NATIONAL REPORT
Submitted by the Russian Federation

BASIC INFORMATION

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4. Tsunami Standard Operating Procedures for a Local Tsunami (when a local tsunami hazard exists)

Tsunami monitoring, prediction and warning for the Pacific coasts of Russia now are provided by the centers of the Tsunami Warning System (TWCs) of ROSHYDROMET in Yuzhno-Sakhalinsk, Petropavlovsk-Kamchatsky and Vladivostok working in close cooperation with regional structures of the Ministry for Emergency Situations of the Russian Federation, seismic centers of the Geophysical Service of the Russian Academy of Sciences (GS RAS) and local hydrometeorological stations of ROSHYDROMET. Russian TWCs efficiently cooperate with the TWCs of other Pacific countries.

The divisions involved in the TWS provide twenty-four hours per day, 7 days per week operation, including continuous monitoring of seismicity and sea level variations, situation analysis, declaring and canceling Tsunami Watches and Warnings, preparation and relaying of appropriate signals and messages in accordance with the established procedure.

In cases of local tsunamigenic events, the parameters of earthquakes are estimated by seismic centers (SC) of the GS RAS located in Yuzhno-Sakhalinsk, Petropavlovsk-Kamchatsky and Vladivostok. The initial tsunami warning is provided by the same seismic centers. Criteria for the warning notification are based on the magnitude, Ms, and the location of the tsunamigenic earthquake.

At present time, the GS RAS magnitude criteria (magnitude threshold values for tsunami warning) are as follows:

– For areas along the coasts of Kamchatka, the Kuril Islands, the Sea of Okhotsk and the Sea of Japan: **Ms = 7.0;**

– For areas along the coasts of the Komandor Islands and Hokkaido Island: **Ms = 7.5**;

– For areas along the coasts of the Andreanof Islands and Honshu Island: **Ms = 8.0**.

Tsunami warning is cancelled:

• If the tsunami has been recorded, but maximum wave heights are less than 0.5 m

• If the tsunami warning has been declared, but tsunami signatures are absent in the data of coastal tide gauges, the warning is cancelled 0.5-1.0 hour after the latest estimated tsunami arrival time to the settlements on the coast.

The cancellation of tsunami warnings is made by seismic centers and Tsunami Warning Centers (TWCs) in Yuzhno-Sakhalinsk, Petropavlovsk-Kamchatsky and Vladivostok

5. Tsunami Standard Operating Procedures for a Distant Tsunami (when a distant tsunami hazard exists)

Tsunami warnings for distant tsunamigenic events are provided by TWCs in Yuzhno-Sakhalinsk, Petropavlovsk-Kamchatsky and Vladivostok.

After receiving information and corresponding parameters of a major distant earthquake from the seismic centers of the GS RAS, foreign seismic stations, the Pacific Tsunami Warning Center (PTWC) and JMA NWPTAC, the mentioned above Tsunami Warning Centers carry out:

- The estimation of tsunami threat for the Russian coast based on the magnitude-geographical criterion.
- The calculation of tsunami arrival times to specific coastal sites.
- Sending «Warning and Watch» messages to the coastal hydrometeorological stations; activating tide gauge monitoring and witness observations of sea level changes near the coast.
- Situation analysis based on the entire set of information, including information on actual tsunami tide gauge observations from the Pacific Tsunami Warning Center (PTWC), JMA NWPTAC and other foreign centers.
- Final decision about the actual tsunami threat for the Russian coast, declaring (if necessary) a Tsunami Warning.
- The transmission of tsunami warning emergency messages via communication channels according to the rules of notification to local and central authorities, all sectors of the population at risk and to foreign tsunami warning centers.

More precise definition of tsunami parameters and threat for the Russian coast is based on information about recorded tsunami wave heights at stations located near the source area or between the source area and the Russian coast, as well as on other information arriving from the foreign centers.

During the period between 2019 ÷ 2022, a situation analysis was carried out each time when the PTWC provided a tsunami warning for the Pacific Ocean. These analyses, in particular, included examination of the tide gauge data from Russian and foreign stations.

6. National Sea Level Network

Hydrometeorological stations (HMS) located along the Russian coast of the Pacific Ocean and marginal seas of the Russian Far East carry out sea level observations. Some of these stations have digital systems (tide gauges) for monitoring sea level variations (Table 1 and Figure 1).

