Baltic Sea Chart Datum 2000 – a common reference level for nautical charts and sea level information in the Baltic Sea

2019-06-12 BOOS Annual meeting, Rostock

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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
The CDWG will have its next meeting (CDWG12) 3-4 March 2020 in Gdansk, Poland

http://www.bshc.pro/working-groups/cdwg
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>System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweden</td>
<td>RH2000</td>
</tr>
<tr>
<td>Germany</td>
<td>DHHN2016?</td>
</tr>
<tr>
<td>Lithuania</td>
<td>LAS07</td>
</tr>
<tr>
<td>Estonia</td>
<td>EH2000</td>
</tr>
<tr>
<td>Denmark</td>
<td>DVR90</td>
</tr>
<tr>
<td>Poland</td>
<td>PL-EVRF2007-NH</td>
</tr>
<tr>
<td>Latvia</td>
<td>LAS2000,5</td>
</tr>
<tr>
<td>Finland</td>
<td>N2000</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:
Swedish Chart Improvement project

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

Updated 2019-04-08
Difference between present chart datum and BSCD2000

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
1966
1967
1968
1969
1970
1980
1985
1990
2000

1 centimeters = 0.0 kilometers
**Swedish Sea Level Network**

- Real-time data in BSCD2000 from 60 stations
- 1-minute values with 1 cm accuracy
- Real-time and delayed mode quality control

**Classes**

- **Class I** Upgrade with battery backup
  - 26 stations (22SMHI, 3SMA, 1CTH)

- **Class II** Upgrade without battery backup
  - 26 stations (22SMA, 1SKB, 3GBG)

- **Class III** Unchanged, temporary
  - 8 stations (5SMA, 2GBG, 1GU)
New reference datum for sea level

The water depth remains!
The land-uplift lowers the mean sea level

Levelled land-uplift rates

<table>
<thead>
<tr>
<th>Nr</th>
<th>Time serie</th>
<th>Start year</th>
<th>Rate (cm/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Furuögrund</td>
<td>1916</td>
<td>0.945</td>
</tr>
<tr>
<td>2</td>
<td>Ratan</td>
<td>1891</td>
<td>0.952</td>
</tr>
<tr>
<td>3</td>
<td>Draghällan/Spikarna</td>
<td>1897</td>
<td>0.892</td>
</tr>
<tr>
<td>4</td>
<td>Björn/Forsmark</td>
<td>1891</td>
<td>0.677</td>
</tr>
<tr>
<td>5</td>
<td>Stockholm</td>
<td>1889</td>
<td>0.536</td>
</tr>
<tr>
<td>6</td>
<td>Landsort</td>
<td>1886</td>
<td>0.460</td>
</tr>
<tr>
<td>7</td>
<td>Visby</td>
<td>1916</td>
<td>0.290</td>
</tr>
<tr>
<td>8</td>
<td>Ölands norra udde</td>
<td>1851</td>
<td>0.268</td>
</tr>
<tr>
<td>9</td>
<td>Kungsholmsfort</td>
<td>1886</td>
<td>0.133</td>
</tr>
<tr>
<td>10</td>
<td>Ystad/Skanör</td>
<td>1886</td>
<td>0.077</td>
</tr>
<tr>
<td>11</td>
<td>Malmö/Klagshamn</td>
<td>1924</td>
<td>0.084</td>
</tr>
<tr>
<td>12</td>
<td>Varberg/Ringhals</td>
<td>1886</td>
<td>0.252</td>
</tr>
<tr>
<td>13</td>
<td>Göteborg</td>
<td>1887</td>
<td>0.289</td>
</tr>
<tr>
<td>14</td>
<td>Smögen</td>
<td>1910</td>
<td>0.340</td>
</tr>
</tbody>
</table>

(NKG2016LU_LEV, rates relative to the geoid)
Stockholm
"World’s longest sealevel record"

Sealevel Stockholm 1774 - 2019

Yearly observations
Regression 1774-1885
Regression 1886-2019
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)
Fig. 4b: Differences between the reference levels of the old national chart datums with respect to BSCD2000. In Sweden, Finland and Norway, the old reference levels are equal to Mean Sea Level transferred to year 2019 (according to different national conventions). In Estonia, Latvia, Lithuania and Poland, the Kronstadt reference level is used as old 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.
Reference datums in Skagerack

- Norwegian chart datum (LAT-20) ca 50-60 cm below BSCD2000
- Danish LAT ca 20 cm below BSCD2000
Sweden has changed reference system

Swedish Maritime Administration (SMA) and Swedish Meteorological and Hydrological Institute (SMHI) will present sea level data relative BSCD2000 from 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
Present situation (June 2019)

BSCD2000 (m)

+ 0,20
+ 0,10
± 0,00
- 0,20

Reduction of depths due to land-uplift
Chart datum 1990
Mean sea level 2019
New reference level
Current sea level

≈2,7m depth  3,1m charted depth

Stone
Bottom
Future situation (2024)

BSCD2000 (m)

+ 0,08
± 0,00
- 0,20

Mean sea level 2024
New reference level
Current sea level

≈2,7m depth
2,9m charted depth

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.


www.sjofartsverket.se/RH2000 www.smhi.se

SMHI och Sjöfartsverket. Publ. 15 May 2019
New info sheet 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
Thank you!

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