Intergovernmental Oceanographic Commission
Reports of Governing and Major Subsidiary Bodies

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

Tenth Session

Sidney, B.C., Canada, 1-3 August 1985

Unesco

In this Series

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:

- Eleventh Session of the Working Committee on International Oceanographic Data Exchange
- Seventeenth Session of the Executive Council
- Fourth Session of the Working Committee for Training, Education and Mutual Assistance
- Fifth Session of the Working Committee for the Global Investigation of Pollution in the Marine Environment
- First Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions
- 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
- First Session of the Programme Group on Ocean Processes and Climate
- Eighteenth Session of the Executive Council
- Thirteenth Session of the Assembly
- Tenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific

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1. OPENING OF THE SESSION

1 The Tenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU) was convened at the Institute of Ocean Sciences in Sidney, B.C., Canada on Wednesday 1 August 1985 at 10.00 a.m. The Institute served as the host of the meeting and made the arrangements for logistical support.

2 Mr. Norman Ridgway, Chairman of the Group,opened the session by welcoming the participants and invited Dr. Cedric Mann, Director General of the Institute, to address the Group.

3 Dr. Mann extended a warm welcome and his best wishes to the participants. The full text of his opening remarks are in Annex IV.

4 Mr. Ridgway, on the behalf of the Group, thanked the canadian authorities for hosting the Session He referred to the success of the three-day Workshop on the Technical Aspects of Tsunami Analyses, Prediction and Communications. During the Workshop experts were privileged to hear lectures given by tsunami scientists who are at the forefront of the battle to increase mankind's knowledge and understanding of the tsunami phenomena. He pointed out that through the application of scientific knowledge we can create sound, rational and effective tsunami warning systems so as to take the necessary counter-measures to mitigate the tsunami threat in the various countries. He called attention to two major problems which appear to be common experiences. First there is the problem of communication not only between some national authorities and PTWC but also between national authorities and people under immediate threat from tsunamis. The second problem is the threat of locally-generated tsunamis. Many thousands of lives have been lost as a result of locally generated tsunamis over the past decade; in Indonesia, Philippines, Columbia, Ecuador and Japan for example. In spite of the fact that major improvements have been made to all the existing tsunami warning services - PTWC, ATWC, Japanese TWS, the USSR Tsunami Warning Service - tremendous problems still have to be overcome, expecially in the South Pacific. He appealed to the Group to accept the challenge that these problems offer and to make a particular effort to solve such problems. He stressed that this Session is a good opportunity to initiate and adopt policies which through international co-operation will help all Member States in their important task of mitigating the tsunami hazard and thereby protecting human lives.

5 Representatives of 16 Member States attended the Session Four international bodies were also represented. (See Annex III - List of Participants).

13 Other areas of interaction and coordination between ITIC and PTWC include PTWC automation efforts, improvement of PTWC's communication with the countries represented by the Group and initiations for obtaining tide information from critical areas, using Handar units. Data from three tide stations (La Libertad in Ecuador, Baltrais, Rabaul in New Britain) are now available to the PTWC, thus improving its services to Member States. He also stated that continued efforts are being made to include other tide sites in the PTWC tide network.

14 ITIC continues to fulfill its duties by the collection, exchange and dissemination of tsunami data and information. This permits ITIC's files and library to be continually updated and thus enables more comprehensive replies to be given to the numerous inquiries for tsunami data and information. The requests for data and information come from many different sources such as academic institutions, engineering firms, hazard authorities, banks, insurance firms etc...

15 ITIC continues to assist the Tsunami Hazard Reduction Utilizing Systems Technology (THRUST) pilot study. It is a continuing project which is expected to serve elsewhere as a prototype for similar early warning regional systems. The present THRUST project is being implemented in the Chile area.

16 Dr. Pararas-Carayannis reported that all Resolutions resulting from ITSU-IX and concerning ITIC have been completed. These resolutions involved: assisting an expert to develop a Master Plan for International Tsunami Warning Operations; determining requirements for the production of additional travel time charts; determining changes to the present Communication Plan; seeking additional funding for the day-to-day operations of ITIC and providing a priority list of requirements to support ITIC activities using audio-visual materials, library updates, run-up surveys and printing.

17 The Group expressed its appreciation for the work carried out by the Chairman, the Director of ITIC and the IOC Secretariat during the intersessional period. It was underlined that even though the intersessional period was a short one, all of the Recommendation and Resolutions were successfully completed. The Chairman's and Director's reports were accepted as submitted.

18 The Group appreciated the successful efforts of the Secretary IOC to provide direct financial support to assist the ITIC in carrying out its vital role by providing technical advice and assistance to Member States. The Group stressed the importance of the continued support from the IOC for the major activities that are undertaken by the Group for the protection of mankind from the tsunami hazard.

4. IMPLEMENTATION OF RESOLUTIONS AND RECOMMENDATIONS OF THE NINTH SESSION OF THE ICG/ITSU (13-17 MARCH, 1984, HONOLULU)

4.1 DISCUSSION AND ADOPTION OF THE MASTER PLAN FOR INTERNATIONAL TSUNAMI WARNING OPERATIONS

25 The importance of the Master Plan was recognized at ITSU-IX and in response to Resolution ITSU-IX.1, the Secretary IOC invited Mr. G. Dohler to prepare, as a Consultant, the draft of the Master Plan. The draft of the Master Plan was prepared and submitted to the Group for comments and in view to its adoption.

26 The Group, because of a lack of time to adequately review the draft, commented on the contents and decided to accept the draft as an Interim Master Plan. However, because of the importance of the matter it was agreed that, after further consultation and review of the Master Plan in respective countries, comments will be sent to Mr. G. Dohler with copies to Mr. N. Ridgway and the Secretary IOC by the 1st October 1985 at the latest. Taking into account comments made during the session and any amendment proposed before 1st October 1985, Mr. G. Dohler was requested to complete a revised draft and submit it to the Secretariat IOC for circulation to Member States of the ICG/ITSU. It was further recommended to consider the final version for approval at the next session of the Group.

27 The Group expressed its appreciation to Mr. G. Dohler for his efforts made in the preparation of the draft of the Master Plan.

4.2 STATUS OF PREPARATION OF ADDITIONAL TSUNAMI TRAVEL-TIME CHARTS

28 The Chairman informed the Group of the results of the survey carried out following Resolution ITSU-IX.2 in which he was requested to contact all national contacts to determine their need for travel-time charts. As a result of this survey, nine Member States responded and requested travel-time charts to be made available for 23 locations. The Soviet Union accepted the responsibility of preparing these charts before the end of 1986.

29 The Chairman and the Director of ITIC gave advice to the Soviet Union experts on the list of locations for which travel-time charts are required, the identification of the most probable tsunami generation areas and the availability of bathymetric data which is of vital importance for the development of these charts.

30 The delegate of the Soviet Union informed the Group that the software for the preparation of charts has been developed and that the first two charts should be published before September of this year. He pointed out that the lack of sufficient bathymetric data may cause a delay in the development of charts and will decrease accuracy.

6. REGIONAL DEVELOPMENT OF THE TSUNAMI WARNING SYSTEM AND TRAINING ACTIVITIES UNDER THE ICG/ITSU-STATUS AND PLANS

6.1 AFTER-EFFECTS OF THE IOC MISSION TO THE WESTERN PACIFIC (JANUARY 1984) FOR THE IMPROVEMENT OF REGIONAL COOPERATION

38 The Assistant Secretary IOC outlined progress made in finalizing the project proposal entitled "Regional Tsunami Warning System in south-east Asia" which was drafted based on the findings and recommendations of the experts' mission to the Philippines, Papau-New Guinea and Indonesia. This mission was implemented in January 1984. The project aims at the establishment of a regional Tsunami Warning System by strengthening existing seismological and tidal-station networks and by the development of research/observational capabilities of scientists/technicians in participating countries. The Group was informed that after some revisions, including one made by the Group at its Ninth Session, the final version of the project proposal was directed to the Governments concerned and after their approval the proposal will be submitted to UNDP in time for the UNDP's Third Meeting for the Aid Coordinators (MAC-III) where the Inter-Country Programmes for Asia and the Pacific of the UNDP's Fourth Cycle (1987-1991) will be discussed.

39 The Group thanked the IOC for its efforts and urged the Chairman of the Group to contact National Coordinators for ITSU in Indonesia, the Philippines and Papua-New Guinea with a view of encouraging them to take prompt action. The Group reiterated the importance for the States concerned to show some initiative and independently contact the UNDP, using their national channels, with the aim of explaining the vital need for regional tsunami warning systems for the protection of the lives and property of their people.

40 The Group expressed its regret that none of the experts from Indonesia, the Philippines, Papua-New Guinea were able to attend the Workshop and ITSU-X.

41 The Delegates from Colombia and Tonga proposed that new regional tsunami warning centers should be established in their regions. However the Group felt that it might be more effective to postpone any decision on this matter until the project proposal for South-East Asia is approved by the UNDP.

42 Mr. N. Ridgway and Mr. G. Dohler reported to the Group on their respective missions to Colombia and Ecuador which were arranged in reply to requests made by the Member States concerned, with an aim to investigate the existing tsunami warning systems, to advise national authorities on the preparation of the national tsunami warning plan and to recommend on the selection of stations, equipment and communication systems. The Group expressed satisfaction on the successful completion of these missions, stressed the importance of this type of activity to assist developing countries and recomended that the Secretary IOC continues efforts directed towards sponsoring future missions.

51 The Group emphasized the continued success of the Visiting Experts Training Program and stressed the importance of continuing this program. The Group thanked the IOC and PTWC for their support.

7. REVIEW OF PLANS AND ACTIVITIES OF THE ICG/ITSU FOR 1986-1987

52 After the introduction made by the Assistant Secretary who informed the participants of the decisions of the Thirteenth Session of the IOC Assembly relevant to the programme and of the budget planned for the next biannual period 1986-1987, the Group reviewed proposed activities for 1986-1987 as outlined in Recommendation ITSU-IX.2. The Group modified the above-mentioned Recommendation based on the decisions of its Tenth Session and taking into account Unesco's plans relevant to the IOC tsunami programme. The Group accepted Recommendation ITSU-X.2.

8. OTHER BUSINESS

53 Under this Agenda Item, the Group considered the followed topics:

8.1 ASSOCIATE DIRECTOR OF ITIC

54 The Group was informed of the request made by the Thirteenth Session of the IOC Assembly to Member States to forward to the Secretary IOC the names of candidates for the post of the Associate Director, at their earliest convenience, bearing in mind that the salary and related enhancements for the incumbent have to be covered by his government.