Table 1 Sea level observation network

N	Station	Latitude (Degrees)	Longitude (Degrees)
1.	Korf (Kamchatka)	60.43	166.075
2.	Ossora (Kamchatka)	59.3	163.167
3.	Nikol'skoe (Bering Isl.)	55.200	165.983
4.	Semyachik (Kamchatka)	54.117	159.983
5.	Petropavlovsk-Kamchatsky (Kamchatka)	52.983	158.650
6.	Ozernaya (Kamchatka)	51.497	156.496
7.	Vodopadnaja (Kamchatka)	51.49	158.067

N	Station	Latitude (Degrees)	Longitude (Degrees)
8.	Poronaisk (Sakhalin Isl)	49.217	143.100
9.	Uglegorsk (Sakhalin Isl)	49.076	142.074
10.	Sovetskaya Gavan' (Primorje)	48.970	140.291
11.	Starodubskoye (Sakhalin Isl)	47.417	142.850
12.	Kholmsk (Sakhalin Isl)	47.050	142.050
13.	Nevel'sk (Sakhalin Isl)	46.685	141.859
14.	Korsakov (Sakhalin Isl)	46.650	142.767
15.	Sosunovo (Primorje)	46.533	138.333
16.	Cril'ion (Sakhalin Isl)	45.900	142.083
17.	Vladivostok (Primorje)	43.11	131.90
18.	Preobragenie (Primorje)	42.900	133.900
19.	Nakhodka (Primorje)	42.80	132.92
20.	Posiet (Primorje)	42.651	130,808
21.	Rudnaya Pristan' (Primorje)	42.367	135.850
22.	B. Olga (Primorje)	43.733	135.267
23.	Kurilsk (Sakhalin Isl)	45.23	147.88
24.	Cape Lopatka (Kamchatka)	50.867	156.667
25.	Malokurilskoe (Sakhalin Isl)	43.85	146.6
26.	Severo-Kurilsk (Sakhalin Isl)	50.683	156.133
27.	Simushir (Sakhalin Isl)	46.851	151.901
28.	Yuzhno-Kurilsk (Sakhalin Isl)	44.017	145.867

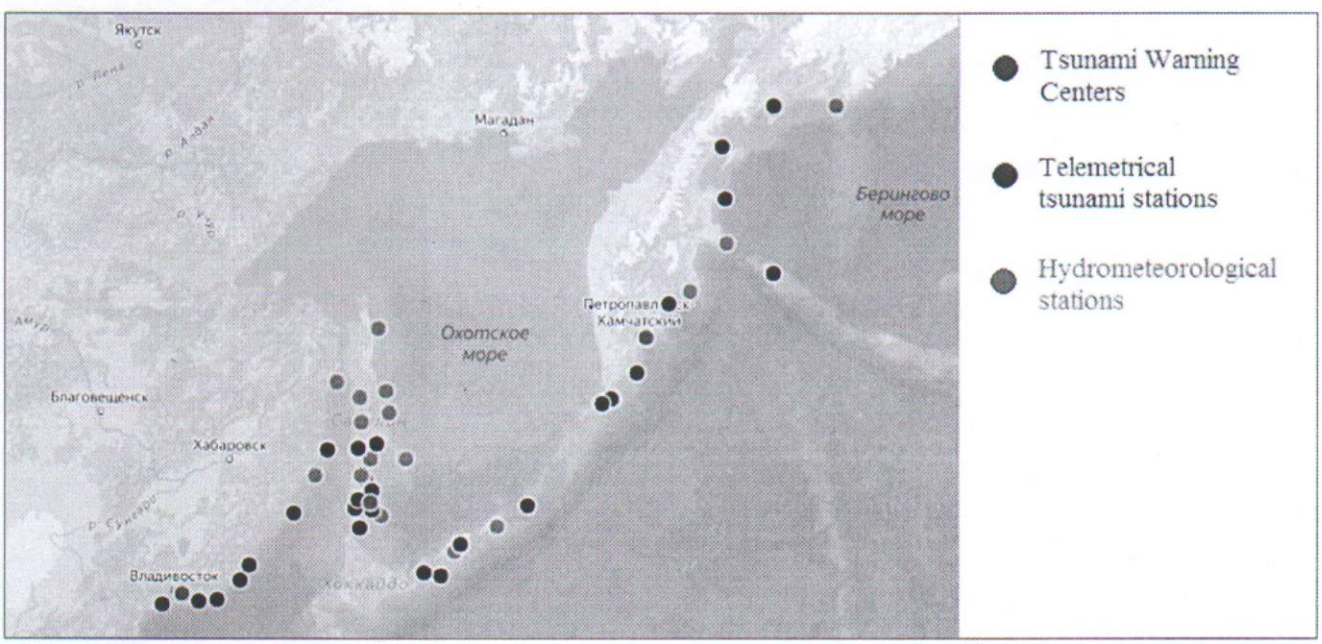

Figure 1. Scheme of location of tide gauges

7. Information on Tsunami occurrences

Events of 2019-2022

The earthquakes that led to the announcement of alarm of a tsunami by the Pacific tsunami warning center are:

- *Coast of Papua New Guinea: 14.05.2019, magnitude 7.3, depth 10 km, the coordinates 4.10 S., 152.6 E.;*
- *Kermadec Islands: 15.06.2019, magnitude 7.2, the coordinates 30.2 S., 178.1 W.;*
- *Japan coast: 18.06.2019, magnitude 6.7, depth 16 km, the coordinates 38.3 N., 139.9 E.;*
- *Commander Islands: 25.06.2019, magnitude 6.5, depth 39 km, the coordinates 56.05 N., 164.75 E.;*
- *Coast of indonesia: 14.11.2019, magnitude 6.7, depth 33 km, the coordinates 1.60 N., 126.5 E.;*
- *Kuril Islands 13.02.2020, magnitude 6.4, depth of 158 km, the coordinates 45.30 N, 149.2 E;*
- *Mexico coast: 23.06.2020, magnitude 7.5, depth 26.3 km, the coordinates 16.1 N., 96.04 W;*
- *Coast of Papua New Guinea: 17.07.2020, magnitude 7.2, depth 50 km, the coordinates 7.8 S., 148.2 E.;*
- *Alaska Bay: 22.07.2020, magnitude 7.6, depth 10 km, the coordinates 54.97 N., 158.8 W.*
- *Alaska Bay: 20.10.2020, magnitude 7.5, depth 46 km, the coordinates 54.70 N., 159.9 W.;*
- *Southeast of the Loyalty Islands: 10.02.2021, magnitude 7.2, depth 33 km, the coordinates 22.50 S., 171.4 E.;*
- *New Zealand coast 04.03.2021, magnitude 7.3, depth of 10 km, the coordinates 37.8 S, 179.5W.*
- *Kermadec Islands: 04.03.2021, magnitude 7.8, depth 16 km, the coordinates 29.4 S., 177.4 W.;*
- *Alaska Bay: 29.07.2021, magnitude 8.0, depth 15 km, the coordinates 55.3 N., 157.3 W.;*
- *Coast of the Philippines: 11.08.2021, magnitude 6.4, depth 54 km, the coordinates 6.7 S., 126.6 E.;*
- *Mexico coast: 08.09.2021, magnitude 7.3, depth 20 km, the coordinates 16.90 N., 99.5 W.*
- *near Loyalty Island: 30.03.2022, magnitude 7.0, depth 10 km, the coordinates 22.70 S., 170.2 E.;*
- *Japan coast: 16.03.2022, magnitude 6.9, depth 63 km, the coordinates 38.10 N., 141.8 E.;*
- *Taiwan coast: 18.09.2022, magnitude 7.1, depth 29 km, the coordinates 23.20 N., 121.3 E.;*
- *coast of the Solomon Islands: 22.11.2022, magnitude 7.3, the coordinates 09.50 S., 159.8 W.;*
- *in the Tonga archipelago: 11.11.2022, magnitude 6.9, the coordinates 19.20 S., 172.2 W.*

The parameters of all earthquakes show that these earthquakes posed no threat to the coast of the Russian Federation.

The tsunami alert was announced by the Russian Tsunami Warning System due to the occurrence of earthquakes:

- *Coast of Kamchatka Krai 26.06.2019, magnitude 6.4, the coordinates 56.36 N, 163.84 E.*
- *Kuril Islands 25.03.2020, magnitude 7.1, depth of 79 km, the coordinates 48.93 N, 157.89 E.*
- *Coast of Kamchatka Krai 01.09.2020, magnitude 6.0, depth of 42 km, the coordinates 58.66 N, 159.31 E.*

and after the eruption of an underwater volcano:

- *in the Tonga archipelago: 15.01.2022, the coordinates 20.50 S., 175.4 W.*

On the manifestation of the tsunami in the Kuril Islands due to the eruption of the Tonga volcano on January 15, 2022.

