



SWEDISH MARITIME
ADMINISTRATION

SMHI

National height system 2000 | Baltic Sea Chart Datum 2000

New reference level for
sea level, nautical charts
and warnings

The national height system 2000 (RH 2000, Rikets Höjdsystem 2000) is the new Swedish national reference system for height and depth, both on land and at sea. Swedish authorities, municipalities and other organizations have been transitioning to RH 2000 since 2005. The Swedish Maritime Administration (SMA) and the Swedish Meteorological and Hydrological Institute (SMHI) are now coordinating and improving sea level information. Beginning in June 2019, all observations and forecasts of sea level will be presented in RH 2000.

Sea level

For many years, the zero-level (also called the reference level or chart datum) for sea level along the Swedish coastline has been a calculated mean sea level, unique for each measurement station. Mean sea level varies both geographically and over time due to land-uplift and sea level rise. The zero-level in RH 2000 is connected to land and does not change over time. Since RH 2000 is also used for height on land, there are many benefits to using the same reference level for nautical charts, analyses and forecasted sea level variations.

In early June of 2019, a transition to present sea level in RH 2000 instead of the relative mean sea level will take place. Sea level observations will then refer to the new reference system in SMA's display service *ViVa*. The same applies for SMHI's web services, for example *Vattenstånd och vågor*, where current sea level observations and forecasts are shown.

It will be possible to obtain information on current sea level in both RH 2000 and relative mean sea level in some viewing services. SMHI will also transition to issuing warnings for high and low sea levels in the new reference system in June 2019.



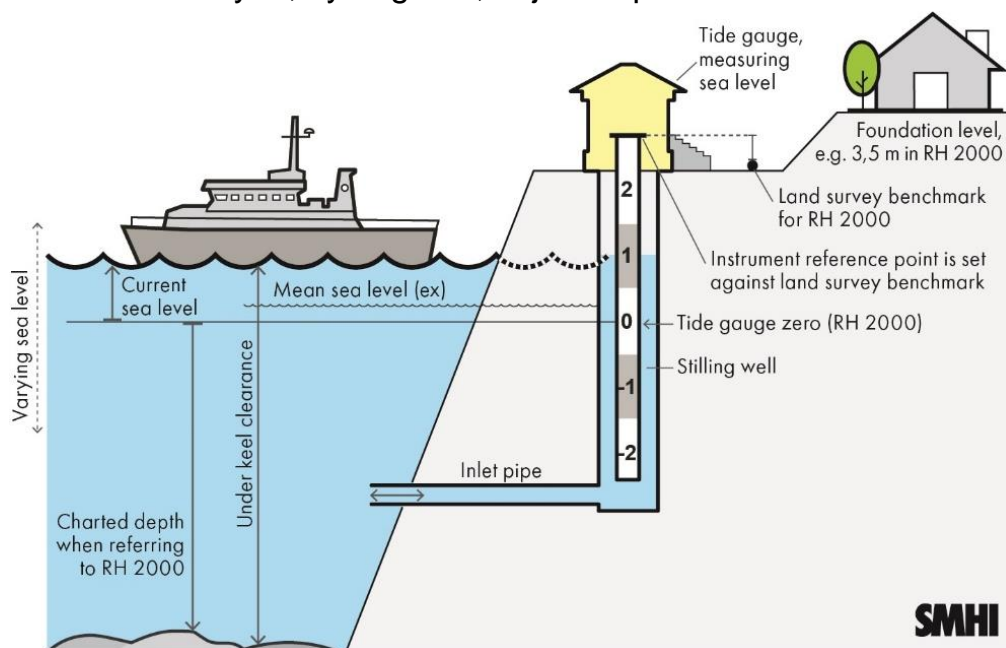
Photo: Sea level station at Kungsholmsfort and measurement equipment inside the station at Landsort Norra.

SMA and SMHI are now upgrading their techniques to measure and store sea level observations. At the oceanographic stations that measure sea level, reference points are weighed against the National Land Survey's (Lantmäteriet's) height fixes. Sea level around the Swedish coast is now measured in RH 2000 and reported once a minute.

Chart Improvement Project

The depth in Swedish nautical charts has traditionally referred to the mean sea level (MSL, also called mean surface) for a specific year. This is often the year the nautical chart was originally produced.

However, the data collected by SMA and SMHI is referred to the mean sea level of the year of collection. As land uplift progresses in almost all Swedish waters, these depths are slowly becoming outdated. To be able to navigate safely with older nautical charts, it has therefore been necessary to, by degrees, adjust depth information for the land uplift.



