BSHC Chart Datum Working Group (CDWG)

CDWG Report to the BSHC 21st Conference

The CDWG TORs request the CDWG to report annually to the BSHC.

1. Status of Work of CDWG since BSHC 20th Conference

Mr. Jyrki Mononen has acted as the Chair. There is no permanent secretory for the CDWG. *Dr. Wilfried Ellmeer* was elected as the secretary of the CDWG 8th meeting. All the BSHC countries have nominated members to the working group, however not all have been active or participated to the meetings. BOOS has nominated their Point of Contact. There are also observers from Finnish Geodetic Institute, Finnish Meteorological Institute, Swedish National Land Survey, Federal Agency for Cartography and Geodesy (Germany), Norwegian Mapping Authority.

One of the most important tasks agreed in CDWG 7th meeting in 11-12 February 2015 has been to formulate a separate specification document for the Baltic Sea Chart Datum 2000. The draft specification was reviewed and approved in the CDWG 8th meeting. The draft is in Annex 1.

The main tasks for the CDWG has been to continue the implementation of the EVRS in the Baltic Sea, to review the progress of transition to the harmonized vertical reference, to promote development of a common geoid model for the Baltic Sea, and to cooperate with relevant other international bodies.

The communication within the CDWG has been by CDWG Letters and e-mails. Meeting was held on 23-24 February 2016 in Helsinki, Finland.

Members of CDWG:	Denmark	Mr Lars Hansen
	Denmark	PhD Joanna Gerlings
	Estonia	Mr Peeter Väling
	Estonia	Mr Tõnis Siilanarusk
	Estonia	Ms Nele Savi
	Finland	Mr Jyrki Mononen
	Germany	Dr Wilfried Ellmer
	Latvia	Armands Murans
	Latvia	Mr Jurijs Rizhovs
	Lithuania	Mr Mindaugas Zakarauskas
	Poland	Cdr Sławomir Lipiński
	Poland	Lt Cdr Marcin Banaszak
	Russia	Capt S. Travin
	Russia	Capt Sergey Progudin
	Russia	Ph.D. Andrey Sharkov
	Russia	Dr Sergey V. Reshetniak
	Sweden	Mr Lars Jakobsson
	Sweden	Mr Henrik Tengbert

Representative of BOOS: Sweden Mr Thomas Hammarklint

Observers:		
	Finland	Mrs Mirjam Bilker-Koivula
	Finland	Dr Kimmo Kahma
	Sweden	Dr Martin Lidberg
	Sweden	Dr Jonas Ågren
	Norway	Mr Tor Tørresen
	Germany	Dr Gunter Liebsch

2. CDWG 8th meeting 23 – 24 February 2016, Helsinki, Finland

One of the most important items in the meeting was to review and approve the first draft of the specification for the Baltic Sea Chart Datum 2000 (Annex 1). The specification consists of four sections which are 1) definition, 2) realization, 3) comments and remarks and 4) references. It was noted that specification is an essential document for applying and realizing the Baltic Sea Chart Datum 2000 and it can be applied in all BSHC member states. It should be taken into account that in some countries vertical datum differs from the specification, but the differences can be determined. It was deemed to be important that the specification should be used in national Hydrographic Offices as a guideline for using their national GNSS reference station networks as the realization of the Baltic Sea Chart Datum 2000. In addition, it was noted that if using other GNSS reference station services, e.g. commercial services, national HOs should check their conformity with the specification.

Other main themes were to review national plans and status of transition to common vertical reference, plan the cooperation with BOOS in future, to review and update the TORs and the Work Programme for the years 2016-17 and plan the future work of CDWG.

The national implementation plans were reviewed by participants. Based on the presentations and questionnaire made before the meeting, it can be concluded that most member states has made actions to implement the common vertical datum. There are differences concerning readiness of implementation plans and schedules. In some member states the actual transition starts after the national height network levelling and calculations has been finalized. Sweden has already published some charts in Baltic Sea Chart Datum 2000 (RH2000). E.g. in Germany EVRS realization is already used in practise. In the Russian Federation decisions follows after the implementation of the new State Coordinate system.

The status of FAMOS-project (Finalising Surveys for the Baltic Motorways of the Sea) and especially activity 2, geoid model, was reviewed. The goal for FAMOS activity 2 is to improve the geoid model for the whole Baltic Sea. During 2015 several ship borne gravity campaigns were conducted to produce data for improving existing geoid model.

3. Future Work of the CDWG

CDWG will continue to guide and follow up the progress of the implementation of the harmonised vertical reference.

Further develop the first version of the specification for “Baltic Sea Chart Datum 2000”, which was approved in CDWG8 meeting.

Continue cooperation with FAMOS concerning improving geoid model for the whole Baltic Sea, promoting studies and further development of dynamic topography of sea surface and promote improving precise real-time GNSS navigation.

Continue cooperation with BOOS concerning water level information. Cooperation is important for the implementation and usage of the harmonised vertical reference.

Continue communication with relevant organisations and inform users by giving presentations and participating in relevant conferences.

To activate all the member states to send representatives to CDWG meetings.

The CDWG plans to have its next meeting on 4 - 5 April 2017 in Rostock, Germany.

4. The results of the CDWG during 2015-2016

The most important result was finalizing the first version of the specification for the Baltic Sea Chart Datum 2000. (Annex 1).

CDWG has promoted studies and development of a common geoid model for the Baltic Sea by supporting FAMOS-project. Within FAMOS-project several gravity-surveying campaigns were executed in the Baltic Sea during 2015.

Presentations were given by CDWG members as planned in the communication plan in following conferences:

- BOOS annual meeting (2015)
- EUREF Technical Working Group meeting (2015)
- EUREF Symposium (2015)
- FAMOS Freja mid-term meeting, 2-3 February 2016, Malmö

5. Actions for the BSHC 21st Conference

The BSHC 21st Conference is requested to

1. note this Report
2. note the first version of the specification for the Baltic Sea Chart Datum 2000 *(Annex 1)*
3. endorse CDWG TORs 24Feb2016 (*Annex 2*)
4. endorse CDWG Work Programme 2016-2016 24Feb2016 (*Annex 3*)
5. support CDWG clarification for displaying the name "*Baltic Sea Chart Datum 2000*" in paper charts (answer to BSHC20, action 7: CDWG to clarify the use of the common name of Baltic harmonized Chart Datum, "Baltic Sea Chart Datum 2000"). *(Annex 4)*
6. to note the answers of questionnaire on national naming of chart datum on chart (answer to BSHC20, action 6: To study and clarify use of national naming of chart datum on chart) *(Annex 5)*
7. give further guidance to CDWG, as seen appropriate

Annexes:

1. Specification of Baltic Sea Chart Datum 2000, Draft ver. 2c.
2. CDWG TORs, 12 Feb 2015.
3. CDWG Work Programme 2015-2016, 12 Feb 2015
4. CDWG answer to BSHC20 action 7: clarification for displaying the name “Baltic Sea Chart Datum 2000”
5. CDWG answer to BSHC20 action 6: national naming of the chart datum

