



The Norwegian Tide Gauge Network

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INTRODUCTION

The Norwegian Tide Gauge Network is operated by the Norwegian Mapping Authority, Hydrographic Service (NHS). There are 23 digital tide gauges along the Norwegian coast and one gauge in Ny-Ålesund at Svalbard (see Figure 1 and Table 1).

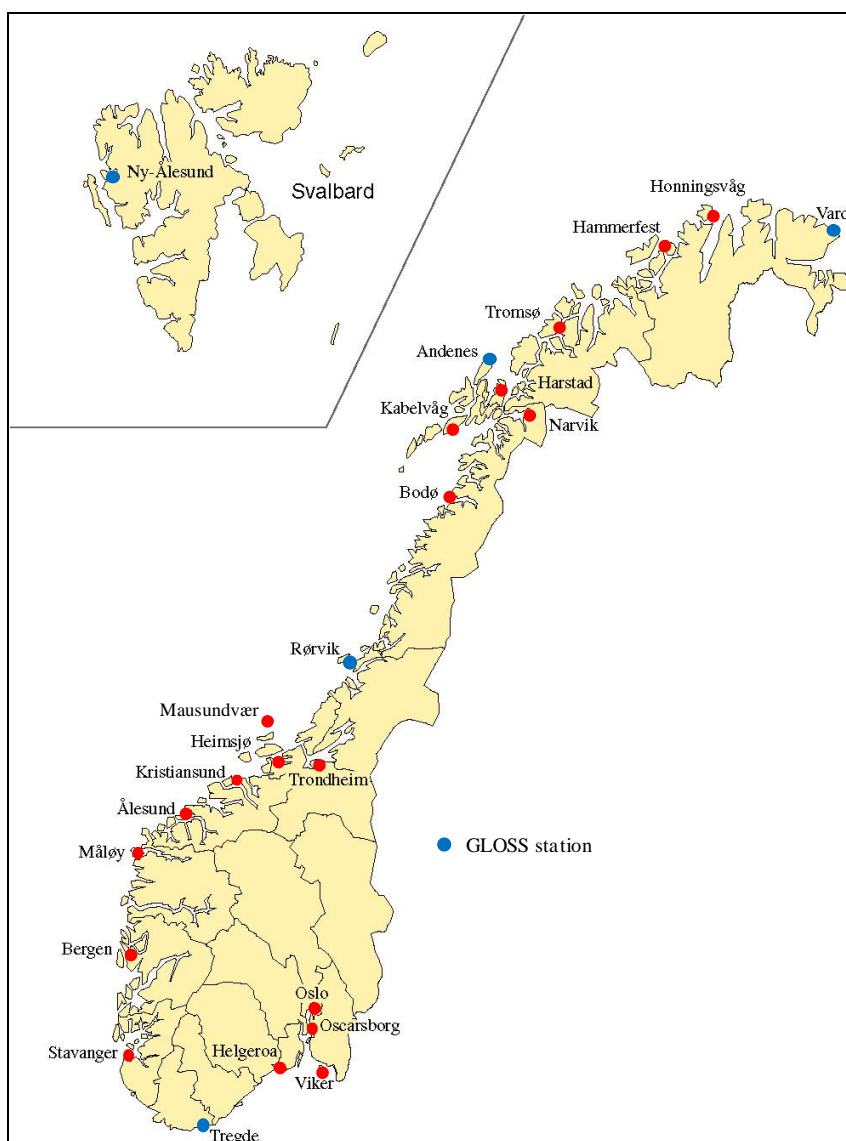


Figure 1. The Norwegian Tide Gauge Network, November 2011.

