secretary IOC, reconsider the programme and the budgetary priority assigned to the programme and that additional funds be available for the purpose of tsunami research, publicity, warning, education and training,

Further urges that Member States of the ICG/ITSU give most serious consideration to making direct contributions to the IOC for the support of the tsunami programme,

Recommends that the Secretary IOC anticipate and secure appropriate funds to support the following minimum activities needed for the successful implementation of the programme:

- i) provision of assistance for the continuing activities of the International Tsunami Information Centre;
- ii) provision of assistance to Member States for the implementation of the components of the tsunami programme (consultations and missions by experts and staff members, visiting experts programme - 4 trainees from the countries of the region);
- iii) provision of support for the production of additional travel time charts and of an atlas of travel time charts;
- iv) provision of assistance to Member States for the implementation of the provisions of the Master Plan, particularly the recommendations regarding regional centres;
- v) provision of living allowance and travel for the Associate Director, ITIC;
- vi) provision of funds for: ICG/ITSU Officers, IOC staff and experts attendance at subject-related meetings of other organizations and advisory bodies; for ITSU-XII and a Tsunami Workshop associated with it; for an Editorial Board Meeting to complete the Glossary of Tsunami Terms; for publication of IOC Manuals and Guides relevant to the Programme;
- vii) provision of funds for co-sponsoring scientific conferences and symposia of other international bodies related to the Programme, i.e., those of the IUGG Tsunami Commission, Tsunami Society and others.

1. The first part of the paper discusses the importance of the study of the history of the United States. It is argued that a knowledge of the past is essential for a full understanding of the present and for the development of a sound perspective on the future. The author points out that the study of history is not merely a collection of facts and dates, but a process of critical thinking and analysis. It is through the study of history that we can learn from the mistakes of the past and avoid them in the future. The author also emphasizes that the study of history is a continuous process, one that is constantly evolving as new discoveries are made and new perspectives are developed.

2. The second part of the paper discusses the role of the individual in the history of the United States. It is argued that the actions of individuals, both great and small, have shaped the course of the nation's history. The author points out that the study of history is not merely a study of the past, but a study of the present. It is through the study of history that we can learn about the values and beliefs that have shaped the nation and that we can apply these lessons to the present. The author also emphasizes that the study of history is a process of discovery, one that is constantly evolving as new discoveries are made and new perspectives are developed.

3. The third part of the paper discusses the importance of the study of the history of the United States. It is argued that a knowledge of the past is essential for a full understanding of the present and for the development of a sound perspective on the future. The author points out that the study of history is not merely a collection of facts and dates, but a process of critical thinking and analysis. It is through the study of history that we can learn from the mistakes of the past and avoid them in the future. The author also emphasizes that the study of history is a continuous process, one that is constantly evolving as new discoveries are made and new perspectives are developed.

4. The fourth part of the paper discusses the role of the individual in the history of the United States. It is argued that the actions of individuals, both great and small, have shaped the course of the nation's history. The author points out that the study of history is not merely a study of the past, but a study of the present. It is through the study of history that we can learn about the values and beliefs that have shaped the nation and that we can apply these lessons to the present. The author also emphasizes that the study of history is a process of discovery, one that is constantly evolving as new discoveries are made and new perspectives are developed.

5. The fifth part of the paper discusses the importance of the study of the history of the United States. It is argued that a knowledge of the past is essential for a full understanding of the present and for the development of a sound perspective on the future. The author points out that the study of history is not merely a collection of facts and dates, but a process of critical thinking and analysis. It is through the study of history that we can learn from the mistakes of the past and avoid them in the future. The author also emphasizes that the study of history is a continuous process, one that is constantly evolving as new discoveries are made and new perspectives are developed.

ANNEX III

LIST OF PARTICIPANTS

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ANNEX IV

LIST OF DOCUMENTS

<u>Document Code</u>	<u>Title of Document</u>
IOC/ITSU-XI/1 prov.	Agenda
IOC/ITSU-XI/2	Annotated Agenda
IOC/ITSU-XI/3	Summary Report
IOC/ITSU-XI/4 prov.	List of Documents
IOC/ITSU-XI/5	List of Participants
IOC/ITSU-XI/6	Report of the IOC Senior Assistant Secretary, Head, Ocean Services Unit
IOC/ITSU-XI/7	Report of the Director of ITIC
IOC/ITSU-XI/8	National Reports on Intersessional Activities
IOC/ITSI-XI/9	Final Draft of the Master Plan
IOC/ITSU-XI/10	Mission Report to Mexico
IOC/ITSU-XI/11	Eleventh Edition of the Communication Plan (Final Draft)
IOC/ITSI-XI/12	Guide on the Wave Reporting Procedures for Tide Observations in the Tsunami Warning System (revised, IOC Manuals and Guides No. 6) (Final Draft)
IOC/ITSU-XI/13	Glossary of Tsunami Related Terms (First draft)
IOC/ITSU-XI-14	Final Draft of the Tsunami Brochure

* N.B. This list is for reference only. No stocks of these documents are maintained.

