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

2019-04-11 TWCWG4/GLOSS GE XVI-meeting, Busan, Korea

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

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 included in:
IHO Geospatial Information (GI) Registry,
as chart datum number 44
BSCD2000 is included as a reference plane in BODC Vocabulary list / SeaDataNet

### L11 (SEADATANET DEPTH MEASUREMENT REFERENCE PLANES)

<table>
<thead>
<tr>
<th>ConceptID</th>
<th>Preferred label</th>
<th>Alt label</th>
<th>Definition</th>
</tr>
</thead>
</table>
| D33       | Baltic Sea Chart Datum 2000      | BSCD2000  | The elevation of the zero metres contour in the Baltic Sea as approved by the IHO Baltic Sea Hydrographic Commission as the common chart datum for the Baltic Sea. The datum refers to each Baltic country’s realization of the European Vertical Reference System (EVRS), which is connected to the Normaal Amsterdams Peil (NAP). | 5/22/2017 16:41:48
Swedish Chart Improvement project

Old

New

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

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

Legend
Approach MSL (year)
1930
1942
1960
1966
1957
1958
1969
1980
1980
1985
1990
2000

1 centimeters = 00 kilometers

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

Class I: Upgrade with battery backup
- 28 stations (24 SMHI + 3 SMA + 1 CTH)

Class II: Upgrade without battery backup
- 26 stations (23 SMA + 3 GBG)

Class III: Unchanged, temporary
- 5 stations (5 SMA)
New reference datum for sea level

The water depth remains!
Glacial Isostatic Adjustment (GIA)

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 - 2018

Yearly means  Regression 1774-1885  Regression 1886-2018
The sea level rise raises the mean sea level

Analysis of 14 Swedish sealevel records since 1886

Sealevels corrected for the levelled land-uplift (glacial isostatic adjustment)
Future sea level rise (SLR)

Stockholm
Baltic Sea Chart Datum 2000

- Observations
- Mean sea level
- SLR +1m
- SLR +0.65m
- SLR +0.3m

Sealevel (cm)

Year

1880 1900 1920 1940 1960 1980 2000 2020 2040 2060 2080 2100

Map of the Baltic Sea area showing data locations.
Changing mean sea level

Mean Sea Level
Baltic Sea Chart Datum 2000

- 2000
- 2020
- 2050
- BSCD2000=0.0

cm

Locations listed:
- Haparanda (SWE)
- Calks Torö (SWE)
- Ljungskile (SWE)
- Nora (SWE)
- Flädten (SWE)
- Gripen (SWE)
- Grönö (SWE)
- Fiskhamn (SWE)
- Helsingfors (FIN)
- Kökar (FIN)
- Visby (SWE)
- Västerås (SWE)
- Stockholm (SWEDEN)
- Copenhagen (DENMARK)
- Dover (UK)
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- Brittany (FRANCE)
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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 2019 (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, 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 0,5-0,6 m below BSCD2000
- Danish LAT ca 0,2 m below BSCD2000
Sweden will change reference datum

Swedish Maritime Administration (SMA) and Swedish Meteorological and Hydrological Institute (SMHI) will present sea level data relative BSCD2000 from 3rd June 2019
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
New Sealevel service from SMHI

Kalix-Storön
SMHI:s mätstation

Välj tidsspann: Fler dygn Närtid

Diagram Tabell

Vattenstånd (cm i RH 2000)
Idag kl. 02.45

03/04 21:00 05/04 09:00 06/04 21:00 08/04 09:00 09/04 21:00

-110 -55 0 55 110

Red Observation Green Kort prognos Blue Lång prognos Gray Årets beräknade medelvattenstånd

SWEDISH MARITIME ADMINISTRATION
Present situation (2019)

- **BSCD2000 (m)**
  - + 0.20
  - + 0.10
  - - 0.20

**0.10 difference**

- **Chart datum 1990**
- **Mean sea level 2019**
- **Current sea level**

- **≈2.7m depth**
- **3.1m charted depth**

Reduction of depths due to land-uplift

Bottom
Future situation (2024)

BSCD2000 (m)

+ 0,08 0,08 plus water
± 0,00
- 0,20 - 0,20 ViVa

Mean sea level 2024
New reference level (geoid)
Current sea level

≈2,7m depth 2,9m charted depth

Stone
Bottom
New info sheet about the transition to BSCD2000 as the new reference level for sea level, nautical charts and warnings

**Svensk**

**Ny referensnivå för vattenstånd, sjökort och varningar**

**English**

**New reference system for sea level, nautical charts and warnings**
A uniform reference system from land to sea

- Charted depth when referring to RH 2000
- Water depth
- Under keel clearance
- Mean sea level (example)
- Varying sea level
- Current sea level
- Inlet pipe
- Tide gauge zero (RH 2000)
- Stilling well
- Foundation level, e.g. 3.5 m in RH 2000
- Land survey benchmark for RH 2000
- Instrument reference point is set against land survey benchmark
- Sea level station

Illustration Veronica Wärn SMHI
Thank you!

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