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5. *Tsunami Sources in Hokkaido and Southern Kuril Regions.*

By Tokutaro HATORI,
Earthquake Research Institute.

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Abstract

Adding new data of tsunamis which were observed at tide stations of Japan and USSR during the last 76 years (1894~1969), the characteristics of tsunami sources in the Kuril region are investigated. The estimated tsunami sources are located on the steep continental slope near the ocean trench and agree approximately with the aftershock areas reported by the USSR sources. According to the statistical formula (Iida, 1958), the source dimensions of tsunamis in this region generated by shallow earthquakes ($d<30$ km) are of the standard size. Judging from the initial motion of the tsunami observed by tide gauges, the shoreward sea bottoms in the tsunami source areas are upheaved in most cases. The peaks of tsunami spectra are in the range of 16~35 min and the peak period is longer for the larger tsunami magnitude. From the tide gauge records in Hokkaido, the possibility of tsunami generation in this region is uncertain for the earthquakes in the magnitude range $M=5.9$ to 6.7.

1. Introduction

The aftershock areas of large earthquakes which occurred in the region from Hokkaido to the southern Kuril Islands have been reported by many investigators (21, 23, 25, 28). Source areas of some large tsunamis were also estimated but those of small tsunamis are uncertain. According to the tsunami catalogue given by Soloviev and Go (1969), four small tsunamis were generated in the southern Kuril region since 1960 besides the tsunamis in October, 1963.

On the basis of mareographic data of both Japan and USSR, source areas of these small tsunamis together with historical tsunamis (1894, 1918) are estimated by means of an inverse refraction diagram. Adding new data, all the estimated source areas of tsunamis during the last 76 years (1894~1969) are shown on a bathymetric chart. The characteristics of the distribution and source dimension are investigated in comparison with the case existing in northeastern Japan.

The predominant periods of tsunamis are related to the earthquake magnitude (Takahasi, 1961; Iida, 1961) so that they can be used as information with regards to the source dimension. Making use of several tsunami records observed at Hanasaki and Kushiro, spectral analyses are made. The feature of spectrum for the different tsunami magnitudes is discussed by taking the background noise into account.

2. Estimation of tsunami source area

Inverse refraction diagrams are drawn at two minutes interval, starting from the tide station and the locations of the visual observation. Final wave-fronts corresponding to travel times are shown in the following maps. Here, many records of small tsunamis are collected by courtesy of the Japan Meteorological Agency (JMA), Hokkaido Development Bureau and Iwate Prefectural Office.

1) *The Kushiro-oki tsunami of March 22, 1894*

This tsunami was recorded by the tide gauge at Ayukawa (Omori, 1901). Initial upward motion began 64 min after the main shock ($M=7.9$) and reached the first crest of 25 cm. The maximum wave height was 68 cm. According to visual observations (Omori, 1895), the tsunami travel time at other locations were as follows: Kushiro 20~30 min, Miyako 42 min, and Ruyabetsu, Kunashiri Island, 1 hour or less. From these data, the tsunami source is roughly inferred as shown in Fig. 1.

The tsunami heights along the Sanriku coast (Miyako~Ayukawa) were in the range of 1~1.5 m and the distribution pattern was similar to that of the 1952 Tokachi-oki tsunami. However, the inundated heights of the 1894 tsunami were larger than those of the 1952 tsunami at Cape Nosappu and the eastern coast of Kunashiri Island. The epicenter of the 1894 earthquake was located eastward from that of the 1952 earthquake. Thus, the source area of the 1894 tsunami seems to extend up to the neighborhood of the Habomai Islands and may be larger than that of the 1952 tsunami.

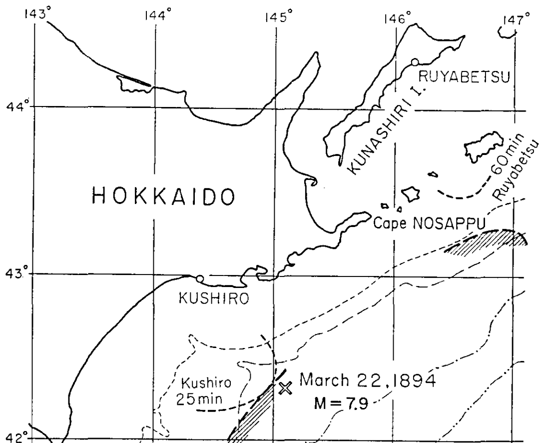

Fig. 1. Estimated source area of the tsunami on March 22, 1894.

