



Harmonized chart datum in the Baltic Sea and in Finland

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Contents

Presentation consist of

- **Harmonization of vertical datums in the Baltic Sea (IHO Baltic Sea Hydrographic Commission Chart Datum Working Group)**
- **What is the status in Finland concerning harmonized vertical datum.**
- **Improving the geoid model for the Baltic Sea Area**





Harmonizing vertical datums in the Baltic Sea

Background in the Baltic Sea

- Today not any common chart datum in the Baltic Sea
- National chart datums are based principally on the Mean Sea Level (MSL)
- But the MSL realization differs between countries
- It was deemed to be important to have a common chart datum
- IHO, Baltic Sea Hydrographic Commission (BSHC) established the Chart Datum Working Group (CDWG) to guide the harmonizing work





Harmonizing vertical datums in the Baltic Sea

BSHC / CDWG

- New vertical datum based on the European Vertical Reference System (EVRS):
Baltic Sea Chart Datum 2000
- Well defined, European height system
- National realizations of EVRS agrees well between countries
- Many national land survey height systems in BSHC member states are realizations of EVRS
- Differences between EVRS and MSL are known around the Baltic Sea



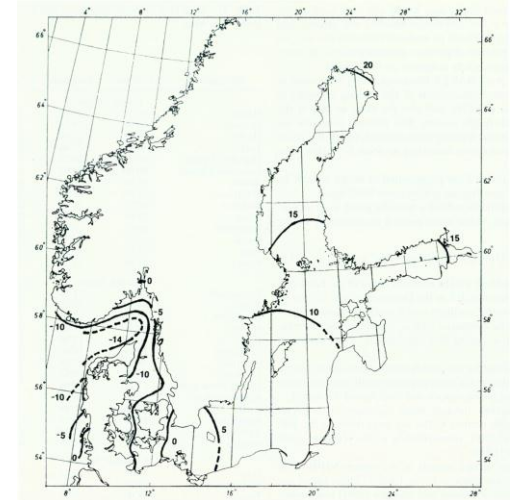
Harmonizing vertical datums in the Baltic Sea

Effects in practise

- From MSL-based to geodetically defined chart datum
- In the northern part of the Baltic Sea depth figures in nautical charts will be reduced
- In the southern part of the Baltic Sea not any paractical effects
- All the depth data is in the same chart datum

Expected benefits

- Easier, safer and more efficient shipping and navigation
- Wider and easier use of a bathymetric data
- Nautical charts and topographical maps in same vertical datum



MDT from tide gauges and levelling in cm. Epoch 1960.0.
Zero is NAP, same for EVRS.
Ekman and Mäkinen, 1996.



Harmonizing vertical datums in the Baltic Sea

Status of the harmonization

- Commitment to take harmonized vertical datum in to use => the goal is 2020
- Different states, different status
 - Transition started
 - Already in use
 - Waiting for national coordinate system implementation
- CDWG has made a first version of specification for the Baltic Sea Chart Datum 2000 (based on the conventions of EVRS, taking into account the needs of navigational use)
- IHO resolution 3/1919 important: *"The adopted level may be a well-defined geodetic datum as used for heights in land survey ..."*



Harmonizing vertical datums in the Baltic Sea

Specification for the Baltic Sea Chart Datum 2000

- Deemed to be important in the CDWG meeting in February 2015
- The first draft was presented in the CDWG meeting, February 2016
- Consists following sections: 1) Definition, 2) Realization, 3) Comments and remarks, 4) References and 5) Figures
- Appendix 1

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:

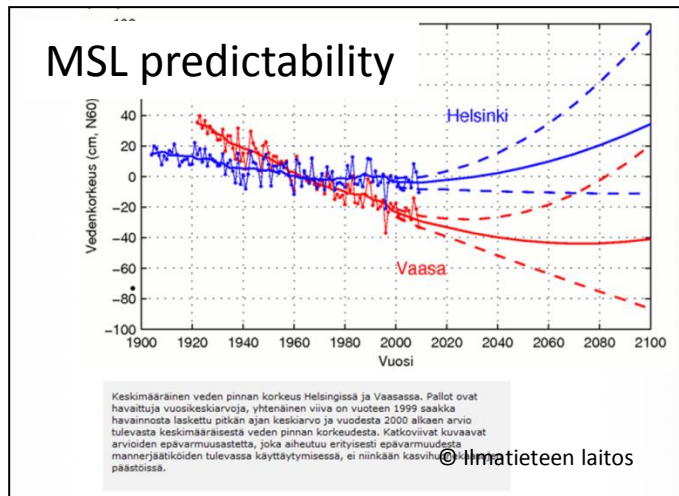
- a) The height reference surface of BSCD2000 over the sea area is an equipotential surface of the Earth's gravity field. The zero level of BSCD2000 is in accordance with the Normaal Amsterdams Peil (NAP).
- b) The vertical coordinate is specified by normal heights. The normal potential is defined by 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.



