

UNITED NATIONS EDUCATIONAL,  
SCIENTIFIC AND CULTURAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

INTERNATIONAL CO-ORDINATION GROUP FOR THE  
TSUNAMI WARNING SYSTEM IN THE PACIFIC

Second Meeting, Vancouver, Canada, 12-14 May 1970

SUMMARY REPORT

ITEM 1: Opening of the Meeting:

The meeting was opened by the Vice-Chairman of the Group, Dr. Pickard, acting on behalf of the Chairman who for medical reasons was unable to attend. On behalf of the host country and the Department of Energy, Mines and Resources, Dr. Pickard welcomed the delegates and observers to the University of British Columbia, Vancouver. He then passed the floor to the representative of Unesco and the IOC, Dr. Giermann, who welcomed the participants in the name of Unesco and of the IOC, and who thanked the host country for its offer to hold the meeting in Canada. Dr. Giermann agreed to become rapporteur. (List of participants: Annex I.)

ITEM 2: Adoption of the Agenda

The Group adopted the agenda without any changes, and the Acting Chairman opened the discussion on its different items. The Addendum to the agenda was introduced as Item 6b (Annex II).

ITEM 3: Report on recommendations and resolutions from March 1968 meeting

The Acting Chairman read the report (Annex III) which the Chairman had prepared on the actions taken on the recommendations of the first ICG meeting. After a lengthy discussion, the Group adopted recommendations, 1, 2 and 3 (see Annex IV); the first one concerning equipment to be made available by some countries and utilized by others, the second concerning membership of the Group, the third one a list of key stations desirable to close the gaps in the existing network. It was felt that a list of key scientists of the region might also be useful. The representative of CERESIS offered to make available a list of scientists for South America.

ITEM 4: ITIC Developments

Captain Munson, Director of the International Tsunami Information Centre (ITIC) of IOC, gave a report on the development of this Centre (Annex V). The delegate of the USSR welcomed the activity of the Centre and thanked Captain Munson for his work.

ITEM 5: Summary Report on IUGG Tsunami Symposium

Mr. Zetler, Chairman of the IUGG Tsunami Committee, gave a short report on the International Symposium on Tsunami Research, held in Honolulu in October 1969. He outlined three of the resolutions of this Symposium which are related to the activities of the ICG; they read as follows:

- (3) The Committee endorses and encourages the use of off-shore and deep-sea tsunami gauges (in particular the re-establishment of the off-shore gauge at Wake Island), intercalibration tests of these gauges, and studies involving the utilization of local source mechanisms as significant steps towards more effective tsunami warnings.
- (5) The Committee wishes to clarify previous recommendations with reference to the compilation of tsunami records at the World Data Centre. Whenever a tsunami exceeds two (2) metres anywhere, records from representative stations should be submitted from all co-operative nations to the World Data Centre.
- (7) The Committee endorses the effort by the International Tsunami Information Centre to compile a collection of photographic copies of marigrams showing tsunamis. It urges that this effort be continued and, if possible, accelerated. It defers a decision on publishing an atlas of these marigrams until the next meeting, but all members are requested to investigate the possibility of publishing such an atlas in whole or in part of their respective countries.

ITEM 6(a): Tsunami data reporting; (b) Improvement of the system of international exchange of urgent information on tsunami

The Acting Chairman introduced a suggestion of the Chairman on "Tsunami data reporting" annexed to the Chairman's report mentioned under Item 3 (Annex III). A lengthy discussion started on whether the heights of the tsunami waves should be reported to ITIC (at a regular time interval of approximately 30 minutes), or rather to know the heights above chart datum or mean sea level (Mr. Dohler, Canada). Recommendation 4 was adopted on this subject (see Annex IV).

The Group was then informed on the recommendations of the last meeting of the Joint WMO/IOC Group of Experts on Telecommunication which only finished on 6 May. The Group studied the relevant parts of the draft summary report of this meeting, and felt that it should ask its members to reply to Items 3.3.4 (a)-(e) of this draft report which requested information on the needs of special systems of which the Tsunami Warning System is one. Recommendation 5 was adopted on this subject (see Annex IV).

Concerning Item 6 (b), the delegates of Japan and of the USSR informed the Group on improved telecommunications means for the exchange of tsunami messages between these two countries (Annex VI). This improvement links the USSR now with the Honolulu Centre (through point-to-point transmission via Tokyo). Two draft resolutions proposed by the USSR delegate were adopted as recommendations 6 and 7 (see Annex IV).

ITEM 7: Status reports on current tsunami research and fundamental developments, and

ITEM 8: National dissemination programmes

The delegates of Canada, Japan, United States of America and the USSR presented their reports on the national activities of these countries; the full text of these reports is found in Annex VII.

The delegate of France made the following statement:

The French Administration has no objection to the meteorological telecommunication network being used for the transmission of tsunami warning. In the case where it would be impossible to use that network the warnings must be transmitted by ordinary telegraphic services. The Civil Aviation Meteorological Service in French Polynesia should be a destination point for the tsunami warnings transmitted from other Pacific centres and should be informed of the subsequent destinations to which other observations would be forwarded. The telegraphic address of this service is: "Aviacivile Meteo-Papeete".

ITEM 9: Tsunami forecasting

Captain Munson, Director of ITIC, made a statement on the needs of the Centre for prediction of tsunamis which is included in the ITIC report. The Acting Chairman felt that a recommendation should be brought in on this matter, but as changes of the procedures adopted by the WDC's were proposed, the delegate of the USSR regretted to be unable to agree to any recommendation.