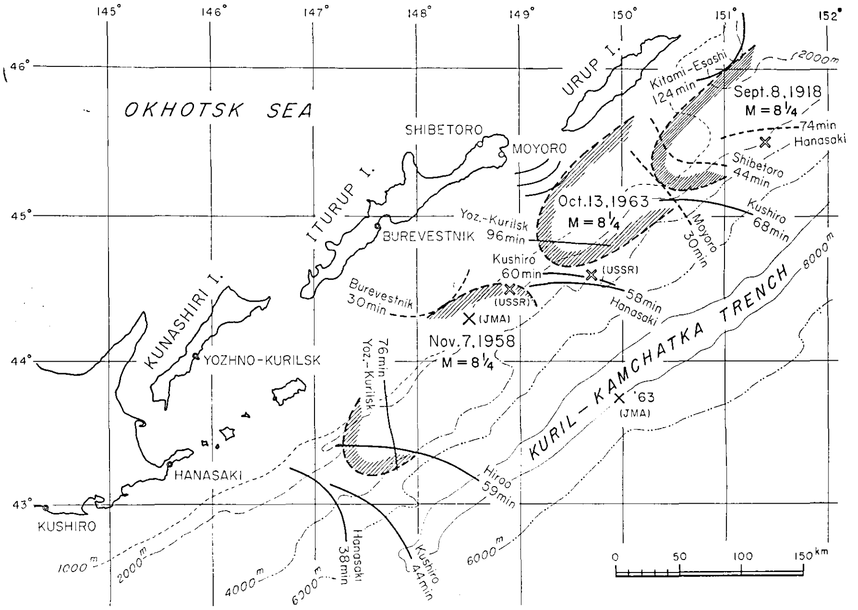

Fig. 2. The tsunami sources of 1918, 1958 and 1963 which were inferred, adding the mareographic data at Hokkaido.

2) *The Urup tsunami of Sept. 8, 1918*

This tsunami was the largest among tsunamis generated recently in the vicinity of the southern Kuril Islands, and was observed in all the regions of the Pacific coast. On the basis of three tide gauge records (Nakamura, 1918a, b; Imamura and Moriya, 1939) and two observations by eyewitnesses (Soloviev and Ferchev, 1961), the southern part of the tsunami source is estimated in Fig. 2. According to the records, the initial motion of the tsunami is upward. Nakamura (1918b) pointed out that the record at Kitami-Esashi showed a downward direction, but its beginning time cannot be harmonized in the source estimation.

The travel times at Hokkaido for the 1918 tsunami are 8～16 min longer than those of the 1963 tsunami, so that the southern end of the tsunami source would be located northward. The northern end of the source cannot be delineated, but the source dimension will be discussed later with the aid of a feature of the tsunami spectrum (see Section 4).

3) *The 1958 Iturup and the 1963 Urup tsunamis*

The tsunami sources inferred from observations at the Kuril Islands (Fedotov, 1962; Soloviev, 1965) are reviewed, adding the mareographic data of Hokkaido (JMA, 1959; Hatori and Takahasi, 1964). As shown in Fig. 2, the southern margin of the wave source for the 1958 tsunami approaches Hokkaido and the source area is slightly elongated.

4) *Small tsunamis during the period from 1961 to 1968*

During these eight years, four small tsunamis (except the tsunamis in 1963) were generated off the southern Kuril Islands, and observed at tide stations in Japan and USSR. The earthquake data which were determined by the USSR are included in Table 6. According to the seismological bulletin of USSR, the magnitudes of these earthquakes were in the range of 7~7.5 but JMA estimated about 0.5 smaller. The summary of principal features of tsunami records at various stations

Table 1. The tsunami generated off Shikotan at 06 53 on Feb. 13, 1961 (JST), as recorded by tide gauges

Station	Initial wave			Max. wave Double amplitude (cm)
	Travel time (min)	Initial rise (cm)	Period 1st to 2nd crest (min)	
Hanasaki	46	7	13	12
Kushiro	50?	3	30	9
Hiroo	60?	3	12	8

Table 2. The tsunami generated off Simushir at 17 15 on July 24, 1964 (JST), as recorded by tide gauges

Station	Initial wave			Max. wave Double amplitude (cm)	Ref.
	Travel time (min)	Initial rise (cm)	Period 1st to 2nd crest (min)		
Matua	17.5	8	5	15	26)
Hanasaki	?			5	
Kushiro	86	3	25	6	
Hiroo	98?	2	10	7	

Table 3. The tsunami generated off Iturup at 12 33 on June 11, 1965 (JST), as recorded by tide gauges

Station	Initial wave			Max. wave Double amplitude (cm)	Ref.
	Travel time (min)	Initial rise (cm)	Period 1st to 2nd crest (min)		
Matua	?			2	27)
Burevestnik	37	4		9	27)
Hanasaki	?			8	
Kushiro	58?	2	12	8	
Hiroo	67?	2	8	10	