55 At the present no Member State has proposed a candidate for the position of Associate Director of ITIC.

56 The Group stressed that another Circular Letter be sent to all Member States requesting that the Associate Director's position be filled. This letter should also include an up-to-date discription of the Associate Director's functions.

8.2 SYMPOSIUM ON NATURAL AND MAN-MADE HAZARDS TO BE HELD IN CANADA IN AUGUST 1986

57 The Group stressed that the IOC through ITIC is taking an active role in this meeting by co-sponsoring it and that all ITSU Member States be encouraged to participate in this meeting.

9. DATE AND PLACE OF NEXT SESSION

65 The Delegate of China, on behalf of his Government, suggested that his country host the Eleventh Session of the ICG/ITSU. The invitation was accepted with thanks and appreciation.

66 The Group agreed to hold its next session at the end of 1987 or at the beginning of 1988 at the latest.

10. ELECTION OF THE VICE-CHAIRMAN

67 The Chairman informed the Group that Dr. Norio Yamakawa, the Vice-Chairman of the Group, had to resign from this post due a change of responsibilities at home. The Group expresssed its thanks to Dr. Yamakawa for his work as Vice-Chairman.

68 Proposed by Colombia and seconded unanimously Eng. Eddy H. Sanchez from Guatemala was elected as a new Vice-Chairman of the Group.

11. ADOPTION OF THE SUMMARY REPORT, RESOLUTIONS AND RECOMMENDATIONS

69 The Group adopted the Summary Report and Recommendations and requested the Chairman to endorse the final edited version to be prepared by the IOC Secretariat in consultation with the Rapporteur.

12. CLOSURE OF THE SESSION

70 The Chairman thanked the participants for their efforts, cooperation and for the frank and open atmosphere that prevailed during the session and, on behalf of the Group, extended his thanks to the Government of Canada and IOS for hosting the meeting.

71 The Group expressed its appreciation to the Chairman, the Secretariat and the local Organizing Committee for their hard work.

72 The Session closed at 16.00 on 3 August 1985.

ANNEX I

AGENDA

1. OPENING OF THE SESSION

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   2.1 DESIGNATION OF THE RAPPORTEUR

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   3.1 REPORTS OF THE CHAIRMAN OF THE GROUP AND THE DIRECTOR OF ITIC ON INTERSESSIONAL ACTIVITIES

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   3.3 IMPLICATIONS OF THE DECISIONS TAKEN BY THE THIRTEENTH SESSION OF THE IOC ASSEMBLY (12-28 MARCH 1985, PARIS) ON THE GROUP'S ACTIVITIES

4. IMPLEMENTATION OF RESOLUTIONS AND RECOMMENDATIONS OF THE NINTH SESSION OF THE ICG/ITSU (13-17 MARCH 1984, HONOLULU)

   4.1 DISCUSSION AND ADOPTION OF THE MASTER PLAN FOR INTERNATIONAL TSUNAMI WARNING OPERATIONS

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5. MODUS OPERANDI, MANDATE AND FUNCTIONS OF THE INTERNATIONAL TSUNAMI INFORMATION CENTER

6. REGIONAL DEVELOPMENT OF THE TSUNAMI WARNING SYSTEM AND TRAINING ACTIVITIES UNDER THE ICG/ITSU-STATUS AND PLANS

   6.1 AFTER-EFFECTS OF THE IOC MISSION TO THE WESTERN PACIFIC (JANUARY 1984) FOR THE IMPROVEMENT OF REGIONAL COOPERATION

   6.2 RESULTS OF THE WORKSHOP ON THE TECHNICAL ASPECTS OF TSUNAMI ANALYSES, PREDICTION AND COMMUNICATION

ANNEX II

RECOMMENDATIONS ADOPTED BY THE SESSION

Recommendation ITSU-X.1

The International Coordination Group for the Tsunami Warning System in the Pacific,

Taking into account a kind offer of the Soviet Union to produce additional tsunamis travel-time charts before the end of 1986,

Noting that first drafts of the charts for selected location are planned to be prepared before the end of 1985,

Expresses its appreciation to the Soviet Union for the agreement to produce the charts,

Recommends that the Secretary of IOC convene a meeting of an editorial group of 3-4 experts as soon as drafts are available with a view to comment and adopt the charts for production.

Recommendation ITSU-X.2

The International Coordination Group for the Tsunami Warning System in the Pacific,

Being informed on the plans of IOC for budget and programme of the ICG/ITSU for 1986-1987,

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

Expressing its satisfaction with the policy of Unesco to give hign 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,

Noting however with regret that notwithstanding what is mentioned above Unesco proposes in Draft Doc. 23 C/5 to give only a secondary priority to the provisions of assistance to Member States for further development of the regional tsunami warning centres,

Urges that Member States of the ICG/ITSU be requested to raise their voices at the Unesco General Conference in support of the IOC Tsunami Programme and that additional funds be available to IOC for the purpose of tsunami research, publicity, warning, education and training,

ANNEX III

LIST OF PARTICIPANTS

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II - REPRESENTATIVE OF ORGANIZATION

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III - OBSERVERS

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ANNEX IV

OPENING ADDRESS
by
DR. CEDRIC MANN, DIRECTOR-GENERAL OF THE INSTITUTE OF OCEAN SCIENCES, B.C., CANADA

Honourable Delegates and Observers, Ladies and Gentlemen,

The Canadian Government is greatly honoured to host the Tenth Session on the International Coordination Group for the Tsunami Warning System in the Pacific. Indeed, this is the second time Canada has hosted an ITSU session, the first occasion being in May, 1970, in Vancouver, where the second ITSU meeting took place. I am especially pleased to address this distinguished gathering of Oceanographers, Seismologists, and Engineers who are involved in the important aspects of the Tsunami Warning System in the Pacific.

Tsunamis are considered the sixth largest natural hazard, the first five being, in order: storm surges, earthquakes, flash floods, cyclones, and tornadoes. Tsunamis do not occur regularly or frequently. There has been no Pacific Ocean-wide tsunami since March, 1964, but there have been local tsunamis in the Pacific which killed, on the average, about a thousand people a year.

On the Pacific coast of Canada, we had about fourty tsunamis in this century. Out of this, only the tsunami due to the Alaska earthquake of March, 1964 was severe. The tsunami due to the May 1960 Chilean earthquake was moderate on our coast. There were three other tsunamis which were almost moderate, the remaining ones being of scientific interest only. However, a large earthquake is predicted to occur in the near future in the Shumagin seismic gap of the eastern part of the Aleutian Islands chain. And no doubt there will be a tsunami associated with it.

The loss of life can be mitigated with an adequate warning system, but for a natural hazard that occurs infrequently there is always a danger that the public and the people concerned with the warning may become complacent, and allow the warning system to get out-dated and ineffective. We have to guard against this.

In Canada we have been very active in ITSU since its inception. Mr. G.C. Dohler has served as chairman of ITSU and Dr. G.L. Pickard has served as vice-chairman, Mr. Dohler and Mr. Wigen both served as associate directors of the International Tsunami Information Center. In addition to the seismographic systems in the Warning System, Canada maintains two tide gauges for the Warning System. These tide gauges are located at Tofino and Langara.

The Province of British Columbia has an earthquake and tsunami working group that works to upgrade the warning system. Tsunami research is being done in the governmental institutions as well as the universities. The Provincial Government of British Columbia and the City of Port Alberni are carrying out studies for establishing inundation zones for land subdivision. These are the steps we are taking in Canada to minimize the effect of tsunami.

ANNEX V

NATIONAL REPORTS

3. Murty, T.S. and H.G. Loomis. Diffracted Long Waves along Continental Shelf Edges, Proc. 1983 Tsunami Symposium, Hamburg. Ed. E.N. Bernard, pp. 211-228.

4. Kowalik, Z. and T.S. Murty. Computation of Tsunami Amplitudes resulting from a predicted large Earthquake in the Shumagin Seismic Gap. Geophysical Research Letters, 1984.

5. Murty, T.S. Is there a Seasonality in Tsunami Data? ITIC Newsletter, 1985.

6. Murty, T.S. Tsunami Detection Systems for the Pacific Ocean. Proc. Pacific Congress on Marine Technology, Honolulu, 1984.

7. Murty, T.S., M.I. El-Sabh and Y. Gratton. Hurst Phenomenon in Tsunamigenic Earthquake Data. Science of Tsunami Hazards (1984), Vol. 2, 001, pp. 55-63.

8. Zielinski, A. and N.K. Saxena. Modelling of Tsunami Directivity, Science of Tsunami Hazards (1984), Vol. 2, 002, pp. 113-118.

Further information regarding any aspect of this report may be requested from the National Contact for Canada:

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SESSIONS OF THE NATIONAL TIDAL WAVE WARNING SYSTEM (SNAM)

The Chilean national system (SNAM) consists of the Naval Hydrographical Institute, which heads it, the National Emergency Office of the Ministry of the Interior and the Department of Geophysics of the University of Chile.

Since 29 May 1984 representatives of these bodies have been meeting periodically with a view to improving the operation of the SNAM system.

ESTABLISHMENT OF NEW TIDE STATIONS

On 8 October 1983 a new tide station was brought into service under the National Tsunami Warning system. Its characteristics are as follows:

(a)	Name:	Iquique
(b)	Location:	Lat. 20°12' 05"S. Long. 70° 09' 27"W.
(c)	Instrument:	Ballauf automatic tide gauge Standard type with float

At the end of April 1985 another tide station is to be brought into service within the SNAM system. Its characeristics are as folows:

(a)	Name:	Corral
(b)	Location:	Lat. 30°58'S. Long. 73°25'W.
(c)	Instrument:	Ballauf automatic tide gauge Standard type with float.

NEW PUBLICATION ON TSUNAMIS

While the Ninth Session of ITSU was being held in Honolulu, the Chilean Delegation gave each of the national representatives present a copy of the Naval Hydrographical Institute's publication No. 3017, in Spanish, entitled Nociones Fundamentales sobre Maremotos e Tsunamis, produced to inform the general public of the characteristics of the tsunami phenomenon.

The publication has been distributed in all parts of the country subject to the risk of a tsunami.

ABANDONMENT OF THE PROJECT FOR A SEISMOLOGICAL NETWORK FOR TSUNAMI WARNING

As a result of the damage caused to the Naval Hydrographic Institute's installations by the earthquake of 3 March 1985, the project mentioned in Chile's report for the Ninth Session of ITSU had to be cancelled.

The small budget available will be used to improve communication systems within the SNAM system.

FUTURE ACTIVITIES

(i) THRUST Project

On 21 December 1984 an agreement was signed between the Governments of Chile and the United States of America on assistance for the establishment of a tsunami early warning system by means of the project entitled 'Tsunami Hazard Reduction through the Use of Systems Technology' (THRUST).