ITEM 10: Date and place of next meeting and arrangements for co-ordination of ICG activities during the interim period

The representative of IOC informed the Group that it should take into account that for budgetary reasons only one meeting of the Group should take place in the next budgetary period from 1971 to 1972.

The delegate of the United States of America then proposed that it would be most desirable to hold the meeting in Japan, around 15 May 1972.

The delegate of Japan stated that the Japan Meteorological Agency would be pleased to host the meeting but that a definite invitation could not be released before the agency has the approval of the Japanese Government.

Concerning the arrangements for co-ordination of ICG activities, the Group felt that any business in future should be carried out through the Chairman's office.

ITEM 11: Other business

The representative of IOC brought a letter from the Director of the Permanent Service for Mean Sea Level, IAPSO, to the attention of the Group saying that the service would like "to be kept informed of the installation of any new tide gauges in the Pacific". The Group found that the Service should get in contact with ITIC for further information.

Further, the IOC representative informed the Group of a recommendation adopted by the Upper Mantle Committee at its meeting in Canberra, January 1969, in which the UMC recommends that "Unesco be approached relative to funding of on-bottom instrumentation that would significantly improve the tsunami warning system".

A short discussion followed on the IUGG recommendations mentioned under Item 5 of this report.

The delegate of the USSR suggested a recommendation on future tsunami research. The Group felt that the IUGG Tsunami Committee should be requested to comment on this matter. The discussion resulted in the adoption of recommendation 8 (see Annex IV).

ITEM 12: Adoption of report of meeting

The summary report and the recommendations were adopted by the Group after a short discussion.

ITEM 13: Closure of the meeting

The Acting Chairman thanked the Group and the local staff for their excellent collaboration.

The meeting was closed on Thursday afternoon, 14 May.

LIST OF ANNEXES

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Annex II	Agenda
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Annex V	ITIC Developments
Annex VI	Improved telecommunication means for the exchange of tsunami messages between Japan, the United States of America and the USSR.
Annex VII	National reports (a) Canada, (b) Japan, (c) United States of America, (d) USSR.

ANNEX/ANNEXE/ANEXO/ПРИЛОЖЕНИЕ

Names and titles in the following lists are reproduced as handed in to the Secretariat by the delegations concerned. Countries are shown in the English alphabetical order

Les noms et titres qui figurent dans les listes ci-après sont reproduits dans la forme où ils ont été communiqués au Secrétariat par les délégations intéressées. Les pays sont mentionnés dans l'ordre alphabétique anglais.

Los nombres y títulos que figuran en las listas siguientes se reproducen en la forma en que las delegaciones interesadas los han comunicado a la Secretaría. Los países se mencionan en el orden alfabético inglés.

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ANNEX II

AGENDA

1. Opening of the meeting.
2. Adoption of the agenda.
3. Report on recommendations and resolutions from March 1968 meeting.
4. ITIC developments.
5. Summary report on IUGG Tsunami Symposium.
- 6(a) Tsunami data reporting.
- 6(b) Improvement of the system of international exchange of urgent information on tsunami.
7. Status reports on current tsunami research and instrumental developments.
8. National dissemination programmes.
9. Tsunami forecasting.
10. Date and place of next meeting and arrangements for co-ordination of ICG activities during the interim period.
11. Other business.
12. Adoption of report of meeting.
13. Closure of meeting.

ANNEX III

Report of the Chairman on actions taken on the recommendations  
of the first meeting of the International Co-ordination Group  
for the Tsunami Warning System in the Pacific.

RECOMMENDATION ON COMMUNICATION FREQUENCIES

The following is a summary of actions taken with reference to the recommendation of the ICG that the IGOSS Committee consider the feasibility of utilizing a portion of the radio channels designated for oceanographic data collection for the transmission of seismic and sea level data.

The IGOSS Committee met from 2 to 5 April, and adopted the ICG recommendation. During their discussion, a representative from the ITU commented that one of the ten channels in 35 kc/s bands might be reserved for warning purposes as communications in a guard band might be subject to interference from other communications. The problem was referred to the Joint Panel of Experts on Requirements and the Joint Group of Experts on Telecommunications for study at their next meetings.

On 17-20 September 1968 the Joint Group of Experts on Telecommunications held their first meeting. They noted that the Joint Panel of Experts on Requirements had not expressed its views on the request for use of radio frequencies to transmit tsunami warning data. The Group suggested that the lowest part of each frequency band might be used for critical warning purposes only and that it might be possible for the interim period to adopt a recognized modulation system for engineering the automatic stations established for tsunami detection. The Group requested that the IOC obtain from the ICG details on the minimum information request so that they may review the problem at their next session.

Copies of the above report were distributed to all ICG delegates requesting that they submit their comments to the Chairman, ICG. The responses indicated that the six channels suggested by the Group of Experts on Telecommunications would be of considerable value for the telemetry of data from seismic and tsunami sensors to local and regional warning centres. However, since the six frequency bands are not particularly reliable for long range transmission and in view of the additional demands for an expanded TWS, the following requirements were submitted on 3 February 1969, to the Secretary, IOC:

- (1) At least one voice channel for passing watch and warning information between the Honolulu Observatory and the islands and countries throughout and surrounding the Pacific Ocean; and
- (2) At least thirty channels for the transmission of data to the Honolulu Observatory from various participating stations throughout the Pacific Ocean. It is anticipated that while the TWS will have approximately 120 tide stations and 30 seismograph stations, no more than 30 will transmit at any given time.