Annex 1 (1/12)

Definition and Realization of Baltic Sea Chart Datum 2000

DRAFT by Jonas Ågren, Gunter Liebsch and Jyrki Mononen

Version 2c, 2016-02-11

1. *Definition*

The Baltic Sea Chart Datum 2000 (BSCD2000) is a geodetic reference system adopted for the Baltic Sea nautical charts and publications. It is based on the definitions for the European Vertical Reference System (EVRS) as well as the European Terrestrial Reference System 89 (ETRS89a, b, c). The reference epoch for height changes due to the postglacial land uplift in Fennoscandia is 2000.0. According to this definition:

a) The height reference surface of BSCD2000 over the sea area is an equipotential surface of the Earth's gravity field. The zero level of BSCD2000 is in accordance with the Normaal Amsterdams Peil (NAP).
b) The vertical coordinate is specified by normal heights. The normal potential is defined by the Geodetic Reference system 1980 (GRS80).
c) Corrections of the permanent solid earth tides are made so that the normal heights are in the zero tide system.
d) Temporal height changes due to the postglacial land uplift will be reduced to the epoch 2000.0.
e) The unit of the normal heights is meter.

2. *Realization*

The realization of the Baltic Sea Chart Datum is based on the following principles:

a) The realization of BSCD2000 shall make use of the existing national geodetic infrastructure, i.e. the official national vertical and spatial reference frames and corresponding services.
b) It is the goal that the geodetic infrastructure for the realization of BSCD2000 shall provide a standard uncertainty better than 5 cm over the whole Baltic Sea including the costal zones.
c) BSCD2000 will be realized by the official national vertical and spatial national reference frames if
   - the official national reference systems are in accordance with the definition given in Section 1 respectively
   - the official national reference frames are in agreement with the official realizations of the European vertical and spatial reference systems EVRS and ETRS89 within the level of a few centimeters

Annex 1 (2/12)

d) Offshore, BSCD2000 shall be realized based on the national GNSS positioning services (e.g. SWEPOS, FINNREF, SAPOS,…), the corresponding official national spatial reference frames (SWEREF 99, EUREF-FIN, XXXX, …) and a consistent model of the BSCD2000 height reference surface. The BSCD2000 height reference surface is primarily realized by a gravimetric quasigeoid model. It shall take into account the necessary corrections due to the existing differences in the definition and realization of the reference frames, especially
   - differences of the permanent solid earth tide conventions for physical and ellipsoidal heights,
   - differences caused by the datum transformation between the international and European spatial reference frames (Fig. 6) and
   - remaining discrepancies between the national vertical and spatial reference frames according to Section 2, item c.

   On land, BSCD2000 is (nowadays) realized by the official national height reference frames, typically based on levelling. The BSCD2000 height reference surface shall then continue in over land and be aligned with the official national height reference frames with an accuracy better than about 1 cm. It is recommended to agree on the same model of the height reference surface for the whole Baltic Sea as soon as a corresponding model is available.

e) Land uplift corrections shall be applied in areas with significant land uplift. The corrections have to be computed with a common up-to date land uplift model in the way specified by the national surveying authorities.

3. *Comments and Remarks:*

Section 1, item a

The BSCD2000 height reference surface is not identical with the mean sea level of the Baltic Sea. Due to the definition, the zero level of BSCD2000 deviates from the current mean sea level of the Baltic Sea by about 0 to 25 cm (Figs. 2 and 4). The differences are caused by long-term temporal sea level changes as well as the mean dynamic topography.

Section 1, item b

At sea, normal heights are practically equivalent to orthometric heights.

Section 1, item c

This convention is in accordance with the EVRS definition. It differs from the recent IAG resolution for the definition and realization of an International Height Reference System (resolution No. 1 adopted at the IUGG General Assembly in Praha in 2015) which recommends the mean tidal system.

Normal heights in the zero and mean tide system differ maximally about 5 cm over the Baltic Sea (Fig. 1). The zero tide convention causes an additional artificial slope of the sea surface heights with respect to BSCD2000 (Figs. 2 and 3).

Annex 1 (3/12)

Section 1, item d

There are many different geodynamical effects that cause vertical deformation. Currently only models of the postglacial uplift are available with the necessary accuracy. Therefore, other reasons for height change are not taken into account in this definition.

Section 2, item c

The official realizations of the European reference systems will be adopted by the EUREF Technical Working Group. The current official realizations are EVRF2007 and ETRF2000.

The official national height systems (height reference frames) in Sweden (RH 2000), Norway (NN2000), Finland (N2000) and Latvia (LAS-2000,5) fulfill the definition of BSCD2000 according to Section 1. Heights have been reduced to the common epoch 2000.0 subject to the postglacial land uplift, using the land uplift model NKG2005LU. The specification of the land uplift epoch 2000.0 rules out older height reference frames with a deviating land uplift epoch in the middle and the northern parts of the Baltic Sea, e.g. the reference frames RH 70 (Sweden, epoch 1970.0), N60 (Finland, epoch 1960.0) and EVRF2000 (Europe, epoch 1960.0 in Sweden, Finland and Norway). These epochs imply differences of up to around 30-40 cm along the Bay of Bothnia coast compared to a BSCD2000 realization.

The official national height reference frames from Denmark (DVR 90) and Germany (DHHN92 and DHHN2016, the latter valid from 2017), which do not strictly fulfill the definition of Section 1 are valid realizations of BSCD2000 since their differences to EVRF2007 are within the specified limits (CRS-EU). The differences of these height reference frames with respect to EVRF2007 are below the 2 cm level and do not exceed the usual differences between different height reference frames which follow strictly the same definition (Fig. 5).

Section 2, item d

A model of the height reference surface shall be computed within the EU FAMOS project until 2020.

4. *References*

CRS-EU: http://www.crs-geo.eu, last access February 8, 2016

ETRS89a: http://etrs89.ensg.ign.fr/, last access February 8, 2016

ETRS89b: Boucher, C. and Altamimi, Z., The EUREF Terrestrial Reference System and its first realizations, EUREF Meeting, Bern, Switzerland March 4-6, 1992

ETRS89c: European Commission, Joint Research Centre, Space Applications Institute Proceedings & Recommendations of Spatial Reference Workshop, November 1999, http://www.crs-geo.eu/crseu/EN/References/Elemente/pub03ProceedingsWS1999, templateId=raw,property=publicationFile.pdf/pub03ProceedingsWS1999.pdf, last access February 8, 2016

Annex 1 (4/12)

EVRS:
http://www.bkg.bund.de/nn_164794/geodIS/EVRS/EN/DefEVRS/evrs__node.html__nnn=true, last access February 8, 2016

GRS80: H. Moritz: Geodetic reference system 1980.
Bulletin Géodésique (1984) 58(3):388-398; Bulletin Géodésique (1988) 62(3):348-358; Journal of Geodesy (2000) 74(1):128-133

Annex 1 (5/12)

