



Questionnaire to BSHC Member States on their implementation status of the transition to a Harmonised Vertical Reference, Baltic Sea Chart Datum 2000.

Please return to Thomas Hammarklint by email (thomas.hammarklint@sjofartsverket.se) at the latest by **17 March 2023**.

Member state	Sweden
Date of reply	2023-01-16 (updated 2023-03-15)
Point of Contact	Thomas Hammarklint, Hydrographic Office (HO), Swedish Maritime Administration (SMA), thomas.hammarklint@sjofartsverket.se

1. Are all the decisions done to implement the Baltic Sea Chart Datum 2000?

The change of chart datum in Swedish official nautical chart portfolio; the Chart Improvement project (Sjökortslyftet) is included in the Swedish HO "Vision 2020" (Målbild 2020), approved and decided 2014 of SMA HO management.

Chart Improvement project: The vertical reference and coastline will be updated and referred to Baltic Sea Chart Datum 2000^(RH2000) (BSCD2000) in all Swedish charts, except those covering inland waters, at the latest in the year of 2030. Lakes covered of official charts will be taken care of in similar before 2030.

Swedish Maritime Administration (SMA) and Swedish Meteorological and Hydrological Institute (SMHI) have a cooperation agreement covering this area of responsibility. Transition to the new vertical reference for the water level was implemented June 3, 2019. The user of water level information has the possibility to choose between mean sea level and BSCD2000 as the reference.

In the EU-financed project FAMOS, SMA and SMHI have harmonized and upgraded the Swedish Water Level network (2017-2019), including new sensors for 60 stations. All stations in the network are connected to the land based height system RH2000, and by that, BSCD2000.

1.1. When the decisions has been done or planned to be done?

Year 2014.

1.2. What are the national decisive organizations?

Swedish Maritime Administration (SMA) includes Hydrographic Office (HO) and is representing Sweden in IHO and is also responsible for the official Swedish nautical charts.

SMA cooperates with the Swedish Meteorological and Hydrological Institute (SMHI) to observe and present water level information. During 2017-2019, SMA and SMHI have established a new Swedish Sea Level network (as a part of FAMOS Odin), using the Baltic Sea Chart Datum 2000 (BSCD2000) as the reference datum for all water level information. Since 2019-06-03, all data is presented related to BSCD2000, however the user can choose to present data relative mean sea level as well.



Data will also be distributed to BOOS and other European networks referring to this datum. SMHI have a coordination role for the Baltic Sea and within BOOS to distribute this kind of data. SMA has been a member of BOOS since May 2017 and nowadays almost all oceanographic data are distributed to the BOOS Data Exchange system via SMHI.

2. What is the national status of implementation of chart datum?

2.1. What actions have already been done?

- All new hydrographic surveys started July 1, 2013 or later refer to BSCD2000.
- The Swedish depths database (DIS) was transformed to the Swedish realisation of the harmonized vertical reference (BSCD2000) 2013-05-23.
- All new charts in inland waters produced 2008 or later refer to BSCD2000 with added offset adapted for each lake.
- In September 2015 the Chart Improvement project started. 28 paper charts and 128 ENCs (different layers) have been updated to BSCD2000.
- In areas where no modern surveying has been performed and only old analogue depth data is available these fair sheets has been scanned, transformed and uploaded into DIS (referring to BSCD2000). Digitalization has been finalized 2016.
- Vertical/Height information in the database Poseidon, storing nautical object including lighthouses, refer to BSCD2000.
- Since 2019-06-03, all Swedish Sea Level stations are connected to BSCD2000 and data is presented in BSCD2000, however the user can choose to present data relative mean sea level as well.

2.2. What actions have been planned to be executed and what is the schedule?

See answer 1.

2.3 Which ENC Approach have been updated with the new reference datum? If possible, attach a chart datum overview covering Your countries nautical charts, designed graphically or as a table, updated around January, 2020. Also, if possible, include an attribute to each named chart describing the CD difference to BSCD2000 in cm (CD minus BSCD2000). Example attached at the end of the Questionnaire (Annex).