The Joint Group of Experts on Telecommunications held their second meeting on 27-31 January, 1969, so they were not able to act on the above requirements. However, the Group did make a recommendation concerning frequencies for the Tsunami Warning System, stated as follows from their summary report:

"The Group felt that it should make interim arrangements for the collection of initial data for warning purposes, e.g., tsunami, hazardous weather phenomena, etc. Since this data will have to be transmitted on a non-scheduled basis, it was felt that the lowest assignable frequency in each of the six allocated bands should be reserved for the collection of these data exclusively. The occupied band widths for these transmissions should be as small as possible and preferably should not exceed 100 hz."

No further action has been taken to date. It is anticipated that the ICG requirements will be considered at the next meeting of the Telecommunications Group which is planned for April or May 1970.

#### RECOMMENDATION ON EQUIPMENT

Canada has reported that a third automated tsunami gage has been installed at Langara Island, British Columbia. This is the third automated gage to be established by Canada, the others located at Tofino and Victoria.

Remote recording tide gages and visual recording seismic systems are being furnished by the United States of America to a number of participating tide and seismic stations. Efforts are being made this year to install the equipment at Apia (seismic and tide), Suva (seismic and tide), Guam (seismic and tide), Johnston Island (tide), Valparaiso (tide), La Punta (tide), Balboa (tide), Crescent City (tide), Tucson (seismic), Hong Kong (seismic), Manila (seismic), Huancayo (seismic). The instrumentation was selected on the basis of compatibility with interface electronics and transmitting equipment which would be necessary for eventual long range telemetry of the tide and seismic data. The United States of America hopes, by 1972, to equip several stations for real-time telemetry via satellite relay to Honolulu Observatory.

#### RECOMMENDATION ON WDC RELOCATION

At the March 1968 meeting of the ICG, it was recommended that the Branch for Tsunamis in World Data Centre A be relocated to the ITIC in Honolulu. Since 1957 the WDC Subcentre for Geomagnetism, Seismology, Gravity and Tsunami has been operated as a component of the Coast and Geodetic Survey's Geomagnetism Division, until recently when it became a part of the Environmental Data Service, ESSA, in Rockville, Maryland.

With the establishment of the International Tsunami Information Centre at Honolulu in 1967 as a focal point for the collection and dissemination of large amounts of international data, there were obvious advantages for having it closely associated with WDC-A.

The co-location of WDC-A Subcentre for Tsunami with the ITIC in Honolulu was approved by the National Academy of Sciences - Geophysics Research Board in December 1968. After the transfer of all records to Honolulu was accomplished in 1969, the Centre became operational and ready to serve the needs of the scientific community.

## RECOMMENDATION ON ICG MEMBERSHIP AND OBSERVERS

On 19 February 1970, the Chairman, ICG, sent the following letter to Dr. Giermann, Assistant Secretary, IOC:

"At the last meeting of the International Co-ordinating Group for the Tsunami Warning System in March 1968, the delegates recommended that the ICG remain open to additional IOC Member States and to the attendance of observers from States of the United Nations family.

Accordingly, it is requested that invitations to send observers to the next ICG meeting at Vancouver, Canada, on 12-14 May, 1970 be sent to the following countries: Peru, Mexico, El Salvador, Republic of China (Taiwan), Republic of the Philippines, France, Territory of French Polynesia, Territory of New Caledonia, Territory of Papua and New Guinea, New Zealand, Australia and Western Samoa. In addition, we feel it would be appropriate to invite observers from the Centro Regional de Seismologia para la America del Sur (CERESIS) and the World Meteorological Organization.

Please keep me advised of all actions taken by the IOC concerning ICG meeting invitations and responses."

On 4 March 1970, Dr. Giermann wrote the Chairman, ICG, to inform him that two circular letters had been released, one announcing the meeting to members of the ICG, the other inviting the Pacific countries of the United Nations family who are not yet members, to join the Group.

### TSUNAMI DATA REPORTING

An informal recommendation was made at the March 1968 ICG meeting that the Director, ITIC, conduct a survey of the wave reporting procedures by tide stations in the Tsunami Warning System and make recommendations concerning a standard system for reporting wave heights.

The survey revealed that different units of measurement are used in reporting wave data. For example, all United States stations report wave height in feet, Japanese and Canadian stations report height in centimetres and South American stations report in metres. In order to achieve standardization in reporting units, the United States of America is instructing all its participating tide observers to commence measuring and reporting tsunami heights in centimetres. This change in procedure for United States stations is expected to be effective in April or May 1970. It is recommended that all participating TWS tide stations report tsunami heights in centimetres indicated by four digits as agreed at the 1968 ICG meeting.

The survey also disclosed a variety of procedures in reporting tsunami data. The four possible methods for measuring tsunami waves can be described as follows:

1. The absolute height above current stage of the tide.
2. The absolute range of the wave (wave height) from trough to crest or crest to trough.

3. The amplitude, which is the absolute range divided by 2.
4. The relative height above certain datum which requires knowledge of the tide's stage at the time of the reading.