5. *Figures*

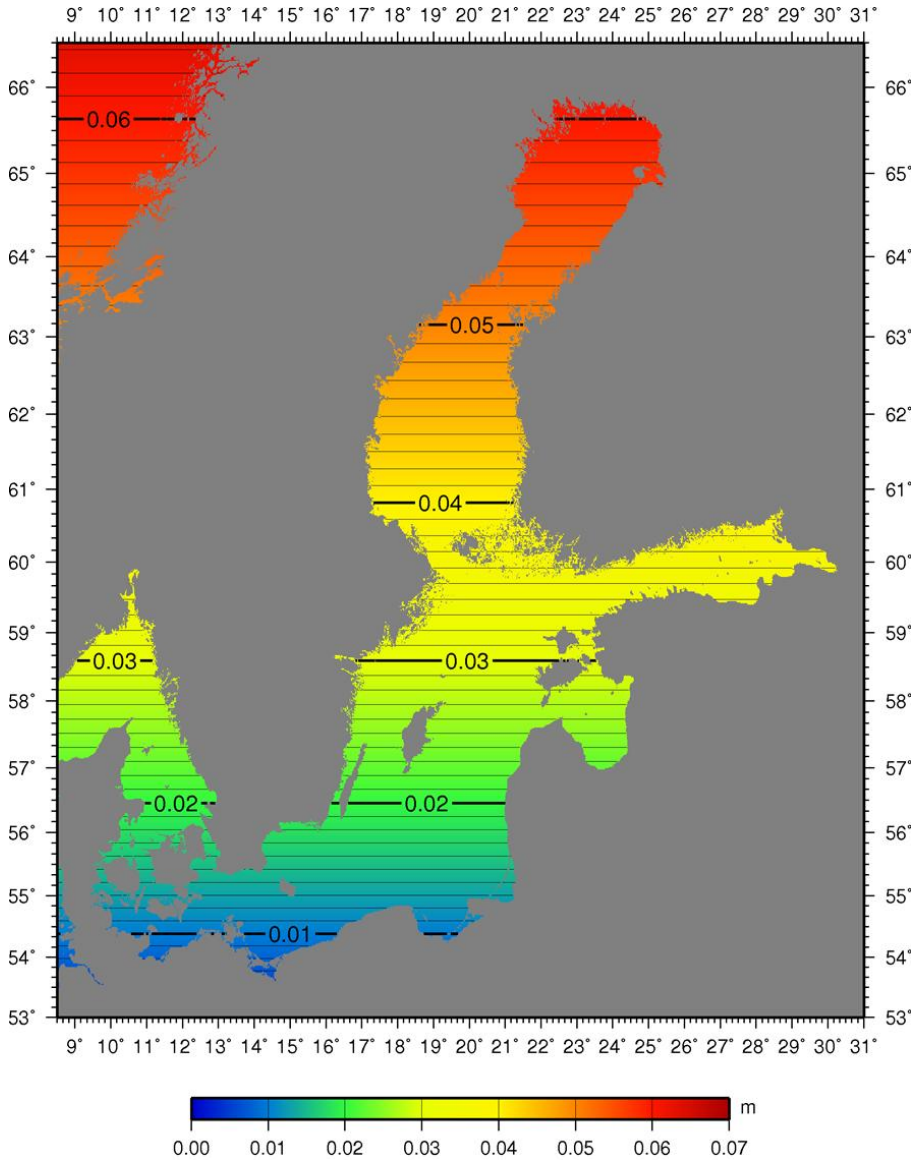


Fig. 1: Differences of the normal heights due to different solid Earth tide conventions (differences of mean and zero tide system)

Annex 1 (6/12)

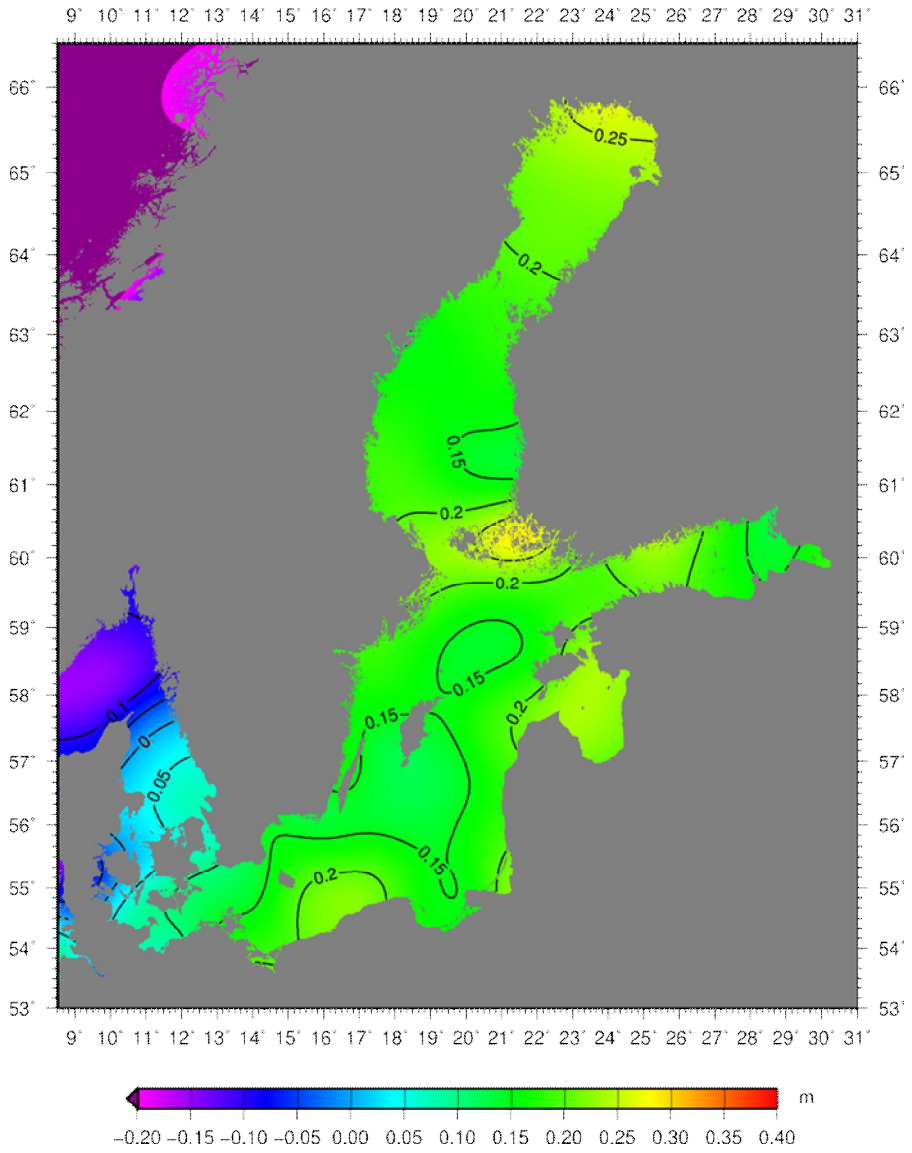


Fig. 2: Estimation of the mean dynamic topography in the zero tide system.

