



INTERNATIONAL TSUNAMI INFORMATION CENTER

NEWSLETTER

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IUGG TSUNAMI COMMITTEE REPORT

The Tsunami Symposium was held at the East-West Center, University of Hawaii, Honolulu, Hawaii, 7-10 October 1969. The 59 registered attendants came from Australia, Canada, Federal Republic of Germany, Japan, New Zealand, USA, and USSR. Seminars were held on (1) seismic source and energy transfer, (2) tsunami instrumentation, and (3) tsunami propagation and runup. A summary session was held on the last day with considerable emphasis on the inadequacies of the existing magnitude scale for tsunamis.

The following is a synopsis of the resolutions that were adopted by the Tsunami Committee:

1. Publication of symposium proceedings.
2. Propose that an interdisciplinary symposium on tsunamis and earthquakes be arranged for the IUGG meeting planned for Moscow, USSR, during August 1971. The symposium should have the following format:

<u>Day</u>	<u>Topic</u>	<u>Convener</u>
First	Tsunami Committee Meeting	Zetler
Second	Redefining Tsunami Magnitude	Iida
Third	Prediction of Tsunami Inundation: Short Term	Miller
Fourth	Prediction of Tsunami Inundation: Long Term	Voit

3. Endorse and encourage the use of offshore and deep-sea tsunami gauges (in particular the re-establishment of the gauge at Wake Island), intercalibration tests of these gauges, and studies involving the utilization of focal source mechanisms as significant steps toward more effective tsunami warnings.
4. Deeply appreciate the efforts of the East-West Center and the Institute of Geophysics, University of Hawaii, in arranging the symposium and for their hospitality, and to IUGG and the Office of Oceanography, UNESCO, for their support.
5. Clarify previous recommendations with reference to the compilation of tsunami records at World Data Centers. Whenever a tsunami exceeds two (2) meters anywhere, records from representative stations should be submitted from all cooperating nations to the World Data Centers.
6. Suggests that agencies distributing questionnaires relative to earthquake information include a request for information on sea state.
7. Endorse the efforts by the International Tsunami Information Center 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 in their respective countries.
8. Commends Mr. G. Pararas-Carayannis, International Tsunami Information Center, for his fine effort in collecting the data for a catalog of Pacific tsunamis, as noted in his progress report of 10 October 1969. Inasmuch as his efforts and various preliminary and regional catalogs have largely exhausted the sources of data and information, it is therefore proposed that a final version of a Pacific catalog be published under the joint authorship of K. Iida, D. C. Cox, S. I. Soloviev, and G. Pararas-Carayannis. The Committee calls on all members to investigate in their own countries the possibility of obtaining some measure of support for the publication. The Committee requests any possible financial support for this project from IUGG. The total estimated cost is \$12,000, \$10,000 of which is for printing costs and computer time and \$2,000 for travel.
9. The officers of the Committee were re-elected, to serve until the Moscow meeting. Five additional scientists are being invited to serve on the Committee which is presently constituted as follows:

Chairman	Zetler, U.S.A.
Vice Chairmen	Soloviev, U.S.S.R. Iida, Japan
Secretary	Adams, U.S.A.

Braddock, Australia (invited to join)
 Brodie, New Zealand
 Gajardo, Peru (invited to join)
 Kajiura, Japan
 Lomnitz, Mexico
 Miller, U.S.A. (invited to join)
 Moreira, Portugal (invited to join)
 Murphy, U.S.A.
 Pickard, Canada
 Reid, U.S.A. (IAPSO representative)
 Savarensky, U.S.S.R.
 Voit, U.S.S.R. (invited to join)

ABSTRACT OF THE IUGG TSUNAMI SYMPOSIUM

There were three seminars:

1. "Seismic Source and Energy Transfer," convened by Dr. S. Soloviev.
2. "Tsunami Instrumentation," convened by Dr. Vitousek.
3. "Tsunami Propagation of Run-up." convened by Dr. K. Kajiura.

Many of the scientific findings were of considerable significance. With respect to tsunami generation, papers by Dr. Iida, Dr. Watanabe, and Dr. Hatori provided vital statistical correlations of tsunami sources and tsunamigenic earthquakes. The theoretical dependence of gravity-wave parameters on source parameters was reported by Dr. G. Podyapolskii.

In the discussion on instrumentation, an automatic, remote, vocal type gauge was described by G. Dohler. Dr. K. Terada reported on the progress in Japan for both remote analog and remote digital tide gauges. Four submerged long wave recorders were used to study seiche in Ofunato Bay which was severely damaged by the 1960 Chilean tsunami. An offshore ocean-wave meter has been modified to report for the tsunami period range. Design, development, and utilization of a Bourdon-tube, deep-sea, tide gauge and of a Snodgrass vibration system repackaged in glass spheres were meticulously described by Drs. J. Filloux and M. Vitousek, respectively. A recording of the water wave generated by the underground nuclear explosion at Amchitka on 2 October 1969 is included in the Proceedings.

