Report of the Russian Federation to the 18th Session of the IOC Group of Experts on the Global Sea Level Observing System (GLOSS)

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Russian Federation national tide gauge network

The Russian state marine tide gauge network consists of 118 active stations, which are located at the coast and islands of 13 seas surrounding Russia and at the Russian coast of the Pacific Ocean. This national sea level network is maintained by the Federal Service for Hydrometeorology and Environmental Monitoring Russian Federation (Roshydromet), including 15 regional centers of the Roshydromet, which discuss marine stations and collect sea level data.

About half of the active sea level monitoring stations are hard–to-reach stations that are difficult to support. Basically, all stations are inhabited and/or have personnel who conduct visual observations. The average density of the sea level network depends on the region: in the Atlantic direction (the seas of the European part of the Russian Federation) – 2 stations per 100 km, in the Arctic and also Far Eastern direction – 0.35 stations per 100 km. The lowest network density above sea level is located in the most inaccessible regions of the Arctic: Yakutia, Chukotka and Kamchatka. There is a Tsunami network operating in the seas of the Far East, which consists of 26 stations.

The gauge devices used in sea level monitoring stations are visual tide poles (mostly) and piles, float operated gauges (including digital floating gauges) in stilling wells, gauges with submerged hydrostatic pressure sensors. Observations of a sea level with the help of tide poles are carried out 3-4 times a day as a rule; accuracy of observations equals 1 cm. Noncontact radar gauges are currently not used on the Russian sea-level network. Float operated gauges and digital floating gauges are the most reliable in Russia. An analysis of the operation of automated sea level stations shows that the tide sensors located in the operational availability zone from the regional centers of the Roshydromet, where timely repairs are carried out, are most stable.

Regional centers of ROSHYDROMET have a great deal of independence. They themselves may choose and buy tide gauges and it is not good, because the stock of tide gauges at the state network should be homogeneous. However, at least 10 different types of hydrostatic pressure gauges are used at the Russian state network (5 – of Russian and 5 or more – of foreign production).

Height datum

Heights of all benchm**a**rks in Russia are measured from the Kronshtadt datum (plate with a horizontal line in the stone bridge abutment in Kronshtadt) which was equal in past to the long-term mean level of the Baltic Sea in the region of Kronshtadt – the so called Baltic normal height system 1977 (BS-77). Sea level is measured according to the reference horizon located 5 m below the Kronshtadt datum at all seas surrounding Russia except the Caspian Sea where the reference horizon located 28 m below the Kronshtadt datum used. The values of 5 and 28 m were chosen in order to avoid negative sea level values at measurements of sea level.

Leveling of level measuring devices is carried out 2 times a year.

For the last 20 years, episodic short-term measurements of heights and horizontal coordinates of benchmarks of on most station of sea level observations at all seas were carried out with the help of GNSS-receivers. At the same time, the relationship between WGS-84, Parameters Planet 90.11 which Then coordinate system of the GNSS GLONASS and BS-77 was determined on the reference points.

Since 2016, as part of the cooperation between Roshydromet and Rosreestr (the Russian National Service of Geodesy and Cartography), permanent GNSS stations (FAGS points) have been installed at marine sea level measuring stations. Such stations appeared, among others, at Dikson, Barentsburg, etc. Map of FAGS points and access to data:: https://rgs.cgkipd.ru/fags-map.

Scientific and methodological support

Scientific and methodological support for sea level observations in Russia is provided by four scientific institutes of the Roshydromet by region of responsibility.

These four scientific institutes are responsible for the development of measurement methods and are responsible for periodic inspections and the quality control of sea level measurements made by regional centers of ROSHYDROMET. Coastal stations at Arctic seas are inspected by the Arctic and Antarctic Research Institute, Saint-Petersburg (AARI); at Far-Eastern seas – by the Far-Eastern Hydrometeorological Research Institute, Vladivostok (FERHRI); at Caspian sea – by the Caspian Marine Scientific Research Centre, Astrakhan (KaspMnitz); at Azov, Baltic, Black and White seas – by the State Oceanographic Institute, Moscow (SOI). SOI is the head of the development of methods for observing sea level and other oceanographic parameters.

In 2023, SOI, together with AARI and RNODC updated the national standard for inspections of the marine network by scientific institutes and regional centers of the ROSHYDROMET. The updated standard regulates the procedure for inspection of automatic tide sensors, as well as the form of technical file of station. This technical file contains all the necessary meta-information about the station, measuring devices, heights of all benchmarks, etc.