The figure shows a low-pass filtered version of the difference between the mean sea surface model DTU15_MSS and the quasigeoid model EGG08, both related to the GRS80 reference ellipsoid and the zero tide system according to the EVRS definition (filter length 50 km). The mean sea surface model as well as the quasigeoid model still show some errors (e.g. DTU15_MSS in the area of the Åland Islands, EGG08 in the southern Baltic Sea).

Annex 1 (7/12)

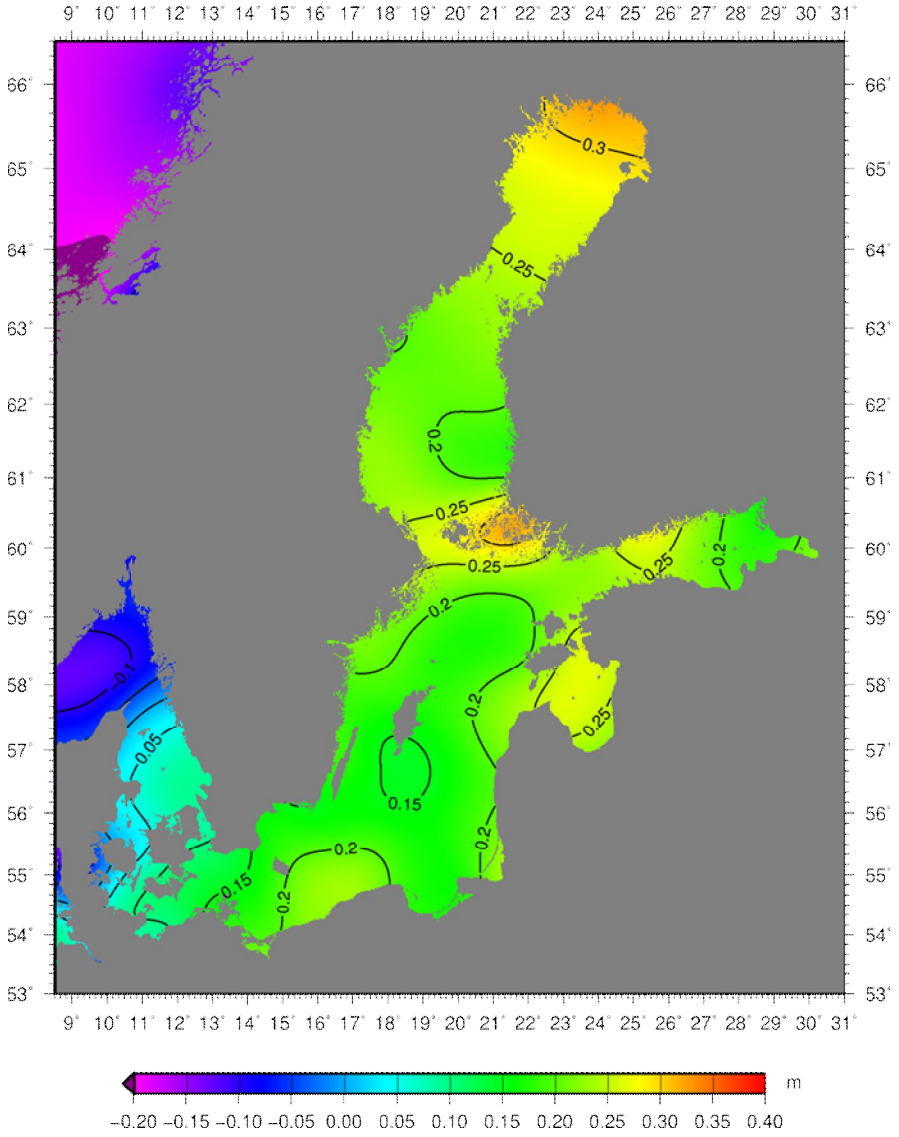


Fig. 3: Estimation of the mean dynamic topography in the mean tide system.
Same as figure 2 transformed to the mean tide system.

Annex 1 (8/12)

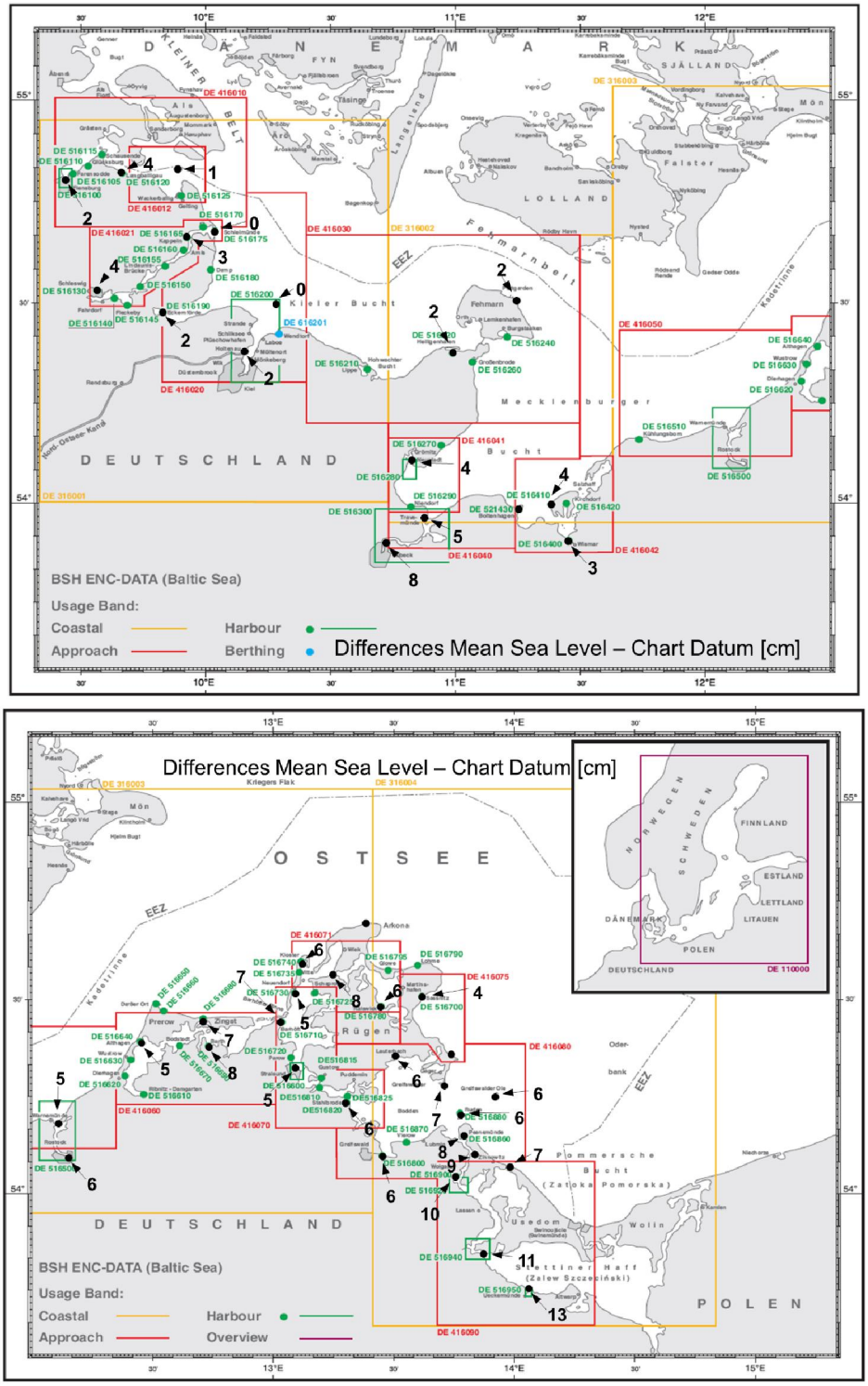
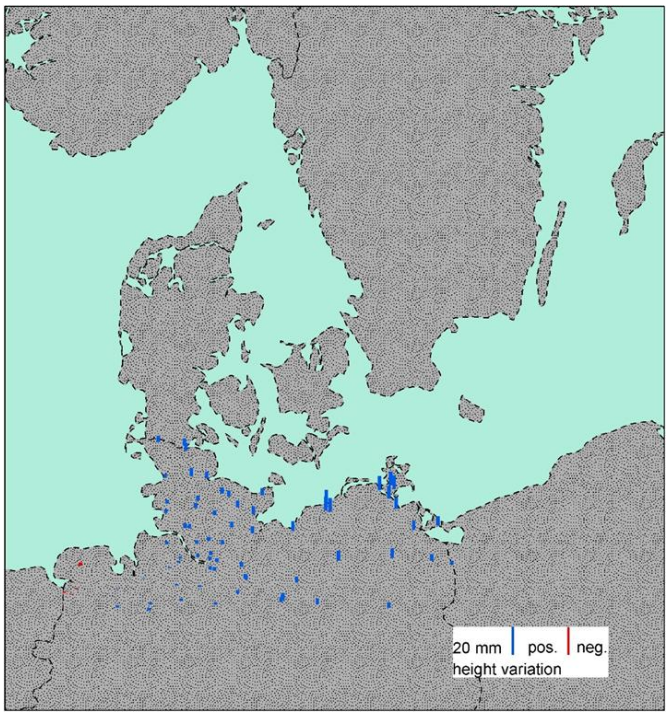


