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44. On the Changes in the Heights of Yearly Mean Sea-levels in Recent Years.*

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Introduction

The data for mean sea-levels as well as for levelling survey were kindly placed at my disposal by the Geographical Survey Institute, for which I wish to express my hearty thanks.

Investigations on the changes in the heights of the mean sea-levels have been made, and the results for the years from 1900 to 1958, have already been reported in my paper.[1)]

In the Symposium on Mean Sea Level, held at Washington D. C., April 13-15, 1967, the results of investigations on the slopes of sea levels along the coasts of U.S.A., on both sides of the Pacific as well as Atlantic Oceans, and also along the European waters, were reported.

Investigations on the changes in the heights of yearly mean sea-levels near Japan for the years from 1959 to 1967, were made in the same manner as before, and moreover, investigations on the slopes of sea levels along the Japanese coast, were made, the heights of mean sea-level at

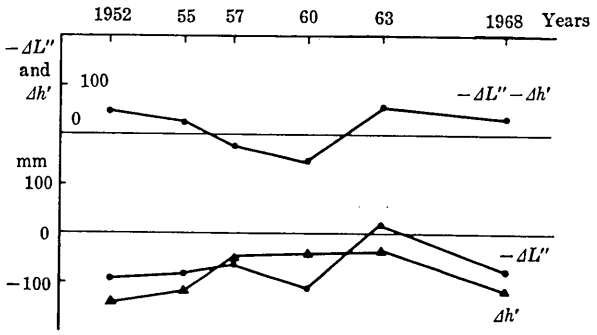

Fig. 1. Change in the height of fixed plane inside the mareographic station at Aburatubo.
$-\Delta L''$: derived from mean sea-level. $\Delta h'$: derived from levelling survey.

* Communicated by T. Minakami.

1) S. YAMAGUTI, *Bull. Earthq. Res. Inst.*, **38** (1960), 145-175.

Table 1. Yearly mean values of sea-levels, and their differences from that of Aburatubo or of Nezugaseki, in millimetres during the period of 21 years (1947～1967), calculated with the values of $\Delta L'' = \Delta L' - p\Delta b' - q\Delta T'$.

Stations \ Years	1947	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	Mean
	mm																					
Aburatubo	−26	−2	33	33	49	60	78	70	78	79	65	52	90	170	93	85	37	95	55	66	82	62
Hososima	17	57	86	95	70	71	63	99	72	84	49	11	−7	−36	−42	−63	−65	−23	−50	−57	−51	17
Kôti					−37	25	48	22	−21	2	−5	−16	−25	−35	−50	−90	−108	−51	−106	−101	−44	−35
Kainan							6	7	−48	4	33	34	26	30	25	−5	−57	−8	−23	−27	17	1
Asamusi								−9	7	8	−14	−13	−31	−49	−56	−35	−49	−21	−14	−35	−51	−26
H−A	43	59	53	62	21	11	−5	29	−6	5	−16	−41	−97	−206	−135	−148	−102	−118	−105	−123	−133	−42
Kô−A					−86	−35	−30	−48	−99	−77	−70	−68	−115	−205	−143	−175	−145	−146	−161	−167	−126	−111
Kai−A							−72	−63	−126	−75	−32	−18	−64	−140	−68	−90	−94	−103	−78	−93	−65	−80
Asa−A								−79	−71	−71	−79	−65	−121	−219	−149	−120	−86	−116	−69	−101	−133	−104
Wasima								6	5	14	−2	−22	−4	−5	−5	−22	−73	−16	−23	−34	−52	−14
Kasiwazaki									−16	10	3	−13	1	0	−20	1	−13	−7	−2	−34	−58	−11
Osyoro								−23	−29	−9	4	−5	−15	−45	−55	−28	−49	−62	−60	−69	−87	−38
Nezugaseki									−13	9	12	10	12	−45	−55	−39	−59	$\frac{-45}{117}$	175	159	150	32
W−Kasi									21	4	−5	−9	−5	−5	15	−23	−60	−9	25	0	+6	− 4
W−A								−64	−73	−65	−67	−74	−94	−175	−98	−107	−110	−111	−32	−100	−134	−90
N−Kasi									3	=1	9	23	11	−45	−35	−40	−46	$\frac{-38}{184}$	177	193	208	30
Kasi−A									−94	−69	−62	−65	−89	−170	−113	−84	−50	−102	−57	−100	−140	−88
O−Kasi									−13	−19	1	9	−16	−45	−35	−29	−36	−55	−58	−35	−29	−28
N−A									−91	−70	−53	−42	−78	−215	−148	−124	−96	$\frac{-140}{82}$	120	93	68	−59
O−Asa								−14	−36	−17	18	8	16	4	1	7	0	−41	−46	−34	−36	−10
Kô−Kasi							42	15	27	−2	−38	−50	−51	−65	−75	−85	−51	−43	−83	−74	−61	−40
O−A								−93	−107	−88	−61	−57	−105	−215	−148	−113	−86	−157	−115	−135	−169	−114
Asa−Kasi									23	−2	−17	0	32	−49	−36	−36	−36	−14	−12	−1	7	−18

Aburatubo being assumed constant.