Table 4. The tsunami generated off Shikotan at 19 19 on Jan. 29, 1968 (JST), as recorded by tide gauges

Station	Initial wave			Max. wave Double amplitude (cm)	Ref.
	Travel time (min)	Initial rise (cm)	Period 1st to 2nd crest (min)		
Burevestnik	52	17	30	23	10)
Yozhno-Kurilsk	40	15	25*	25	10)
Hanasaki	37	11	14	19	
Kushiro	42?	5	18	11	
Hiroo	54	18	10	22	
Hachinohe	?			4	
Shimanokoshi	60	8	12	16	

* Average period

are given in Tables 1～4. The initial motion of these tsunamis were upward at all stations. The tsunami associated with the earthquake on Jan. 29, 1968 ($M=6.9$, JMA; $7\frac{1}{2}$, USSR) was the largest among the small tsunamis, and was observed far from the wave source at Shimanokoshi in the Sanriku district (Fig. 3). Wave-heights for other tsunamis are about 10 cm at Hokkaido, and are indefinite in the Sanriku district. Figure 3 shows the principal records of three tsunamis generated off Shikotan I. (Feb. 13, 1961), Simushir I. (July 24, 1964) and Shikotan I. (Jan. 29, 1968).

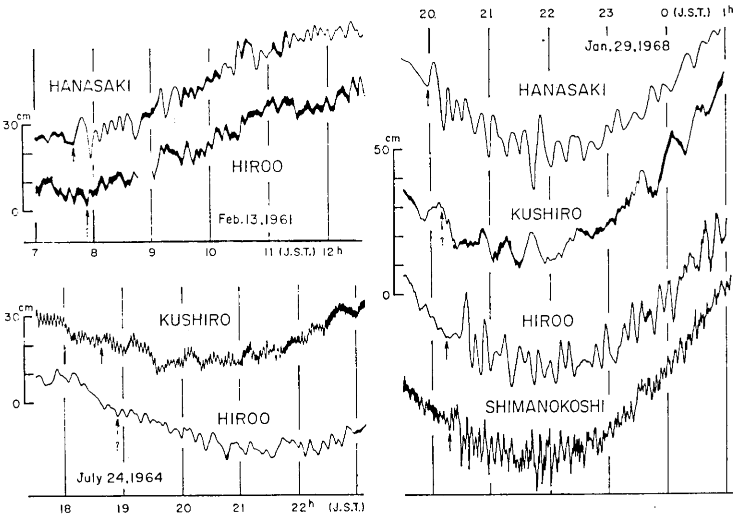

Fig. 3. Records of the tsunamis on Feb. 13, 1961, July 24, 1964, and Jan. 29, 1968.

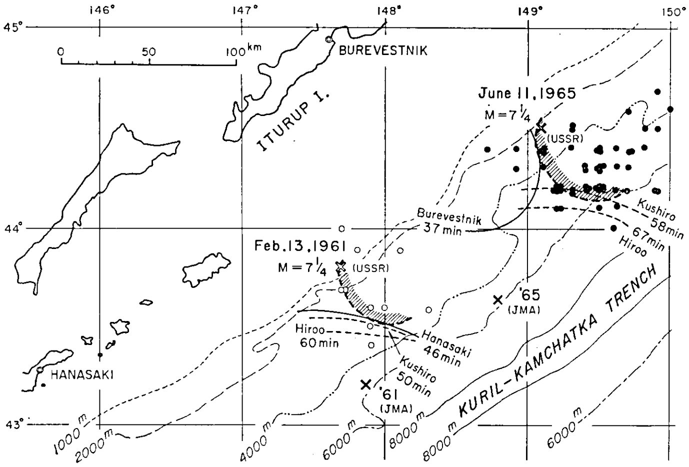

Fig. 4. Estimated sources areas of the tsunamis on Feb. 13, 1961 and June 11, 1965 and the distributions of aftershocks determined by USSR.

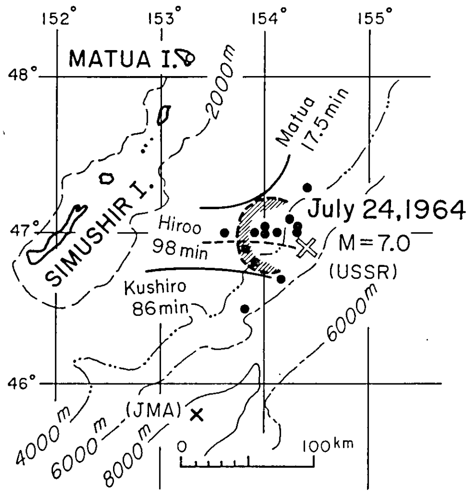

Fig. 5. Estimated source area of the tsunami on July 24, 1964 and the distribution of aftershocks determined by USSR.

