SHORT REPORT / КРАТКОЕ СООБЩЕНИЕ
UDK 550.344.42
doi.org/10.30730/2541-8912.2019.3.4.417-422

The manifestation of tsunami of August 1, 1940 in the Kamenka settlement, Primorye (new data concerning the old tsunami)

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Abstract. One of the most powerful earthquakes in the Sea of Japan area happened on August 1, 1940. This earthquake had been accompanied by a large tsunami in the Northern part of the sea. The article contains the description of an unusual feature of the 1940 Japan Sea tsunami manifestation: maximum tsunami run-up heights were observed in the far-field zone (Primorye coast, Russia), not in the near-field zone (Hokaido coast, Japan). Description of the striking manifestation of this tsunami with run-up heights up to 5 m in the vicinity of the Kamenka settlement in Primorye is based on the information from eyewitness and their descendants. These data were not mentioned in the tsunami catalogues and are thus news for tsunami science. Three torpedo motor-boats had been displaced by the tsunami from the Kamenka harbor to the peat area far from the sea. Corresponding map is shown.

Keywords: Sea of Japan, Primorye, Hokkaido, Kamenka settlement, earthquake, tsunami, run-up height.

For citation: Kaistrenko V.M., Razjigaeva N.G., Ganzey L.A., Gorbunov A.O., Nishimura Yu. The manifestation of tsunami of August 1, 1940 in the Kamenka settlement, Primorye (new data concerning the old tsunami). *Geosystems of Transition Zones*, 2019, vol. 3, no. 4. P. 417–422 (In Englich, abstract in Russian).
https://doi.org/10.30730/2541-8912.2019.3.4.417-422

Проявления цунами 1 августа 1940 г. в Каменке, Приморье (новые данные о давнем историческом цунами)

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Реферат (расширенный). В статье изложены результаты исследования исторического цунами 1940 г., одного из наименее изученных на побережье России. Это цунами было вызвано сильным землетрясением в акватории Японского моря с магнитудой M = 7.5, которое произошло 1 августа 1940 г. в 15:08:24 GMT. Цунами, сопровождавшееся опасными высотами заплесков в северной части Японского моря, было достаточно хорошо обследовано на побережье Японии (53 места) и очень фрагментарно на побережье Кореи (4 места) и на побережье России (7 мест). Максимальные заплески в ближней зоне на побережье Японии достигали 3 м в трех местах на о. Рисири и в порту Томамаэ на восточном побережье Хоккайдо. На остальных участках побережья Хоккайдо заплески были в основном менее 2 м. Максимальный заплеск, равный 3.5 м, был зафиксирован в Приморье в Рудной Пристани, т.е. в дальней зоне, что было отмечено исследователями как необычная особенность этого цунами.

В процессе изучения проявлений палео- и исторических цунами на побережье Приморья, проводимых с 2010 г. специалистами Тихоокеанского института географии ДВО РАН с участием сотрудников Института морской геологии и геофизики ДВО РАН и специалистов других учреждений, удалось обнаружить надежные свидетельства, что заплеск этого цунами в пос. Каменка достигал 5 м над средним уровнем моря (точка 595; 05.07.2010; 44°27’18.99” N, 136° 1’19.74” E). Этот факт свидетельствует о еще большем контрасте в проявлениях этого цунами в ближней и дальней зонах.

Впечатляющее проявление этого цунами осталось в памяти жителей пос. Каменка. Неожиданная атака цунами в ночное время создала опасную ситуацию в порту и низинной части поселка. Значительная часть улиц Заречная и Набережная, расположенных в низинной части, оказались затопленными морской водой. Волна оторвала суда от причальных сооружений и вынесла два торпедных катера далеко от моря на торфяник, расположенный между руслами рек Опричнинка и Прямая Падь, а один катер перенесла через дорогу на Пластун. Удивительно, что суда не получили серьезных повреждений и позже были возвращены к морю с помощью тракторов. Несмотря на панику, вызванную ночной атакой цунами, пропавших и получивших серьезные ранения не было.