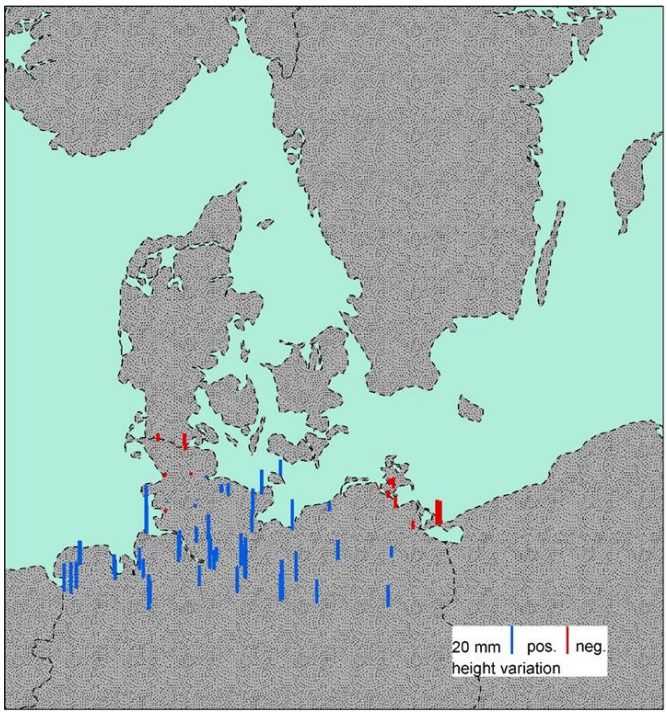
Fig. 4: Mean sea level with respect to the chart datum

Annex 1 (9/12)

Figs. 5: Differences between height reference frames

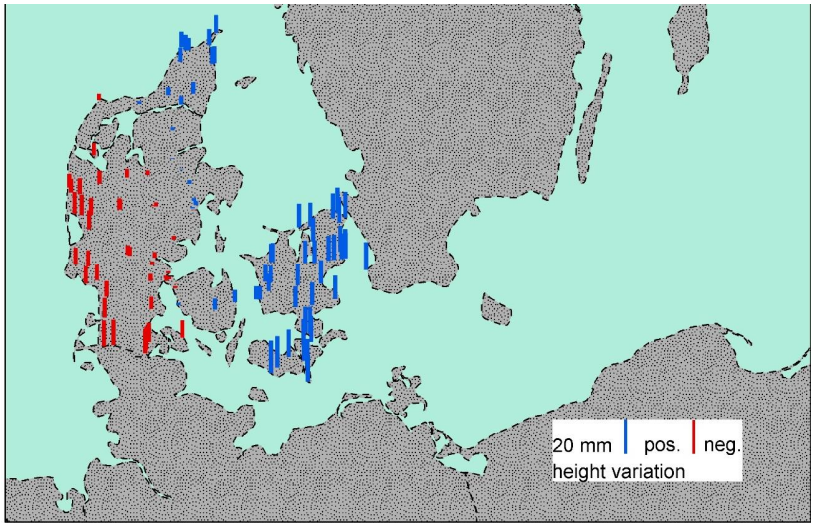


a) Height differences between national height reference frame of Germany (DHHN92, northern part) and EVRF2007 (mean difference 3.8 mm; min. difference -1.4 mm; max. difference 10.7 mm)

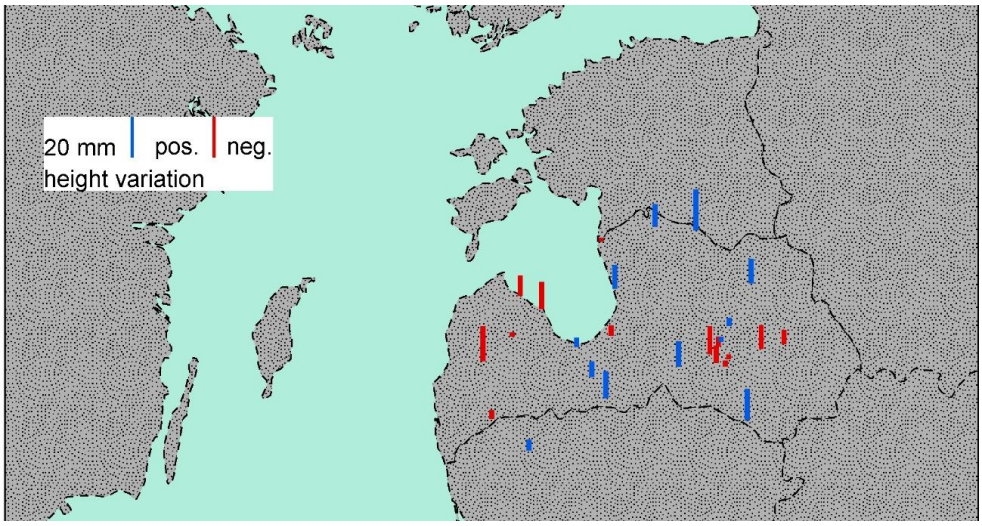


b) Height differences between national height reference frame of Germany (DHHN2016, northern part) and EVRF2007 (mean difference 10.3 mm; min. difference -18.0 mm; max. difference 34.2 mm