Most participating tide stations report either (1) or (2). However, there is occasional confusion and uncertainty concerning certain wave reports received at the Tsunami Warning Centre. It would, therefore, be most desirable to have all participating tide stations follow the same procedures in reporting to the Tsunami Warning Centre. The recommended reporting procedures are as follows:

If an unusual disturbance begins while the observer is checking the record, he should report the time at which the disturbance begins and the change (rise or fall) in the water level to the time the observer makes his report. For example, if an observer arrived at his gage at 0915 and was watching as a tsunami began at 0920, he would send a message such as the following at 0925:

Tsunami. Wave began at 0920Z and rose 0085 cm in 5 minutes. Still rising at 0925. Will report further.

If the record shows that a tsunami has already begun when the observer reaches his gage, the observer should immediately report to the Tsunami Warning Centre the time of the beginning, the amplitude of the first rise or fall if it has been completed, and the maximum wave height, trough to peak or peak to trough, that has been recorded by the time the gage is checked. For example, if the observer arrived at his gage at 0945 and found that a tsunami had begun recording at 0920, he would immediately send a message such as the following:

Tsunami. Wave began at 0920Z. Rose 0150 cm in 10 minutes. Maximum wave height observed by 0945Z is 0210 cm. Will report further.

If the observer is not sure that the disturbance he sees on his record is a tsunami, he should report immediately giving a description of the observed phenomenon. For example, suppose that a tide observer was requested to observe his gage for a tsunami whose estimated arrival time was 0920Z. If his station was experiencing severe weather conditions, he might send the following message:

Tsunami. Tsunami disturbance very indistinct due to heavy surf and seiche action. 0100 cm seiche active for past 4 hours. Possible slight disturbance due to tsunami about 0930Z.

Once the initial report of an unusual disturbance has been submitted, additional messages should be filed at regular intervals for at least the first two hours of the tsunami. The intervals usually should not exceed 30 minutes; however, reports may be delayed for a few minutes if necessary to record complete waves. Data to be given in these messages include the maximum height measured from trough to crest or crest to trough which has been recorded since the previous message and the beginning and ending times of the reporting interval. For example, the observer who sent the first message above might submit the following message at 0955Z:

Tsunami. Maximum wave height observed between 0925Z and 0955Z is 0230 cm. Minor flooding is occurring.

If damaging waves are still occurring after two hours, or if the wave size is still increasing, the tide observer must continue reporting to the Tsunami Warning Centre at regular intervals until such time as the damaging waves cease or the size begins decreasing.

If the size of the waves begins to increase significantly after the observer has stopped reporting, he should resume reporting, giving the maximum wave height recorded since his previous message. The observer should continue reporting at regular intervals until the height of the waves again decreases.

To summarize briefly, it is recommended that all participating tide stations:

1. Report wave heights in centimetres (four figures).
2. Report amplitude of initial rise or fall.
3. Report maximum wave height (crest to trough or trough to crest) at regular intervals until waves diminish.

ANNEX IV

RECOMMENDATIONS

1. It is recommended that, through IOC, countries bordering the Pacific Ocean be approached to install for the benefit of the Tsunami Warning System, equipment to transmit sea level and seismic data on a real-time basis. It is further recommended that in the initial phase, Unesco should give to the countries willing to participate in the Warning System financial support for the installation of instruments and for the maintenance of transmission of data.
2. In the interest of broadening international participation in the Tsunami Warning System, IOC is requested to re-issue invitations to its Member States to join the ICG and to invite other countries of the area and appropriate regional international organizations to be represented by observers at future ICG meetings.
3. Considering the locations of seismic and tidal stations in the Pacific Ocean area, it is recommended that a list of key stations be compiled for use in designing a network to protect life and property in those countries;
  - (a) belonging to the Tsunami Warning System in the Pacific, and
  - (b) which may join in the future.

In selecting the stations consideration should be given to the tsunami origin either close to or distant from the coasts.

It is further recommended that ICG should accept the offer of the ITIC to compile a draft list which will be distributed to the Member States for review and finalization.
4. In order to achieve standardization in the reporting of tsunami data by tide observers during emergency situations, it is recommended that all participating tide stations use the following procedures:
  - (a) Report all wave data in centimetres (four digits).
  - (b) Report the amplitude and beginning and end times of the initial rise or fall.
  - (c) Continue to report extreme wave heights (either crest to trough or trough to crest) at intervals of about 30 minutes until waves diminish. Each message should include the beginning and end times of the interval being reported and the extreme wave height during that interval. It may sometimes be desirable to overlap the reporting intervals of two messages in order to include a maximum wave that should be reported.
  - (d) A final message should be sent indicating that the waves have diminished and that no additional message will be sent unless the waves increase significantly again.



5. Referring to the Draft, reference WMO/IOC/TEL-III/P.7 and 8, p.3-3.4 on the use of the HF radio frequency bands allocated by WARC, 1967, the ICG requests that the Member States prepare answers as required and submit them to IOC which will collate the information, obtain approval of the revised material from the Member States and then submit it to the Joint Group of Experts on Telecommunication.

It is further recommended that IOC should send a representative of the ICG to the next relevant meeting of the Joint Group of Experts on Telecommunication.

6. With a view of further improving the system of exchange of urgent information about tsunamis between the countries of the Pacific basin, the ICG considers organizing a dummy transmission between Khabarovsk, Honolulu, and Tokyo to be a primary requirement. This transmission is to be made on radio frequencies specially allocated for the purpose. The ICG requests the Secretariat of IOC to co-ordinate the carrying out of the first dummy tests on Tsunami communication on 16 September 1970.