This project includes:

(a) the construction and installation of two high-intensity seismic detectors and two sea-level sensors with telemetric links via operational geostationary satellite for the study of the environment (GOES), for installations already planned on mutually agreed sites on Chilean territory;

(b) the preparation of a standard operational plan for tsunami warning;

(c) the compilation of up-to-date bases on tsunamis recorded in Chile with a view to conducting a detailed analysis in Valparaiso of the tsunami hazard.

(ii) Participation in the TOGA Programme

Under the United States of America's TOGA Programme the need is recognized to carry out monitoring operations in meteorological stations and tide stations in key areas in the eastern Pacific. The State University of Oregon made a proposal to NOAA for an improvement in the existing network of South American tide stations by the establishment of stations in Chile linked up with the GOES satellite by means of HANDAR data collecting platforms in Arica, Antofagasta, San Felix Island and the Isle of Pascua, which would be programmed to detect tsunamis. This project is now being financed by NOAA, and it is hoped that the first platform will be installed by the end of 1985.

COLOMBIA

This is a report on Colombia's activities during the period April 1984-1985 and proposals with regard to the Tsunami Warning System in the Pacific.

VISIT OF DR. NORMAN N. RIDGWAY

In reply to a request by the Colombian Oceanographic Commission to the IOC Secretariat, Dr. Norman Ridgway visited us to give his advice on the preparation of the National Plan for the Tsunami Warning System and on the selection of the stations, equipment and communication systems required to activate the network of seismological and tidal stations along the Pacific coast of Colombia.

The National Tsunami Warning Committee is analysing Dr. Ridgway's report with a view to taking appropriate action on its recommendations. Noteworthy among these recommendations are the following, which we request should be discussed at the Tenth Session of ITSU:

(i) Recommendations concerning the future development of Tsunami Warning Systems in Colombia

The main tsunami risk in Colombia stems from tsunamis which are generated locally and strike about 30 minutes after an earthquake. The only effective national warning system is one using computer-based techniques for:

a) detecting local earthquakes;

b) calculating their magnitude and position;

c) sending out warnings or other information;

d) confirming the formation of tsunamis.

Such systems are technically feasible, and it is our intention to establish one in Colombia as soon as possiboe.

(ii) Programme for the development of a computerized Tsunami Warning System in Colombia

Staff Training

This takes first priority. Although the standard of scientific and technical experience in Colombia is high, specialized training is required for:

a) the development of the system

b) the installation and maintenance of equipment

c) national civil defence programmes.

We recommend taking into account the training opportunities afforded by the different international agencies and national institutions belonging to the ITSU system.

However, the National Council of Oceanography wishes to postpone the final decision until more information is acquired about the country's responsibilities, budget and infrastructure required.

TSUNAMI WARNING COMMUNICATIONS PLAN

The Colombian Oceanographic Commission attaches great importance to the proposal submitted for the preparation of the International Telecommunication Plan in view of its usefulness to the ITSU member countries.

Information relating to Colombia considered relevant for inclusion in the Plan has been forwarded to ITIC.

PTWC COMMUNICATIONS TEST

In agreement with the report by the Director of ITIC, two test communications were made with Colombia on 30 November and 3 December, which were unsuccessful. In order to solve the problems arising with the national stations, information was forwarded to ITIC on the respective call signals and it was pointed out that the recent telex installation (No. 44345) in the HIMAT afforded an alternative means of liaison between PTWC and the Marine Meteorological Service in Bogota.

It was also specified that the tidal wave observation stations at Buenaventura and Tumaco have no direct liaison with the Global Telecommunications System.

ASSESSMENT OF THE CURRENT SITUATION

(i) Activities carried out by the Colombian Institute of Hydrology, Meteorology and Land-Use Planning (HIMTAT) and plans for 1985 under the Marine Meteorological Service Project for the implementation of activities related to the Tsunami Warning Service (SAT)

HIMTAT has shown special interest in the development and organization of the Tsunami Warning Service (SAT). It has therefore included activities related to the development of SAT in the General Plan of activities of the Marine Meteorological Service. One of the first aims in this field has been to reactivate the tidal wave observation stations at Buenaventura and Tumaco. To that end they have been restrucutred, and greater attention paid to their operation.

At present an agreement is being negotiated with the firm Pertos de Colombia (COLPUERTOS) with a view to incorporating in the SAT service the sea level data obtained by COLPUERTOS at Buenaventura. The Harbour Master's Office at Puerto de Tumaco has also given full support for the installation at the port of a limnimeter. The data collected will be checked against, and will complement those obtained at the tide station of the Agustin-Codazzi Geographical Institute (IGAC), which at present operates the tide gauges. Among the short-term activities planned, arrangements are proceeding for the purchase of two radio transmitters for these two towns so as to provide an efficient warning and information exchanging service with the National Meteorological Centre in Bogota, and through it with the Global Telecommunications System.

The General Directorate is at present engaged in a programme for the purchase and installation of repeater stations in order to increase the number of VHF radio stations and thus ensure better coverage of the districts for which the country's civil defence bodies are responsible.

As regards the Pacific coast departments, such repeaters have been installed on four mountain peaks - Pan de Azucar, Monchique, Tres Cruces and Galeras.

Safety Campaigns

The General Directorate has launched a campaign to make the public aware of the need for safety and emergency precautions and the advisability of setting up Emergency Committees at the local and regional levels in order to coordinate the efforts of the bodies responsible for taking action in the event of a disaster.

It has therefore published a series of textbooks for school children, and brochures for the adult public, to spread awareness of the need for advance emergency measures.

Training and Education

The Colombian Civil Defence organizes permanent courses to train volunteers throughout the country as recommended in the Instruction and Training Plan.

Directorate staff help to conduct simulation exercises on different types of emergency which might arise in Colombia.

A simulation exercise on a tsunami is presently being prepared which will be conducted first with Directorate staff and then with all the official and unofficial bodies which might be involved in such an emergency.

(iii) Activities of the Andean Geophysical Institute

As part of the regular activities of the Geophysical Institute (Javeriana University) an effort has been made to record as effectively as possible the earthquakes throughout the year in the coastal regions of the country. Most of them occurred off the Pacific coast, only a few off the Atlantic coast. In all, fifteen earthquakes were recorded in the Pacific, all below grade 5 magnitude. They caused no damage, although they were very much felt by the coastal populations. On the Atlantic coast there were three earthquakes of grade 5 intensity or above, which gave rise to warnings in the area from Santa Marta to Barranquilla, but caused no appreciable damage either.

As part of a special research project, all the information published on focal mechanisms of significant earthquakes occurring in maritime zones in past years has been compiled. This work has been carried out in coordination with other South American countries on the Pacific coast for the purpose of monitoring the development and subduction of the undersea plate of NAZCA in the American continent, and thus learning more about the part

ECUADOR

Ecuador, through the Institute of Oceanographico de la Armada (INOCAR), has been participating actively in measurements of mean sea level and providing gauge data from La Libertad to PSMSL, SOC and the Tsunami Warning Center.

INOCAR operates at the present time 9 permanent tide stations along the Pacific coast at the following locations: Esmeraldas, Bahia de Caraquez, Manta, La Libertad, Posorja, Guayaguil (Rio Guayas), Puna (Rio Guayas), Puerto Bolivar and Isla Baltra (Galapagos).

TSUNAMI DATA ACQUISITION

Two Handar Satellite Data Collection Platforms (DCP) have been installed for the Tsunami Program at Baltra Island and La Libertad, in the Galapagos Islands and in the continental part of Ecuador respectively. These stations provide a continuous record of sea level changes via regular self-times GOES transmissions. Each unit is also programmed as an event detector to begin data transmission on an emergency GOES channel as soon as the tsunamis at that station exceed certain previously determined thresholds.

These Handar DCP's were installed in cooperation with Dr. Klaus Wyrtki of the University of Hawaii and Dr. David Enfield of Oregon State University. The Handar DCP's function as a micro-processor capable of receiving and processing multiple channels of input data. Continuous sea level data are collected from a digital encoder using 5-second sample averaged over a 4-minute period, while mean sea level measurements at a 15-minute sample are collected from a Leupold-Stevens ADR tide gauge for Dr. Wyrtki and Dr. Enfield.

In addition to the two stations, Baltra and La Libertad, it seems to be of great importance to include Esmeraldas and Manta gauging stations in the global sea level network. INOCAR has already reconstructed the gauging station of Manta. Assistance in funding should be provided from UNESCO or other international agencies to upgrade the stations at La Libertad, Manta and Esmeraldas for digital and analogue data storage and real time data access by INOCAR for subsequent transmission to SOC and TWC in Hawaii.

INTERNATIONAL ASSISTANCE AND COORDINATION

Dr. Gerry C. Dohler, past Chairman of the ICG/ITSU, stayed at INOCAR for about two months in 1985 as a volunteer consultant and carried out a careful study of the national tsunami warning system and sea level measurements. Dr. Dohler made a project proposal presented to IOC and supported by INOCAR for the improvement of the national system. It should be mentioned that the assistance given to INOCAR by Dr. Dohler was really important.

In May of 1985, Mr. Richard Sillcox of Pacific Tsunami Warning Center came to INOCAR for the purpose of coordinating tsunami warning procedures with the official dissemination agencies. INOCAR described to Mr. Sillcox the problems that Ecuador has with the communications between PTWC and its office. It was suggested that a direct channel of communication via Telex or telephone on a 24 hour basis be used, instead of the channels currently in use.

FIJI

The present report summarizes actions taken by the Mineral Resources Department of Fiji since the Ninth Session of ITSU in March 1984.

Fiji became a full member of ITSU in March 1978 and has consequently responded to the best of its ability to the objectives approved in the resolutions and recommendations of ITSU. Fiji's initial project was to form a Tsunami Working Group comprised of personnel from the Military Forces, news media, Emergency Services Committee (EMSEC), Marine Department, Communications and Mineral Resources Department. The Group is responsible under EMSEC for the public preparedness for tsunamis, their rehabilitation after a significant tsunami event and for the development and implementation of a Tsunami Warning System. However the Group could not meet during 1984 because of EMSEC's commitment to hurricane relief activities.

GENERAL ACTIVITIES 1984 - 1985

During September 1984 a station was installed at Yasawa and earthquake activity is now monitored by a network of 16 stations telemetered into the central observatory in Suva. A seismograph station also operates at the Weather Office, Nadi, and is useful for providing P-arrivals to the PTWC, Hawaii, via the Nandi Communications Centre.

The Communications Centre at Nandi also relays seismic information and alerts from PTWC to other S.W. Pacific countries.