The plans for the Pacific Tsunami Warning System were reviewed by L. Murphy and R. Eppley. Dr. R. Johnson proposed a method for using a

hydrophone array to record T-Phase data suitable for estimating fault characteristics. The suggested method is designed to eliminate from consideration those events for which no significant tsunami has been generated.

The propagation of tsunamis was analyzed both analytically and numerically. Analytical studies of point-source generation, significance of Coriolis effect, the effects of heterogeneity and viscosity of the fluid medium were presented by Drs. S. Voit and B. Sebekin. Dr. A. Nekrasov analyzed the transformation of waves by a step model of the continental shelf. The tsunami response of a uniform-depth model harbor connected to an ocean by a channel was considered by Drs. G. Carrier and R. Shaw. The numerical studies were also represented by a dynamic-programming approach for improving prediction of arrival times devised by Dr. R. Braddock. Professor R. Reid and Dr. C. Knowles described the estimation of the deep-water tsunami form by an inverse transformation of a marigram obtained near the island. Several laboratory model studies were reported; local geometry effects by L. Hwang and A. Lin; wave intrusion into a harbor by R. Whalin and D. Bucci; and a verification of the Carrier-Greenspan transform theory, as applied to a double-humped wave, by Dr. J. Williams. An unusually small, distorted scale model of 1:65,000 and 1:12,500 was used to quantitatively study deep-ocean tsunami propagation by Dr. M. Krivoshey. The tsunami inundation was evaluated as to extent and depth by a larger scale, distorted model of 1:5000 and 1:350. The effects of such extreme scale distortion on wave parameters were studied in a flume.

Recent progress towards solving the problem of storing and quickly retrieving relevant tsunami facts of documents was reported by J. Walling. A digital computer is used for analysis of indexed properties of documents stored in microfiche form on a five-second, random-access, display file.

The Proceedings will be available approximately 1 April 1970 at a cost of \$12.50 per copy. Orders should be sent to Mr. Norman Wright, Sales Manager, East-West Center Press, 1777 East-West Road, Honolulu, Hawaii 96822. The planned table of contents is as follows:

SEISMIC SOURCE AND ENERGY TRANSFER

GENERATION OF TSUNAMI, FOCAL MECHANISM OF EARTHQUAKE, AND THEIR SOURCES,
K. Iida

GENERATION OF THE TSUNAMI BY THE EARTHQUAKE, G. S. Podyapolskii

A MODEL EXPERIMENT ON THE GENERATION OF THE TSUNAMI OF MARCH 28, 1964
IN ALASKA, W. G. Van Dorn

RELATIONSHIP OF TSUNAMI GENERATION AND EARTHQUAKE MECHANISM IN THE
NORTHWESTERN PACIFIC, L. M. Balakina

FEATURES OF TSUNAMIGENIC EARTHQUAKES, W. M. Adams and A. S. Furumoto

- TSUNAMI ACCOMPANYING THE TOKACHIOLI EARTHQUAKE, 1968, Z. Suzuki
- STATISTICAL STUDIES OF TSUNAMI SOURCES AND TSUNAMIGENIC EARTHQUAKES OCCURRING IN AND NEAR JAPAN -- TSUNAMI SOURCE, AFTERSHOCK, AND EARTHQUAKE MECHANISM, H. Watanabe
- IONOSPHERIC RECORDING OF RAYLEIGH WAVES FOR SOURCE MECHANISM ESTIMATION, A. S. Furumoto
- LOCATION OF EPICENTERS FROM A SINGLE SEISMIC RECORD, G. Miller and T. Sokolowski
- SOME PRELIMINARY RESULTS OF A THEORETICAL STUDY OF TSUNAMI IN THE ALBERNI INLET DUE TO THE ALASKA EARTHQUAKE OF MARCH 28, 1964, T. S. Murty and L. Boilard

TSUNAMI INSTRUMENTATION

- TIDE GAUGE DATA TELEMTRY BETWEEN THE TSUNAMI WARNING CENTER AT HONOLULU, HAWAII AND SELECTED STATIONS IN CANADA, G. C. Dohler
- RECENT ADVANCES IN TSUNAMI INSTRUMENTATION IN JAPAN, K. Terada
- BOURDON-TUBE, DEEP SEA TIDE GAGES, J. H. Filloux
- INSTRUMENTATION SYSTEM FOR THE MEASUREMENT OF TSUNAMIS IN THE DEEP OCEAN, M. Vitousek and G. Miller
- USE OF THE T-PHASE IN TSUNAMI WARNING, R. Johnson
- DEVELOPMENTS AND PLANS FOR THE PACIFIC TSUNAMI WARNING SYSTEM, R. A. Eppley and L. M. Murphy
- PROBLEMS OF THE TSUNAMI WARNING SYSTEM IN THE USSR, Z. K. Abouzjarov

