Baltic Sea Chart Datum 2000

Thomas Hammarklint
Thomas.Hammarklint@sjofartsverket.se
2020-11-05
The Baltic Sea Hydrographic Commission, which is an integral part of the International Hydrographic Organisation (IHO), promotes the technical co-operation in the domain of hydrographic surveying, marine cartography and nautical information among the neighboring countries of the Baltic Sea region.

The main objectives of the Commission are the coordination of the production of the Baltic Sea INT Charts, the coordination of hydrographic re-surveys, harmonization of chart datums, harmonization of Baltic Sea ENCs, and the exchange of information and the harmonization of practices with regard to various issues related to hydrography.

The most recent development is the Baltic Sea Bathymetric Database – accessible via this portal.

International Hydrographic Organization
The International Hydrographic Organization is an intergovernmental consultative and technical organization that was established in 1921 to support safety of navigation and the protection of the marine environment.

The object of the Organization is to bring about:
- The coordination of the activities of national hydrographic offices
- The greatest possible uniformity in nautical charts and documents
- The adoption of reliable and efficient methods of carrying out and exploiting hydrographic surveys
- The development of the sciences in the field of hydrography and the techniques employed in descriptive oceanography
BSHC Chart Datum Working Group

"To implement a common reference level in the Baltic Sea"

The CDWG will have its next meeting (CDWG13) 27-28 April 2021 in Gothenburg, Sweden

http://www.bshc.pro/working-groups/cdwg

Members of CDWG:

- Denmark  Mr Peter Ladegård Sørensen
- Estonia   Mrs Gabriela Kotsulim
- Finland   Mr Jyrki Mononen
- Finland   Mrs Janina Tapia Cotrino
- Germany   Dr Patrick Westfeld
- Latvia    Mr Bruno Špēls
- Lithuania Mr Mindaugas Zakarauskas
- Poland    Mr Witold Stasiak
- Russia    Dr Sergey V. Reshetniak
- Sweden    Mr Thomas Hammarklint (Chair)
- Sweden    Mr Lars Jakobsson
- Sweden    Mr Henrik Tengbert

Representative of BOOS:
- Sweden    Mr Thomas Hammarklint

Observers:
- Finland   Mrs Mirjam Bilker-Koivula
- Finland   Mrs Anni Montonen
- Germany   Dr Gunter Liebsch
- Germany   Dr Joachim Schwabe
- Norway    Mr Aksel Voldsund
- Sweden    Dr Jonas Ågren
- Sweden    Dr Per-Anders Olsson
- Sweden    Mr Mikael Stenström

The BSHC18 (September 2013) decided to continue CDWG work and wished the harmonized Baltic Sea vertical reference to be implemented.
Baltic Sea Chart Datum 2000 (BSCD2000)


- **Justification:**
The Baltic Sea is an international shallow, non-tidal area in the northern part of Europe with dense traffic. IHO BSHC has approved the name and the adoption of the Baltic Sea Chart Datum 2000.

- **Definition:**
The datum refers to each Baltic country’s realization of the European Vertical Reference System (EVRS) with land-uplift epoch 2000, which is connected to the Normaal Amsterdams Peil (NAP).

- **Height systems used as national realization of BSCD2000 (EVRS-based):**

<table>
<thead>
<tr>
<th>Country</th>
<th>Height System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweden</td>
<td>RH2000</td>
</tr>
<tr>
<td>Poland</td>
<td>PL-EVRF2007-NH</td>
</tr>
<tr>
<td>Estonia</td>
<td>EH2000</td>
</tr>
<tr>
<td>Denmark</td>
<td>DVR90</td>
</tr>
<tr>
<td>Lithuania</td>
<td>LAS07</td>
</tr>
<tr>
<td>Latvia</td>
<td>LAS2000,5</td>
</tr>
<tr>
<td>Finland</td>
<td>N2000</td>
</tr>
<tr>
<td>Norway</td>
<td>NN2000</td>
</tr>
</tbody>
</table>

