

## National Report of Japan

Keizo SAKURAI, Japan Meteorological Agency, Japan

### ▪ Sea Level Observing System

The sea level around Japan varies with several factors such as the status of Kuroshio, which is one of the greatest western boundary currents, sea surface temperature and westward propagation of Rossby waves.

The principal purpose of sea level observations of Japan Meteorological Agency (JMA) is to watch storm surges and tsunamis which Japan has suffered since ancient times. In addition, monitoring of long-term sea level rise caused by global warming has become one of those purposes.

In Japan, tide stations are operated by several national and local governmental organizations including JMA, Japan Coast Guard (JCG) and Geographical Survey Institute (GSI). These three organizations run 66, 30 (including Syowa station in the Antarctic) and 25 tide stations, respectively. Among the stations, fourteen stations of JMA and Syowa station are registered at the GLOSS Core Network (GCN, see Fig.1 and Table1).



Fig.1: Tide stations around Japan registered in GCN

STATION NAME	CODE	LAT	LON
ABASHIRI	AS	44 01N	144 17E
ABURATSU	AB	31 35N	131 25E
CHICHIJIMA	CC	27 06N	142 11E
HAKODATE	HK	41 47N	140 43E
HAMADA	HA	34 54N	132 04E
KUSHIMOTO	KS	33 29N	135 46E
KUSHIRO	KR	42 58N	144 22E
MERA	MR	34 55N	139 49E
MINAMI-TORI-SHIMA	MC	24 18N	153 58E
NAGASAKI	NS	32 44N	129 52E
NAHA	NH	26 13N	127 40E
OFUNATO	OF	39 01N	141 45E
TOYAMA	TY	36 46N	137 14E
WAKKANAI	WN	45 24N	141 41E
SYOWA		69 00S	39 34E

Table1: Tide stations registered at GCN

- **Tide gauge**

JMA uses the Fuess (float)-type tide gauges with digital encoders at 52 tide stations, acoustic gauges at 13 stations and a hydraulic pressure sensor at the Minami-tori-shima station. Those instruments measure the sea level with a resolution of 1cm.

The acoustic tide gauges installed at the 13 GCN stations in Japan (except Minami-tori-shima) are now on a test run and being compared with Fuess-type tide gauges. These 13 stations were also equipped with GPS sensors in order to detect crustal movement in cooperation with GSI.

- **Acquisition and Processing Sea Level Data**

All of the tide stations of JMA make an observation approximately every second. Observational data except those at Minami-tori-shima are transmitted to the “Earthquake Phenomenon Observing System” (EPOS) at the headquarters of JMA on a real-time basis. The data observed at the Minami-tori-shima stations are transmitted to the JMA headquarters via the Data Collection Platform (DCP) system of the Geostationary Meteorological Satellite (GMS-5) every 10 minutes. The data collected by the JMA headquarters are distributed to the local meteorological observatories every 15 minutes. JMA also processes the data to produce hourly sea level data and monthly mean sea level data. Hourly data are sent to GLOSS Fast Data Center at Hawaii University and monthly mean data are sent to the Permanent Service for Mean Sea Level (PSMSL) at Proudman Oceanographic Laboratory.

Hourly sea level data are provided from JMA within 1-2 days of the calculation at:

[http://www.data.kishou.go.jp/marine/tide/sokuho/YYYYMM/z\\_hryYYYYMMCD.txt](http://www.data.kishou.go.jp/marine/tide/sokuho/YYYYMM/z_hryYYYYMMCD.txt)

where YYYY, MM, CD stand for year, month and the code of a station name, respectively as shown in Table 1. All the tidal data made by JMA are also published annually in CD-ROM.

JMA analyzes hourly data to determine tidal harmonic constants for the calculation of the astronomical tides.

- **Monitoring Long-Term Sea Level Changes**

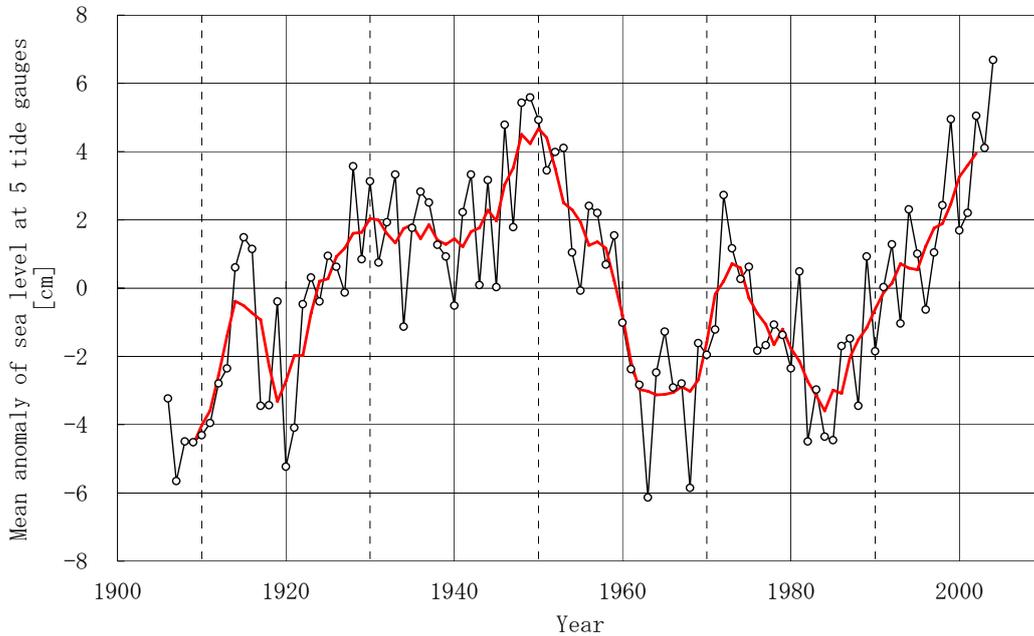


Fig. 2: Variations of anomaly of the annual mean sea levels from 100-year mean (average for 5 tide stations). Red line is the 5-year running mean over the past 100 years.

As shown in Fig. 2, the anomaly of the annual mean sea levels from 100-year mean, which was averaged for 5 tide stations less subject to crustal movement, shows that the annual mean sea level around Japan has been fluctuating in a cycle of roughly 20 years, and had its maximum around the year of 1950. Also, sea level has been continuously rising since the middle of 1980's and has reached the 1950 level recently. In 2004, sea level around Japan was the highest over the past 100 years.

For the clearer understanding of the mechanism of sea level variations, JMA has started quantitative analysis on the cause of such a sea level variation using sea level and crustal movements observed at these stations, oceanographic data by research vessels, and the results of numerical ocean models, etc.

- **Online Databank for Oceanographic Data**

The oceanographic data and related information obtained by various oceanographic research institutes in Japan are archived in the Japan Oceanographic Data Center (JODC). Hourly sea level data of more than hundred tide stations in Japan including GCN stations and other oceanographic data are available at the JODC web site:

<http://www.jodc.go.jp/index.html>