Technical details concerning the use of radio-frequencies for the transmission of information about Tsunami should be agreed upon by the participating countries by means of correspondence through the medium of ITIC in Honolulu.

7. Noting the satisfactory results of the dummy test on tsunami carried out on 15 September 1968, and bearing in mind the need for overall modernization of the system of exchanging urgent information about tsunami between Khabarovsk, Honolulu and Tokyo, the ICG considers it desirable to have exchange of such information done not less often than once a quarter. In view of this it is recommended to have the next dummy run on 16 June 1970 at 0200 h GMT originating from Honolulu to Khabarovsk.

On 16 September 1970 at 0200 h GMT a transmission is to be made from Khabarovsk to Honolulu. Subsequently transmissions are to be made alternatively from Honolulu and Khabarovsk not less often than once every three months.

Transmission of information is to be done in agreement with the regulations concerning exchange of urgent information on tsunamis as agreed between USSR, Japan and United States of America.

The most effective means of communication are to be used for the transmission of information, including the use of underground cable linking USSR and Japan, after this cable line becomes available for permanent use to transmit meteorological information.

8. Bearing in mind the results obtained in the field of theoretical works on tsunami and the practical need for creating a generally acceptable method for forecasting concrete parameters of tsunami, and in particular their height in different regions of coastlines, ICG urges the Member States to expand in general the national research programmes on formulating the above-mentioned methods and by the next meeting of ICG to prepare their respective proposals on the subject.

It is further recommended that the IUGG Tsunami Committee be requested to consider this matter and to submit suitable proposals to the next ICG meeting.

ANNEX V

ITIC DEVELOPMENTS

It gives me great pleasure to report briefly on the developments at the International Tsunami Information Centre since your last meeting in 1968. If in this summary there are areas in which you would like detailed information, I will be glad to elaborate for you individually during a break in the meeting or collectively here as you so wish.

I would like to start off by recapping the aims of the International Tsunami Information Centre as was reported to you in 1968. Our function is to:

- (1) ensure dissemination of tsunami warnings and collection of tsunami information on a real-time basis;
- (2) encourage tsunami research;
- (3) promote the exchange of scientific and technical personnel among participating nations. Now with these aims in mind, the following is a report of our developments to date.

The capability to collect tsunami information on a real-time basis is being improved by the addition of new equipment to present recording stations and the addition of new tidal and seismic stations to the system. These improvements and additions are covered in detail in the United States of America National Report and will not be elaborated upon in the ITIC report.

During 1968 the Tsunami Warning Centre investigated 62 earthquakes. These investigations resulted in the issuance of 38 press releases, 3 tsunami watches and 1 tsunami warning. The remainder of the investigations (21) were closed as soon as it was determined that either the earthquake magnitude or epicenter was such as to preclude any tsunami generation.

Eleven tsunamis were reported to ITIC during the year. Two of the reporting agencies could not be certain as to what actually occurred and designated the event as a possible tsunami. Six of the tsunamis were very local in extent and all but one were less than 1.2 m in double amplitude. The exception being the 14 August 1968 local tsunami in the Northern Celebes area that was reported as "tsunami waves 9-10 metres in height". The remaining three tsunamis resulted in tsunami warnings being issued by Japan for their country and tsunami watch's being issued by ITIC for the remainder of the Pacific. On 16 May there were two tsunamis generated from Japan and it was thought that the second series of waves could possibly amplify the waves of the first event that were in the harbours of North and South America so the watch was up-graded to a warning for that particular coastline. Two of these three tsunamis were greater than 2m near their origin but less than 2 m elsewhere in the Pacific.

In 1969, 31 earthquakes were investigated for potential tsunami danger. Four investigations were closed as soon as it was determined that either the earthquake magnitude or the epicentre was such as to preclude any tsunami generation. Twenty-five of these events resulted in the issuance of press releases stating there was no tsunami danger and two investigations resulted in issuance of tsunami watches.

Five tsunamis were reported to ITIC during the year and of these five, two were local tsunamis in the Atlantic, one was a local tsunami in the Pacific and the remaining two were Pacific-wide but considered minor everywhere except near their origin.

Thus far in 1970, 24 earthquakes have been investigated with 24 press releases issued and no tsunami watches or warnings. One very weak local tsunami has been reported to ITIC.

The second ITIC aim is to encourage tsunami research. This is accomplished through the articles in the ITIC Newsletter, the historical data and the scientific articles and papers available at the ITIC Library and the exchange of scientific and technical personnel.

The ITIC Newsletter is published quarterly, or as nearly so as possible. It started as an informal document to keep the tsunami-oriented scientists around the Pacific informed about what was happening in this field. The steady flow of requests to be placed on the mailing list has expanded the circulation to about 300. This interest in the newsletter, I feel, proves there is a real need for such a document and this need is being met. Articles are solicited and received from scientists the world over.

During this two-year period, the staff has pursued the accumulation of data of all tsunamis as they occurred. This data is in the form of copies of mareograms, seismograms and descriptive information of the events. An index has been compiled of all the marigrams, both film and paper copies, in the ITIC Library. This index will assist the ITIC staff in fulfilling requests for copies of the data and the research scientist in determining what data are available for detailed study.

Scientists from around the world who are interested in tsunamis have been forwarding tsunami-oriented publications for inclusion in the ITIC Library. The contributions to the library are not left to voluntary response but are solicited as soon as the Centre is aware of their existence. We feel that although the subject matter is limited and the library is small, it is probably the most extensive one on this subject in the world.