As a result of an underwater explosion of a volcano on the islands of Tonga (January 15, 2022), atmospheric fluctuations were formed, which, in turn, caused the generation of tsunami waves and were observed not only in the Pacific Ocean, but also in the Caribbean, the Atlantic and the Indian Ocean. In this situation, it is difficult to predict the parameters; a tsunami can be detected only upon registration. Bulletins from the Pacific Tsunami Warning Center (Honolulu, USA) also indicated the impossibility of performing tsunami calculations. The work «blindly», in the absence of the possibility of even visual observations at night, significantly complicated the assessment of the degree of tsunami threat for the Russian coast. In accordance with the Regulations of the Tsunami Center, the duty oceanologist of the Tsunami Center informed the ports and port points of the Kuril

Islands about the possibility of a weak tsunami approach, with recommendations to limit work in the port, and observe safety rules on the coast. Also, the message was transferred to the National Crisis Management Center of the Ministry of Emergency Situations of Russia of Russia for the Sakhalin Region. The duration of the Tsunami Warning was 13 hours. The maximum recorded height of tsunami waves was observed in Malokurilsky (Shikotan Island) - 120-130 cm. During the notification of the port points of the Kuril Islands, interaction with local authorities and the National Crisis Management Center of the Federal State Budgetary Institution of the Ministry of Emergency Situations of Russia for the Sakhalin Region was carried out without failures and comments.

The Russian TWS regularly participates in the PTWC and NVWPTA communication tests:

- *in 2019 took part in 2 tests of NWPTA and 12 tests of PTWC;*
- *in 2020 took part in 2 tests of NWPTA and 13tests of PTWC;*
- *in 2021 took part in 2 tests of NWPTA and 13 tests of PTWC;*
- *in 2022 took part in 2 tests of NWPTA and 12 tests of PTWC;*

Since IOC of UNESCO has designated 5 November as world day of disseminating information about tsunami, the Russian TWS organized and conducted various activities among the population of the far Eastern region of Russia to mark this day.

8 Web sites (URLs) of national tsunami-related web sites

http://www.rtws.ru

9 Summary plans of future improvements of tsunami warning and mitigation system

10 EXECUTIVE SUMMARY

The modernization of Russian TWS was carried out on an ongoing basis.

During the inter-sessional period of 2019-2022 the new version of software system was installed in tsunami warning centers.

Russian TWS now provides:

• tsunami warning within 4 minutes after detecting earthquake by macroseismic characteristics for tsunami-protected populated centers nearest to the epicenter;

• determination of earthquake parameters (time at epicenter, epicentercoordinates, magnitude, depth) and evaluating its tsunamigenity within 7 minutes for nearest area and within 30 minutes for distant earthquakes;

• analysis of the situation , taking a decision on tsunami alert within 5 minutes of receiving earthquake parameters;

• transmission of messages "Storm. Tsunami" to territorial centers of Ministry of Emergency of Russia within 1 minute;

• excluding tsunami misses and minimizing false alerts of tsunami.

Exercise Pacific Wave 2020(05 November)

The Russian Federation joined 46 countries of the Asia-Pacific region as a participant in the tsunami exercise on November 5, 2020, on World Tsunami Awareness Day, established by UN

General Assembly Resolution No. 70/203 of December 22, 2015. The purpose of this drill is to test the availability of the authorities (National Tsunami Warning Centers and National Tsunami Warning Coordinators) across the Pacific across the Pacific by sending test messages. Exercise reports (for each country) were sent from the Pacific Tsunami Warning Center (PTWC) in Hawaii, USA, and the Northwest Pacific Tsunami Warning Center (NWPTAC) in Japan.

The functioning and availability of communication channels of all services of the Russian Tsunami Warning System (TWS) was checked. All test messages sent on November 5 during the exercise were received on time by the National Tsunami Warning Center (FIAC of Roshydromet FSBI NPO Typhoon), as well as the National Tsunami Warning Coordinator (Tsunami Center of the Sakhalin TWC FSBI). Detailed information about the exercises conducted by the National Tsunami Warning Coordinator is available at http://www.sakhTWC.ru/.

No disruptions in the work of the Russian TWC were identified.

Exercise Pacific Wave 2020 (PacWave20) confirms that the Pacific Tsunami Warning Communications System and Tsunami Mitigation System are operational. These are the ninth such exercises, the first of which was performed in 2006, and subsequent exercises were conducted in: 2008, 2011, 2013, 2015, 2016, 2017 and 2018.