ANNEX V

OPENING ADDRESS

by

MR. YANG WENHE, DEPUTY DIRECTOR-GENERAL
OF THE STATE OCEANIC ADMINISTRATION

Respected Mr. Chairman, distinguished Delegates, Ladies and Gentlemen,

It is a great pleasure for me to be present here today at the Eleventh Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific. First of all, please allow me to extend, on behalf of the State Oceanic Administration, a warm welcome to the participants from members of ICG/ITSU, other international organizations and various circles at home. In particular, I would like to take this opportunity to pay tribute to the oceanographers, seismologists and engineers who have made great contributions to the development of the Tsunami Warning System in the Pacific over the past decades. Mr. N.M. Ridgway of the New Zealand Oceanographic Institute, Chairman of the ICG/ITSU, who passed away last year, was among those prominent figures. The remarkable service which he rendered will always be cherished by us.

Storm surges, earthquakes, flash floods, cyclones, tornados and tsunamis are the 6 major natural catastrophes. China is one of the countries which has high exposure to these hazards. The first documented tsunami event can be traced back to September, 47 BC, when an Tsunami earthquake occurred in the Laizhou Bay of the Bohai Sea in China. This event was 220 years earlier than the Tsunami earthquake off the Huang County, Shandong Province in 173 AC, which used to be considered as the earliest documented Tsunami along the coasts of the Pacific. The statistics show that 17 destructive local Tsunamis were recorded during a period of 362 years from 1604 to 1966, with an average of one destructive Tsunami event taking place every 21 years. Among these Tsunamis, the one generated in the Taiwan Strait on 22 May 1781 was the worst, which lasted 8 hours and inundated 120 kilometres of coastline, resulting in a loss of 40,000 to 50,000 lives. The Taiwan Strait Tsunami was the most violent one on record in the world in terms of death and destruction. Undoubtedly, Tsunami is one of the natural catastrophes which affect the coast of our country. With the rapid economic progress and the increasing population in the coastal regions, especially with the development of engineering installations for oil exploitation in the offshore and continental shelf areas, emphasis must be given to Tsunami hazard prevention, Tsunami research and the establishment of a Tsunami warning system.

The following principles are considered and observed by China in determining the set-up of the Tsunami warning system:

1. The Tsunami warning service is an important part of the national forecasting services. The existing networks of oceanographic and seismological observation stations should be fully utilized to facilitate the Tsunami observations;
2. In view of the facts that Tsunami occurrence is not frequent in China and that Tsunami and storm surge warning services, in many aspects, could be combined, it is appropriate to build an integrated system in China for both Tsunami and storm surge warnings;
3. The Tsunami Warning System of China and the Tsunami Warning System in the Pacific are closely related. In developing China's Tsunami Warning System, consideration will be given to the Master Plan for the Tsunami Warning System in the Pacific and to co-ordination with other relevant international, regional or national programmes, such as the Sea Level Monitoring Programme.

In general, a national Tsunami warning system based on the above principles will come into operation in one or two years.

China, as a Member State of the IOC and a country bordering the Pacific, has been active in the activities of ICG/ITSU. We have noted the positive contributions made by ICG/ITSU in co-ordination and development of the Tsunami Warning System in the Pacific, in training and assistance of Tsunami preparedness, in the formulation of the Master Plan for the Tsunami Warning System in the Pacific and in promotion of scientific exchanges on an international basis. We have also noted that more and more efforts have been made by ICG/ITSU in recent years for the development of national or regional Tsunami warning systems, aiming at the monitoring and prevention of local Tsunami hazards. We highly appreciate the efforts made by ICG/ITSU in highlighting the importance of close collaboration between warning services of Tsunamis and that of other natural hazards (such as storm surges and earthquakes) as well as the importance of co-operation between Tsunami warning programme and other related international co-operative programmes, with a view to enhancing socio-economic benefits of Tsunami warning systems. This constitutes an important element in the steady growth of the International Tsunami Warning System. It is China's sincere hope that the international co-operation in Tsunami science and Tsunami warning will develop fruitfully and will contribute to combatting against major natural catastrophes in the world. I believe that the achievements of this Session will play an important role in the advancement of the Tsunami warning service. I wish this Session a great success.

