Report of the Russian Federation to the 16th Session of the IOC Group of Experts on the Global Sea Level Observing System (GLOSS)

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National tide gauge network

The Russian state marine tide gauge network consists of 102 active stations, which are located at the coast and islands of 13 seas surrounding Russia and at the Russian coast of the Pacific Ocean. About half of them are hard-to-reach stations, which is difficult to support. Almost all sites have sea ice cover for the cold part of the year. Some of the stations work only in free of sea ice cover periods of the year. This national sea level network is maintained by the Federal Service for Hydrometeorology and Environmental Monitoring (FSHEM). Sea level data from the stations are collected by 11 regional centers of FSHEM and in 1-2 years after preliminary processing and quality control are delivered to the Russian oceanographic data center (RNODC) in Obninsk (Kaluga region).

The gauge devices used in these stations are visual tide poles (mostly) and piles, float operated gauges (including digital floating gauges) in stilling wells, gauges with submerged hydrostatic pressure sensors and noncontact radar gauges. Regional centers of FSHEM 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 6 different types of hydrostatic pressure gauges are used at the Russian state network (3 – of Russian and 3 or more – of foreign production). 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. Data of observations from the automatic tide gauges are stored in RNODC with one hour discreteness.

Four scientific institutes of FSHEM are responsible for periodic inspections and the quality control of sea level measurements made by regional centers of FSHEM. Coastal stations at Arctic seas are inspected by the Arctic and Antarctic Research Institute (Saint-Petersburg); at Far-Eastern seas – by the Far-Eastern Hydrometeorological Research Institute (Vladivostok); at Azov, Baltic, Black and White seas – by the State Oceanographic Institute (Moscow) and at Caspian sea – by the Caspian Marine Scientific Research Centre (Astrakhan).

Heights of all benchmarks 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. 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 is used. The values of 5 and 28 m were chosen in order to avoid negative sea level values at measurements of sea level.

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.

CODE	LON	LAT	NAME	DATA IN PSMSL
98	$39^0$04’ E	$44^0$06’ N	Tuapse	1917 – 2017
231	$14^0$15’ E	$78^0$04’ N	Barentsburg (Spitsbergen)	1948 – 2017
274	$33^0$03’ E	$68^0$58’ N	Murmansk	1952 – 2017
92	$150^0$42’ E	$59^0$44’ N	Nagaevo	1957 – 2017
93	$158^0$39’ E	$52^0$59’ N	Petropavlovsk-Kamchatsky	1957 – 2017
97	$20^0$29’ E	$54^0$42’ N	Kaliningrad	1987 – 2017
312	$80^0$39’ E	$73^0$32’ N	Dikson	1950 – 2012
313	$128^0$45’ E	$71^0$40’ N	Tiksi	1949 – 2010
90	$145^0$52’ E	44^0 01’ N	Yuzhno-Kurilsk	1948 – 1994
99	$62^0$35’ E	$76^0$14’ N	Russkaya Gavan	1953 – 1993
309	$173^0$11’ W	$64^0$30’ N	Providenya	1951 – 1983
25	$93^0$01’ E	$66^0$33’ S	Mirny (Antarctica)	---------

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.

At Barentsburg, Murmansk, Nagaevo and Petropavlovsk-Kamchatsky the sea level is measured by automatic sea-level meters in stilling wells.