ITIC responds to approximately 100 queries for information each year. The number slowly but steadily increases as people around the world learn of the Centre's existence. These queries range from the grade school student wanting information about earthquakes, to the research scientist wanting data concerning tsunami records or newsletter items.

The Centre furnishes the information for the tsunami section of Unesco's "Annual Summary of Information on Natural Disasters". To further the public information and education effort, groups are given tours of the Tsunami Warning Centre; the ESSA film, "Tsunami" is shown to school science classes and adult groups; lectures are given to all interested groups; and the news media is kept informed of all improvements to the system.

Mr. George Pararas-Carayannis of the ITIC staff has completed tsunami travel time charts for 26 specially selected localities in the Pacific. These travel time charts are computer-generated using the programme devised by Dr. Gaylord Miller and George Pararas-Carayannis. There are seven additional localities for which the travel time charts are presently in progress.

The third and last ITIC aim is to promote the exchange of scientific and technical personnel among participating nations.

In 1969 there were two visiting scientists to the Centre. Dr. Hideo Watanabe, Senior Seismologist of the Japan Meteorological Agency's Seismology Section, and Mr. Ziadin Abouzjarov of the Hydrometeorological Service of the USSR. Both of these scientists were with us for a three-month period. During this time, they informed us of their tsunami activities in their respective countries and had an opportunity to witness our operations in Honolulu. Both gentlemen presented papers at the IUGG Tsunami Symposium which was held in Honolulu, 7-10 October 1969 and made full use of the material in the ITIC Library for their field of research. At present we have no other applications from scientists to visit the Centre.

Other items of interest that do not fall into the three stated ITIC aims are:

Item Number 9 in your 1968 meeting under the section Consideration of 1965 recommendations concerned itself with the units in which tide data were being transmitted. This group agreed that Tsunami Warning participants should be asked by the Director, ITIC, to send to ITIC as early as possible a definition of the height parameters that will be used in their transmissions to ITIC, and that the ITIC study the parameters used and report to ICG members through the ICG permanent chairman, a recommendation as to a standard system for height reporting, to be considered by ICG members as soon as possible.

This survey was conducted by ITIC and the results were reported with the requested recommendation to ICG members through the ICG permanent chairman as directed.

Items 12 through 15 of this same section pertained to Communications. Dr. Suyehiro's report for the three nation task group included a request that a "Dummy" communications test be initiated in accordance with the International Agreement of 1 December 1964 by the seismic and tide stations in Kamchatka and Sakhalin regions at 12h 00m (Khabarovsk local time) on 15 September 1968 which will be addressed to Tokyo and Honolulu. A report of the "Dummy" test will be prepared by ITIC, Honolulu and sent to Tokyo and Moscow.

The USSR initiated the "Dummy" test on 15 September 1968 and upon receipt Tokyo sent the information on to Honolulu. ITIC prepared a report of the "Dummy" test and sent it to Tokyo and Moscow as directed.

As Director of ITIC, I had the pleasure to represent the Centre at the IUGG Symposium last October in Honolulu. Every other month informal tsunami meetings are held with representatives of the Hawaii State Civil Defense, University of Hawaii Institute of Geophysics, Joint Tsunami Research Effort, National Tsunami Warning Centre, Honolulu Observatory, Pacific Tide Party and the Honolulu Police Department. These meetings are attended by the ITIC Director.

One sad note to report is that George Pararas-Carayannis has left ITIC in pursuit of a personal venture in another field. He is greatly missed.

The World Data Centre A-Subcentre Tsunami has been transferred to the ESSA/Coast and Geodetic Survey's Honolulu Field Office. So, although WDC-A Subcentre Tsunami and ITIC are separate entities, their co-location tends to complement and benefit both. Dr. Gaylord Miller, ESSA/JTRE, is Acting Director of the Centre replacing George Pararas-Carayannis. The "Catalogue of Tsunamis in Alaska", by Cox and Pararas-Carayannis and the "Catalogue of tsunamis in the Hawaiian Islands" by Pararas-Carayannis have been published as WDCA Subcentre Tsunami Reports.

I believe we have made many accomplishments in the past years and assure you that every effort will be made to continue this trend.

ANNEX VI

Improved telecommunication means for the exchange of tsunami messages (tsunami warning and information, tsunami and seismic data) between Japan, the United States of America and the USSR

1. It is proposed that the exchange of tsunami messages for the portion between Japan and the USSR, being made by Tokyo and Khabarovsk subregional broadcasts, should be replaced by the exchange through the Tokyo-Khabarovsk teleprinter circuit when established under the International Meteorological Telecommunication Plan for the WMO Regional Association II (Asia).

The automatic relay system at JMA, having the Tokyo-Honolulu circuit governed by ICAO telecommunications practices and procedures, then will have the Tokyo-Khabarovsk circuit on the other hand which will be operated by WMO procedures. It is necessary that telecommunications procedures for these two circuits should be arranged in such a way as to permit automatic data transmission through the relay system, if no other means is available for direct transmission between the United States and the USSR.

2. Reasons for the proposal.

By switching the current exchange by subregional broadcasts to that by the point-to-point teleprinter circuit, we should like to eliminate the following inconveniences experienced in the transmission by Tokyo subregional broadcast.