Annex 1 (10/12)

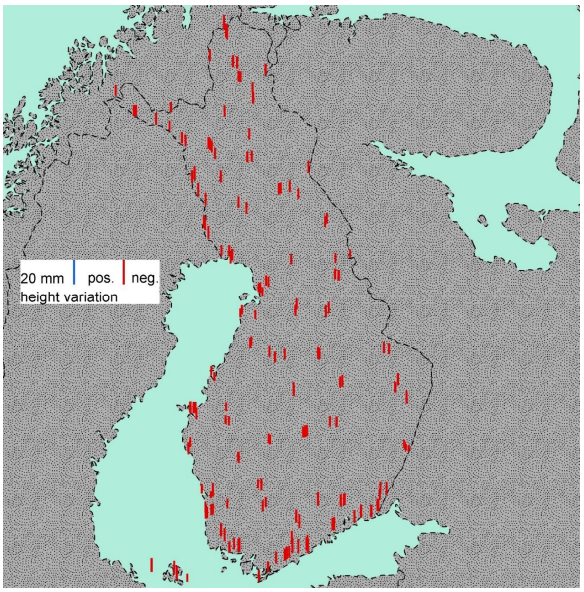


c) Height differences between national height reference frame of Denmark (DVR90) and EVRF2007 (mean difference 3.5 mm; min. difference -15.6 mm; max. difference 19.3 mm)

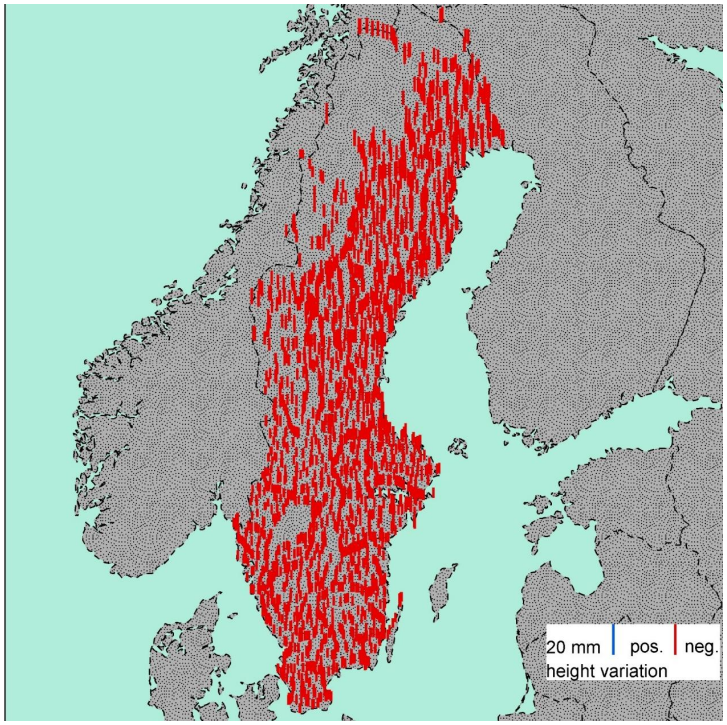


d) Height differences between national height reference frame of Latvia (LAS-2000,5) and EVRF2007 (mean difference 0.6 mm; min. difference -17.1 mm; max. difference 20.0 mm)

Annex 1 (11/12)



e) Height differences between national height reference frame of Finland (N2000) and EVRF2007 (mean difference -9.1 mm; min. difference -12.1 mm; max. difference -5.3 mm)



f) Height differences between national height reference frame of Sweden (RH2000) and EVRF2007 (mean difference -7.3 mm; min. difference -13.8 mm; max. difference -2.6 mm)

Annex 1 (12/12)