Warnings may be broadcast by several AM and FM regional broadcast stations with back up radio communications to the central Fiji Broadcasting Commission's station at Suva. Warnings will also be issued via the Police Communications Centre telex system which has the facility to simultaneously issue messages to Police Stations st main centres in the Fiji Islands.

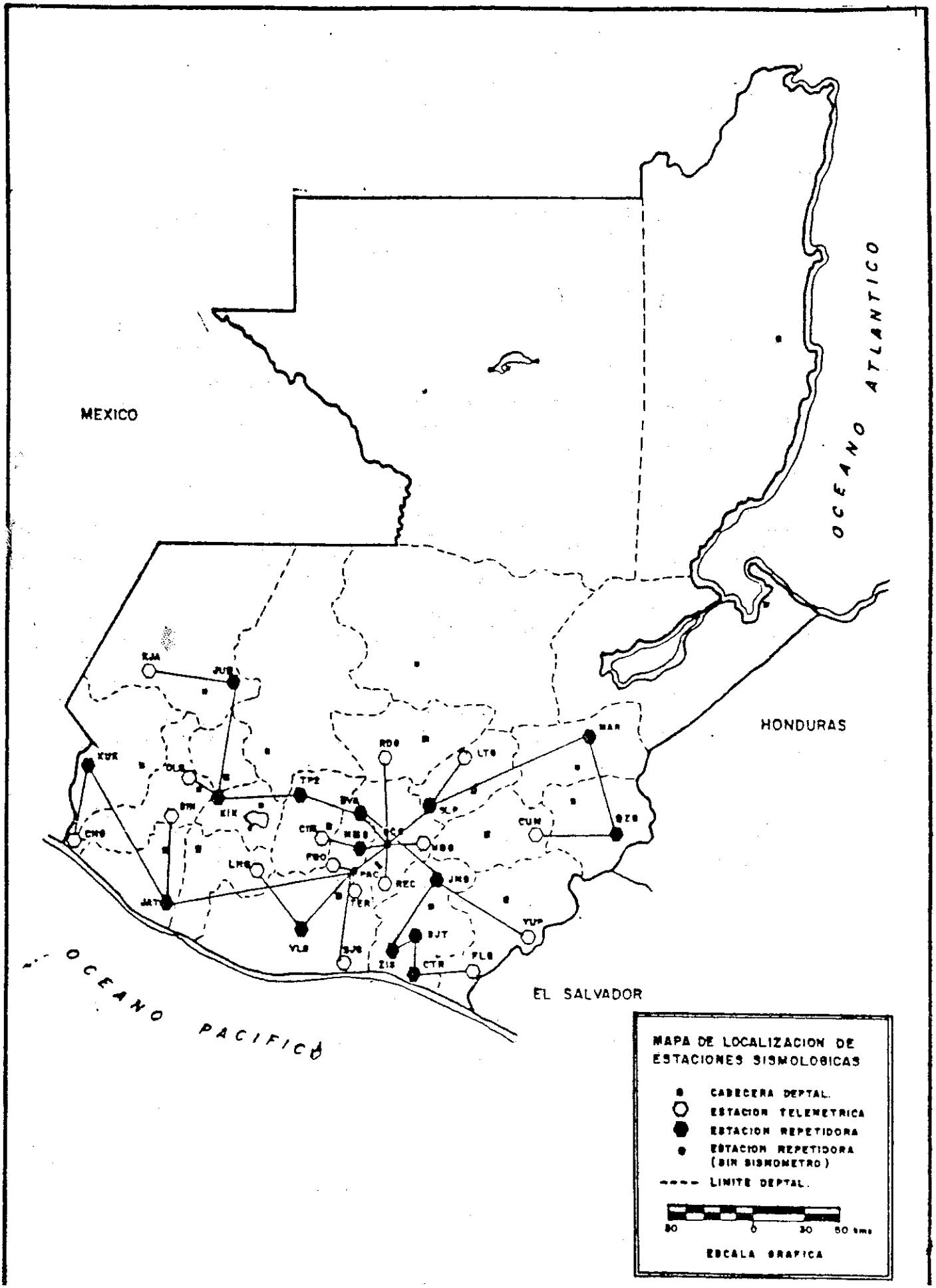
The only tsunami warning tide gauge operating in Fiji is situated in the Suva Harbour wharf and records at the Police Information Centre and at the Marine Department. This has been out of action during 1984/85 whilst major renovations to the wharf have been in progress, but is expected to be back in operation by October 1985. The establishment of a new base for the Fiji Naval Division is not expected to affect the Suva tide gauge.

The largest earthquakes in the area (MS 6.1, 5.7, 6.0) occurred offshore from the north-western margin of the Fiji Platform on 12 and 13 October 1984 but did not cause tsunamis.

TABLE 1

SEISMOLOGICAL STATIONS OPERATED BY INSIVUMEH 1984

NO.	NAME OF STATION	CODE	REGION	DEPARTMENT	LOCATION LATITUDE NORTH	LOCATION LONGITUDE WEST	HEIGHT MTS.
1.	Chimachoy	CIM	S. Andres Itzapa	Chimaltenango	14°35.69'	90°51.62'	2450
2.	Buena Vista	BVA	S. Pedro Sacatepequez	Guatemala	14°40.00'	90°34.24	2262
3.	Magdalena Milhas Altas	MMG	Magdalena Milpas Altas	Sacatepequez	14°32.28'	90°40.89'	2190
4.	Fuego	FGO	Alotenango	Sacatepequez	14°26.74'	90°50.43'	1410
5.	Recreo	REC	Villa Canales	Guatemala	14°26.25'	90°31.36'	1500
6.	Terranova	TER	Escuintla	Escuintla	14°18.14'	90°41.02'	0560
7.	"Centro Sismologico Jose Vassaux Palomo" (Estacion Central)	GCG	Ciudad de Guatemala	Guatemala	14°35.17'	90°31.97'	1502
8.	Kika Raxquin	KIK	Nahuala	Solola	14°47.78'	91°24.63'	3200
9.	Olintepeque	OLG	Olintepeque	Quezaltenango	14°53.86'	91°30.46'	2855
10.	Tecpan	TP2	Tecpan	Chimaltenango	14°46.90'	91°01.38'	3075
11.	Rabinal	RDG	El Chol	Baja Verapaz	15°00.45'	90°28.31'	1930
12.	San Antonio La Paz	SLP	San Antonio la Paz	El Progreso	14°44.58'	90°16.97'	1410
13.	Los Tablones	LTG	Morazan	El Progreso	14°57.75'	90°09.53'	0928
14.	La Concha	LHG	San Juan Bautista	Suchitepequez	14°26.70'	91°10.95'	0600
15.	Zishin	ZIS	Guazacapan	Santa Rosa	14°02.00'	90°27.30'	0050
16.	Junjel	JUN	Chiantla	Huehuetenango	15°23.93'	91°25.72'	3348
17.	Marmol	MAR	Rio Hondo	Zacapa	15°03.95'	89°41.47'	1460
18.	Jumaytepeque	JMG	Nueva Santa Rosa	Santa Rosa	14°20.32'	90°16.22'	1815
19.	El Jato	JAT	Parcelamiento La Maquina	Retalhuleu	14°19.08'	91°38.20'	0068
20.	Sinonel	SIN	El Palmar	Quezaltenango	14°42.47'	91°38.13'	1220
21.	Kukul	KUK	Malacatan	San Marcos	14°59.00'	92°02.50'	0900
22.	San Juan Tecuaco	SJT	San Juan Tecuaco	Santa Rosa	14°04.88'	90°16.13'	0460
23.	La Cumbre	CUM	La Estrella	Jalapa	14°40.24'	89°42.17'	1802
24.	Velasquez	VLG	La Democracia	Escuintla	14°14.43'	91°00.46'	0212
25.	Kiajanaja	KJA	S. Idelfonso Ixtahuacan	Huehuetenango	15°26.63'	91°46.96'	2280
26.	Yupiltepeque	YUP	Yupiltepeque	Jutiapa	14°12.08'	89°48.09'	1430
27.	Quezaltepeque	QZG	Quezaltepeque	Chiquimula	14°38.18'	89°23.04'	1798
28.	Las Flores	FLG	Ciudad Pedro de Alvarado	Jutiapa	13°53.66'	90°03.95'	0180
29.	Puerto San Jose	SJG	San Jose	Escuintla	12°56.87'	90°47.49'	0005


MEXICO
OCEANO ATLANTICO
HONDURAS
EL SALVADOR
OCEANO PACIFICO
RJM
JUT
XUR
OLS
EIK
TPZ
BVR
RDG
LTG
SLP
MAR
CUN
BZS
CHG
CTR
HBG
PBO
LMG
PAC
REC
TER
JRG
YUP
YLG
SJR
SJT
ZIS
CTR
FLG
MAPA DE LOCALIZACION DE ESTACIONES SISMOLOGICAS
CABECERA DEPTAL.
ESTACION TELEMETRICA
ESTACION REPETIDORA
ESTACION REPETIDORA (SIN SISMOMETRO)
LIMITE DEPTAL.
30
0
30
60 kms
ESCALA GRAFICA