In the comparison of the results of levelling survey from the standard origin of bench mark at Miyakesaka, Tokyo, to the fixed plane inside the mareographic station at Aburatubo with those derived from the mean sea-level taken by tide gauge there, some parallelism has been shown, and the period of 18.6 years, which may correspond to the effect of nodal tide has appeared during the period of 35 years from 1923 to 1957.[2] After the year, the levelling surveys have been carried out by the Geographical Survey Institute, three times in 1960, 1963, and 1968, so that the curves for comparison are extended to 1968, as shown in Fig. 1.

Method of Investigation and Results

Monthly deviations of sea-levels from many years' mean for each month are taken and denoted $\Delta L'$, which may be considered to be corrected by the factors due to sea water density and barometric height, both of which contain the dynamical as well as statical effects, respectively, and others for the first approximation. Residual values of $\Delta L'$, corrected with the corresponding $\Delta T'$ and $\Delta b'$, represented by the equation, $\Delta L'' = \Delta L' - q\Delta T - p\Delta b'$, were calculated.

With these monthly values of sea-levels, corrected, the yearly mean sea-levels were calculated, the probable error of which being about ± 5 mm. Diagrams were plotted with these yearly values as ordinates against the years taken as abscissa as shown in Fig. 2, for the sea-levels on the Pacific Ocean side. The differences of the heights of yearly mean sea-levels from that of Aburatubo, are shown in Fig. 3. Similarly, for the yearly mean sea-levels and also for the differences of the heights of those from that of Kasiwazaki on the Japan Sea side, diagrams were plotted as shown in Fig. 4. Those above values are tabulated as shown in Table 1.

Secular mean variations of sea-levels for various stations, on the Pacific Ocean side relative to Aburatubo, and those on the Japan Sea side relative to Kasiwazaki, during the period of 14 years (1954—1967), were calculated respectively and are shown in Fig. 5, (a) and (b).

Secular mean heights of sea-levels for various stations, during the period of 14 years (1954—1967), relative to that at Aburatubo, were calculated and plotted with these values as ordinates against the stations taken as abscissa as shown in Fig. 6. These curves may be considered

2) S. YAMAGUTI, *Bull. Earthq. Res. Inst.*, **37** (1959), 33-37.

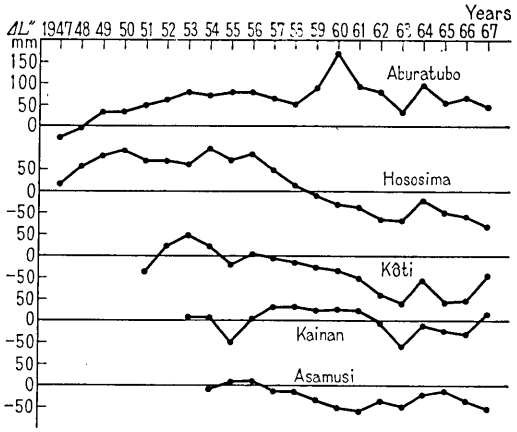

Fig. 2. Changes in the heights of yearly mean sea-levels.

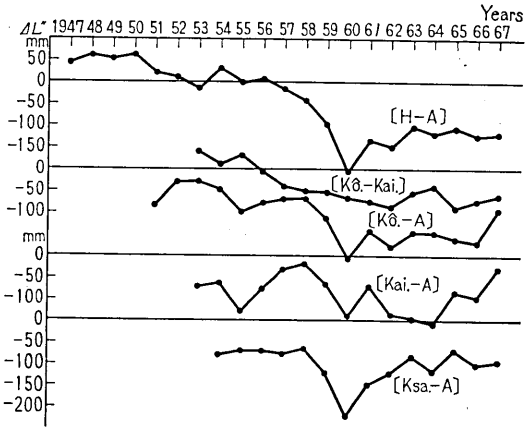

Fig. 3. Differences of the heights of yearly mean sea-levels.

to show the slopes of sea-levels along the coasts of Japan, both on the Pacific Ocean side, and on the Japan Sea side, the height of sea-level at Aburatubo being assumed to be zero.