Figures 4~5 show the estimated tsunami sources and distributions of aftershocks (the time interval of one day following the main shock) which were determined by the USSR. As shown in the figures, the epicenters of the main shocks determined by JMA are located at the southwestern side of those of the USSR. For the earthquakes which occurred in the vicinity of the southern Kuril Islands, the epicenters determined by JMA have a tendency to show a discrepancy because of the arrangement of seismological network (Ichikawa, 1969). The estimated tsunami sources nearly agree with the aftershock areas determined by the USSR. However, the source area of the 1968 tsunami located near Hokkaido, agrees rather with the aftershock areas observed by JMA. The aftershocks during the period of one week are plotted in Fig. 6. This distribution is in good agreement with the determination by the Urakawa Seismological Observatory, Hokkaido University (Hirota, 1969).

The possibility of tsunami generation is checked on the tide gauge

Table 5. Earthquakes for which the possibility of tsunami generation is checked by tide gauge records

Date (JST)	Epicenter		Location	d (km)	M	Tide station	Remark
	Lat. N	Long. E					
1960 Sept. 4	44 °	149.8°	Iturup	60	5.9	Hanasaki, Hiroo	Seiche
1961 Apr. 23	43.6	149.6	〃	0	6.6	Hahasaki, Hiroo, Hachinohe	〃
1962 Dec. 21	42.0	142.5	Urakawa	60	6.3	Hiroo, Muroran, Hachinohe	
1964 May 31	43.3	147.2	Shikotan	60	6.7	Hanasaki, Kushiro, Hiroo	Seiche
1964 Oct. 16	43.4	149.5	Iturup	20	5.9	Hanasaki, Kushiro, Hiroo	Swell
1966 Nov. 12	41.6	144.4	Erimo	40	5.9	Hiroo, Urakawa, Hachinohe	
1967 Mar. 19	44.8	151.4	Urup	60	6.3	Hanasaki, Kushiro, Hiroo	

records for the earthquakes with a magnitude of 5.9 or more, listed in Table 5. However, tsunami could not be identified because of the background noise. The frequencies of aftershocks were relatively small except the earthquakes on May 31, and October 16, 1964.

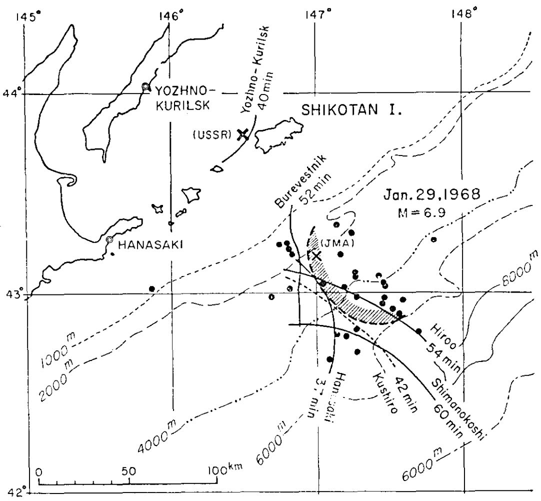

Fig. 6. Estimated source area of the tsunami on Jan. 29, 1968 and the distribution of aftershocks determined by JMA.

3. Geographic distribution of tsunami sources

By adding the present results, the total number of the estimated source areas of tsunamis is 14 or about 75% of the whole tsunamis listed in the tsunami catalogue (Watanabe, 1968; Soloviev and Go, 1969). All the estimated source areas of tsunamis, classified by the magnitude, and the epicenters of the related earthquakes are shown on a bathymetric chart (Fig. 7). It is seen that most of tsunami sources are located on the continental slope along the island arc, and cannot be found in the shallow sea or outside the trench. In northeastern Japan, the sources of small tsunamis are mostly located in the shallow sea (Hatori, 1969), while in the southern Kuril region, the tsunami sources of various dimensions line up on the same depth.