TSUNAMI PROPOGATION AND RUN-UP

- TSUNAMI PROPAGATION OVER LARGE DISTANCES, R. D. Braddock
- SOME HYDRODYNAMIC MODELS OF THE UNSTATIONARY WAVE MOTIONS OF TSUNAMI TYPE, S. S. Voit and B. I. Sebekin
- SOME PROBLEMS OF HYDRODYNAMICS OF TSUNAMI, L. V. Cherkasov
- CALCULATION AND ANALYSIS OF TSUNAMI TRANSFORM ON THE SHELF, A. V. Nekrasov
- EXPERIMENTAL INVESTIGATION OF TSUNAMI WAVES, M. I. Krivoshey
- A LABORATORY MODEL OF A DOUBLE-HUMPED WAVE IMPINGENT ON A PLANE, SLOPING BEACH, J. S. Williams and J. M. Jordaan, Jr.
- RESPONSE OF NARROW-MOUTHED HARBORS TO TSUNAMIS, G. F. Carrier and R. P. Shaw

AN INVERSE TSUNAMI PROBLEM, R. O. Reid and C. E. Knowles

EXPERIMENTAL INVESTIGATION OF WAVE RUN-UP UNDER THE INFLUENCE OF LOCAL GEOMETRY, L. Hwang and A. C. Lin

IMMEDIATE PERIOD WAVE RUN-UP AT SAN DIEGO, CALIFORNIA, R. W. Whalin and D. R. Bucci

NUMERICAL SIMULATION OF LONG WATER WAVES--PROGRESS ON TWO FRONTS, R. L. Street, R. Chan, and J. E. Fromm

SUMMARY SESSION

IMPROVED STATISTICAL DATA ON TSUNAMI RECURRENCE IN THE PACIFIC AND SOME FEATURES ON TSUNAMIGENIC EARTHQUAKES, S. L. Soloviev

INITIATING AN IBM SYSTEM/360 DOCUMENT PROCESSING SYSTEM USING AN EXISTING KWIC INDEX DATA BASE, J. Walling and W. M. Adams

REPORT ON THE TSUNAMI COMMITTEE, IUGG, B. D. Zetler

ECUMENICAL TSUNAMIGAKU, D. Cox

TSUNAMI PROPAGATION - R. C. Braddock

The Grid Refinement (GR) technique has been applied to tsunamis to obtain approximate wave paths and tsunami travel times. This technique represents a new method of systematically calculating converging sequences of approximations to an optimal path and the corresponding travel time. Unlike the wave front method, the GR-technique requires relatively small calculations and iterates to the optimal path under consideration.

In analyzing the Alaskan tsunami of March 28, 1964, the epicenter of the tsunami was assumed to be at 60° N, 147° W. The calculated values were obtained by using great circles as first approximations. Except for Sitka and Astoria, these arcs passed over land and broad initial grids including a section of the Pacific Ocean were employed. As a consequence, some of the early approximations obtained from the GR-technique were inaccurate and the approximating travel times converged more slowly.

A description of the probable propagation of the Alaskan tsunami of March 28, 1964 into the southwest Pacific follows. The earthquake in Prince William Sound generated a large tsunami which spread out into the Pacific Ocean. After passing into deep water in the Gulf of Alaska, the wave train travelled along paths closely approximating great circle arcs to Canton Island, Pago Pago and the Fiji Basin to the north-east of Australia. The section of the tsunami which passed into the Solomon and New Hebrides Islands, was dispersed by the many islands, reefs and shoals which abound in this region. The remaining energy of this section of the tsunami was finally dissipated on the Great Barrier Reef.

Another portion of the tsunami entered the Fiji Basin and was refracted and reflected into the Tasman Sea by the Lord Howe Rise and the Norfolk Island Ridge. This wave system spread out over the Tasman Sea and was reflected by the Undulla Deep off the east coast of Australia. This reflected wave recrossed the southern portion of the Tasman Sea and was recorded on the South Island of New Zealand and at Macquarie Island. The remaining portion of the tsunami travelled through the deep waters east of the Tonga and Kermadec Islands and continued towards the east coast of New Zealand and Macquarie Island. The remaining wave energy, which was sufficient to penetrate the pack-ice and travel into McMurdo Sound, was expended on the rugged ice-bound coast of Antarctica.