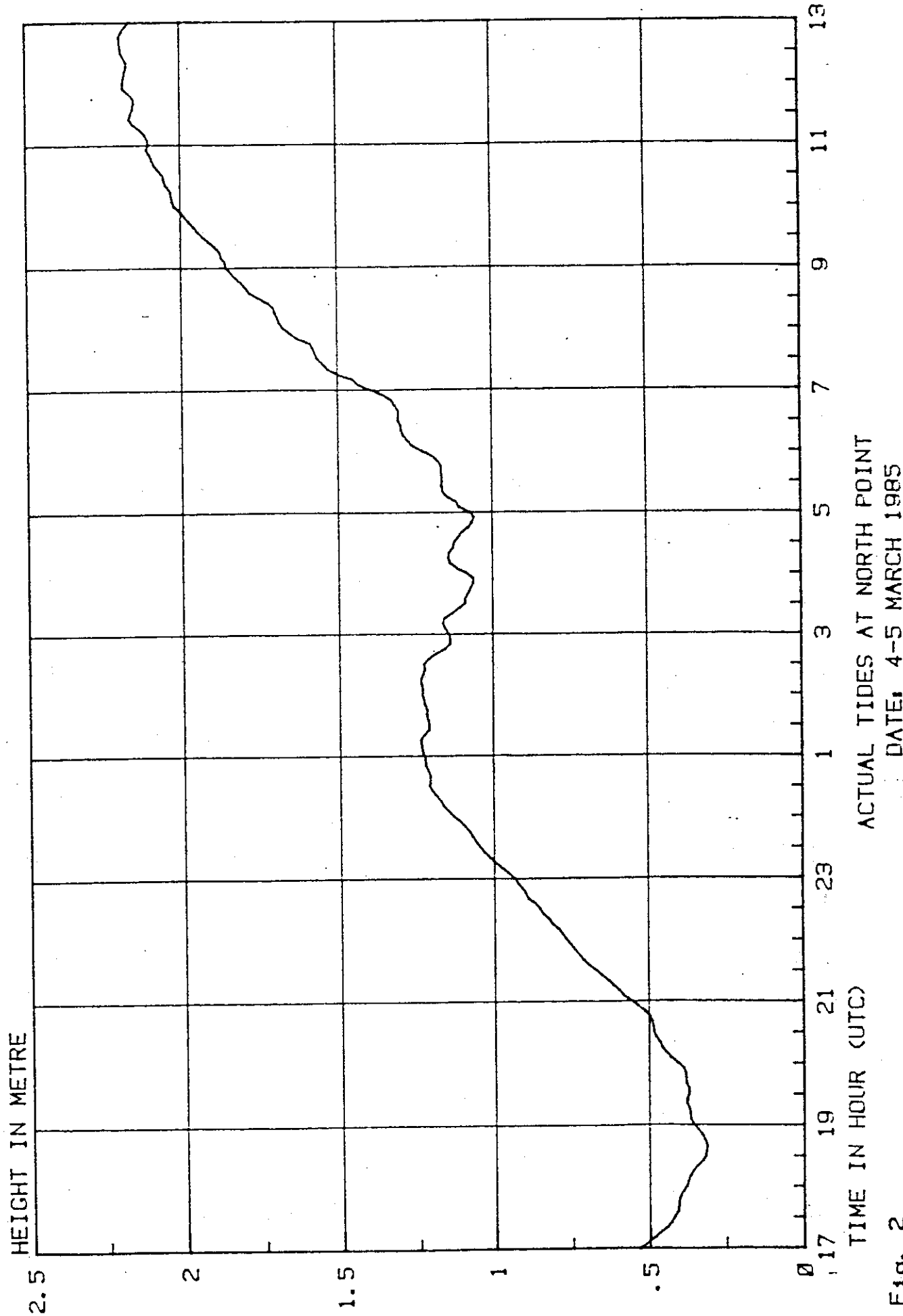

HEIGHT IN METRE
2.5
2
1.5
1
.5
0
17
19
21
23
1
3
5
7
9
11
13
TIME IN HOUR (UTC)
ACTUAL TIDES AT NORTH POINT
DATE: 4-5 MARCH 1985

Fig. 2

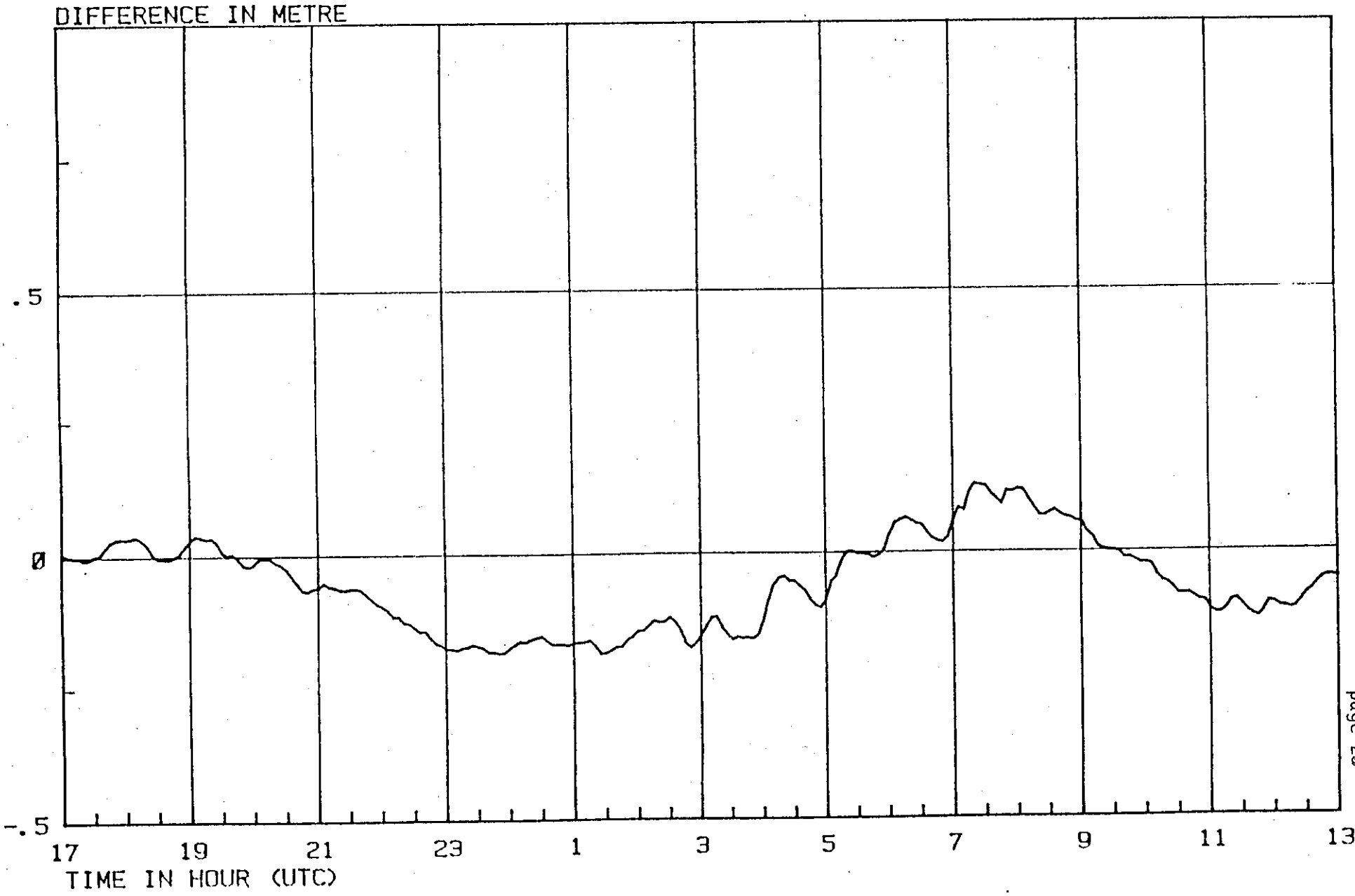
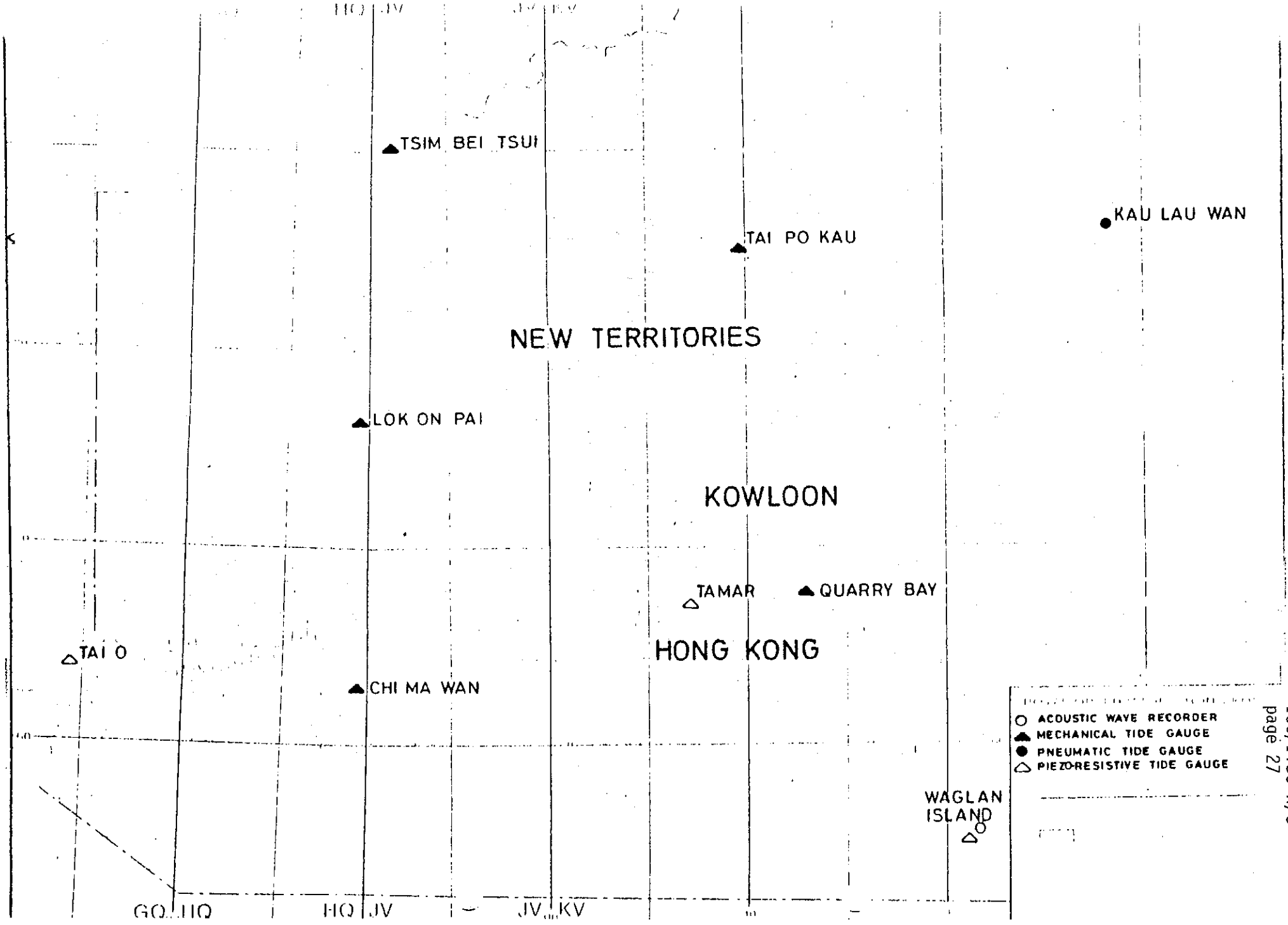


Fig. 4 DIFFERENCE BETWEEN ACTUAL & ASTRONOMICAL TIDES AT NORTH POINT
DATE: 4-5 MARCH 1985


TSIM BEI TSUI
KAU LAU WAN
TAI PO KAU
NEW TERRITORIES
LOK ON PAI
KOWLOON
TAMAR
QUARRY BAY
HONG KONG
TAI O
CHI MA WAN
WAGLAN ISLAND
ACOUSTIC WAVE RECORDER
MECHANICAL TIDE GAUGE
PNEUMATIC TIDE GAUGE
PIEZO-RESISTIVE TIDE GAUGE
GQ HQ
HQ JV
JV KV

DEVELOPMENT OF A NEW COMPUTER SYSTEM

JMA is responsible for monitoring of earthquakes with magnitude 3 or above occurring in and near the Japanese Islands.