The estimated source dimensions (major length: L, area: S) are

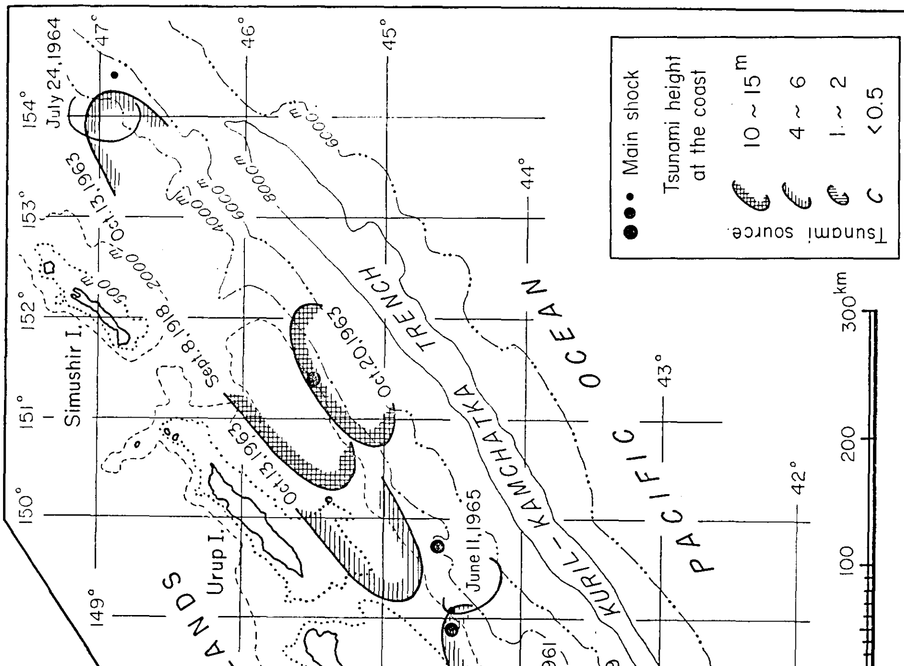

Fig. 7. Geographic distribution of the estimated source areas of tsunamis in the region from Hokkaido to South Kurils during the last 76 years (1894-1969), classified by the tsunami height at the coast.

Table 6. Dimension of the tsunami sources in the region from Hokkaido to South Kurils

Date (JST)	Earthquake					Tsunami			Ref.
	Epicenter		Location	d (km)	M	m*	L (km)	S $\times 10^3 km^2$	
	Lat. N	Long. E							
1893 June 4	43.3°	147.5°	Shikotan		6.6	1			
1894 Mar. 22	42.3	145.1	Hokkaido		7.9	2	(250)		
1918 Sept. 8	45.5	151.4	Urup	S	$8\frac{1}{4}$	3	(370)		
1918 Nov. 8	45.5	151.5	〃	S	$7\frac{3}{4}$	0			
1952 Mar. 4	42.2	143.9	Hokkaido	45	8.1	2	90	3.7	19)
1952 Mar. 10	41.7	143.5	〃	10	7.0	−1			
1958 Nov. 7	44.5	148.9	Itrup	80	$8\frac{1}{4}$	2	200	11	24)
1958 Nov. 13	44.3	148.9	〃	50	7.5				
1961 Feb. 13	43.8	147.7	Shikotan	50	$7\frac{1}{4}$	0	50	1.2	
1961 Aug. 12	42.9	145.6	Hokkaido	80	7.2	−1	35	0.7	2)
1961 Nov. 15	42.7	145.6	〃	60	6.9	−1	40	0.8	2)
1962 Apr. 23	42.2	143.9	〃	60	7.0	−1	40	0.9	2)
1963 Oct. 12	44.7	149.1	Urup	50	$7\frac{1}{4}$	−2			
1963 Oct. 13	44.6	149.7	〃	60	$8\frac{1}{4}$	2	470	33	18)
1963 Oct. 20	45.4	150.2	〃	20	$7\frac{1}{4}$	2?	120	4.7	18)
1964 July 24	46.9	154.4	Simushir	40	7	−2	50	1.5	
1965 June 11	44.5	149.1	Itrup	30	$7\frac{1}{4}$	−2	60	1.9	
1968 Jan. 29	43.2	147.0	Shikotan	30	6.9	0	70	2.2	
1969 Aug. 12	43.5	147.4	〃	30	7.8	2	170	8	3)

* m: Imamura-Iida's magnitude of tsunami.

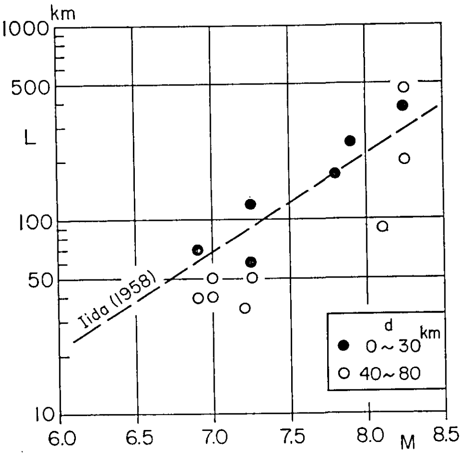

Fig. 8. Relation between the dimension of tsunami source indicated in Fig. 7. and earthquake magnitude. d: focal depth of the main shock.

given in Table 6. Figure 8 shows the relation between the length of the tsunami source and the earthquake magnitude where closed circles are the tsunamis which are accompanied by the main shocks with a focal depth shallower than 30 km and open circles are those deeper than 40 km. It is seen that the source dimension of a tsunami due to a shallow earthquake is closely represented by the empirical formula given by Iida (1958); namely,

$$\log L = 0.5M - 1.7 ,$$

where L is measured in km. The

source dimension for a deep earthquake has a tendency to be smaller, consistent with the case in Japan.