Данные о проявлениях цунами 1940 г. в Каменке, полученные авторами в процессе опроса очевидцев этого цунами и замеров заплеска, являются значимыми, они отсутствуют в каталогах цунами и не упоминаются в научной периодике и после публикации могут быть использованы в исследованиях цунами.

Ключевые слова: Японское море, Приморье, Хоккайдо, Каменка, землетрясение, цунами, высота наката.

Для цитирования: Кайстренко В.М., Разжигаева Н.Г., Ганзей Л.А., Горбунов А.О., Нисимура Ю. Проявления цунами 1 августа 1940 г в Каменке, Приморье (новые данные о давнем историческом цунами). *Геосистемы переходных зон.* 2019. Т. 3, № 4. С. 417–422. (На англ. яз., реферат на русском).
https://doi.org/10.30730/2541-8912.2019.3.4.417-422

A short sketch on Tsunamis in the Sea of Japan (Introduction)

Sea of Japan is really a closed basin, and all tsunamis from Pacific sources arrive weakened through the narrow straits. Because of it, tsunami activity in the Sea of Japanis created by the tsunami sources within the area. All known large earthquakes that had caused tsunamis are located along the Eastern coast of the sea near Japan (Fig. 1). Information related to the tsunamis in the Sea of Japan is availablein books and articles [Soloviev, Go, 1984; Polyakova, 1988; Go et al., 1985; Gorbunova et al., 1997; The 2 August, 2007 Nevel'sk… , 2009] and Internet catalogues [HTDB/WLD: Historical Tsunami Database…; NGDC: Tsunami Data…].

Since 1940, several large earthquakes with tsunamis had happened. Information about prior tsunamis is fragmentary.

The Tsunami of 1940 (Shakotan-Oki Tsunami) has been caused by the earthquake with magnitude M = 7.5 on August 1st, 15 h 8 m 24 s, GMT. Its source was located near the N-W coast of Hokkaido (Fig 1). Maximum run-up heights in the near-field zone equal to 3 m were measured at three locations on the coast of the Rishiri Island and in the port of Tomamae, on the Western Hokkaido coast. Run-up heights at all the other locations along the Hokkaido coast were mostly lower than 2 m (Fig 2).

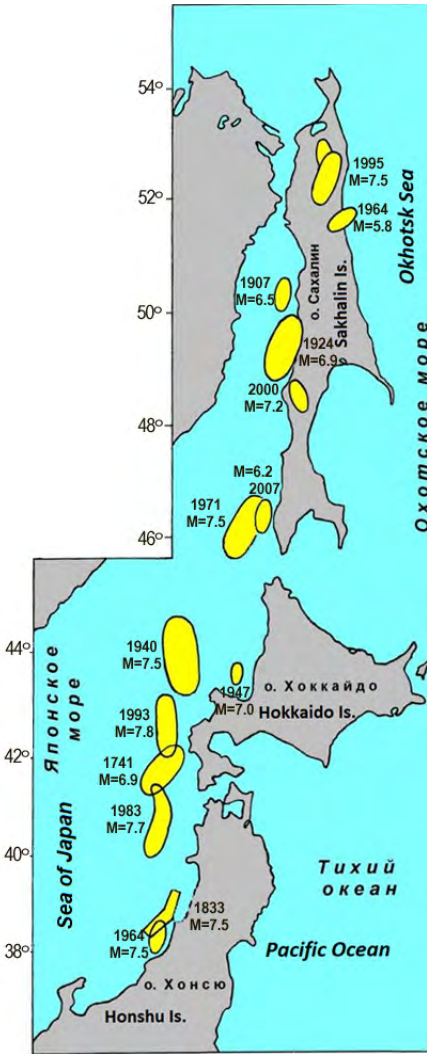

Fig. 1. Sources of the largest earthquakes in the Sea of Japan area [Tikhonov, 2006].

Generally, this tsunami had been investigated rather well in Japan (53 locations) and very fragmentarily on the Korean coast (4 locations) and on the Russian coast (7 locations).

