

# The Norwegian Tide Gauge Network

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## INTRODUCTION

The Norwegian Tide Gauge Network, operated by the Norwegian Hydrographic Service (NHS), records tidal elevations at 23 locations. Of these are 22 located along the Norwegian coast from the Swedish border in the south to the Russian border in the north. One tide gauge is located in Ny-Ålesund at Svalbard.

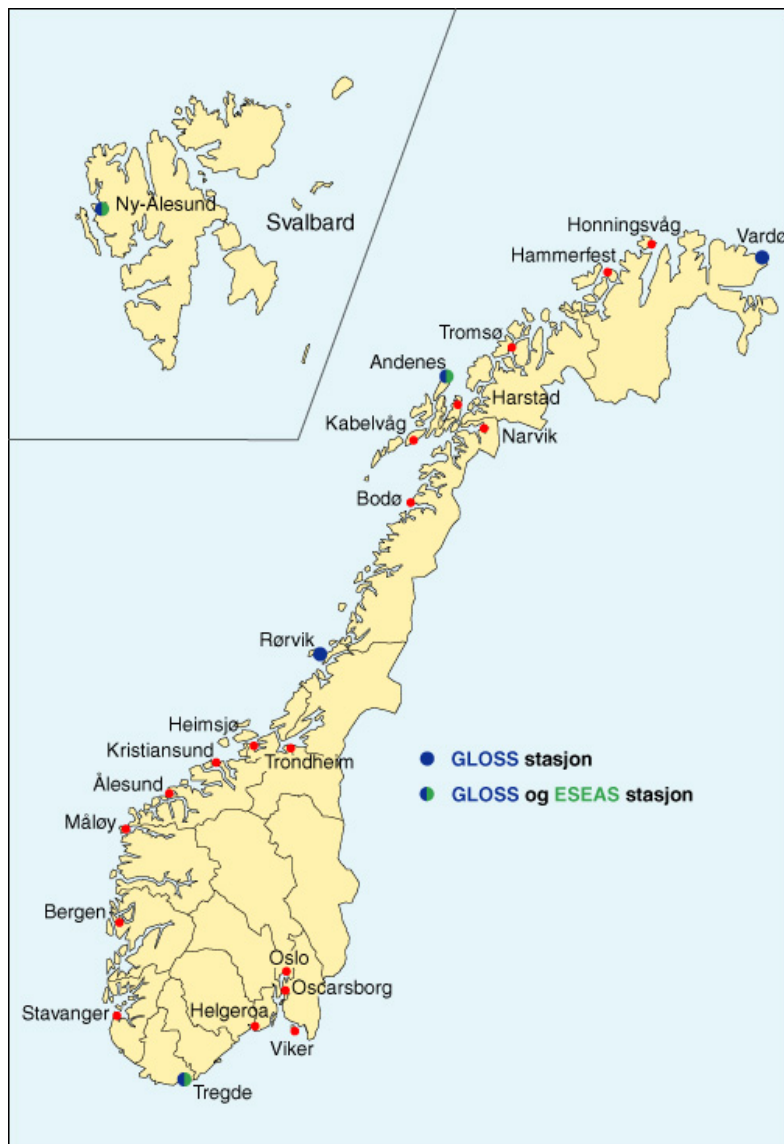


Figure 1. The Norwegian Tide Gauge Network as at February 2005.

| Station      | Latitude | Longitude | CGPS            | 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                        |
| 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  | No              | 1970                        |
| Vardø        | 70°20' N | 31°06' E  | March 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

The Norwegian Tide Gauge Network was completely modernised during the 1980s using the new technology available at the beginning of that decade. The stilling well was still used, but the gauges were converted from analogue to digital with automatic data transfer to the Hydrographic office. There used to be two tide gauge networks belonging to The Norwegian Geographical Survey and The Norwegian Hydrographic Service, NHS (both institutions are now divisions in The Norwegian Mapping Authority). After the modernisation the NHS became responsible for the network and the data, while the Geodetic Institute, Norwegian Mapping Authority became responsible for the levelling.

A new modernisation of the network was completed at the end of 2002. The traditional float and stilling well is still in use, but the datalogger (Sutron 8210) is more capable of delivering near real time data. The data are automatically transferred to the NHS at regular intervals, stored in a database (Oracle) and automatically quality controlled. Software developed at NHS is used for editing and correcting the data. We can delete data, fill small gaps with "adjusted" predictions and add/subtract a constant offset to the data. All corrections are logged in the database, and the original data are stored in a separate table. At present we store data every 10 minutes and transfer data twice a day.