Exercise Pacific Wave 2022 (13 October)

The Russian Federation joined 46 countries of the Pacific region as a participant in the Pacific Wave 2022 exercise (Pacific Wave 2020 - PacWave22) on October 13, 2022, held on the eve of World Tsunami Awareness Day (05.11.2022), established by UN General Assembly Resolution No. 70/203 of December 22, 2015.

The exercise was conducted by the Intergovernmental Oceanographic Commission of UNESCO through its Intergovernmental Coordinating Group of the Pacific Tsunami Warning and Mitigation System (ICG/PTWS). This is the tenth exercise of its kind, with the first being held in 2006 and subsequent exercises in 2008, 2011, 2013, 2015, 2016, 2017, 2018 and 2020.

The purpose of the exercise «Pacific Wave 2022» is to test the functioning of the communication system for the official notification of the countries of the Pacific tsunami warning system and mitigation of their consequences in the event of a tsunami threat.

Test messages during the exercise were sent from: Pacific Tsunami Warning Center (PTWC), Northwest Pacific Tsunami Advisory Center (NWPTAC), Southwest Pacific Tsunami Advisory Center (NWPTAC), China Sea (South China Sea Tsunami Advisory Center - SCSTAC), Tsunami Advisory Center in Central America (Central America Tsunami Advisory Center - CATAC).

The Tsunami Warning Center of the Federal State Budgetary Institution Sakhalin TWC and the Federal Information and Analytical Center of Roshydromet of the Federal State Budgetary Institution RPA Typhoon took part in the exercise from the Russian TWS. There were no failures in the functioning of communication channels.

11 NARRATIVE

On April 20, 2022, the Russian Tsunami Warning System conducted an interagency exercise.

The purpose of the exercise: to improve the mechanism for transmitting messages about the threat of a tsunami to the coast of the Far East in terms of the implementation of regulatory documents regulating the work of Roshydromet organizations in this direction.

Participants of the exercise: Sakhalin Tsunami Warning Center, Petropavlovsk-Kamchatsky Tsunami Warning Center, Vladivostok Tsunami Warning Center, Federal State Budget Institution (FSBI) RPA Typhoon, Aviametelecom of Roshydromet, FSBI Hydrometeorological Center of Russia and Department for Monitoring Environmental Pollution, Polar and Offshore Operations of Roshydromet of Roshydromet.

Description of the scenario of the exercise: a simulated strong underwater earthquake of magnitude 7.1 occurred in the area of Loyalty Island with coordinates 22.6 S, 170.2 E. at a depth of 10 km.

Brief description of the actions performed by the participants of the exercise:

Sakhalin TWC

Formation and prompt sending of a message about a conditional strong underwater earthquake that has occurred to all participants in the exercise.

Constant interaction and exchange of messages with the operational divisions of the Federal State Budgetary Institution «Petropavlovsk-Kamchatsky TWC», Vladivostok TWC and the Regional Information Processing Center «Yuzhno-Sakhalinsk» and the Unified duty and dispatch service of the region.

Petropavlovsk-Kamchatsky TWC

Formation and prompt sending of a message about a simulated earthquake that has occurred to all participants in the exercise.

Constant interaction and exchange of messages with the operational divisions of the Sakhalin TWC, the Vladivostok TWC, the Petropavlovsk Regional Information Processing Center and the Unified duty and dispatch service of the region.

Vladivostok TWC

Providing operational information about the current situation in the Unified duty and dispatch service of the region and the Main Directorate of the Ministry of Emergency Situations.

Constant interaction and exchange of messages with the operational units of the Sakhalin TWC and the Petropavlovsk-Kamchatsky TWC.

FSBI «RPA «Typhoon»

Preparation of expert advisory materials and their prompt sending to the Department for Monitoring Environmental Pollution, Polar and Offshore Operations of Roshydromet of Roshydromet and the Federal State Budgetary Institution «Hydrometeorological Center of Russia».

FSBI «Aviamettelecom of Roshydromet»

Prompt communication of all messages about the simulated earthquake that occurred to all participants in the exercise was ensured.

FSBI «Hydrometeorological Center of Russia»

Receiving and sending messages about the occurrence of a simulated earthquake in the Pacific Ocean to the addressees specified in the regulatory documents.

Department for Monitoring Environmental Pollution, Polar and Offshore Operations of Roshydromet

General management and coordination of interaction with all participants in the training event.

Results of the exercise:

Within the framework of the exercises, the mechanisms of interaction between the participants of the event were worked out. All actions were performed in accordance with current regulations.