Unexpectedly, maximum run-up height 3.5 m had been measured in Rudnaya Pristan' (Tetyuhe), i.e., in the far-field zone. Earlier, T. Hatory [Hatory, 1991] noticed that run-ups in the far-field zone of this tsunami are anomalously high. For example, maximum run-up height on the Korean coast was 2 m (Ullyungdo Is.). Detailed description of this tsunami is given in [Soloviev, Go, 1984; Miyabe, 1940, 1941; Hatori, 1969].

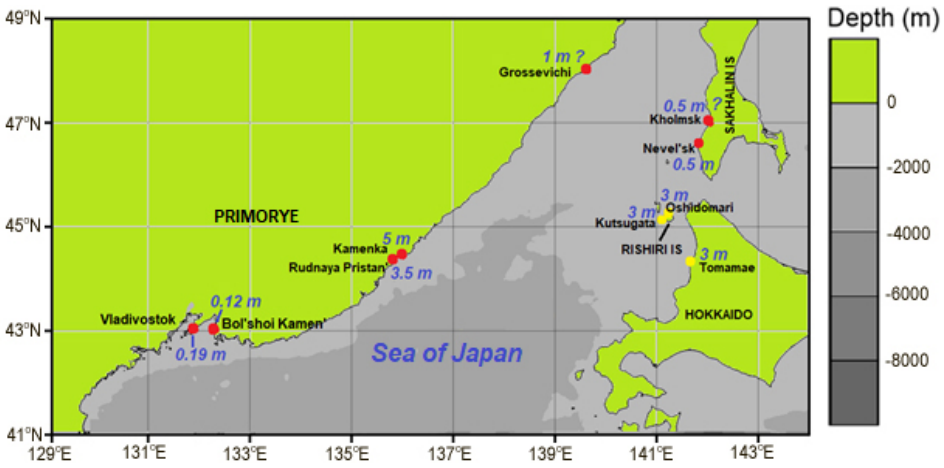

Fig. 2. Maximum 1940 tsunami run-up heights on the Japan coast (yellow circles) and run-up heights registered on the Russian coast (red circles).

The source of tsunami on June 16, 1964 was located opposite the port of Niigata. Tsunami heights in the nearest coast had reached 6 m, but generally, this tsunami was not large. On the Russian and Korean coasts, this tsunami was detected by the tide gauges only.

Tsunami on September 6, 1971 was created by an earthquake with a 7.5 magnitude, located near the Moneron Island. Maximum heights up to 2 m were observed on the Southern part of the Sakhalin coast of the Tatar Strait. Tsunami heights on the Japan coast were lower than 0.3 m [Shchetnikov, 1981].

Large tsunami on May 26, 1983 (Nihonkai-Chubu tsunami) was caused by an earthquake with a 7.8 magnitude, located near Akita prefecture, Honshu Island. The largest tsunami heights had been observed in the near-field zone (14.93 m in Minehama and 12.7 m near Noshiro, …). Dangerous tsunami heights have been observed in the far-field zone on the Hokkaido coast (3.5 m in the Matsumae port), on the Korean coast (5 m on the Ullyungdo Island, coast, 4 m in the port of Imwon, …), on the Primorye coast (4.8 m in Rudnaya Pristan' port, 5 m in the Lidovka bay, …). Detailed information was collected in [Polyakova, 1988; Go et al., 1985; Hatori, 1983; Abe, Ishii, 1987].

Large tsunami on July 12, 1993 (Hokkaido Nansei-Oki Tsunami) was generated by an earthquake with a 7.7 magnitude and an epicenter located close to Okushiri Island. Maximum tsunami heights have been observed on the coast of the Okushiri Island (32 m) and Hokkaido coast (19 m in Hamatsumae). Tsunami heights on the coast of Korea and Primorye, in the far-field zone, were generally lower than the 1983 tsunami heights: 2.39 m in the port of Imwon, 3.78 m in the port of Rudnaya Pristan' and 4.43 m in the Kit bay. On the Sakhalin coast, this tsunami was detected by the tide gauges only. Manifestation of this tsunami on the Japan coast has been described in several Japanese sources. Detailed description of the manifestation of this tsunami on the Primorye coast is contained in the [Gorbunova et al., 1997].