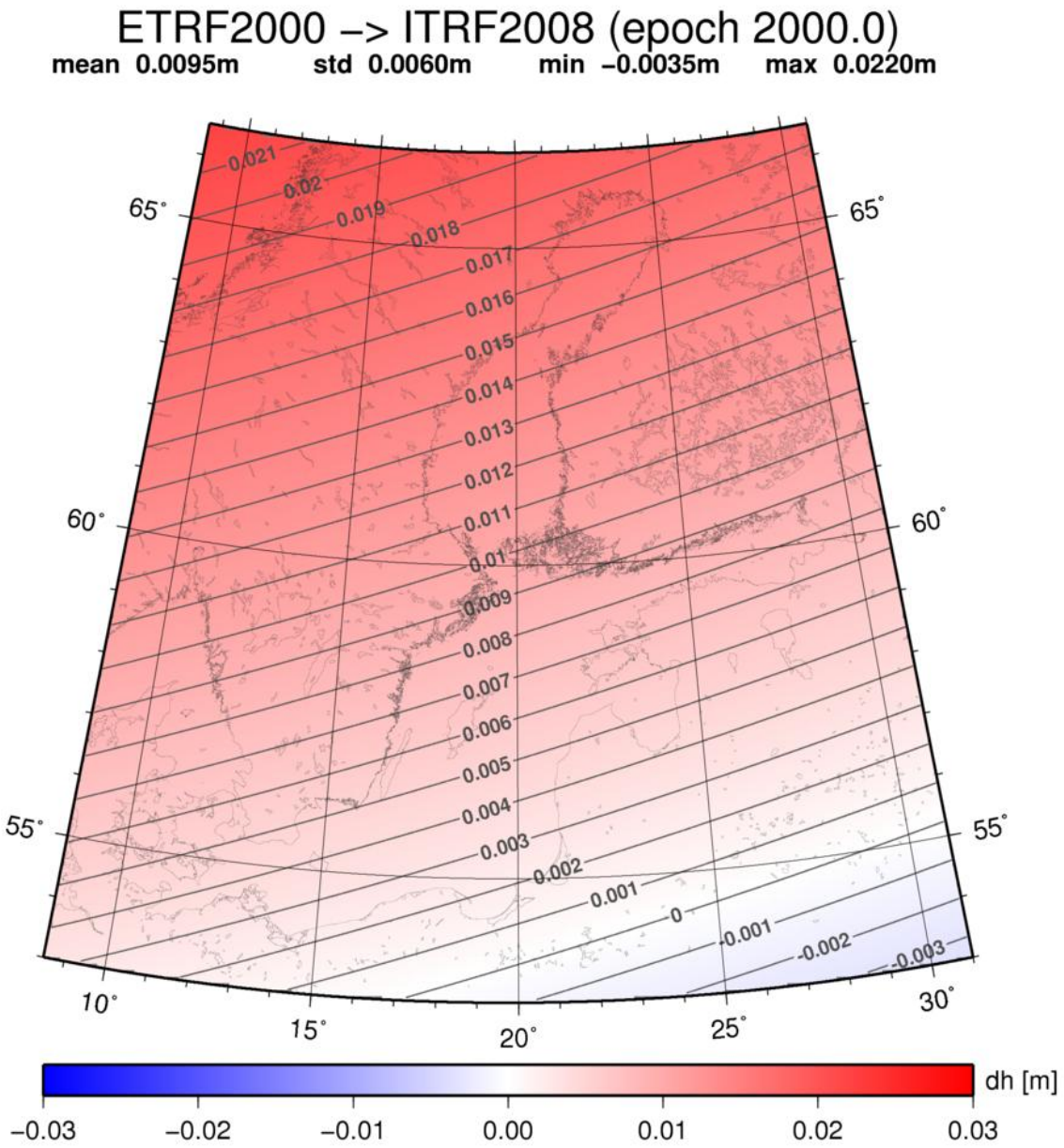


Fig. 6: Differences of the ellipsoidal height between ETRF2000 and ITRF2008 (epoch 2000.0)

Annex 2

BSHC Chart Datum Working Group
Terms of Reference

Proposed to be approved by BSHC21st conference, September 2016
[24 February 2016]

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

The Working Group should

1. To continue implementation of the EVRS.

2. To prepare the road map for transition, including e.g:

   - to establish a network of relevant bodies involved into the transition and efficiently communicate and give guidance within this network

   - to invite relevant bodies to inform the users

   - to review of progress of national plans and actions

   - to propose harmonization actions.

3. To cooperate with relevant bodies on water level related issues e.g:

   - to promote studies on the validation, status and distribution of water level information, and to promote studies on interpolation and prediction of water levels

   - to promote studies on displaying schemes for joint Baltic Sea water level information

   - to promote studies on recommendations to IHO how the sea level and its variations should be shown on nautical paper and ENC charts and publications, and conveying water level information to mariners [ref. IHO Technical Resolutions].

4. To further development of a common harmonized height reference, including further development of a common geoid model for the whole Baltic Sea area and supporting geoid and oceanographic studies relevant to these purposes.

5. To cooperate with BOOS and other relevant international bodies.

6. To liaise with relevant IHO bodies.

The Working Group should report to the BSHC Conferences.

Annex 3

Proposed BSHC Chart Datum Working Group Work Programme for 2016 – 2017

[Proposed to be approved by the BSHC 21st Conference, September 2016]

[24 February 2016]

Note: This Work Programme includes those Tasks which were identified as the priority issues and which are expected to be fostered during 2016 - 2017 bearing in mind the resources the BSHC members have.

Tasks:

1. Guide the implementation process of vertical reference within the Baltic Sea region.
   a. To monitor and follow up the status of the relevant actions identified.
   b. To ensure efficient communication with relevant bodies.
   c. To propagate and explain the idea of harmonized chart datum.
2. Review of progress of national plans and actions.
3. Propose harmonization actions.
4. Promote studies and further development of a common geoid model and dynamic topography for the whole Baltic Sea, mainly by supporting and collaborating with FAMOS project, e.g. organizing ship time for gravity measurements.
5. Promote the work of FAMOS to improve precise real-time GNSS navigation for the future.
6. Cooperate with BOOS and other relevant institutes and organizations.
7. Support other IHO working groups and European projects in issues concerning vertical references.

Annex 4

BSHC Chart Datum Working Group

BSHC20th Conference Action number 7 (note: based on the draft list of actions of the BSHC20 sent by the chair of the BSHC):

"*CDWG to clarify the use of the common name of Baltic harmonized Chart Datum ("Baltic Sea Chart Datum 2000")*."

Note: This action has been informed in the draft list of actions by the chair of BSHC. Although the final list of actions from BSHC20 was not available for CDWG meeting, this matter was handled in the CDWG8 meeting.

CDWG Answer

It was agreed in the CDWG8 meeting that "Baltic Sea Chart Datum 2000" should be displayed in paper charts in one of two following ways:

Mean Sea Level (Baltic Sea Chart Datum 2000$^{NATIONAL\ REALIZATION\ NAME}$*)*

or

Mean Sea Level (Baltic Sea Chart Datum 2000)

Thus *national realization name* is not mandatory to display.

Annex 5 (1/6)

CDWG answer to BSHC20, action 6:
To study and clarify use of national naming of chart datum on chart

CDWG made a questionnaire "To study and clarify the use of national naming of chart datum on chart in parallel to BSCD2000".
In the questionnaire following three questions were asked:

1. *What vertical datum/datums are used today in nautical charts in your country?*
2. *How the datum/datums are displayed in paper charts and ENCs?*
3. *How the new chart datum, Baltic Sea Chart Datum 2000, is planned to show nationally on charts.*

Because there is only three answers, all of them are attached here to be noted by BSHC21st Conference as a reply to BSHC20 action 6.

Answers were received by following BSHC member states:

- Finland
- Germany
- Sweden

Annex 5 (2/6)

FINLAND (page 1/1)

1. What vertical datum/datums are used today in nautical charts in your country?

- Sea areas: Theoretical mean sea level (MSL).
  - The Finnish Meteorological Institute confirms the height of the theoretical mean sea level annually, using the most recent knowledge on the past and future changes of the factors affecting the sea level.
  - The theoretical mean sea level (or theoretical mean water, MSL) is an estimate for the long-term mean value (more precisely, expectation value) of sea level, made for practical purposes.
  - Theoretical mean sea level changes yearly and neither the change or the rate of change is constant.
- Lakes: NWnav (low water), 0-level referred to Finnish national height system NN or N2000. Different lakes have different 0-level.

2. How the datum/datums are displayed in paper charts and ENCs?

- Sea areas:
  - paper charts: Text *"Soundings and heights in meters and reduced to Mean Sea Level. The range of tide is not appreciable. The water level varies depending on the winds."*
  - ENC: VDAT (vertical datum), value = 3 (mean sea level)
  - ENC: SDAT (sounding datum), value = 3 (mean sea level)

3. How the new chart datum, Baltic Sea Chart Datum 2000, is planned to show nationally on charts.

Finland will follow decisions of BSHC. Based on the present information of guidelines the new chart datum name will be showed on charts in following ways:

- On paper charts: Mean Sea Level (Baltic Sea Chart Datum 2000^{N2000})

Syvyys- ja korkeustiedot metreinä keskivedestä (Baltic Sea Chart Datum 2000 N2000). Vuoroveden vaikutus ei ole merkittävä, mutta vedenkorkeus vaihtelee tuuliolosuhteista johtuen.	Djup och höjder i meter vid medelvattenstånd (Baltic Sea Chart Datum 2000 N2000). Tidvattnets verkan är inte märkbar, men vattennivån varierar enligt vindförhållandena.	Soundings and heights in meters and reduced to Mean Sea Level (Baltic Sea Chart Datum 2000 N2000). The range of tide is not appreciable. The water level varies depending on the winds.