To meet the requirement efficiently, JMA is going to set up a new computer system, through which seismological signals telemetered from selected stations will continuously be sampled, seismic wave phases will automatically be identified by use of the AR (Auto-Regressive) Model, and the epicenter location, focal depth and magnitude will also be determined automatically. Planned to be completed by March 1987, this system will shorten significantly the time for issuing tsunami warnings. It is hoped to accommodate in the tsunami prediction model such parameters as the fault and source mechanisms, topography of sea floor, configuration of coastline for better results.

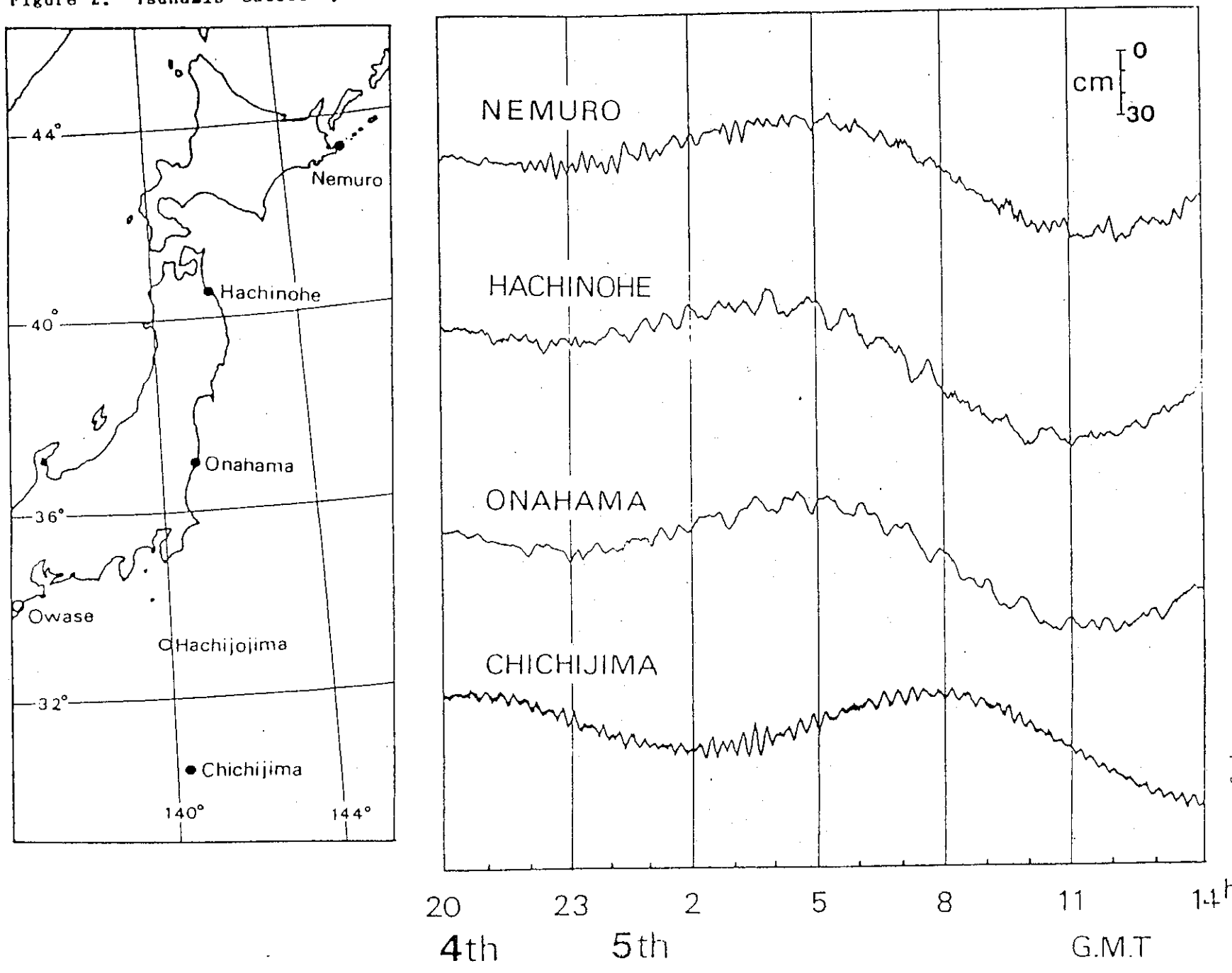
PERMANENT OCEAN BOTTOM SEISMOGRAPH (POBS) SYSTEM OFF THE SOUTHEASTERN COAST OF THE BOSO PENINSULA

One POBS system has successfully been operating since 1978 off the south coast of the Tokai District, with four seismographs on a string of cable 110 km long from the coast to its southern end. This system includes a tsunami sensor - a quartz crystal pressure gauge - at the end of the cable, at a depth of 2,200 m. The result of analyses of the pelagic tide indicates that this tsunami sensor has been functioning satisfactorily. Now JMA is going to lay another POBS system (see Figure 1) extending to about 100 km south-eastwards from the coast of the Boso Peninsula. The submarine equipment will comprize one terminal apparatus (4,000 m depth) and three intermediate apparatus, each with seismographs and a tsunami sensor. The tsunami sensor is nearly identical to the above-mentioned. The new system will also be linked to the Tokyo Headquarters through the telemetering. The laying of submarine cable and apparatus is scheduled to begin in August 1985.

TSUNAMIS FROM THE CHILEAN EARTHQUAKE OF 3 MARCH 1985

Tsunami waves caused by the earthquake (magnitude 7.7) of 3 March 1985 near the coast of central Chile were recorded on the tide gauges throughout the Pacific coast of the Japanese Islands. The first waves of the tsunami reached Hokkaido and Northeastern Honshu about 23 hours after the shock. Some of the maximum wave heights are: 17 cm at Chichijima; 15 cm at Nemuro and Onahama; 13 cm at Ovase; and 12 cm at Hachinohe (Figure 2). On the basis of a teletyped message from PTWC at Honolulu, a tsunami advisory "TSUNAI ATTENTION" had been issued two hours in advance. This advisory is for mamimum wave height of less than several than several tens centimeters. Increasing public awareness of tsunami hazards demands detailed care in execution of information dissemination on the part of JMA.

Figure 2. Tsunamis caused by the Chilean Earthquake of March 3, 1985.



PERU

As a full member of the Group and an active participant in the System trhough the Naval Directorate of Hydrography and Navigation, Peru has prepared the following national report on the activities carried out in the country in connection with tsunamis during the period May 1984 to May 1985. Seismological information was provided by the Geophysical Institute of Peru.

TIDE STATIONS

The oceanographic and climatological conditions created by the 1982-1983 'El Nino" phenomenon caused serious material damage to the coasts of Peru, including certain wharves on which tide-gauges of the national network were installed, making it necessary to relocate some stations and rebuild others. The position of the tide stations of the Peruvian national network is given in Figure 1.

COMMUNICATIONS

A system based on two teleprinters used for no other purpose has been set up between the receiving centre of the Peruvian Airports and Civil Aviation Corporation (CORPAC) and the Naval Directorate of Hydrography and Navigation. The system is completely automatic and back-up systems are provided by commercial telephone and private line (magnetic type).

The system is connected and integrated by telephone (commercial and private line) with the Geophysical Institute of Peru and the Civil Defence Secretariat. Radio back-up systems are being co-ordinated.

The communications network of the Peruvian Navy and the Civil Defence network are used to carry the national system. Figure 2 gives the flow chart of communications under the Tsunami National Warning System of Peru.

TECHNICAL IMPROVEMENTS

In co-ordination with oceanographic research and monitoring programmes tide-gauge platforms with a GOES transmission capability will be set up in May 1985 with the help of technical personnel from the United States National Oceanic and Atmospheric Administration (NOAA), the State University of Oregon and the Directorate of Hydrography and Navigation of the Peruvian Navy.

CIVIL DEFENCE

Through its Executive Secretariat and its Multisectoral Scientific Committee, the National Civil Defence System of Peru collects the relevant information provided by the various bodies concerned at the national level. In the case of tsunamis, the Directorate of Hydrography and Navigation transmits information to the Civil Defence Secretariat by a private telephone line used exclusively for the purpose. The Civil Defence Scientific Committee is at present preparing a new edition of the information brochure on tsunamis, together with education and information programmes advising the public about earthquakes and tsunamis, for use by the mass media.