Most of the tide gauges in the Norwegian network are connected to three Bench Marks. The Norwegian Mapping Authority Geodetic Institute does the precise levelling, i.e. they are responsible for determining the distance between the Contact Point and the Bench Marks. NHS is responsible for keeping Tide Gauge Zero (TGZ) a fixed distance below the Contact Point. Most of the gauges are installed on modern quays fundamented on solid rock, but some are located in slightly unstable areas. Levelling was done once a year until 1994. The levelling showed no significant vertical motion on the majority of the tide gauges and these are today levelled every third year. The others are levelled every year.

## GPS MEASUREMENTS

By mid February 2005 continuous GPS receivers (CGPS) are installed at three Norwegian tide gauges (Ny-Ålesund, Andenes and Tregde). In March 2005 a GPS receiver will be installed at Vardø. With exception for Ny-Ålesund the GPS receivers are installed directly at the tide gauge. In Ny-Ålesund the GPS receiver is installed near the VLBI-station (Very Long Baseline Interferometry), which is located about 1.5 km from the tide gauge.



*Figure 2. GPS receiver at Tregde.*



*Figure 3. GPS receiver at Andenes.*

| Station    | GPS Receiver Type  | Serial number | Firmware version | Sampling rate | Antenna Type | Radome |
|------------|--------------------|---------------|------------------|---------------|--------------|--------|
| Tregde     | AOA SNR12RM ACT    | 207U          | 3.3.32.5         | 30 sec.       | AOAD/M_T     | None   |
| Andenes    | AOA Rouge SNR-8000 | 128           | 3.3.32.11        | 30 sec.       | AOAD/M_T     | None   |
| Ny-Ålesund | AOA Benchmark ACT  | 2023          | 3.3.32.2         | 30 sec.       | ASH 701073.3 | Snow   |
| Ny-Ålesund | AOA Benchmark ACT  | 2020          | 3.3.32.2         | 30 sec.       | AOAD/M_B     | Dome   |
| Vardø      | AOA Benchmark ACT  | 2022          | 3.3.32.2         | 30 sec.       | AOAD/M_T     | None   |

Table 2. An overview of the GPS receivers.

## DATA AVAILABILITY

By the end of 2004 the Norwegian water level database contained about 1370 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 time series from the permanent tide gauges that are operated today.

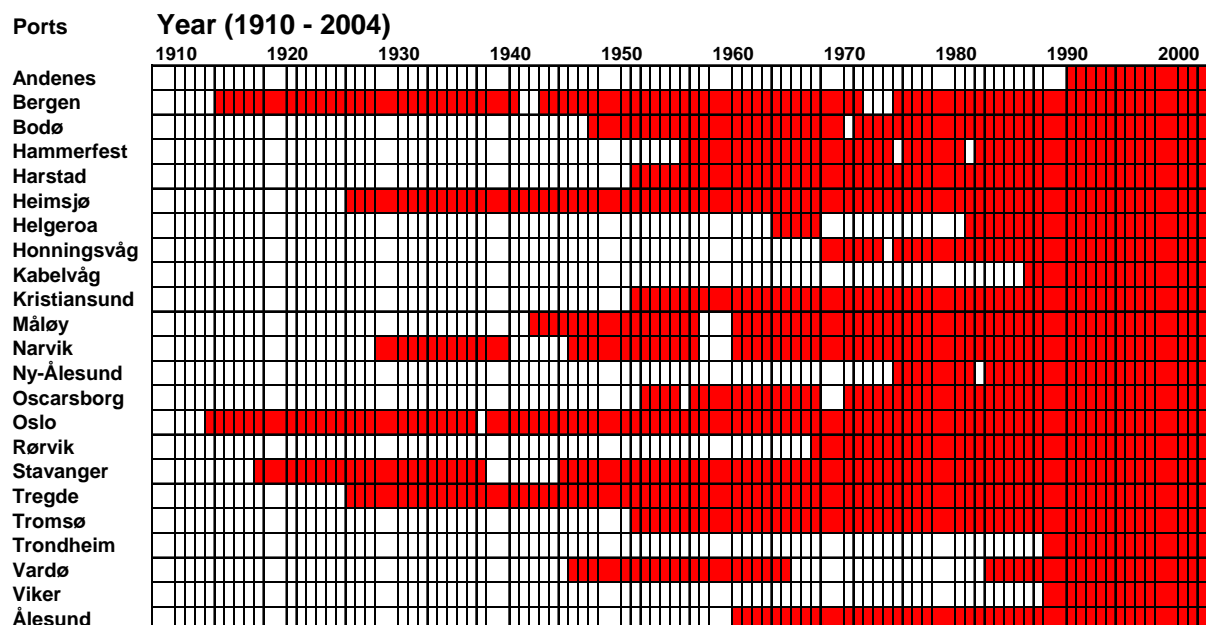


Figure 4. An overview of available digital time series.

## 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
- ESEAS : 10-minutes sea level observations

## **INTERNET**

The following quality checked sea level data are freely available for download on our web site:

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

The data can be obtained via:

<http://vannstand.statkart.no/Engelsk/>