- In ENCs (S-57): VDAT = 3

Annex 5 (3/6)

GERMANY (page 1/1)

1. What vertical datum/datums are used today in nautical charts in your country?

   Refer to Baltic Sea only:

   Formally it is Mean Sea Level, in reality it is DHHN92 (German Main Height Network 1992), which is very close to EVRS within a few Centimeters.

2. How the datum/datums are displayed in paper charts and ENCs?

   "Mean Sea Level" in all German Baltic Charts
   resp. VERDAT ID 3 : Mean sea level in all German Baltic ENC

3. How the new chart datum, Baltic Sea Chart Datum 2000, is planned to show nationally on charts.

   Actually there are no decisions taken, Germany certainly will follow the decisions of CDWG.

Annex 5 (4/6)

SWEDEN (page 1/3)

1. What vertical datum/datums are used today in nautical charts in your country?

Many charts covering open sea areas refer to local MSL2000 (charts produced 1994 or later). Older charts refer to MSL19XX, where XX is the year the specific chart was produced. MSL is defined by long term measurements at local water level stations.

The first complete chart covering in an open sea area and referring to RH2000 (the Swedish realisation of EVRS) was published in June 2014 (5342 INT 1242 1:25 000 Gävle approach). All charts will be updated and refer to RH2000 by the latest 2020. In September 2016 additionally 8 paper chart, covering the northern Bay of Bothnia, will have been published referring to RH2000 (Baltic Sea Chart Datum 2000). Also equivalent ENCs are then published referring to RH2000.

All new charts in inland waters produced 2008 or later are directly referred to RH2000. Specified levels are defined for each inland water. The original reference equivalent reference in old inland water charts is recalculated and defined in RH2000.

RH2000 is the Swedish realisation of EVRS reduced for land uplift to epoch 2000.0 and is used in combination with:

- Geoid model: SWEN08_RH2000 (at present). Including land uplift adjustments for the difference between epoch 1999.5 for SWEREF99 and epoch 2000.0 for RH2000.
- Land uplift model: NKG2005LU (at present).

2. How the datum/datums are displayed in paper charts and ENCs?

The way the Swedish HO display chart datum, or will display chart datum after next edition, is presented in red colour. Comments and explanations are presented in green colour.

2.1 Charts and ENC in open sea

Main text in paper charts referring to RH2000:
CHART DATUM: Mean Sea Level (Baltic Sea Chart Datum 2000 ^{RH2000})
REFERENSNIVÅ: Medelvattenyta (Baltic Sea Chart Datum 2000 ^{RH2000})

If space is insufficient:
CHART DATUM/REFERENSNIVÅ:
Mean Sea Level (Baltic Sea Chart Datum 2000 ^{RH2000})

ENC cells referring to RH2000 (in S-57):
VERDAT value 19 until now. Will as soon as possible be changed to VERDAT value 3.

Main text in paper charts referring to MSLXXXX with chart datum that differs less than 0,3 meters from current MSL:
CHART DATUM: Mean Sea Level (MSL) XXXX
REFERENSNIVÅ: Medelvattenytan (MVY) XXXX

Annex 5 (5/6)

SWEDEN (page 2/3)

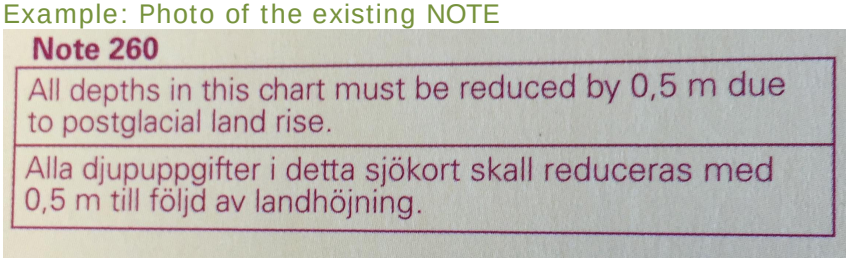
A few paper charts referring to MSLXXXX with chart datum that differ more than 0,3 meters from current MSL:
CHART DATUM: Mean Sea Level (MSL) XXXX
REFERENSNIVÅ FÖR DJUP: Medelvattenytan (MVY) XXXX
LAND RISE / LANDHÖJNING 1,0 cm annually / per år See Note YYY

Note YYY

All depths in this chart must be reduced by 0,n m due to postglacial land rise.
Alla djupuppgifter i detta sjökort skall reduceras med 0,n m till följd av landhöjning.

n is decimetres to reduce the depths in the specific chart.

Example: Photo of the existing NOTE



ENC cells referring to MSLXXXX (in S-57):
M_VDAT Vertical datum: Mean sea level.
Information NOTE: All depths must be reduced by n dm due to land uplift

2.2 Charts and ENC in inland waters

Main text in all paper charts in inland waters is updated or will be updated shortly to:
CHART DATUM/REFERENSNIVÅ:
+ZZ,zz Baltic Sea Chart Datum 2000 ^{RH2000}) (Note YYY)
(ZZ,zz is the specified level in meters defined in RH2000 for each inland water).

NOTE:
Note YYY

CHART DATUM IN LAKE EXAMPLE Charted depths are referred to the mean water level of lake Example, which corresponds to the level +ZZ,zz m Baltic Sea Chart Datum 2000^{RH2000}
REFERENSNIVÅ FÖR DJUPANGIVELSER I EXAMPLE Sjökortets djupuppgifter refererar till Exampels medelvattenyta, vilket motsvarar nivån +ZZ,zz m Baltic Sea Chart Datum 2000^{RH2000}.

Annex 5 (6/6)

SWEDEN (page 3/3)

Example Mälaren:
The note also includes information about water level reference.

Note 245

CHART DATUM IN LAKE MÄLAREN Charted depths and information on actual water level are referred to the mean water level of lake Mälaren, which corresponds to +0,78 m Baltic Sea Chart Datum 2000[RH2000]
REFERENSNIVÅ FÖR DJUP- OCH VATTENSTÅNDSUPPGIFTER I MÄLAREN Sjökortets djupuppgifter och uppgift om aktuellt vattenstånd refererar till Mälarens medelvattenyta, vilket motsvarar nivån +0,78 m Baltic Sea Chart Datum 2000[RH2000].

ENC cells covering inland waters (in S-57):
M_VDAT Vertical datum: Mean sea level.
Information: MSL= +ZZ,zzm RH2000 until now. Will soon as possible be changed to MSL= +ZZ,zzm Baltic Sea Chart Datum 2000.

2.3 QR code in paper charts

QR code are or will be displayed after next New edition. Users are or will be linked by the QR code to a webpage enabling excess to more information in both Swedish and English.

Example:

Comment: In some charts the title to the QR code is ”RH2000” instead of ”Referensnivå”. It will be updated.

3. how the new chart datum, Baltic Sea Chart Datum 2000, is planned to show nationally on charts.

Included in answers of question 2.