Flow Chart of Communications under the National Tsunami Warning System of Peru

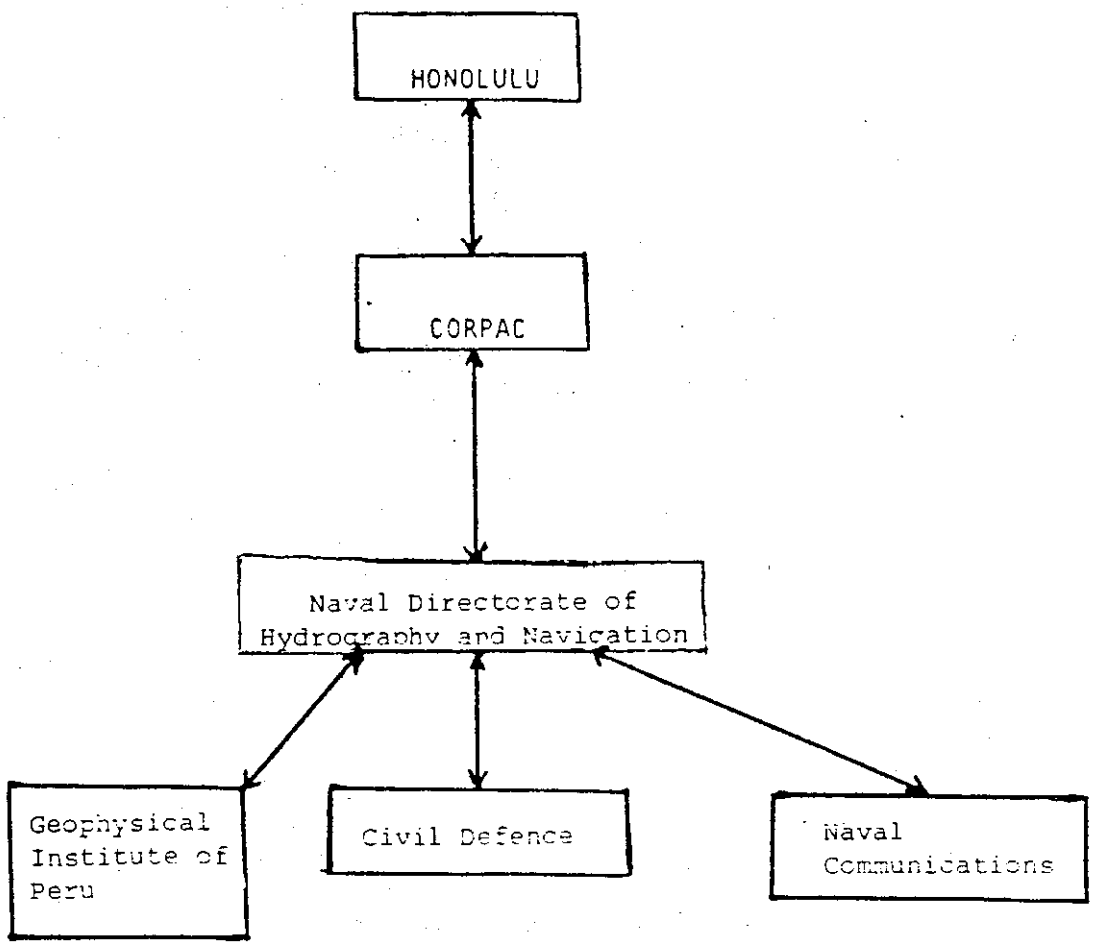


FIGURE 2

The telemetric seismic network which is currently feeding information into the detection system is composed of the stations at Guadalupe (Ica), Quilmana (Canete), Morro Solar (Lima), Suche, Santa Fe y Juni (Lima) and Eten (Lambayeque) in the vicinity of the Lima-Huancayo highway. The Santa Fe station near Ticlio is the highest seismic station in the world (5,200 metres). The equipment consists essentially of a vertical seisometer, a signal-processing pre-amplifying seisometer calibrator (VCO) and a transmitter, powered by a panel of solar batteries. These stations, whose specifications are given in Table 1, form part of the Tsunami Warning System.

The signal processor consists of a kinemetric pre-processor and a PRIME computer, whose functions are at present divided into three basic operations. The first consists in recording data, performed by the processor, which can digitize 200 samples per second and has a receiving capacity of 32 analogue signals. The second, consisting of the detection of events, location of focus co-ordinates and measurement of magnitude, is carried out on a priority basis by the PRIME computer. For the detection of events, use is made of the criteria of the short intervals of the signal in each channel coupled with the long intervals. The location is established by using the arrival times of P waves and the magnitude by the decline in the amplitude of the surface waves. Since the computer has a multiple-time-sharing system, the third operation can take the form of an interactive process with data that have been systematically ordered and filed. The interactive process makes it possible to read the time signals, particularly the S wave arrivals, to obtain the focus mechanism, to modify the catalogue of events and to produce seismic maps of specific areas.

KOREA, REPUBLIC OF

The Central Meteorological Office (CMO), which has the National Contact of ITSU, is the only government institution taking charge of earthquake and tsunami services.

Since Korea became a member of ICG/ITSU in 1978, CMO has shown inactive participation in the tsunami warning system in the Pacific. This can be considered to be due to the fact that natural disaster in Korea is mainly caused by meteorological phenomena, and especially that the Japan Islands screen the Korean Peninsula from direct influence of the Pacific-wide tsunami. However, the damage in the eastern coastal area of Korea from the Japan Sea central region tsunami of 26 May 1983, substantiated the need for measures to be taken to avoid a potential natural disaster. This event can be regarded as a trigger in the development in the field of research and prevention of tsunami.

CMO intends to take this opportunity of attending ITSU-X and for it to be a milestone in the active participation in the tsunami warning sytem in the Pacific.

TSUNAMIS IN KOREA

Though the Korean Peninsula forms part of the north-eastern coastline of the Asian Continent, one of the characeristics of this region is that only a very small portion is exposed directly to the Pacific due to the Japan Islands. With regard to tsunami damage, the following three cases are to be considered:

a) Pacific-wide tsunami travelling through the opening in the Ryukyu Islands;

b) Tsunamis originating in the Yellow Sea and the East China Sea, which may affect the western and southern coastal area;

c) The Japan Sea tsunamis and their impact on the eastern coastal area.

Of these three cases, the third is the most likely to occur, two examples having already taken place - tsunamis from the Niigata earthquake of 16 June 1964 and the Japan Sea central region earthquake of 26 May 1983. The occurrence of tsunamis in the Japan Sea depends on the frequency, magnitude and mechanism of earthquakes located near the western seas of Japan. From a list of damaging earthquakes in Japan, 15 have been found to occur since 416. Two further events have been confirmed as the cause of tsunami damages in the easern coast of Korea. According to Tsuji and An (1985), tsunami run-up heights were reported to be 3 to 4 mts and 2 mts at almost the same area that was damaged by the 1983 occurrence, respectively due to the earthquakes of 28 August 1741 and 2 August 1940 which occurred in the Japan Sea near Hokkaido.

2) Functional expansion of information collection and analysis. Tsunami information, which is issued by the Japan Meteorological Agency and the Pacific Tsunami Warning Center, should be acquired without delay through the Global Telecommunication System of World Meteorological Organization, and be interpreted reasonably. Ullung-Do station, as an advanced post, should instantly report tide gauge data;

3) Systematic issuance of tsunami information. Tsunami advisory and/or warning should be issued rapidly according to the procedures for sever weather warning referring to the evaluated results and tsunami travel-time model;

4) Field survey and support to prevention activities. The competent stations should conduct the field survey for the duration of the event, and induce effective prevention activities by providing the related scientific and technical information and the conditions in progress to the public and the authorities concerned with disaster prevention.

DEVELOPMENT PLAN AND PROSPECT

The tsunami warning system of CMO has the advantage of total participation of the meteorological stations, owing to the parallel operation of meteorological and earthquake-tsunami services. A development plan for preventing tsunami disasters can be accomplished in accordance with the project in progress to enhance nationwide seismological network and research activities.

The basis of improvement in earthquake-tsunami services is the establishment of the Centralized Automatic Seismological Network (CASN). While the seismogram readings of 6 stations are reported to the Main Office under the present system, CASN will acquire the seismic signals in real-time base from 10 remote stations for the immediate computer-aided data processing at the Central Recording and Processing Station. In addition to this nation-wide telemetry, computerized telecommunication will enlarge the utility of tsunami messages from local and international sources.

Systemizing of tsunami services is to be introduced by the operation of CASN which requires some modification of organizational structure. Especially, it is expected that CMO will actively participate in the progress of international co-operation for the Pacific Tsunami Warning System, due to the promotion of research and development.

UNITED STATES OF AMERICA

In the United States, the Tsunami Warning System (TWS) is operated by the National Oceanic and Atmospheric Administration's (NOAA) National Weather Service (NWS). Another component of NOAA, the National Ocean Service (NOS), is primarily responsible for the maintenance of U.S. tide gauges in the TWS. Tsunami research is conducted by NOAA's Environmental Research Laboratories and by various universities under the direction of the National Science Foundation. The World Data Center-A (Tsunamis) is operated by NOAA's National Environmental Satellite, Data, and Information Service. The U.S. Geological Survey (USGS) is responsible for seismological research and assists the TWS through the provision of real time seismic data and in instrument maintenance and development.

The United States has continued to operate two major Tsunami Warning Centers since the Ninth Session of the International Coordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU) in April 1984. These Centers, the Pacific Tsunami Warning Center (PTWC) in Ewa Beach, Hawaii, and the Alaska Tsunami Warning Center (ATWC) in Palmer, Alaska, have access to large arrays of seismic and tide stations, either directly via telemetry from remote locations or indirectly via messages from local observers.

The more significant developments that have occurred during the period since the Ninth session include: the enhancement of the ATWC automated earthquake detection and processing system and the integration of microcomputers into the system; the PTWC has begun operation of its automated detection and processing system and has installed and integrated a second central processor into its computer system; the installation of equipment for the satellite transmission of tide data has been greatly expanded - these will be addressed in detail in the tenth Report. Also changes to the 10th edition of the Communication Plan for the Tsunami Warning System incorporating all changes proposed by the delegates to ITSU IX were distributed to all ITSU National Contacts.

ALASKA TSUNAMI WARNING CENTER (ATWC)

ATWC Procedure Study

The ATWC has conducted an intensive study that examined the present procedures for completing earthquake/tsunami investigations. Five areas, ranging from Kamchatka through California, were chosen which have the potential for generating large earthquakes and possible tsunamis. Specifically, the ATWC procedures were examined with regard to: determing minimal times between the occurrence of an event and the initial dissemination of critical information to intended recipients; and, identifying areas for improvement. This study has been and will be used for improving the operational procedures.

Seismic and Tide Data Acquisition

The ATWC continues to record about 140 real-time seismic and tide analog traces that are telemetered to the Center from sites that are located in the Aleutian Is., throughout Alaska, and the conterminous U.S. This accumulation of data comes from four U.S. agencies' networks, namely ATWC; USGS at Menlo Park, CA; NEIS at Golden, CO.; and, University of Alaska at Fairbanks. Raw seismic data and refined parametric data are

Community Preparedness

A three-part community preparedness effort, concerning earthquake and tsunami hazards, is a continuing program which includes: visits to distant out-lying coastal communities from Ketchikan to Nikolski; visits to local group facilities and schools; and weekly tours through the ATWC facilities. The presentations given during these visits include: a slide show concerning earthquake/tsunami effects; discussions concerning earthquakes and tsunamis; the ATWC operations and functions; and a question and answer period.

During the past year, community preparedness efforts concentrated on coastal communities about the Shumagin Is., Unalaska and Kodiak Is. areas, and the highly seismic Palmer, Anchorage and Wasilla areas. Approximately 30 earthquake/tsunami presentations were given to groups outside the ATWC facilities and about 300 visitors toured the Center.

PACIFIC TSUNAMI WARNING CENTER (PTWC)

Operational Summary of Tsunamigenic Events

During the past fifteen months since the covering of ITSU-IX, no tsunami watch or warning has been issued by PTWC. Four events were reported to have generated minor tsunamis, with three being in Japan and one in Chile. The Japan events occurred on 24 March 1984, 6 August 1984, and 18 September 1984, with maximum 20 cm waves being recorded at tide gauges nearest the tsunami generation area. No sea level fluctuations were recorded at distant tide stations.

