Agenda Item E2

BSHC 12th Conference

Harmonisation of Vertical Reference on the Baltic Sea

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Background:

The BSHC 11th Conference decided that the current status of vertical reference systems and chart datums around the Baltic Sea will be analysed.

A Working Group was established with Dr. Vaido Kraav (Estonia) as a chairman.

This WG has also to make proposals for harmonisation of the datums.

See TORs in the Annex 1.

TOR for the
BSHC WG for the Harmonization of the Chart Datums of the Baltic Sea

To find out the existing situation of the Mean Sea Level and chart datums used in the Baltic Sea area and make proposals for harmonizing the practices used.

Especially the Working Group should
- to prepare an introductive presentation of existing geodetic height datums which cover several countries around the Baltic Sea
- to prepare a presentation of the future international height datum and estimation when it will be implemented
- to clarify the role of other international bodies on this subject and contacts to them
- to specify the existing differences of chart datums used in the Baltic Sea area by making a questionnaire for members states at least on the following issues:

Proposals for harmonization should include
- proposals of information to be printed on charts and other navigational publications
- proposals to use AIS and VTS systems by harmonized way to broadcast real time sea level data and predictions of sea level state for the following hours
- proposals to harmonize the chart datums in relation to a widely adopted European or world wide height datum

The Working Group should report to the BSHC 12th Conference.

Some remarks on the current situation:

Denmark **uses on Baltic Sea geodetic reference system DVR90. This differs in practice about 2 cm from current European height system. It is based on mean sea level.**

Sweden and **Finland**: **Based on mean sea level and long term observations with mareographs. The local mean sea level and the local land survey height system is affected by the Fennoscandian postglacial land uplift.**

Others: **In principal systems based on mean sea level. The length of observation time series varies. The Baltic Geodetic Height system based on Kronstadt zero is adopted as land survey height system in many countries.**

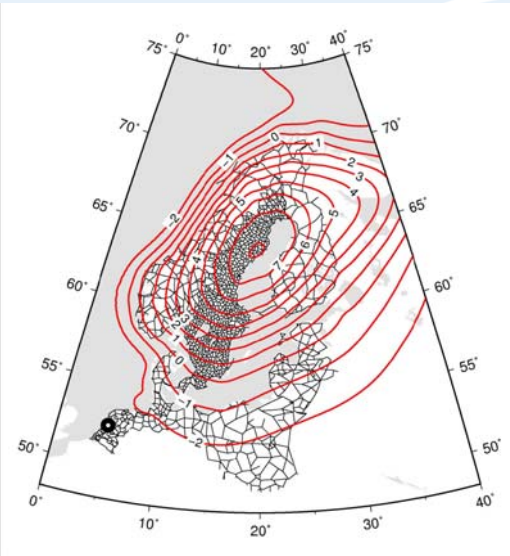
Comparison between the chart reference systems on the Baltic Sea:

The existing network of **Baltic Levelling Ring (BLR)** is very suitable for the comparisons between the national reference systems. This network has been computed and adjusted by the *Finnish Geodetic Institute* in 2006.

In principle the comparison is possible when all the Baltic Sea countries have tied to this levelling network their mareographs and other fixed points which are used to define vertical references of their nautical charts.

The comparison will show the fact that the water surface showing the mean sea level is not similar to the zero height geoid surface computed based on the levelling network. Due e.g. the water flow in the sea there are local variations. In general the water should flow from North to south in the Baltic Sea.

Baltic Sea Levelling network available



Difficulties with reference system based on the mean sea level on the Baltic Sea

More than the last 20 years, the water level (amount of water) has been high on the Baltic Sea. The length of the time series used for computing the mean sea level has an effect of several centimetres to the realization of MSL.

Hydrographic surveys measure the height difference between the mean sea level and the bottom. The mean sea level has its own uncertainty. In addition, in the northern part of the Baltic Sea there is postglacial land uplift which moves the sea bottom. This means that the depths are depending of the time (epoch), especially in Finland and Sweden. The epoch should be included to the meta data of the survey observations, but this kind of method is not very suitable for chart making. It is not possible continuously to update all the depth values of nautical charts. In Finland the depth information on the sea areas has been renewed so that most of the charts are computed in an epoch 1990 or a later one. This kind of general notice is not enough for the most accurate information, eg. fairway information.

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Mean Sea Level is the level defined based on long period mareograph observations.

On Northern Baltic Sea it is difficult to follow the IHO recommendation to use Mean Sea Level because of the land uplift.

There are also other oceanographic phenomena which cause roughly 10 cm differences between mareographs and these can be seen on overlapping charts from different countries.

Finland is planning to move away from the system based on mean sea level, due the fact that the land uplift is the highest on the Finnish coast.

On the northern part of the Swedish coast there is the same phenomenon and **Sweden** is also interested on this solution.

Denmark is already using for hydrography a system, which is tied to land survey height reference.

In **Germany** the height reference for land survey is tied to European zero. European zero is near the MSL in the Southern Baltic Sea. In the Northern Baltic Sea it is now about 15 – 20 cm below the MSL, but about year 2040 it is the same.

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The **Finnish Maritime Administration** has decided that the **nautical charts on the Finnish coast will be based on this EVRF2000 as soon as feasible** in practice. This may be about 2010 or later.

This requires also that the tide gauges and mareographs, which are needed to produce **real time water level information for the mariners**, have to be related to this same vertical reference level.

I may be supposed that the other Baltic countries will take a height system tied to European zero in use, and then the Baltic reference systems can be harmonised within few centimetres differences (which are caused by different epochs or levelling network adjusting methods).

Proposal #1:

To study the feasibility to use the European geodetic height reference system as a principal alternative for a harmonised vertical reference system for Baltic Sea hydrographic databases and nautical charts.

It should also be studied possible time schedules and necessary preconditions with each of the Baltic Sea countries could move to this harmonised datum on their nautical charts.

It is important to note that charts and the water level stations used for providing water level information should be tied to the same reference system.

Proposal #2:

The existing Working Group will continue with amended TORs and with Vaido Kraav as the Chairman.

Note: The success of this Working Group depends on that ALL Baltic Sea countries will be committed on the work and will provide the WG with relevant information.