- (i) Transmission of tsunami warnings and information, being messages of urgent priority, disturbs the routine transmissions of Tokyo subregional broadcast.
- (ii) Transmission of tsunami material as necessary disturbs the regular broadcast and therefore is given up.
- (iii) Transmissions from the United States to the USSR, or vice versa is now relayed at Tokyo, where editing and perforation cause much delay in transmission time.

In general, point-to-point transmission is more desirable than broadcast for certain and steady transmission of messages.

3. Transmissions proposed through the Tokyo-Khabarovsk teleprinter circuit.

- (i) Tsunami warnings issued by JMA to Khabarovsk.
- (ii) Tsunami warnings issued by the USSR to Tokyo.
- (iii) Watch and warning messages issued by Honolulu to the USSR through the automatic relay system at JMA Tokyo, unless other means is available for direct transmission between the United States and the USSR.

- (iv) Tsunami warnings issued by the USSR to Honolulu Centre through the automatic relay system at JMA Tokyo, unless other means is available for direct transmission between the USSR and the United States.
- (v) Tsunami and seismic data originated from Japan to Khabarovsk, at the time of their transmission to Honolulu.
- (vi) Tsunami and seismic data from within the Far East region of the USSR to Tokyo, and to Honolulu unless other means is available for their direct transmission between the USSR and the United States.

ANNEX VII (a)

Canadian National Report for the Second Meeting of the  
International Co-ordinating Group for the Tsunami Warning System  
at Vancouver, Canada from 12 to 14 May 1970

Instrumental developments

The two automatic announcing gauges at Tofino and Victoria have been in operation since the last meeting of the Co-ordinating Group with very little down time. It has been mentioned that the International Tsunami Information Centre (ITIC) did not experience any difficulties while interrogating the stations from time to time. In case of equipment failure ITIC was advised accordingly. In addition to these gauging stations, a telemetry system should be fully operational by the end of 1970 between Langara Island, Lat.  $54^{\circ}15'N$ , Long.  $133^{\circ}02'W$  and Prince Rupert Airport, Lat.  $54^{\circ}19'N$ , Long.  $130^{\circ}25'W$ .

While at Langara Island a digital punch paper tape record is obtained for tide and mean sea level studies, an analogue record for tsunami detection and warning purposes is provided at the receiving station. Prince Rupert Airport will contact ITIC or vice versa by radio or telex in case of tsunami occurrences.

The Langara Island tsunami equipment differs appreciably from the one installed at Tofino and Victoria. At the latter two stations, changes in water level are converted by means of a float and counterweight arrangement into a digital voice recording and announcing device for direct interrogation while at Langara Island changes in hydrostatic pressure are transmitted from a transducer via radio telemetry over a distance of 100 miles to Prince Rupert Airport. Details on the instrumentation used at all localities are available from a report presented at the 1969 IUGG Tsunami Symposium at Honolulu.

No action has been taken to modify our equipment for future utilization of frequencies suggested or designated for oceanographic data collection since it is felt that:

- (a) Present Canadian stations can be interrogated without appreciable time delay utilizing existing hard wire communication facilities.
- (b) If and when a radio voice channel becomes available a radio transmitter can be added.
- (c) Such a transmitter will operate according to the available announcing schedule as presently employed with existing hard wire telecommunication equipment.

Canada would appreciate knowing what key localities in the tsunami warning chain of gauging stations should be equipped for direct interrogation. Furthermore, IOC has approached officially Member States having telemetry and/or direct interrogation equipment developed, to make the same available to other countries.

The presently installed Canadian tsunami announcing gauges upon interrogation from Honolulu or any other locality supply the tidal heights in the metric system in a three-digit figure to the nearest centimetre. The data is referred to one metre above the established chart datum at each locality. The advantage in reporting the stage of the water level at any time above a fixed datum, in



our opinion, reduces errors in the interpretation of the data. It also facilitates plotting the run-up on topographical maps or hydrographic charts since the relationship between chart datum and the datum used for the construction of contour lines is usually known.