See the attached example under Annex.

**3. Has Your country established the national realization of EVRS and are the water level stations connected to this new height system (BSCD2000)?**

3.1 Which organization/-s is responsible for the water level stations/data in Your country?

Swedish Maritime Administration (SMA) and Swedish Meteorological and Hydrological Institute (SMHI).

3.2 Which reference are used today to present water level information? Does Your country planning to present water level information referring to BSCD2000? Doing it already today? Date decided for change the reference to BSCD2000?

All involved water level stations are connected to BSCD2000. Yes, since 2019-06-03, all water level information is presented in BSCD2000, however the user can choose to present data relative mean sea level, as well.

3.3 Are there any plans for digital service/-s intended for the users to have the option to choose MSL or BSCD2000 as the reference level for water level information?

Yes, the users have the possibility to choose reference datum for water level information.

3.4 GNSS supported UKC control/confirmation is probably the reality in a few years. But we also need reliable water level predictions for carrying out optimal loading and real time water level data to check the GNSS data. Do we need a shared service in the Baltic Sea for water level information (predictions/real-time), that fulfils nautical needs and demands?

Sweden see that a service for water level information is needed and that a reliable and robust shared service for nautical use is important.

3.5 Do we need to work together with the development of the IHO S-104 standard?

Yes, as a first step we need to work together and in the next step to develop and validate the new S-104 standard for water level information.

4. Are the relevant national contacts and interest groups defined for the change of chart datum and water level reference?

4.1. What are the essential national interest groups in Your country?

- Swedish Maritime Administration ("Sjöfartsverket" SMA) (including correspondence with local harbours through head of Pilot areas)
- The Swedish Meteorological and Hydrological Institute (SMHI)
- The Swedish National Land Survey ("Lantmäteriet" LM)
- The Swedish Transport Agency ("Transportstyrelsen" TS)
- The Swedish Transport Administration ("Trafikverket" TV)



- The Geological Survey of Sweden ("Sveriges Geologiska Undersökning" SGU)
- The County Administrative Boards ("Länsstyrelserna" Lst)

4.2. Are the relevant point of contacts known and contacts been made to them?

- SMA: Thomas Hammarklint (HO point of contact)
- SMHI: Fredrik Waldh (co-operation in progress)
- LM: Jonas Ågren and Per-Anders Olsson (co-operation in progress)
- TS: Johan Skogwik (HO point of contact)
- TV: Not yet (TBD)
- SGU: Björn Bergman (co-operation in progress)
- Lst: Not yet (TBD)

Also, HELCOM SAFE NAV has been informed by SMA HO.

4.3 Are You planning any information campaign about the change of chart datum and water level reference? If, yes have you published information about this somewhere?

Yes, an information campaign have been conducted during 2019. More information can be found here:

<https://www.sjofartsverket.se/en/services/hydrographic-information/nautical-charts/sjokort/reference-levels/new-reference-level-in-charts-and-products>

5. Have You identified any obstacles or major issues concerning transition to the harmonized vertical reference?

5.1. What are the major obstacles or issues?

The HO has replaced the former chart production system in 2016. Information to the users about the transition to the chart datum Baltic Sea Chart Datum 2000 (BSCD2000) is a major challenge. To change into a new reference datum for water level to early might cause a misleading understanding about the true depths.

Communication with users of data and products under the transition period at the optimal time is a challenge. Chart products belonging to different parts of the coast line will be updated to the new reference level at different times. Parallel to this the change of the reference for water levels was carried out at a given time.

5.2. What measures has been planned to avoid them?

Extra time allocated in the plan but the time schedule is tight. The work started in the northern parts of Bay of Bothnia and the plan for 2021 is to reach the area south of Stockholm.

We probably need to evaluate our timing of our information to those concerned so far.