- **Chart datum name to be shown in paper charts:**
Mean Sea Level (Baltic Sea Chart Datum 2000\textsuperscript{national realization name})
or
Mean Sea Level (Baltic Sea Chart Datum 2000)
BSCD2000 is now included in IHO Geospatial Information (GI) Registry, as chart datum number 44:

**FCD Register**

<table>
<thead>
<tr>
<th>Item Type</th>
<th>Datum</th>
<th>Associated Attribute</th>
<th>Computed Datum Name</th>
<th>Computed Datum Value Code: BVID (44)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Datum</td>
<td>IHO HHD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Associated Attribute</td>
<td></td>
<td>Latitude, Longitude</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computed Datum Name</td>
<td></td>
<td>Baltic Sea Chart Datum 2000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computed Datum Value Code: BVID (44)</td>
<td></td>
<td>44</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Management Details**

- **Proposal Type**: Addition
- **Submitting Organization**: IHO
- **Proposed Change**: Addition of an unassigned value for BVID alignment.
- **Justification**: The BVID System is an international standard, non-geodetic, and unlinked. The (BVID) part of BVIDS is different from (BVID) part of IHO, with the approval of the Baltic Sea Chart Datum 2000.
- **Proposal**: 2010 to Y
- **Accepted**: 2011-10-11
- **Amended**: 2011-10-11
- **Scope Change**: None
- **Filetype**: -
National height systems

- **RH00 National height system 1900**
  Official national height system until 1970
  Zero-level defined by:
  Normal height point in Stockholm from 1886
  Placed +11,800 m above mean sea level in Stockholm 1900

- **RH70 National height system 1970**
  Official national height system 1970-2005
  Zero-level defined by:
  Normaal Amsterdams Peil (NAP), a reference point in Varberg
  placed +4,234 m above NAP

- **RH 2000 National height system 2000**
  "Baltic Sea Chart Datum 2000 (BSCD2000)"
  Official national height system since 2005
  Zero-level defined by:
  NAP is the reference point in the European Vertical Reference System (EVRS)
  Epoch year 2000
Swedish Chart Improvement project

Old

New

Mean Sea Level (Baltic Sea Chart Datum 2000^RH2000)
Plan for transition to BSCD2000 in nautical charts

Updated 2020-10-20
Difference between present chart datum and BSCD2000

Annex 1 To Questionare, BSHC CDWG

Difference between existing chart datum and RH 2000 - Coastal
Swedish Maritime Administration, Hydrographic Office, May 16, 2013

Legend
Coastal
Difference (cm)
-28.4 - -25
-25 - -20
-20 - -15
-15 - -10
-10 - 0

Year of MSL in Swedish chart database - Approach (Swedish water)
Swedish Maritime Administration, Hydrographic Office, May 16, 2013

Legend
Approach
MSL (year)
1930
1942
1960
1968
1967
1958
1969
1960
1962
1965
1970
1980
1985
1990
2000
Swedish Sea Level Network

- Real-time data in BSCD2000 from 59 stations
- 1-minute values with 1 cm accuracy
- Real-time and delayed mode quality control

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
<th>Stations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
<td>Upgrade with battery backup</td>
<td>28 stations (24 SMHI + 3 SMA + 1 CTH)</td>
</tr>
<tr>
<td>Class II</td>
<td>Upgrade without battery backup</td>
<td>26 stations (23 SMA + 3 GBG)</td>
</tr>
<tr>
<td>Class III</td>
<td>Unchanged, temporary</td>
<td>5 stations (5 SMA)</td>
</tr>
</tbody>
</table>
New reference datum for sea level

The water depth remains!
The land-uplift lowers the mean sea level
Stockholm
"World’s longest sealevel record"