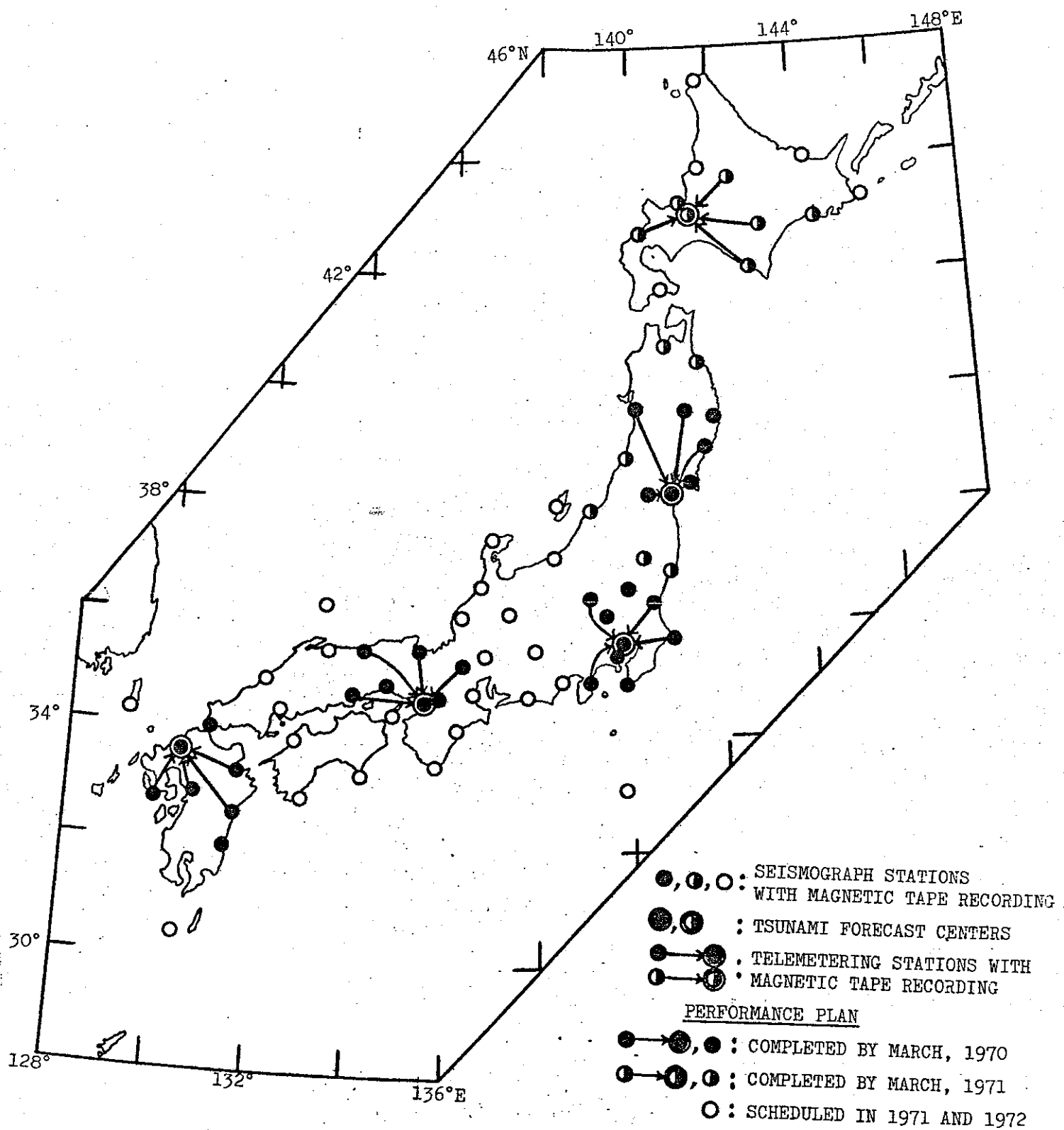
#### Status report on general tsunami research

The activities of the Oceanographic Research Division at Ottawa on the theoretical aspects of the tsunami and related problems during 1969 and continuation into the next two to three years are the following:

1. Detailed calculations of the resonance characteristics, spectra, co-spectra, bispectra, propagation of tsunami into the inlet, energy processes and effects of breakwater have been made for the Trevor Channel - Alberni Inlet system.
2. At present different types of numerical methods are being used for example: standing wave method, method of impulse response etc., to calculate the resonance characteristics of complex inlets, which have many channels. For example the Fisher Inlet-Rivers Inlet complex has 25 different channels connected in a complicated manner.
3. Projects in the near future include:

- (a) Treatment of tsunami propagation on the continental shelf similar to a bore. Method of characteristics for simple geometry; numerical model for complex geometry.

INSTALLATION PLAN OF TELEMETERED AND NON-TELEMETERED SEISMIC OBSERVATION SYSTEM  
WITH MAGNETIC TAPE RECORDING AT JAPAN METEOROLOGICAL AGENCY



ANNEX VII (c)

UNITED STATES NATIONAL REPORT

TSUNAMI WARNING SYSTEM

Prepared for the  
Second Meeting of the  
International Co-ordinating Group of the  
Intergovernmental Oceanographic Commission on the  
Tsunami Warning System

Vancouver, B.C., Canada  
12-14 May 1970

ANNEX VII (d)

NATIONAL REPORT - USSR

Report on the work in the field of Tsunami  
done in the USSR presented at the  
Second Meeting of the Working Group  
on the Tsunami Warning System

Detailed report about the work being done in the USSR in the field of tsunami study was submitted at the Tsunami Symposium at Honolulu in October 1969 by Drs. Solovyev, Voit and Abuziarov.

In addition to what has been said at the symposium, it can be noted here that essentially the progress made has been of practical significance. Work has been done and will be continued in the future on tsunami regionalizing the USSR Pacific shoreline, research has been done on calculations of coefficients of refraction of tsunami waves in the most important points of the Kamchatka and Kurile Islands shoreline and also research on determination of energy loss by tsunami as a result of friction over the bottom in regions with varying bottom gradients.

The Sakhalin Institute has started work on the compilation of a detailed catalogue of weak tsunamis using marioground data. With a view to developing a hydrophysical method of tsunami forecasting observations have been carried out using hydrophysical equipment. At the present time results of these studies are being processed and analysed.

In the field of equipment design, work is in progress on improving the hydrostatic tsunami recorder. New prototypes of this equipment will be constructed at the beginning of 1971.

In the near future it is proposed to carry out model building for processes of action of tsunami on the protection dams as well as construction of models of zones subject to flooding by tsunami in the more important populated areas of Kamchatka and Kurile Islands.

At the Siberian Branch of the Academy of Sciences of the USSR it is planned to study the movement of tsunami waves from the solutions of hydrodynamic equations in a shallow water installation (a two-dimensional problem), and also to investigate phenomena of tsunami surge on to the shoreline and the entry of tsunami waves into river estuaries.