4. Feature of tsunami spectrum

The spectral analyses for several tsunamis observed at Hanasaki and Kushiro are made by Tukey's method. The results are shown in Fig. 9 where the conditions of analysis are as follows: Time length of the record is 6 hours including the initial wave with sampling at every 2 minutes interval. The total number of data points is 180 and the lag is 80.

As seen in Fig. 9, the features of spectra at Hanasaki vary according to the tsunami magnitude. The spectra of the background noise at both stations are shown in Fig. 10 where the analyzed time interval of each record is 12 hours. According to the report of Nemuro

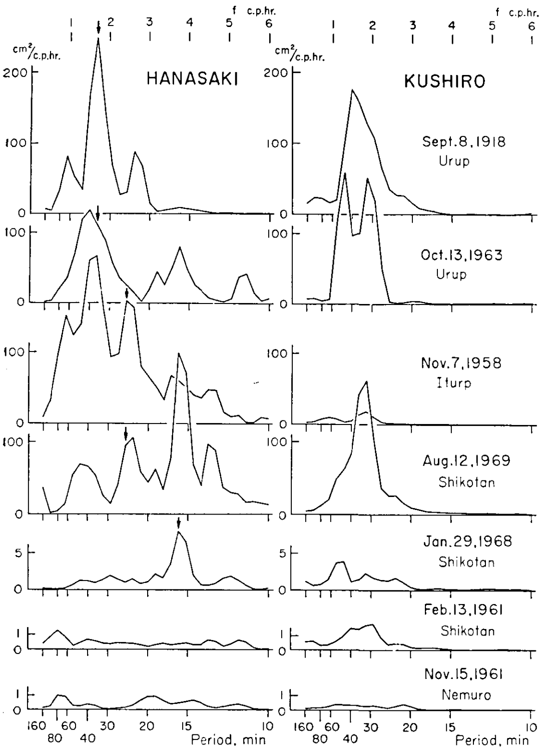

Fig. 9. Power spectra for various tsunamis analyzed from the records at Hanasaki and Kushiro. Arrows indicate the probable peak of tunami spectrum in the outer sea.

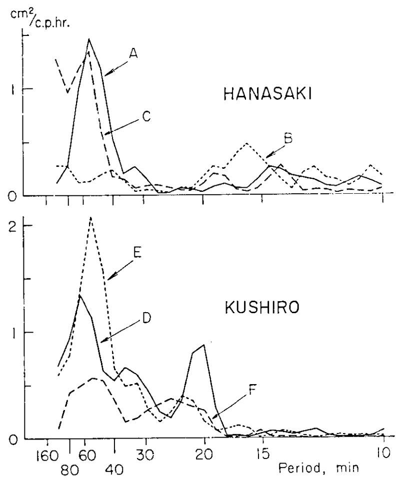

Fig. 10. Spectra of background noises at Hanasaki and Kushiro. Date of spectral analyses; A: Sept. 4, 1960, B: March 19, 1967, C: June 12, 1968, D: Feb. 14, 1961, E: Aug. 11, 1961 and F: Nov. 12, 1966.

Weather Station (1967), the seiche period in Hanasaki Harbor is 15 min but another predominant period of 53 min is found from the present analysis. When the amplitude ratios of the tsunami spectrum to the noise spectrum were calculated, the peaks of spectra fall in the band of period indicated by the arrow. The positions of peaks are as follows: the tsunamis of 1918 and 1963, 35.4 min, tsunamis of 1958 and 1969, 24.4 min, and tsunami of 1968, 16 min. These peaks would correspond to the predominant period of the tsunami incident on the shelf near Hanasaki, if the noise level is assumed to represent the response of the near shore area of Hanasaki. The position of the predominant peak of the tsunami spectrum moves to the low frequency part as the magnitude of tsunami or earthquake increases. Thus, the source dimension of the 1918 tsunami seems to be comparable to that of the 1963 tsunami.

On the other hand, at Kushiro, located at the far end of the continental shelf, the water level variation has always a predominant period of 29～32 min (Nakano and Unoki, 1962). The separation of incident tsunami spectrum having these periods from noise was not successful.