SMA runs the Chart Improvement Project, where nautical charts are adapted to the new international reference system. This is the *Baltic Sea Chart Datum 2000* (BSCD2000), which all Baltic sea chart manufacturers have agreed to implement. For Sweden, BSCD2000 coincides with the zero level of the Swedish national height system RH 2000 and can be regarded as the system's extension to sea.

The heights and depths in nautical charts are thus reported in relation to the same reference level as heights on land. Since the zero level does not change over time, it will not be necessary to adjust for land uplift. For nautical charts that show lakes and rivers, individual reference levels are defined relative to BSCD2000, i.e. height in RH 2000.

As BSCD2000 is based on international recommendations, nautical chart reference levels will eventually be the same in all of the countries around the Baltic Sea. In Sweden, the Chart Improvement Project began in the Gulf of Bothnia in 2016 and will continue south, rounding the coast until the project ends at the Norwegian border.

If the text "Baltic Sea Chart Datum 2000" or BSCD2000 is shown in the printed nautical chart, the improvement has been completed.

Warnings for high and low sea levels

SMHI's oceanographic forecasting and warning service issues warnings when major sea level changes are expected along the Swedish coast. At present, warnings are issued using the zero level of the mean sea level for the current year. However, as of June of 2019, SMHI will issue warnings in RH 2000. This means that warning levels must be adjusted to the new reference system. At the same time, warnings for low sea levels will be adjusted from class 2 to class 1 in certain areas.

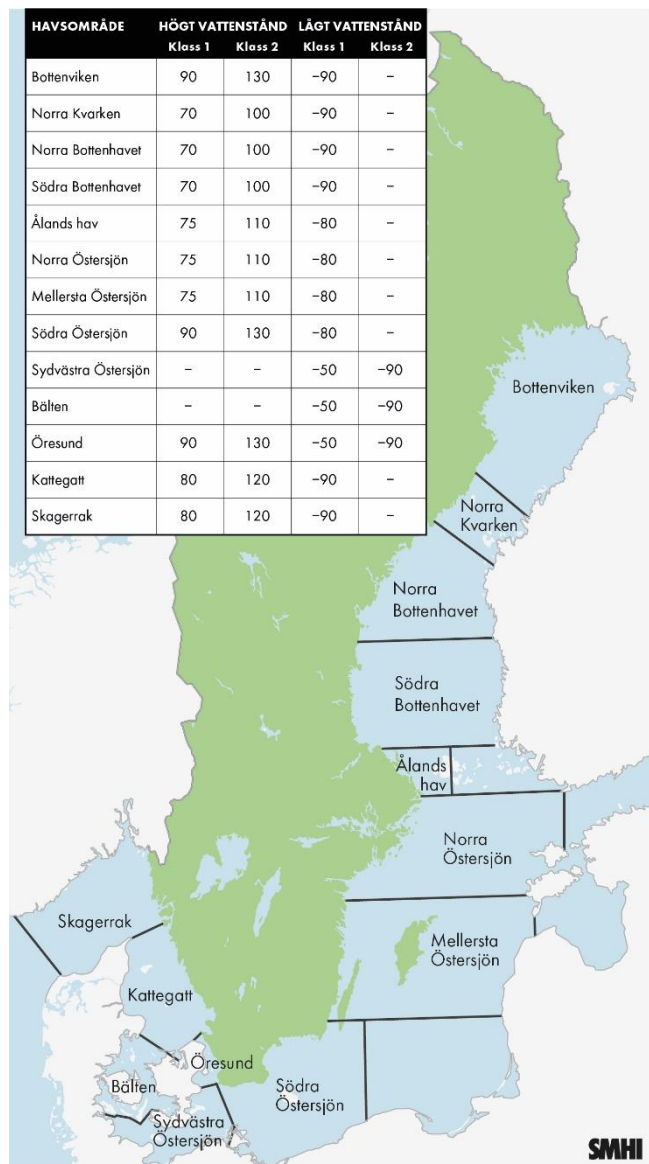


Image: Warning levels for high and low sea levels in RH 2000. Oceanographic warnings for high and low sea levels are not issued in the Archipelago Sea, the Gulf of Finland, the Gulf of Riga or the South-eastern Baltic.