From the curves for Hososima and Kôti in Fig. 2 we see that the decreasing time rates are rather abnormal compared with other curves on the Pacific Ocean side. We see the large values of rates of changes to be 18 mm/year and 14 mm/year for Hososima and Kôti, respectively, instead of being about 5 mm/year, in normal, before the occurrence of Hyûganada Earthquake in 1968, with magnitude, $M=7.5$, whose epi-

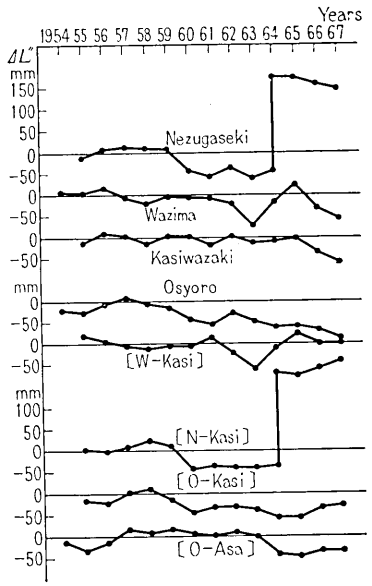

Fig. 4. Changes and their differences in the heights of yearly mean sea-levels.

central distances from Hososima and Kôti are about 130km, and 170km, respectively. These facts may suggest the probability of utilizing tidal curves for predicting an earthquake, though involving difficulties to decide the space and time of occurrence of the earthquake. But I think these difficulties may be solved by executing the continuous observations by tiltmeter or extensometer or others near the tidal stations as such as above cited.

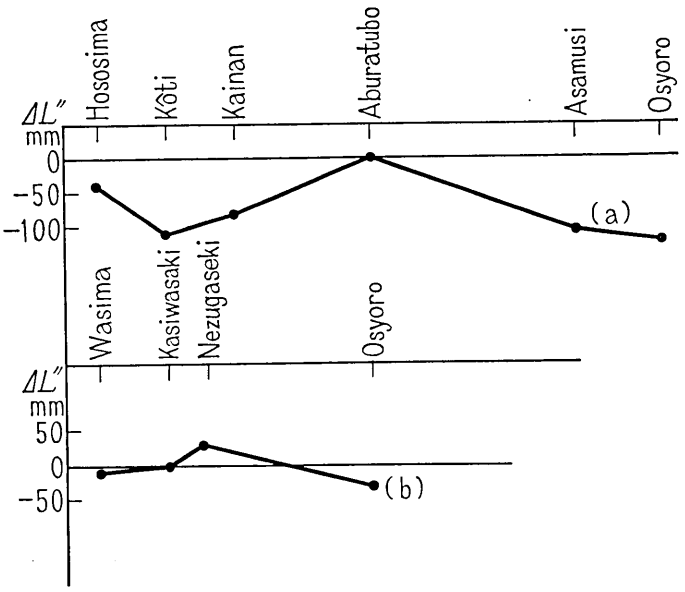

Fig. 5, (a) and (b). Secular mean variations of sea-levels for various stations, during the period of 13 years (1954~1966)
(a) relative to Aburatubo. (b) relative to Kasiwazaki.

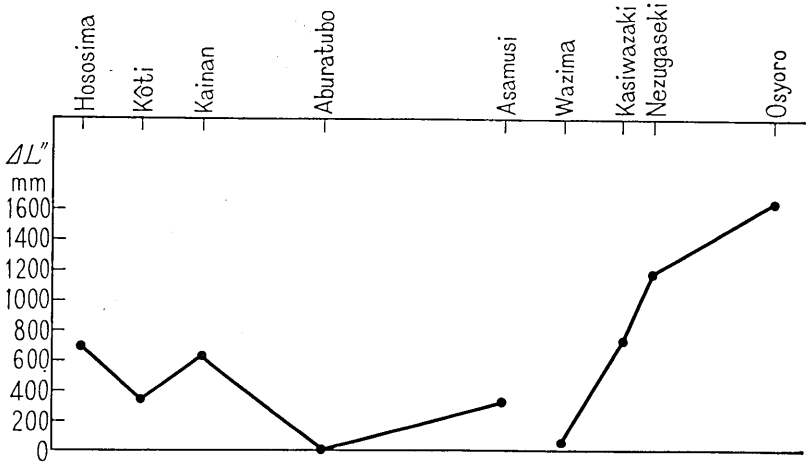

Fig. 6. Secular mean heights of sea-levels for various stations, during the period of 13 years (1954～1966), relative to Aburatubo.

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44. 最近の年平均海水面変化について

神奈川大学　山　口　生　知

1900 年から 1958 年までの研究結果については既に報告してある．今回はその後の 1959 年から 1967 年までの分について報告する．

この期間の変動量も考慮に入れて，油壺の平均海面の高さを標準としたときの太平洋岸，並びに日本海沿岸の傾斜についても計算してみた．

また細島と高知の潮位は 10 年前よりそれぞれ 18 mm/year, 14 mm/year という大きな傾斜で連続下降している．これらの値は普通の場合の数倍に相当する．これは新潟地震のときの鼠ヶ関の潮位が柏崎の潮位と比較して著しく大きな傾斜で 5 年前より下降していたのに匹敵する．それ故上述の事実は 1968 年 4 月 1 日の日向灘地震の発生に関係あるものと思われる．将来の研究を希望して止まない．