Ladies and gentlemen, while you are concentrating on the Eleventh Session of ICG/ITSU, I would like to make the following suggestions:

1. The International Symposium on Storm Surges, sponsored by China and IOC, being the first of its kind in the world, will be held here the week after this Session. Experts and officials are kindly invited to attend that Symposium in order to promote the interaction and concerted development of the 2 areas of Tsunami and storm surges.

2. Beijing, an ancient city with a history of more than 800 years, offers many scenic spots and historical sites of interest. I hope you will see more of Beijing and wish all of you a pleasant stay here.

Thank you Mr. Chairman.

ANNEX VI

RESOLUTIONS OF THE INTERNATIONAL SYMPOSIUM
ON NATURAL AND MAN-MADE HAZARDS

(Rimouski, Quebec, Canada, August 1986)

Resolution I: Ecological Impact

The Delegates of the International Symposium recognize and encourage the development of geophysically and geochemically unique or distinctive locations on this planet as sites for the study of ecological impacts of environmental disturbances and their potentialities for mitigation of these impacts. Such studies must include baseline research and measurement on critical, unique and abnormal environments, both terrestrial and marine.

Resolution II: International Decade for Hazard Reduction

The delegates of the International Symposium do commend the proposal to establish the International Decade for Hazard Reduction.

All of the participating scientists recognized the enormous possibilities for such a Decade to produce direct benefits for all societies.

Resolution III: Bi-National Co-operative Field Programme

Recognizing the potential of high magnitude earthquake in the Shumagin gap during the next decade to decade and a half, thus causing a major Tsunami with most of its energy directed towards the Hawaiian Islands, and some energy to Vancouver Island, B.C. The delegates of the International Symposium recommended a co-operative research programme between the USA and Canada, specifically the University of Hawaii and IOS, Sidney, to study these phenomena and to install instrumentation in and near the source area for early detection of Tsunami affecting Hawaii in order to provide more accurate Tsunami warnings.

Resolution IV: The International Society for the Prevention and Mitigation of Natural Hazards

The next International Symposium on Natural and Man-made Hazards is scheduled for 1988 in San Diego, California-Ensenada, Mexico. The following meeting, planned for 1990, will probably be in the Indo-Pacific region.

ANNEX VII

PROPOSAL FOR A NEW MAGNITUDE Mm SCALE

Abstract

In order to evaluate the Tsunami risk from a distant earthquake, it is necessary to make a real-time measurement of its seismic moment M_0 , if possible using records at a single seismic observatory. We have dropped a new long-period magnitude scale, M_m , using the first passage of mantle Rayleigh waves at periods greater than 50 s :

$$M_m = \log_{10} (a.T) + C_D + C_S + C_0$$

In this formula, a is the amplitude of the wave at period T , and C_D a distance correction reflecting geometrical spreading and attenuation. C_S is a source correction, depending on the period at which the measurement is made. C_0 is a "locking" constant. The resulting relation between M_m and M_0 is simply:

$$\log_{10} M_0 = M_m + 20$$

Two techniques are used for the recovery of M_m from first passage of mantle Rayleigh waves:

First, in a time-domain technique, the record is low-pass filtered to keep only periods above 50 s, and subsequent maxima and minima identified, their amplitudes and separations stored. M_m is thus computed at several periods, and the largest value retained. The measure can also be done manually on the wide band graphic recordings.

Second, in a frequency-domain technique, the Fourier spectrum of the wavetrain is evaluated at frequencies less than 0.02 Hz, and the largest value retained. The equivalence of the 2 methods is ensured by a correction to C_0 , stemming from the expression of the Fourier transform of a single harmonic arch.

MAGNITUDE M_m

The rapid measurement, if possible in real-time and at a single seismic observatory, of the "size" of an earthquake remains a fundamental aspect of prevention of Tsunamis. But it has long been known that any magnitude scale measured at a constant period T saturates when the duration of rupture along the fault becomes comparable to T . Thus, for very large earthquakes, and in particular those carrying Tsunami risk, M_s loses significance. On the other hand, the seismic moment M_0 introduced by Aki (1967), measured at least in principle, at zero-frequency, keeps growing with earthquake size, rather than saturate. In addition, and because of the linearity of the laws of mechanics, the excitation of all seismic waves from an earthquake source is proportional to M_0 .