5. Conclusion

For the tsunamis which were generated off the southern Kuril Islands and its vicinity during the last 76 years, the geographic distribution of the tsunami source is shown, adding new data. The tsunami sources of various sizes line up along the contiental slope near the trench. The initial motions of most tsunamis (except the tsunami on Aug. 12, 1969 (Hatori, 1970)) were in the upward directions, so that the uplift of the bottom may have occurred at the landward side of the tsunami sources. From the spectral analyses of tsunami records at Hanasaki, it is found that the predominant period moves to the lower frequency part as the tsunami magnitude increases.

The estimated tsunami sources in the Kuril region have a tendency to agree with the aftershock areas determined by the USSR. At the tide stations in Hokkaido, the observed tsunamis which were generated in this region are only for an earthquake magnitude of 6.9 or more.

Acknowledgement

The author wishes to express his hearty thanks to the Japan Meteorological Agency, Hokkaido Development Bureau, and Iwate Prefectural Office for putting their tide gauge records at his disposal. His thanks are also due to Prof. K. Kajiura for his valuable advice and to Mr. M. Koyama who has assisted in reading out many records. The

computation of spectrum was made at the Computer Center, Tokyo University.

References

1) HATORI, T., and R. TAKAHASI, 1964, On the Iturup tsunami of Oct. 13, 1963, as observed along the coast of Japan, *Bull. Earthq. Res. Inst.*, **42**, 543-554.
2) HATORI, T., 1969, Dimensions and geographic distribution of tsunami sources near Japan, *Bull. Earthq. Res. Inst.*, **47**, 185-214.
3) HATORI, T., 1970, An investigation of the tsunami generated by the east Hokkaido earthquake of August, 1969, *Bull. Earthq. Res. Inst.*, **48**, 399-412.
4) HIROTA, T., 1969, Aftershock sequence of the earthquake off Shikotan Island on January 29, 1968 (in Japanese), *Geophys. Bull. Hokkaido Univ.*, **21**, 33-43.
5) ICHIKAWA, M., 1969, Epicenter determination capability of the seismological network of Japan Meteorological Agency (in Japanese), *J. Meteorol. Res.*, **21**, 297-308.
6) IIDA, K., 1958, Magnitude and energy of earthquakes accompanied by tsunami and tsunami energy, *J. Earth Sciences, Nagoya Univ.*, **6**, 101-112.
7) IIDA, K., 1961, On the estimation of tsunami energy, *Proc. Tsunami meeting associated with the Tenth Pacific Science Congress*, IUGG Monograph, No. **24**, 167-173.
8) IMAMURA, A., and M. MORIYA, 1939, Mareographic observations of tsunamis in Japan during the period from 1894 to 1924, *J. Astr. Geophys. Japan*, **17**, 119-140.
9) JAPAN METEOROLOGICAL AGENCY, 1959, The Etorofu-oki earthquake of November 7, 1958 (in Japanese), *Quart. J. Seism.*, **24**, 65-89.
10) LAPSHIN, S., 1969, Tsunamis in the Kuril Islands in 1968, *News Letter, International Tsunami Information Center, Hawaii* **2** (4), p. 4.
11) NAKAMURA, S. T., 1918a, Note on tsunamis, *Proc. Physico-Mathem. Soc. Japan*, [ii], **9**, 548-555.
12) NAKAMURA, S. T., 1918b, A tsunami accompanying the Urup earthquake of Sept. 8, 1918 (in Japanese), *Kisho Zatsusan (Miscellaneous Report of Meteorology), Central Meteorol. Obs. (JMA)*, **1** (5), 265-277.
13) NAKANO, M., and S. UNOKI, 1962, On the seiches (the secondary undulations of tides) along the coasts of Japan, *Rec. Oceanogr. Works Japan, Special* No. **6**, 169-214.
14) NEMURO WEATHER STATION, 1967, Seiche in Hanasaki Harbor (in Japanese), *J. Meteorol. Res.*, **19**, 219-222.
15) OMORI, F., 1895, Report of the Hokkaido earthquake of March 22, 1894 (in Japanese), *Rep. Imp. Earthq. Inv. Comm.*, **3**, 27-35.
16) OMORI, F., 1901, On tsunami or destructive sea-waves in Japan (in Japanese), *Rep. Imp. Earthq. Inv. Comm.*, **34**, 1-81.
17) SOLOVIEV, S. L., and M. D. FERCHEV, 1961, Summary of data on tsunamis in the USSR (in Russian), *Bull. Counc. Seismol.*, **9**, 23-55, Eng. transl. by W. G. VAN CAMPEN, *Hawaii Inst. Geophys., Transl.*, **9**, 1-37, 1961.
18) SOLOVIEV, S. L., 1965, The Urup earthquake and associated tsunami of 1963, *Bull. Earthq. Res. Inst.*, **43**, 103-109.
19) SUZUKI, Z., and K. NAKAMURA, 1953, On the heights of the tsunami on March 4, 1952, in the district near Erimo-misaki, *Sci. Rep. Tohoku Univ., Geophysics*, [v], **4**, 139-143.
20) TAKAHASI, R., 1961, On the spectra and the mechanism of generation of tsunamis, *Proc. Tsunami meeting associated with the Tenth Pacific Congress*, IUGG Monograph, No. **24**, 19-25.
21) UTSU, T., 1968, Seismic activity in Hokkaido and its vicinity (in Japaneses), *Geophys. Bull. Hokkaido Univ.*, **20**, 51-75.
22) WATANABE, H., 1968, Descriptive table of tsunami in and near Japan (in Japanese),