REFERENCES

1. BRADDOCK, R. D., The grid refinement technique, Horace Lamb Centre, Flinders Univ., South Australia, Res. Rept. 19, 1968a.
2. BRADDOCK, R. D., Application of the GR-technique to tsunamis, Horace Lamb Centre, Flinders Univ., South Australia, Res. Rept. 20, 1968b.
3. BRADDOCK, R. D., On tsunami propagation, J. Geophys. Res., 74, 1952-1957, 1969.

ITIC VISITING SCIENTISTS PROGRAM

Dr. Hideo Watanabe, Japan Meteorological Agency, and Ziadin Abouzjarov, U.S.S.R. Hydrometeorological Service, completed their UNESCO/IOC-sponsored 3-month visit to ITIC on 1 December and 1 November respectively. During their visit both scientists participated in the IUGG Tsunami Symposium and inspected all of the local facilities that work on the tsunami problems.

Scientists who would like to do research on tsunamis at the International Tsunami Information Center in Honolulu may obtain limited monetary assistance from UNESCO/IOC. Requests for such support should be addressed to the Director, International Tsunami Information Center, P. O. Box 3887, Honolulu, Hawaii 96812, U.S.A., and a copy of the request should be sent to the Secretary, Intergovernmental Oceanographic Commission, UNESCO, Place de Fontenoy, Paris 7^e, France.

NEW TIDE STATION IN SE PACIFIC

The tide station at Rikitea, Mangareva Island, Gambier Isles, has joined the TWS, supplying water level data to Honolulu Observatory. The station is equipped with a Bristol Bubbler tide gage and is operated by the Laboratoire de Geophysique. Located at latitude 23° South, Longitude 135° West, Rikitea will be an important island station for the detection of tsunamis originating in South America.

STORM WAVES HIT HAWAII

Storm waves reaching as high as 50 feet struck the north and north-western coasts of the Hawaiian Islands during 1-5 December 1969. These waves were generated by a pair of severe storms 1500 miles northwest of Hawaii near the western Aleutian Islands. The fetches of these storms were estimated to be 1000 miles or more. One person is missing and presume swept out to sea by a huge wave and another person died of a heart attack after working in the devastated area on the north shore of Oahu. The damage is estimated to be about \$1,000,000 on Oahu, mostly from destruction to homes and roads. These waves were much larger than the storm waves that struck Chile in July 1968 as reported in the September 5, 1968 ITIC NEWSLETTER.

CATALOG OF TSUNAMIS IN ALASKA

An ERRATA and ADDENDA cahier for the Catalog of Tsunamis in Alaska, is being mailed with this issue of the NEWSLETTER. All holders of the catalog are requested to make the necessary corrections and additions or insert the cahier in their catalog for future reference.

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TSUNAMI INVESTIGATIONS - OCTOBER-DECEMBER 1969

<u>GMT</u> <u>Date & Time</u> <u>1969</u>	<u>Epicenter</u>	<u>Magnitude</u> <u>& Depth</u>	<u>Region</u>	<u>Comments</u>
Oct 31, 1133	51.3 N 179.0 W	6.3 49 km	Andreanof Is. Aleutian Is.	No evidence of tsunami
Nov 1, 1108	23.1 N 107.9 W	6.6 Normal	Gulf of Calif. Mazatlan	No evidence of tsunami
Nov 22, 2310	57.8 N 163.5 E	7.3 Normal	Kamchatka	Tsunami Watch issued. Very small tsunami observed and recorded in the Pacific. Maximum wave heights measured & reported were:
				Attu 1.10m Shemya 0.91 Adak 0.30 Kahului, Hawaii 0.34 Honolulu 0.09 Midway 0.09 Hilo 0.09
Dec 25, 2132	15.7 N 59.7 W	7.7 14 km	Leeward Islands	Not in the Pacific

NEW PUBLICATIONS IN ITIC LIBRARY

AIDA, I., 1969

Numerical experiments for tsunamis caused by moving deformations of the sea bottom, Bull. Earthq. Res. Inst., v. 38, pp 849-862.

BASHAM, P. W. and R. M. Ellis, 1969

The composition of P codas using magnetic tape seismograms, Bull. Seism. Soc. Am., v. 59, no. 2, pp 473-486.

HATORI, T., 1969

Analyses of oceanic long-period waves at Hachijo Island, Bull. Earthq. Res. Inst., v. 47, pp 863-874.

HATORI, T., 1969

A study of the wave source of tsunami generated off West Hokkaido on Aug. 2, 1940, Bull. Earthq. Res. Inst., v. 47, pp 1063-1072.

STEVENS, A. E., 1969

Worldwide earthquake mechanism, Geophys. Monograph No. 13, Am. Geophys. Union, pp 153-160.