We proposed the real-time estimation of M_0 through the use of a low-frequency magnitude scale, M_m , based on the measurement of mantle Rayleigh waves (R_1) at a variable period, in a single station, and such that

$$M_m = \log_{10} M_0 - 20 \quad (1)$$

where M_0 is in dyne-cm.

We have established the theoretical background justifying this approach, and explicit M_m as

$$M_m = \log_{10} X(w) + C_D + C_S + C_0 \quad (2)$$

where $X(w)$ is the spectral amplitude of R_1 at angular frequency w , C_D a distance correction and C_S a source excitation correction; both corrections are frequency dependant. C_0 is a "locking" constant.

A frequency-dependant correction C_S is then applied to compensate for the variation of surface wave excitation with T . We have justified the expression

$$C_S = 2.0398 \theta^3 - 1.3.122 \theta^2 + 0.39342 \theta + 3.9335 \quad (3)$$

where $\theta = \log_{10} T - 1.7657$, resulting from theoretical computations of excitability of Rayleigh waves, averaged over all possible focal geometrics, and over depth in the interval $h = 10$ -----75 km. It would be inappropriate only at higher frequencies of, if the station sits in a node of radiation. In order to at least partially remedy the latter situation, we evaluate magnitudes at several (all in the case of FFT) periods between 50 and 300 s, and retain their largest value as the final M_m .

Method

Two techniques are used for recovery of M_m , the first in a time-domain, can be applied manually, the second in a frequency-domain will be necessarily computed.

In the 2 cases, the distance correction C_D contains the geometrical spreading factor $\log \sqrt{\sin \Delta}$ and the frequency dependant correction for anelastic attenuation. The latter takes into account regional variations in group velocity and Q .

$$C_D = \log_{10} \sqrt{\sin \Delta} + (\log_{10} e) w \Delta / 2UQ$$

We use a regionalized model of the Pacific Ocean, with dispersion and attenuation based on the models of Canas and Mitchell (1978), Mitchell and Yu (1980) and Nakanishi (1981). The path under study is then split into segments of various ages, and their contributions to C_D added.

Time-Domain Measurements

The signal is run through a band pass filter eliminating periods outside the 50---300 s range. The resulting time series is searched for subsequent maxima and minima reaching at least 10% of the absolute maximum amplitude of the signal; the resulting amplitudes and periods of the corresponding arches are retained. For each of them, Mm is computed through:

$$Mm^{TD} = \log_{10} (a.T) + C_D + C_S - 1.20 \quad (4)$$

and the maximum value retained (a is in μm and T is s).

The measure of a and T can be done manually on a wide band graphic recording.

Frequency-Domain Measurements

The time series is simply run through a standard FFT algorithm and the corrections C_S and C_D applied at each FFT period between 50 s and 300 s. Mm is then computed from:

$$Mm = \log_{10} X(w) + C_D + C_S - 1.08 \quad (5)$$

at various periods, and the largest value retained. (X(w) is in μm -s).

Conclusions

The magnitude Mm is calculated from the first passage of Rayleigh wave (vertical component) in a single station.

It is directly proportional to the logarithm of the seismic moment and does not sustain a saturation effect as the magnitude scales commonly used : M_S and all the more m_B .

This new magnitude scale is perfectly adapted to Tsunami prevention which needs to evaluate the source size, in a single station and as far as possible in real-time.

Furthermore, Mm has been set up to give $Mm \approx 10$ for the strongest seisms, corresponding to seismic moment, M_0 , near 10^{30} dyne-cm. Hence, with M_0 of 2×10^{30} and 8.2×10^{29} dyne-cm, the earthquake of Chile (22 May 1960) and Alaska (28 March 1964) would be respectively : $Mm = 10.3$ and 9.9 , and the risks of major Tsunami (earthquake of 5.10^{28} dyne-cm) would exist from $Mm = 8.7$ up.

The experimental approach used about 100 seisms for the last 15 years, recorded by the sesimological station of Papeete in Tahiti. This study has proved a very good correlation between Mm and $\log (M_0)$.

This new magnitude scale used for about 2 years by the Centre Polynisien de Prevention des Tsunamis allowed to obtain especially a correct estimate of M_0 ($M_0 = 1.10^{28}$ Dyne-cm) for the Aleutian Islands earthquake of 7 May 1986; consequently no warning was issued for French Polynesia.

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