Moderate earthquake happened on August 2, 2007 in the Tatar Strait near the Western coast of the Sakhalin Island. In spite of rather small magnitude (Mw = 6.2), tsunami caused by this earthquake was not small. Highest run-up of 3.2 m was observed in the vicinity of the Zavety Il'icha settlement. Tsunami heights along the 100 km part of the South-Western coast of the Sakhalin Island locally exceeded 1 m [The 2 August, 2007 Nevel'sk… , 2009].

Manifestation of the 1940 tsunami in Kamenka

Kamenka settlement is located on the high level plateau on the coast of the Oprichnik bay in the Sea of Japan. Joint mouths of Oprichninka and Pryamaya Pad' rivers make a natural harbor equipped with moorings (Fig. 3).

Fig. 3. General view of the Kamenka settlement. *Photography by S. Kondrashkin*

Description of the striking manifestation of this tsunami with run-up heights of up to 5 m in the vicinity of the Kamenka settlement in Primorye has been based on the information received from eyewitness and their descendants.

On the evening of August 1, three torpedo motor-boats came in Kamenka harbor. Tsunami attack was unexpected, and around 1 AM (August 2, local time), the fish-factory sounded the alarm. All the three torpedo motor-boats had been displaced by the tsunami, without any serious damage, to the peat area between rivers Oprichninka and Pryamaya Pad', far from the sea. One of the torpedo motor-boats had been transported to a place behind the road to Plastun. Later, all the torpedo motor-boats were returned to the sea by tractors (Fig. 4).

One Kawasaki boat had been displaced to the tent with seasonal workers, creating a dangerous situation. Workers managed to escape by moving to higher ground. Big parts of the Zarechnaya street and Naberezhnaya street, located close to the Pryamaya Pad' river, had been submerged in sea water. Fish Factory building in the port (now it is Fire Station) had been flooded up to the middle of first story windows. This information was used to measure the tsunami height (Figs. 4, 5) equal to 5 m relatively to the mean sea level (position 595; July 05, 2010; 44°27'18.99" N, 136° 1'19.74" E).

In spite of panic caused by the nighttime tsunami attack, no one was lost or seriously injured.

Fig. 4. Map of the Kamenka vicinity. The red dashed line shows the boundary of the flooded part of the settlement, located close to the Pryamaya Pad' river.

Fig. 5. Measurement of the tsunami height as position of the funnel in the middle of the former window of the fire station building, relatively to the mean sea level. *Photography by V. Kaistrenko*

Conclusions

It is well known that the manifestation of the tsunami of August 1, 1940 was characterized by one unusual feature: maximum run-up height of 3.5 m had been detected in Rudnaya Pristan' (Tetyuhe), i.e., in the far-field zone, not in the near-field zone. In the course of our research of the Primorye coast tsunami, we uncovered evidence that tsunami height in Kamenka settlement, also in the far-field zone, had reached 5 m. This further signifies the contrasting tsunami heights between the far-field and the near-field zones.

These data, along with the description of the striking manifestation of this tsunami in the vicinity of the Kamenka settlement, were not mentioned in the tsunami catalogues and thus present an unexpected phenomenon for tsunami science.

Acknowledgments

We would like to thank the eyewitnesses of the 1940 tsunami N.A. Degasyuk and O.I. Degasyuk (interviewed in Summer'2010) and vice-mayor of Kamenka, E.I. Yakovenko, who had collected materials related to Kamenka history, A.N. Guzhvin for interesting information and S. Kondrashkin for the excellent photography of the Kamenka settlement, and D. Wright for correcting the English text.

The work was made possible with support of the Far East Division of RAS "Catastrophic tsunamis in the Far East Region of Russia" (scientific project no. 18-5-003).

Благодарности

Мы благодарим очевидцев цунами 1940 г. Н.А. Дегасюк и О.И. Дегасюк за интервью (лето 2010 г.), вице-мэра Каменки Е.И. Яковенко, собравшую материал по истории Каменки, А.Н. Гужвина за интересную информацию, С. Кондрашкина за великолепную фотографию пос. Каменка, Д. Райт за коррекцию английского текста статьи.

Работа была поддержана Дальневосточным отделением РАН (проект № 18-5-003. «Катастрофические цунами в Дальневосточном регионе России»).

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