6. Connections to neighbouring countries

6.1. Which are the relevant countries to cooperate?

Sweden has boundaries to all other countries surrounding the Baltic Sea. To some extent cooperation is needed with all of them, but in practice handled through BSHC.

Sweden (and Denmark) has maritime borders adjacent to Norway in areas with limited tide. Norway applies different rules (compared to Sweden and Denmark) regarding the choice of reference level. As a result the reference level used in the charts shifts up to about a half meter along the border. There is need of an agreement between Sweden, Norway and Denmark regarding the delimitation and shift of Chart Datum towards the North Sea. Sweden has an action within the Nordic Hydrographic Commission to invite Denmark and Norway for this.

6.2. Are the needed points of contacts already known?

Necessary point of contacts are known.

Important to continue the dialogue between CDWG/BSHC and BOOS to get the water level operating institutions in the transition to the new reference.

6.3. What actions have been agreed with the relevant countries (e.g. synchronising plans and schedules)?

There is no synchronising done in regards to time schedule. It is up to each and every member state to implement the agreed vertical reference system (EVRS) and reference level. All steps towards EVRS will improve the existing situation.

Sweden has a fruitful exchange of information and experiences with Finland concerning harmonization within the FAMOS project and the Chart Improvement project. Within the FAMOS Continuation project Activity 2 there is an ongoing activity to finalize the FAMOS Geoid model.

7. Are there any needs for support from BSHC?

Support the dialogue with Norway and NSHC in order to handle the reference level difference at the border between Sweden and Norway (...and preferably also between Denmark and Norway). That kind of dialogue will probably support any future agreement concerning the reference level for high-resolution bathymetric data in European coastal waters.

8. Do you have any other proposals or guidance to the CDWG to help and foster the transition process?

The Chart Improvement project was included in the FAMOS project and has received EU co-financing from the Connecting Europe Facility (CEF Transport) for the years 2015-2019. For more information, see:
<http://www.famosproject.eu/activities/future-navigation>



9. Are you using GNSS and GNSS augmentation services for referring to your (bathymetric) surveys to the chart datum?

In areas with acceptable coverage we are using GNSS with RTK, either from own base stations or the SWEPOS Network RTK service provided by Swedish Land Survey "Lantmäteriet". In areas in open sea with poor coverage or where the height component is inadequate we only use the horizontal component from RTK or Network DGPS from SWEPOS or IALA DGPS. Depths are then corrected by tide models to the chart datum.

9.1 What GNSS augmentation service is used for hydrographic surveys? (If there are several augmentation services, list all of them.)

SWEPOS Network services provided by Swedish Land Survey, "Lantmäteriet" and IALA DGPS.

9.2 To which coordinate system, and vertical reference level/frame the GNSS augmentation service is referred to? (If there are several systems in use, list all of them.)

Coordinate system SWEREF 99 (Swedish realization of ETRS89), SWEREF 99 TM (national map projection, extended UTM zone 33). We are using the geoid model SWEN17_RH2000 to convert from ellipsoid height to Swedish national reference level RH2000 (BSCD2000), which is calculated from the NKG gravimetric model.

9.3 Does your HO require, in-house or procured, that Hydrographic survey system shall be prepared to be able to measuring the GNSS-height and refer the depth to the geoid?

Yes.

9.4 Do you discuss within your HO the need of an altimetric measured Mean Sea Surface (MSS)? (For example, in order to support hydrodynamic models, shipping and / or adjust existing depth data?)