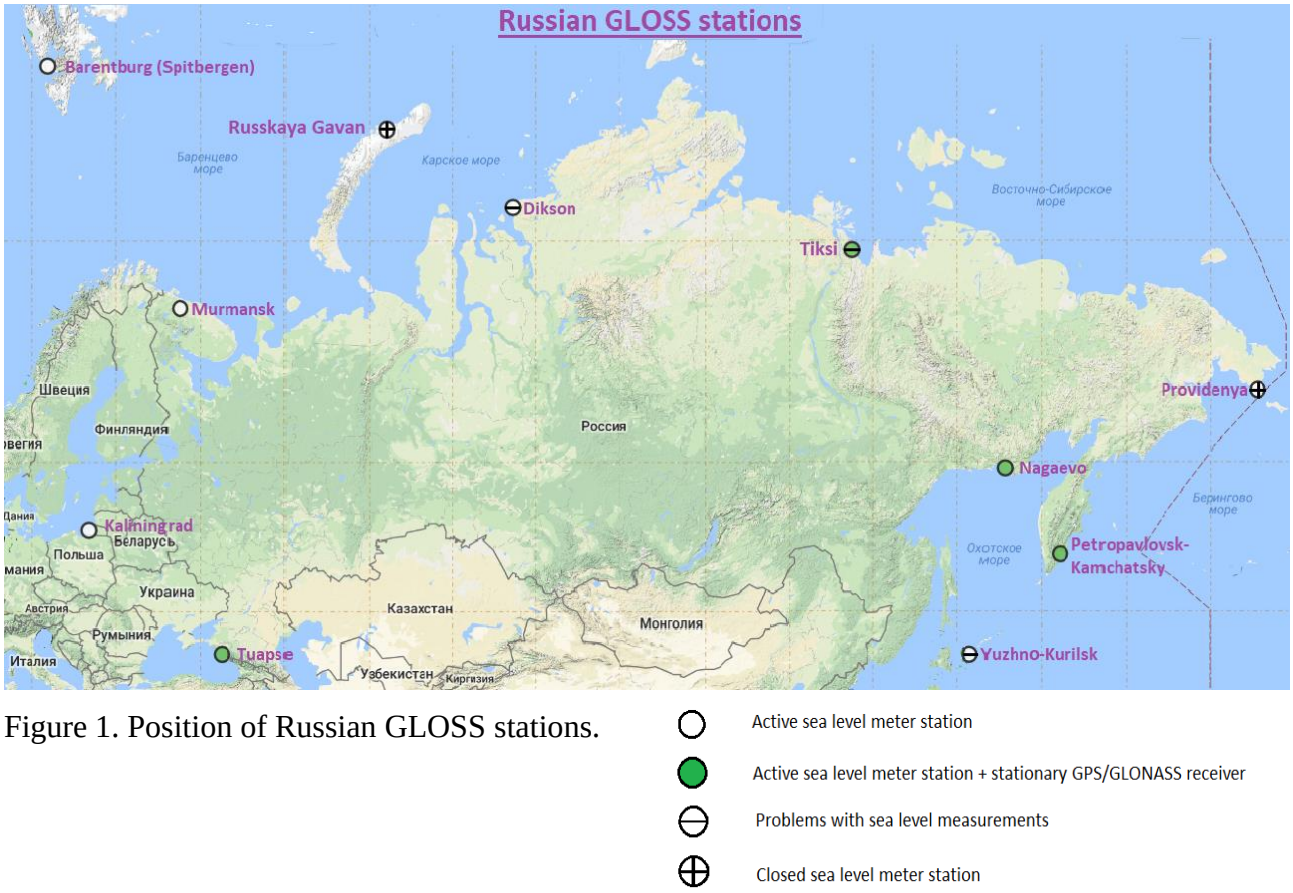

Figure 1. Position of Russian GLOSS stations.

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 based on an ultrasonic sensor 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 11.2010. There is the intention to resume sea level measurements at Tiksi though there are a number of difficulties as port is now a private territory, the coastal waters outside the port are shallow, there are severe Arctic ice and weather conditions, and finally difficulty in establishing the fundamental tide gauge benchmark in conditions of permafrost. Nevertheless, GPS measurements of a vertical land movement in Tiksi are ongoing.

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 on 10.10.2011. Monthly mean values of sea level variations at

Dikson from 1950 up to 2017 are available at the website of the Arctic and Antarctic Research Institute: http://ocean8x.aari.ru/item5/data/level/buildtable.php?pos=45

In March 2016, after a long break, sea level measurements by the automatic sea-level meter (hydrostatic pressure recorder) were resumed at Kaliningrad.

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.

An overview of the GNSS technology in the network

For the last 14 years, short-term measurements of heights and horizontal coordinates of benchmarks near points of sea level observations at Azov, Baltic, Barents, Black, Bering, Caspian, Okhotsk and White seas were carried out with the help of GPS/GLONASS-receivers.

Stationary GNSS-receivers have been working for continuous measurements of the vertical land motion in the vicinity of GLOSS stations in Petropavlovsk-Kamchatsky, Tuapse, Nagaevo and Tiksi.

An overview of the data availability. Web, email etc. addresses of data banks and of sources of further information

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

Monthly mean values of sea level variations (deviations from the mean values) at many dozens of Russian Arctic stations for all historical period of observations are possible to download from the website of the Arctic and Antarctic Research Institute: http://ocean8x.aari.ru/index.php?id=507 (section 4).

Graphs of current or annual variation of a water level at coastal stations in Azov, Baltic, Black, Japan and Okhotsk seas and the Russian coast of the Pacific Ocean are displayed at several Russian websites.

Sea level data from the Russian state marine tide gauge network is stored in the Russian oceanographic data center, All-Russia Research Institute of Hydrometeorological Information – WDC, Federal Service for Hydrometeorology and Environmental Monitoring. Contact E-mail for international sea-level data and information exchange: nodc@meteo.ru.

An international workshop on sea-level measurements in hostile conditions was held 13-15 March 2018 at the State Oceanographic Institute in Moscow. Experts from 10 countries (Australia, Canada, Finland, France, Germany, Norway, Russian Federation, Sweden, United Kingdom and USA) presented to the workshop a total of 24 presentations. They are available from http://www.ioc-unesco.org/hostile-conditions-sea-level-workshop.

Recommendations of the workshop are available from http://www.ioc-unesco.org/index.php?option=com_oe&task=viewDocumentRecord&docID=21507.

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

Dr. Oleg Nikitin,
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- National coordinator and contact point for sea-level observations in seas of the European part of Russia (Azov, Baltic, Black, Caspian and White seas)

Dr. Igor Ashik,
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- Contact point for sea-level observations in Arctic seas (Barents, Kara, Laptev, East-Siberian and Chukchi seas)

Dr. Alexander Manko,
Far-Eastern Hydrometeorological Research Institute, Federal Service for Hydrometeorology and Environmental Monitoring, Vladivostok, hydromet@mail.ru

- Contact point for sea-level observations in Far-Eastern seas (Bering, Okhotsk and Japan seas) and Pacific Ocean