Station	Latitude	Longitude	Continuous GNSS	Digital data available from
Viker	59°02' N	10°57' E	No	1990
Oslo	59°54' N	10°44' E	No	1914
Oscarsborg	59°41' N	10°37' E	No	1953
Helgeroa	59°00' N	09°52' E	No	1965
Tregde	58°00' N	07°34' E	Yes, since 2001	1927
Stavanger	58°58' N	05°44' E	No	1919
Bergen	60°24' N	05°18' E	No	1915
Måløy	61°56' N	05°07' E	No	1943
Ålesund	62°28' N	06°09' E	No	1961
Kristiansund	63°07' N	07°45' E	No	1952
Heimsjø	63°26' N	09°07' E	No	1928
Mausundvær	63°52' N	08°40' E	Yes, since 2007	1988
Trondheim	63°26' N	10°24' E	No	1989
Rørvik	64°52' N	11°15' E	No	1969
Bodø	67°17' N	14°23' E	No	1949
Kabelvåg	68°13' N	14°30' E	No	1988
Narvik	68°26' N	17°25' E	No	1931
Harstad	68°48' N	16°33' E	No	1952
Andenes	69°19' N	16°09' E	Yes, since 2000	1991
Tromsø	69°39' N	18°58' E	No	1952
Hammerfest	70°40' N	23°41' E	No	1957
Honningsvåg	70°59' N	25°59' E	Yes, since 2006	1970
Vardø	70°20' N	31°06' E	Yes, since 2005	1947
Ny-Ålesund	78°56' N	11°57' E	Yes, since 1993	1976

Table 1. List of stations in the Norwegian Tide Gauge Network.

THE TIDE GAUGE NETWORK

Until 1985 there were two tide gauge networks in Norway, but between 1986 and 1992 the gauges were modernized and merged into one network operated by the Norwegian Mapping Authority, Hydrographic Service (NHS). The new system used stilling wells and sampled the water level with 15 second intervals. These data were filtered and decimated to 10 minute values and automatically transferred to NHS.

A new modernization was completed in 2002. The data loggers were changed to Sutron 8210 and the 10 minute values were obtained by making 3 minute averages of one second samples.

In 2007 the sampling and filtering procedures were changed. The sampling frequency is still 1 Hz but now one-minute averages are stored in the data logger and transferred to NHS at regular intervals (every half hour at the moment) and stored in a database. The one-minute values are filtered (Butterworth filter) and decimated to produce ten-minute values. The ten-minute values go through a half automatic quality control. Software developed at NHS is used for manual editing on the data. Ten-minute values are presented on the internet.

All the permanent tide gauges are of the stilling well type, except in Hammerfest where a radar gauge (Miros SM-094) is used (since August 2007).

The analogue tide gauge at Mausundvær was renewed in 2010, and is now part of the network.

The majorities of the gauges are mounted on solid rock and are levelled with about three years intervals. A few gauges are located on slightly unstable ground and are levelled more frequently. The Norwegian Mapping Authority, Geodetic Institute (GI) is responsible for the levelling.

FUTURE WORK

The Norwegian Mapping Authority is working on installation of tide gauges on the remote islands Jan-Mayen and Bjørnøya (Bear Island). Rough weather, ice and lack of sheltered areas make it difficult to find a good technical solution.

GNSS MEASUREMENTS

By October 2011 seven continuous GNSS receivers (CGPS) are installed at six Norwegian tide gauges. In Vardø, Andenes and Tregde the antennas are installed directly at the tide gauge, on the other stations the GNSS receivers are some hundred meters away. In Ny-Ålesund the GNSS receiver is installed near the VLBI-station (Very Long Baseline Interferometry), which is located about 1.5 km from the tide gauge.

In May 2009 the GNSS receivers in Ny Ålesund (NYA1, NYAL) was renewed.

In September 2010 the GNSS receiver and antenna in Honningsvåg (HONS) was renewed.

Station	Continuous GNSS from	GNSS Receiver Type	Serial num.	Firmware version	Sampling rate	Antenna Type	Ra-dome
Tregde TGDE	2001	Trimble NetRS	45412 60265	1.1-5	1 sec.	AOAD/M_T	None
Andenes ANDE	2000	Trimble NetR5	4649K 03383	3.84	1 sec.	Trimble Zephyr TRM55971.00	None
Ny-Ålesund NYA1	1997	Trimble NetR8	4843K 33429	4.03	1 sec.	ASH 701073.3	Snow
Ny-Ålesund NYAL	1993	Trimble NetRS	44392 39123	1.1-5	1 sec.	AOAD/M_B	Dome
Vardø VARD	2005	Trimble NetRS	44122 32898	1.1-5	1 sec.	Trimble TRM 29659.00	Dome SCIS
Mausundvær FROC	2007	Trimble NetR5	4649K 03429	3.84	1 sec.	Trimble Zephyr TRM55971.00	None
Honningsvåg	2006	Trimble NetR8	4923K 35442	4.03	1 sec.	TRM59800.00	Dome SCIS

Table 2. An overview of status of the continuous GNSS receivers per Oct 2011.