The Chilean event of 3 March 1985 generated a minor tsunami which was recorded at many tide gauges across the Pacific. Near the source area at Valparaiso, maximum 110 cm waves were recorded. Ecuador reported 15 cm sea level fluctuations, French Polynesia 10-11 cm, Alaska 4-12 cm, Japan 10 cm, and Hawaii 3-11 cm with 48 cm at Hilo. Marigrams have been forwarded to ITIC and to World Data Center A for consolidation for future research applications.

This event revealed inadequacies in PTWC's operational communications, in acquisition of tide data by PTWC, and in the operational procedures of PTWC in responding to events which generate minor tsunamis. Because of the magnitude of the earthquake, all standard communications with Chile were totally disrupted. It was only through the persistence and dedication of the Instituto Hidrografico de la Armada of Chile that they were able to establish communications with PTWC four hours after the event to provide tsunami data from Chilean tide stations. This was the only tsunami data obtained by PTWC before waves were recorded in Hawaii. This deficiency in tide data acquisition is being improved through the installation of satellite tide platforms in strategic locations. In order to improve PTWC's operational procedures, modifications have been implemented for future events so that all TWS participants will receive notification when sea-level fluctuations are first reported for minor tsunamis and also at the close of the investigation.

Seismic Data Acquisition

PTWC has continued to receive real-time seismic data from 14 stations (9 short-period and 5 long-period seismometers) telemetered via a dedicated data circuit from the National Earthquake Information Service (NEIS) of the U.S. Geological Survey. The distribution of seismic stations

Communications

The first change to the Tenth Edition of the Communication Plan for the Tsunami Warning System was issued in July 1984. This incorporated all changes received at ITSU IX. A sufficient number of changes have not been received since that date to warrant issuance of additional change notices.

Automation

Software development of the on-line seismic processing capability at PTWC is still continuing, with implementation of a computer graphics capability yet to be realized. Computer hardware improvements have included the installation of a second Data General S/230 minicomputer at PTWC to provide a reliable internal backup capability, as well as the operational flexibility provided by simultaneous utilization of two computers.

Administration

Under the direction of Mr. Richard H. Hagemeyer, the National Weather Service Tsunami Program Manager, the administrative structure of the operation of the Tsunami Warning Service has been reviewed and documented as Chapter F-60 of the National Weather Service Operations Manual.

International Coordination

In August and September of 1984, as part of the ITSU/ITIC Visiting Expert's Program, Mr. Emilio Lorca Mella of the Instituto Hidrografico de la Armada of Chile and Mr. Zhou Qinghai of the National Marine Environmental Forecasting Center of the People's Republic of China worked at PTWC in developing improved communications and operational procedures with their respective countries. Because of the loss of the NASA communications relay to Chile, a separate message is now being sent to Valparaiso, Chile, using commercial TELEX, with the message text edited to better meet the specific needs of Chile. Mr. Lorca also was instrumental in the development of a two-station seismic alarm system to improve PTWC's response to South American earthquakes, and in the development of a body-wave magnitude determination of Chilean earthquakes to permit an earlier evaluation of the tsunamigenic potential of a Chilean event. Mr. Zhou of the PRC has returned to Honolulu to conduct tsunami research at the Hawaii Institute of Geophysics, and at PTWC and ITIC over the next two years.

INTERNATIONAL TSUNAMI WARNING CENTER (ITIC)

The United States, recognizing the importance of the International Tsunami Information Center to the Pacific Tsunami Warning System and to ITSU, has contunued to provide support in the period since ITCU-IX at a stable level. Presently United States pays the salaries of the ITIC Director and the Secretary and, through a contractual arrangement, is providing the services of a part-time librarian. In addition, United States provides the logistical support that enables ITIC to fulfil its mandate. A computer/word processor which facilitates office automation, library cataloging, and publication preparation has been installed and is working well. Thus, United States is continuing its support which enables ITIC to

USSR

NATIONAL TSUNAMI WARNING SERVICE

The intersession period, which was shorter than usual, did not see any substantial structural changes in the national tsunami warning service.

Three local warning centers, situated in Petropavlovsk-Kamtchatskii, Uzhno-Sakhalinsk and Vladivostok, were responsible for the tsunami warning of the Ar-Eastern coast of the USSR.

Underwater earthquake recording, determination of their coordinates and magnitudes were made by three seismic stations involved in the operational tsunami warning service - Petropavlovsk-Kamtchatskii, Uzhno-Sakhalinsk and Kourilsk. There have been actions taken to use seismic stations Severo-Kourilsk and Vladivostock and as a result of these actions it can be expected that the improvement of the tsunami warning service for some areas of the soviet Far East, from one part, and from the other part, the increase of the reliability of the parameters determination of underwater earthquakes which might cause tsunamis. Seismic stations are equipped with long-period seismographs, appropriate devices for data procession and instruments for data input to communication channels.

Because of the threat of tsunamis, the tsunami warning service has been set up at the sea-level stations situated on the coast of the Pacific Ocean, the Okhotski and the Japanese seas: Petropavlovsk-Kamtchatskii, Oust-Kamtchatsk, Bering Island, Severo-Kourilsk, Matya Island, Ouroup Island, Kourilsk, Uzhno-Kourilsk, Nakhodka.

In different areas of the tsunami zone of the Far-Eastern coast of the USSR during intersessional period training alarms were carried out to check the reliability of the operational communication channels and develop effective measures in case of real tsunami threat, and to develop protective measures for the public against this disaster. About a hundred specialists from dozens of new institutes took part in the activities.

Further development of tsunami actuation theory confirmed that wave actuation occurs only when deviation of the basin bed from the initial position takes place over a long period and exceeds the wave periods. When the values of the seismotectonic shows in the centres of earthquakes are equal, upthrust and thrust, strange as it may seem, give rise to tsunami of uniform intensity. A thrust equivalent to a wave generator in the form of a horizontal board produces tsunami with a well-marked trend of propagation.

Attempts were continued to derive new differential equations for describing tsunami waves and determining the areas of application for the well-known equations with due account of dispersion effects and wave non-linearity. Numerical methods for tsunami modelling were improved. The calculation of the 1964 Alyaska tsunami propagation from the centre up to the coast of the USSR was carried out.

TSUNAMI PHENOMENA

There were no major tsunami phenomena during the inter-sessional period at the USSR coast.

The most outstanding tsunami phenomenon was considered the one which was caused by the earthquake on 3 March 1985 on the Pacific coast of South America.

The national coordinator from the USSR took advantage of the practical possibility to check the activities of all the units of the national tsunami service when detecting wave propagation presented by this earthquake and participated in data exchange.

Additional records of this latest event have been requested. The World Data Center received photographs of the May 1983 tsunami in Japan, of the March 1957 tsunami in Alaska, and of the 1960 tsunami in Chile.

Bathymetric data and seismograms of tsunamigenic earthquakes continue to be available. The World Data Center supplied a request for 5-minute gridded bathymetric data for the Pacific Ocean to Normal Ridgeway of the New Zealand Oceanographic Institute to be used in the calculation of tsunami travel times. The World Data Center also receives requests for information on occurrence of tsunamis in specified regions and for historical information about a specific event.

A publication describing Chilean tsunamis, which will be completed in 1985, includes locations, operation dates, and characteristics of tide stations, available recorded seismographic data, historical occurrences and effects, analyses, available photographs, and references. This report will be prepared jointly with Chilean experts and issued as World Data Center-A report.

Future projects include a continual refining and supplementing of data now in the data files and an extension of the data to include tsunamis in the Mediterranean and Caribbean Seas and Atlantic Ocean. Information on source dimensions, as inferred from earthquake aftershocks, and information on focal mechanism will also be added to the file over the next several years.

The International Council of Scientific Unions (ICSU) Committee on Data Exchange and Data Centers is attempting a general revision of all the guides in the "Guide of International Data Exchange through the World Data Centres". The current guide for tsunamis was written in 1971 and is in need of revision. The International Union of Geodesy and Geophysics (IUGG) Commission on Tsunamis has been asked to review the current guide and to propose changes. This matter will be discussed during the Commission meeting in Victoria, B.C. in August 1985.

These guides form the broad direction for the activities of the World Data Centres (WDCs). The WDCs also attempt to respond to resolutions from the IUGG Commission on Tsunamis or other international bodies and to requests from individual scientists.

ANNEX VI

RECOMMENDATIONS OF THE WORKSHOP ON TECHNICAL ASPECTS OF TUNAMI ANALYSES, PREDICTION AND COMMUNICATION (29 - 31 JULY 1985, SIDNEY, B.C., CANADA), as approved by the Tenth Session of the International Co-ordination Group for theTsunami Warning System in the Pacific

Recommendation 1

Recognizing the value of historical data collection in understanding the tsunami phenomenon, and the importance of the historical data base for operational analysis, the Workshop recommends that historical documentation of tsunamis should be compared and that a data base format be established to serve as a comprehensive standrad in the collection of seismic and hydrologic parameters of historical tsunamis.

Recommendation 2

Recognizing that a diversity of terms is used in describing the tsunami phenomenon which involves a wide variety of scientific and non-scientific groups in a variety of interdisciplinary fields, the Workshop recommends the preparation of a glossary of tsunami related terms to serve as the basis for defining and understanding tsunami terminology.

Recommendation 3

In reviewing tsunami preparedness in the Pacific and in recognizing the importance of education in hazard preception by the public rendering greater effectiveness to the Tsunami Warning System the Workshop stressed the need for extensive public education and recommends support of an educational programme on tsunamis aimed at the general public.

Recommendation 4

The Workshop recommends that scientists undertake the necessary research to correlate intensity of felt earthquakes on the shore with the probability of tsunami runup and provide this information to the TWS for the purpose of warning the population in those earthquake coastal regions where the effects are felt.

Recommendation 5

The Workshop recommends the investigation in the correlation of time-amplitude range of p-wave oscillations at different epicentral distances and of different frequency pass bands to the tsunameneity of earthquakes and use this parameter, in addition to the earthquake magnitude, as a measure of tsunami probability.

ANNEX VII

LIST OF ABBREVIATIONS AND ACRONYMS

ATWC	Alaska Tsunami Warning Center
ICG/ITSU	International Co-ordination Group for the Tsunami Warning System in the Pacific
ITIC	Internatioanl Tsunami Information Center
MAC	Meeting of Aid Coordinators (UNDP)
PTWC	Pacific Tsunami Warning Center
THRUST	Tsunami Hazard Reduction Utilizing Systems Technology
TWS	Tsunami Warning Service
UNDP	United Nations Development Programme
WDC	World Data Center