Sealevel Stockholm 1774 - 2019
The sea level rise raises the mean sea level

Analysis of 14 Swedish sealevel records since 1886

Sealevel corrected for the levelled land-uplift (glacial isostatic adjustment)
Changing mean sea level
Fig. 4b: Differences between the reference levels of the old national chart datums with respect to Baltic Sea Chart Datum (BSCD2000). In Sweden and Finland, the old reference levels are equal to Mean Sea Level transferred to year 2020 (according to different national conventions). The values from Norway shows the Mean Sea Level over the period 1996-2014, relative NN2000/BSCD2000. In Estonia, Latvia and Lithuania, the Kronstadt reference level is used as old chart datum. In Poland, the local Polish Height System Amsterdam NH2 is used as chart datum. Notice how postglacial rebound reduces the magnitude of the mean sea level in the Bay of Bothnia; it is now just a few cm near the land uplift maximum. The values are shown in this Table.
Reference levels in Skagerack

- Norwegian reference datum (LAT-20) ca 50-60 cm below BSCD2000
- Danish LAT ca 30 cm under BSCD2000
Sea level along the Swedish coast
Example: Stockholm
Sweden have changed reference datum

Swedish Maritime Administration (SMA) and Swedish Meteorological and Hydrological Institute (SMHI) present sea level data relative BSCD2000 since 3rd June 2019
SMHI oceanographic warning and forecasting service

- An ongoing transition to BSCD2000 (RH 2000) at SMHI -> forecasts, warnings and information about current sea level will be issued in BSCD2000

- Warning levels have been adjusted from MSL to BSCD2000

- 2019-06-03: Warnings for high and low sea level will be issued in BSCD2000
Transition to RH 2000/BSCD2000 in charts and sea level

RH 2000/BSCD2000 (m) | Stockholm
--- | ---
+ 0,24 | Chart Datum 1980
+ 0,09 | Mean Sea Level 2020
± 0,00 | New reference level RH 2000/BSCD2000
- 0,20 | Present sea level

≈2,4m depth  | 2,9m chart (1980)
2,6m chart (2020)

Stone

Bottom
* 14040


Expired notices: 2019:754/13917
See: 2018:716/13140

As of June 3, 2019, the Swedish national height system 'Rikets Höjdsystem 2000', or RH 2000 (international name 'Baltic Sea Chart Datum 2000', BSCD2000) will constitute the reference level for observations and forecasts of the water level in Swedish waters.
The zero level in RH 2000 is fixedly linked to land, and is not affected by land uplift, changes in sea level or geographical variations.
The change means that observations, forecasts, and warnings in the Swedish Maritime Administration's and Swedish Meteorological and Hydrological Institute's (SMHI) viewing services from 3 June 2019, or soon thereafter, refer to the new reference level and no longer to the 'mean sea level'.
The Swedish Maritime Administration is gradually adapting the charts to the new reference system. This is a time consuming process which will take several years to complete. During the transition period, it is important to know which reference level is used in the different charts. If the text 'Baltic Sea Chart Datum 2000', or 'BSCD2000' is printed in the chart, the update has been performed.

SMHI och Sjöfartsverket. Publ. 15 May 2019
New info sheets about the transition to BSCD2000 as the new reference level for sea level, nautical charts and warnings
A uniform reference system from land to sea

Illustration Veronica Wärn SMHI
FAMOS Finalization project (no funding)

FAMOS Freja+Odin Infrastructure
- FAMOS Gravity surveys
- FAMOS Geoid computations
- Baltic Sea Chart Datum 2000
- FAMOS Hydrographic surveys

Oceanographic observations
- Oceanographic model

FAMOS Finalization
- FAMOS Geoid model
- BSCD2000 Height Correction model
- Bathymetry
  - S-101 ENC
  - S-102 Bathymetric Surface
- Water level
  - S-104 Waterlevel Information for Surface Navigation
- Surface Currents
  - S-111 Surface Currents
- Navigational Warnings
  - S-124 Navigational Warnings

Under Keel Clearance
- S-129 Under Keel Clearance Management (UKCM)

Oceanographic observations

FAMOS Gravity surveys
Thank you!

Thomas Hammarklint
Thomas.Hammarklint@sjofartsverket.se