The Norwegian Mapping Authority, Geodetic Institute is responsible for the continuous GNSS measurements and analyses of the data.



Figure 2. Tide gauges with continuous GNSS receivers at Tregde (to the left) and at Andenes.

DATA AVAILABILITY

By the end of 2010 the Norwegian water level database contained about 1488 years with digital water level observations. All data have been through a quality control, and all corrections are flagged and documented. Figure 4 gives an overview of the available digital time series from the permanent tide gauges that are operated today.

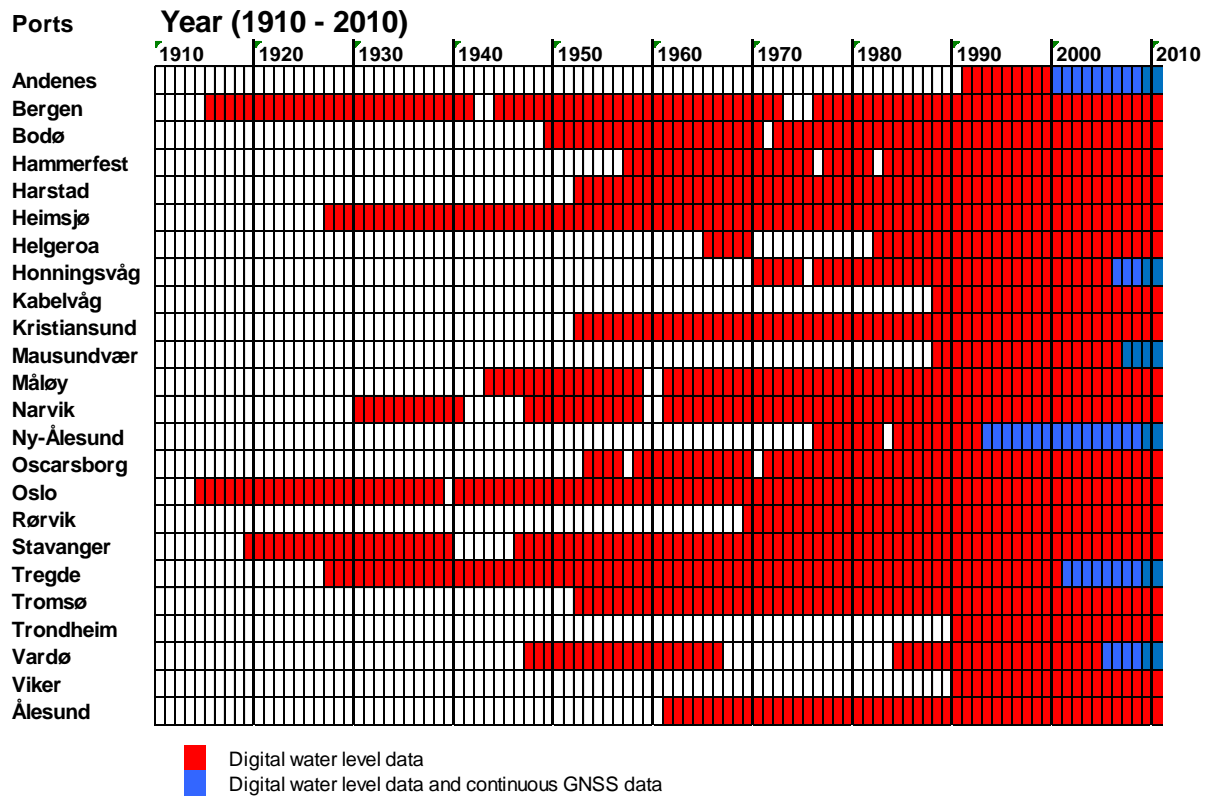


Figure 4. An overview of available digital time series from the stations in the network.

INTERNATIONAL DATA EXCHANGE

Quality controlled sea level data are routinely made available through the following international programmes:

- PSMSL : Monthly and annual means
- GLOSS : Fast delivery data to UHSLC
Delayed mode data to BODC

INTERNET

The following quality checked sea level data are freely available for download on our web site: <http://vannstand.no>

- Water level observations
- Tidal predictions
- Residuals
- Tide tables
- Monthly and annual means
- Harmonic constants
- Levelling data
- Tidal levels
- etc.