In order to implement the recommendations of the international seminar on sea level measurements in adverse conditions, held in GOIN on March 13-15, 2018 (Moscow), SOI, together with FERHRI and KaspMnitz in 2020, prepared the national standard RD 52.10.892–2020 "Methodology for comparative analysis of marine hydrological observation data, obtained by automated and classical measuring instruments in various climatic zones", which regulates the procedure for testing automated tide sensors and switching to the use of automated sensors for routine sea level measurements http://xn--c1akpc.xn--p1ai/upload/iblock/229/ppwms7y960nhs4c1tv2bnt13zvz4bqzc/%D0%A0%D0%94%2052.10.892-2020.pdf

Russian GLOSS core network stations

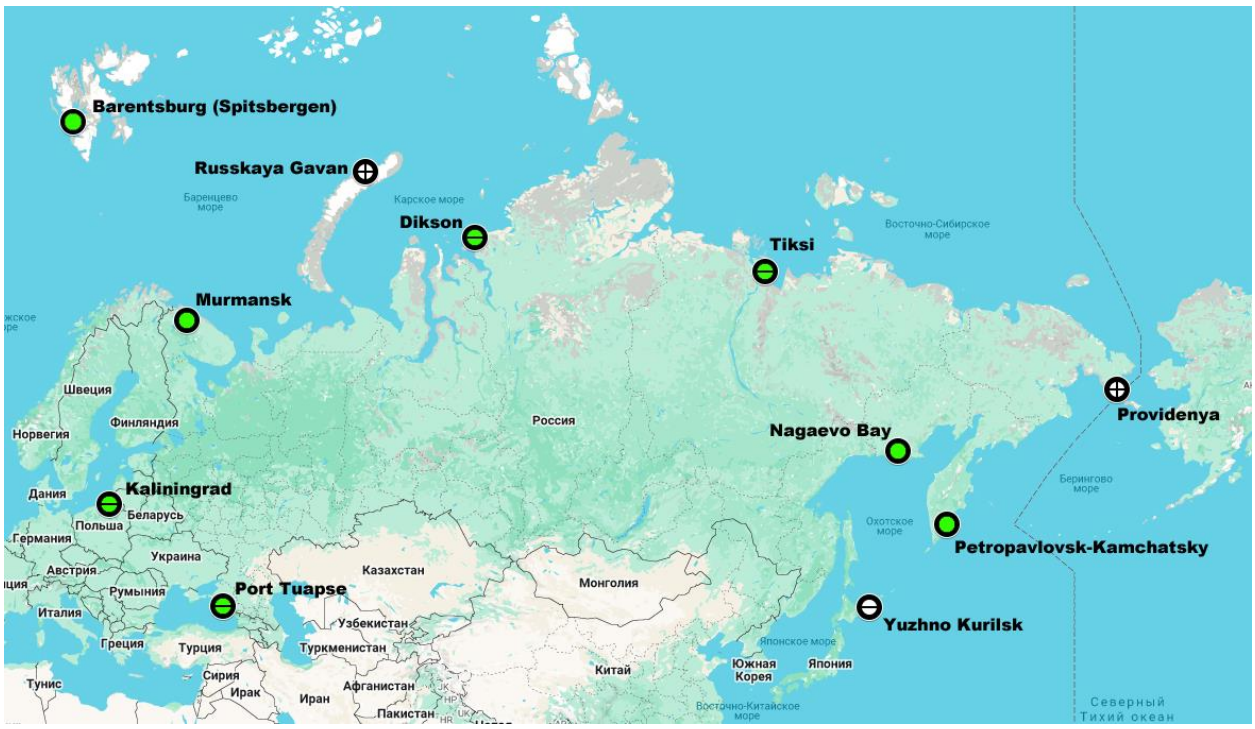
According to the GLOSS Station Handbook the Russian part of the GLOSS tide gauge network consists of 12 coastal stations - see Table 1 and Figure 1.

Station	Latitude (+ve N)	Longitude (+ve E)	Gloss number	PSMSL
Barentsburg (Spitsbergen)	78.06666	14.25	231	1948-2023
Dikson	73.36666	80.65	312	1950-2012
Kaliningrad	54.95	20.21666	97	1987-2023
Mirny (Antarctica)	-66.55	93.01666	25	-------
Murmansk	68.96666	33.05	274	1952-2023
Nagaevo Bay	59.73333	150.7	92	1957-2023
Petropavlovsk-Kamchatsky	52.98333	158.65	93	1957-2023
Port Tuapse, Black Sea	44.1	39.06666	98	1917-2023
Providenya	64.5	-173.18333	309	1951-1983
Russkaya Gavan	76.23333	62.58333	99	1953-1993
Tiksi	71.66666	128.75	313	1949-2010
Yuzhno Kurilsk	44.01666	145.86666	90	1948-1994

Table 1. List of Russian GLOSS stations.

For many years on the regular basis, once per year RNODC sends monthly mean values of a sea level from the active Russian GLOSS stations to the Permanent Service for Mean Sea Level (PSMSL). From Petropavlovsk-Kamchatsky station RNODC also sends monthly mean values of a sea level every month to the Hawaiian University in Honolulu.

Currently, Russian data is supplied to PSMSL at Murmansk (No. 274), Barentsburg (No. 231), Nagaevo (No. 92), Petropavlovsk-Kamchatsky (No. 93), Tuapse (No. 98), Kaliningrad (No. 97) stations. The number of Russian stations included in the GLOSS -2012 Implementation Plan (Global Sea Level Observing System (GLOSS) Implementation Plan-2102, IOC Technical Series 100, Unesco, 2012) is slightly higher, but for technical reasons, data is not provided in PSMSL for a number of stations.