Zisin (*J. Seismol. Soc. Japan*), [ii], **21**, 293-313.

23) АВЕРЬЯНОВА, В. Н., 1968, Закономерности ориентации движений при Курило-Камчатских землетрясениях и возможность районирования цунамигенности, «Проблема Цунами», АН СССР, Москва, 105-120.

24) ФЕДОТОВ, С. А., 1962, Определения областей возникновения волн цунами при Камчатском землетрясении 4 ноября 1952 г. и Итрупском землетрясении 6 ноябре 1958 г., Изв., АН СССР, сер. геофиз., **10**, 1333-1339.

25) ФЕДОТОВ, С. А., 1965, Закономерности распределения сильных землетрясений Камчатки, Курильских островов и северо-восточной Японии, Труды Ин-та Физики Земли АН СССР, No. **36**, 66-93.

26) СОЛОВЬЕВ, С. Л., и др., 1967, Землетрясения Дальнего Востока. -В сб,: Землетрясения в СССР в 1964 г., «Наука», 128-165.

27) СОЛОВЬЕВ, С. Л., и др., 1968, Землетрясения Дальнего Востока. -В сб,: Землетрясения в СССР в 1965 г., «Наука», 119-158.

28) СОЛОВЬЕВ, С. Л., 1968, Проблема цунами и ее значение для Камчатки и Курильских островов, «Проблема Цунами», АН СССР, Москва, 7-50.

29) СОЛОВЬЕВ, С. Л., и Ч. Н. ГО., 1969, Каталог цунами в Тихом океане, АН СССР, Москва, 1-83.

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5. 北海道，南千島沖における津波の波源

地震研究所　羽 鳥 徳 太 郎

戦後，南千島に起きた津波は，Soloviev を中心とするソ連の研究者により，精力的な調査研究が行なわれてきた．1958 年エトロフ沖，1963 年ウルップ沖の津波のほかに，多数の微小津波が報告された．今回，1894 年釧路沖津波，1918 年ウルップ沖の歴史的津波をはじめ，北海道の検潮記録とソ連の報告をもとに，逆伝播図の方法から，これら微小津波の波源域を推定する．以上の結果を加えて 76 年間 (1894～1969)，南千島沖における波源の大きさと地理的分布の特徴を調べた．

津波の表によれば，今回の解析を加えて推定波源の数は，全体の約 75%，14 個となる．まずその分布では，大小各サイズの波源は傾斜の急な陸棚斜面上を島弧に沿つて並び，海溝の外側と浅海にはみられない．東北日本の場合 (Hatori, 1969)，小型の波源が 2000 m 以下の浅海にもあるのと比べて，顕著な違いといえよう．津波の初動については，1969 年 8 月の色丹島沖津波を例外として，多くの津波は総べて押し波で観測され，波源上，陸側に面した海底が隆起したことを暗示する．本震が 30 km より浅い地震による津波では，波源の大きさは Iida (1958) により与えられた地震マグニチュードと関係する経験式であらわせる．

花咲で観測した津波のスペクトル解析によると，大きな規模をもつ津波ほど，スペクトルのピークは長周期部分に現われる．花咲のバックグランド・ノイズが 20～40 分の周期帯域で小さく，この部分に現われたピークは花咲付近の陸棚へ入射した卓越周期とみなされる．1918 年ウルップ沖津波では，波源の北端をきめる資料がない．しかし 1963 年 10 月の津波と同じ 35 分の周期にスペクトルのピークが現われ，1918 年津波の波源のサイズは，1963 年のものにちかいことが推測できる．一方，陸棚の奥にある釧路では，30 分付近に顕著な静振があり，津波入射波の分離はできなかつた．

南千島における推定波源は，ソ連の報告による余震域と合致する傾向にある．またマグニチュードが 5.9～6.7 をもつた 7 個の地震のときの，北海道の検潮記録を調べたが，津波は認められなかつた．これらの地震は比較的余震数が少ない．観測された津波は，6.9 以上のマグニチュードをもつた地震によつて起こされた．