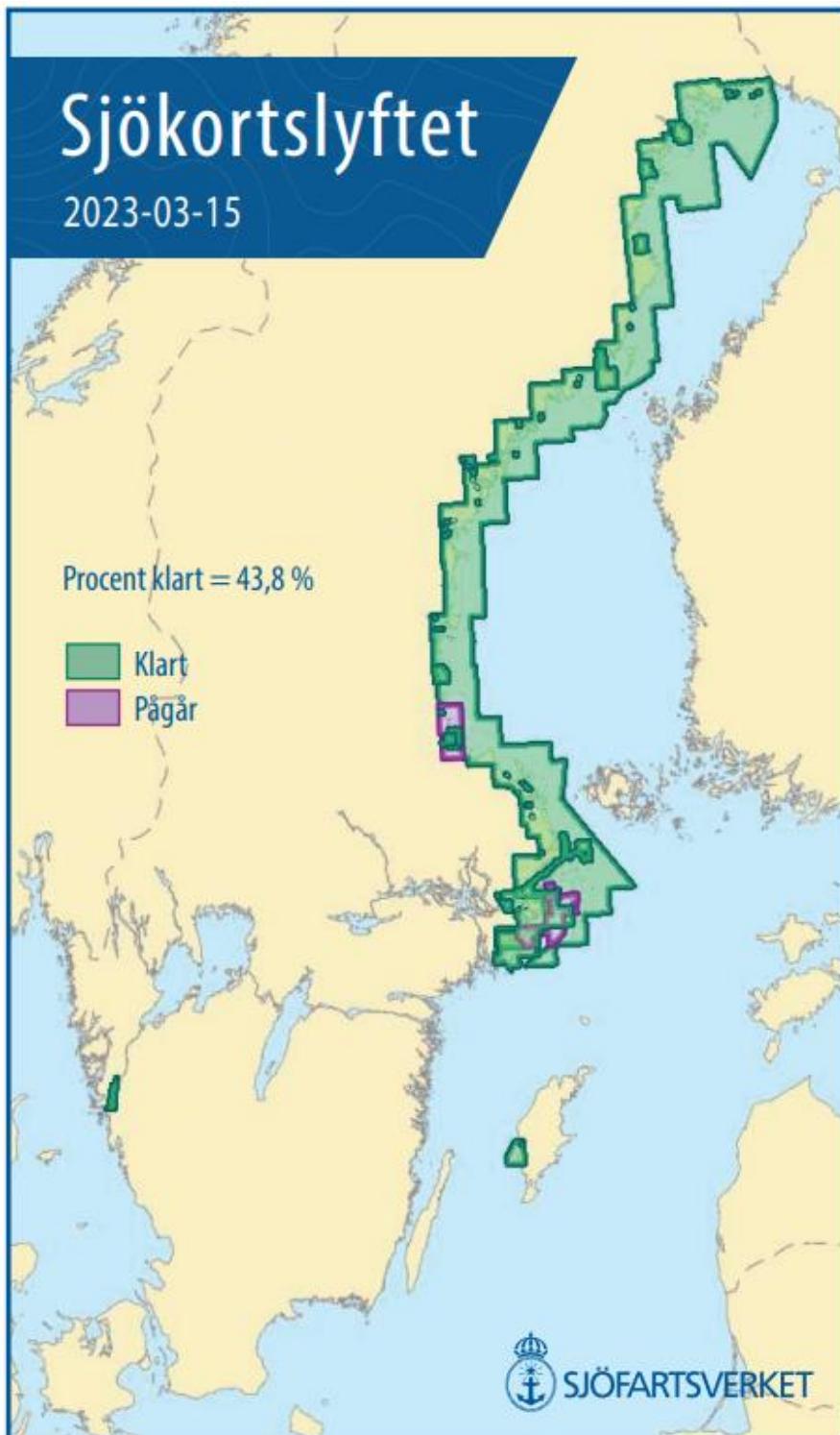
Yes.

9.5 Has your HO assessed the need for dynamic geodetic reference systems (time-dependent transformation relationship) between primarily national and global reference frames?

Yes.



Annex



Example of ENC Approach from Sweden (updated 2023-03-15): **Green** cells are referring to the new chart datum BSCD2000, **purple** cells are ongoing adjustments to BSCD2000 and the rest of the cells refer to various Mean Sea Level.