– active sea level station + GNSS-station;
– active sea level station;
– problems with sea level measurements + GNSS-station;
– problems with sea level measurements;
– closed sea level station.

Figure 1. Position of Russian GLOSS stations.

Due to dredging works in the port of Tuapse the stilling well and the float operated gauge were destroyed in June 2013. However, later in 2013 sea level measurements in Tuapse port were resumed with the help of the automatic hydrostatic pressure tide gauge GMU-4. In 2015 the additional tide gauge **was operating radar gauges** was installed near GMU-4. Measurements of the sea level in Tuapse port have been performed almost without gaps for more than 100 years: the completeness of the time series of monthly mean values of a sea level is 99%.

In the port of Tiksi a pavilion with the stilling well and the float operated gauge inside (which had provided good measurements since 1949 without gaps) was destroyed in 2010. In 2023 last year, a new hydrostatic sensor and tide poles were installed in Tiksi on the territory of a private port. However, sea level observations along the tide poles are not carried out due to the large distance of the rail from the marine station.

The sea level at the Dikson station is being measured visually by a tide pole four times per day. Measurements are sometimes stopped due to difficult ice conditions. In the period of 01.04.2008 – 10.10.2011 the automatic hydrostatic tide gauge Priliv-2D was working. It was destroyed during a severe storm in October 2011.

Due to the destructive earthquake on the southern Kuril Islands on 4-5 of October 1994, a stilling well at Yuzhno-Kurilsk station was damaged and the delivery of sea level data to PSMSL was stopped. According to the data registered at nearby Malokurilskoe station (146°50', 43°53', where the float gauge in a stilling well was working well) the sea level jumped up after the

earthquake by 50 cm which was explained as a consequence of the sharp geotectonic subsidence of the Shikotan Island. Yuzhno-Kurilsk and Malokurilskoe stations are located in a seismically active zone and their height positions are not stable. Therefore they probably both are not suitable as a GLOSS stations for a long-term measurements and accumulation of sea level data without gaps and for studying sea level changes under the influence of hydrometeorological factors.

In Antarctica only episodic sea level measurements were carried out.

Sea level measurements at Providenya were closed in 1991 and at Russkaya Gavan – in 1993. There are no plans now to resume sea level measurements at these sites.

According to the state program, since 2022, the modernization of marine stations in the Arctic zone is underway (repair of the observation infrastructure and equipping with automatic tide gauges).

In October 2024, the pavilion with the stilling well and ladder were replaced at the Murmansk marine station, and the pole was reinstalled (Figure 2). New tide sensors have also been installed, which are undergoing testing.

Before After 2024

Figure 2. The restored the mareographic pavilion and the stilling well at Murmansk station.

Given that there are no plans to restore the inactive stations, there is a need to update the list of GLOSS stations. This requires additional discussion and coordination with Roshydromet.

Russian Oceanographic Data Centers

Sea level data from the stations are collected by 15 regional centers of the ROSHYDROMET and in 1-2 years after preliminary processing and quality control are delivered to the RNODC – All-Russia Research Institute of Hydrometeorological Information – World Data Center of the ROSHYDROMET, the city of Obninsk, Kaluga region. Contact E-mail for international sea-level data and information exchange: av10921@meteo.ru.

Also sea level data from the Russian state marine tide gauge network is stored in four scientific institutes of the ROSHYDROMET by region of responsibility (SOI, AARI, FERHRI and KaspMnitz).

A lot of historical monthly mean sea-level data from Russia were delivered in the past to the PSMSL. In total, the data from 112 Russian stations are in the database of the PSMSL and are available for downloading.

Development plan

In order to improve and develop the marine sea level monitoring network in the Russian Federation, it is advisable to adhere to the following plan.

1) To carry out special control over the preservation of the quantitative composition of existing marine sea-level observation stations.

2) To continue the restoration and repair of the observation infrastructure (mareograph pavilions and stiling wells), as well as housing and production facilities of marine stations

3) To carry out a complex of works on the development and control of the reference point system included in the infrastructure of the level stations; to level the reference points of marine observation points to the Baltic normal height system 1977. Continue the development of the GNSS point network.

4) Continue installing automated level measuring instruments at marine observation points; the choice of the type of automated measuring instruments should be selected based on the available infrastructure (mareograph facilities, piers, etc.); if there are mareograph facilities, it is advisable to install automated float SI, which have proven themselves to be the most reliable in terms of quality and reliability of observations; in conditions of unequipped It is proposed to install hydrostatic tide gauges on the coast; to ensure the smooth operation of automatic measuring instruments, to provide additional sensors for replacement during the metrological certification (verification).

5) To document the operation of tide gauges in accordance with developed national standards.

6) To consider a proposal to update the list of marine stations of the Russian Federation participating in the GLOSS program.

National contact points of Russian Federation for sea-level observations and GLOSS

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