When SMHI issues a warning for high or low sea levels, the text always specifies the expected sea level. It is therefore important to read the text, regardless of the warning class, to see how high or low the level is expected to be and to stay updated about the current sea level.

FAQ

Why is the zero level adjusted to the height system RH 2000?

It makes it easier for the user if depth information in nautical charts is presented in the same reference system as information on sea level forecasts, warnings and current conditions. Having a common zero level also facilitates work using measurements from both land and sea, such as infrastructure projects and wind power construction projects.

What does land uplift mean?

Land uplift means that land and the seabed are together slowly rising. The land uplift rate varies geographically and is greatest in the area around the Quark in northern Sweden. In this area, land uplift is larger than sea level rise, partially contributing to why depth is decreasing over time. In the southern parts of Sweden, where sea level rise is greater than land uplift, the situation is the opposite, i.e. depths are increasing.

How do I compare sea level in RH 2000 with sea level relative to the mean sea level?

At smhi.se, the current year's mean sea level is presented in RH 2000 for all sea level stations. Use the following:

1. Current sea level at the Stockholm station is -50 cm in RH 2000.
2. Mean sea level for 2019 in Stockholm is +10 cm in RH 2000.
3. At Stockholm, -50 cm in RH 2000 is 60 cm below mean sea level ($-50 - 10 = -60$ cm).

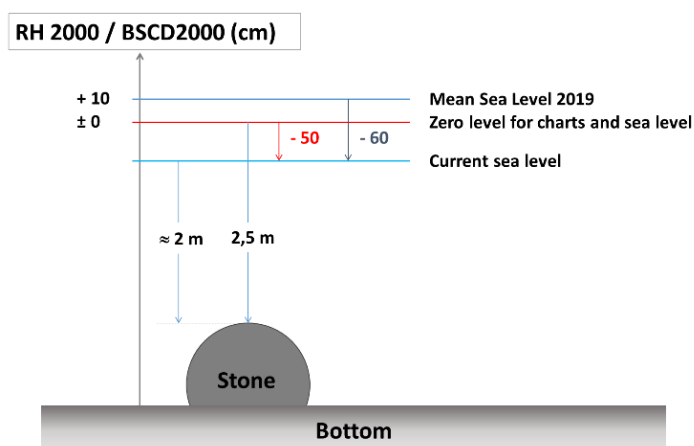


Image: Example of the relationship between the mean sea level and the zero level in RH 2000 / BSCD2000.

How should I use the new nautical charts?

With the new nautical charts, you only need to adjust the depth and height for the current sea level in RH 2000, i.e. you no longer need to compensate depths and heights for land uplift.

Why do the depth data differ from previous nautical charts?

Depth data in nautical charts that refer to a mean sea level for a certain year have become obsolete over time as a result of land uplift (mean sea level is decreasing) and sea level rise (mean sea level is increasing). The new zero level has a solid connection to land. A sea level scale that is mounted on a stable jetty that refers to RH 2000 / BSCD2000 will not have to be adjusted in the future.

Are the new nautical charts more accurate?

The new nautical charts will be better with regard to certain information, for example the shoreline. In terms of depth data, they will not be better than the underlying data for the nautical chart, i.e. if the area was not surveyed with modern techniques, there is a risk that the depths are not entirely correct.

Same reference system for height, depth, sea level, nautical charts and warnings!

At SMA and SMHI, a transition is under way to use the national height system 2000 (RH 2000) as a reference system for sea level in nautical charts and warnings. With the same reference system as on land, information management will become easier, both in shipping and on land:

- When navigating at sea, the depth on nautical charts will be specified in relation to the same zero level as, for example, information about the current and forecasted sea level.
- In work that includes measurements from both land and sea, such as infrastructure projects or wind power construction.

The transition to a new reference level will not take place simultaneously in all coastal areas. During the transition period, it is important to know which reference systems are used in different contexts and how they relate to each other.

Information services that will display sea level and depth in the new reference system include SMA's new nautical charts, the display service *ViVa* and SMHI's viewing service *Vattenstånd och Vågor* (Water Level and Waves).

The Baltic Sea Hydrographic Commission (BSHC), the cooperative community for nautical chart-producing authorities around the Baltic Sea, has decided that all countries should have the same zero level in their nautical charts. In Sweden, SMA and SMHI coordinate and improve information about sea level.

More information can be found at each authority's respective web page.

You can find more information about the Chart Improvement Project via <http://www.sjofartsverket.se/rh2000>

Photos: SMHI

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