Finland

Background and why to change vertical datum?

- Today predicted theoretical MSL is used in sea areas
- Every year has different MSL -> different vertical datum
- The prediction of MSL has become difficult
- Postglacial land uplift changes the depths
- Official national height syst in Finland is EVRS based N2000-height system
- Harmonizing the vertical datum in the Baltic Sea





Finland

Visible effects

- Depths in charts reduces (10 – 60 cm)
- Nominal depths of fairways reduces

⇒ updating the bathymetric database

⇒ Renewing Finnish nautical charts

⇒ Big task, taking resources and time

Differences in millimetres between theoretical MSL and N2000-height system in different tide gauges for different years.

	1980	1990	2000	2010	2015
ASEMA					
Kemi	331	258	209	156	125
Oulu	316	245	200	151	122
Raahe	306	228	178	135	114
Pietarsaari	300	218	162	115	94
Vaasa	302	222	169	123	101
Kaskinen	304	230	182	140	121
Mäntyluoto	288	224	184	152	137
Rauma	256	197	167	143	131
Turku	229	285	168	157	153
Föglö	203	157	138	126	121
Hanko	205	174	171	174	176
Helsinki	208	183	186	195	200
Porvoo	205	181	185	195	201
Hamina	197	175	182	196	203



Finland - ongoing

R&D-project for transition to the new vertical datum (N2000-project)

- Recommendations for actions for changing chart datum in Finnish nautical charts
- End report ready on May 2016

⇒ Actual transition starts

R&D-project Intelligent Fairway

One of the goals is to increase efficiency safely in fairways by

- Real time water level models and better short time water level predictions
- Providing on-line weather and other environmental information
- Connection to S-100 products, especially S-101 and S-102



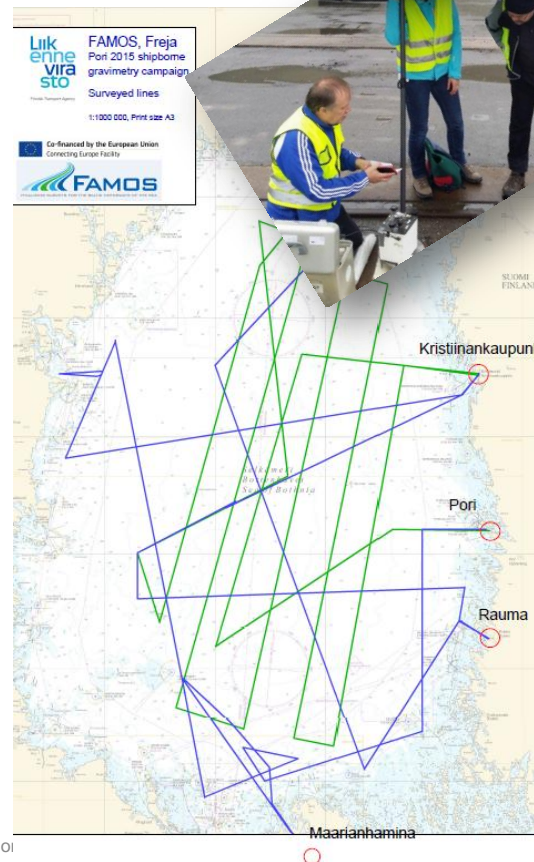
Improving the geoid model in the Baltic Sea

Geoid improvement in the Baltic Sea

- Within EU-funded project FAMOS (Freja 2014-16, Odin 2017-18 and Tor 2019-2020)
- Several gravimetric surveys were conducted in 2015 by FAMOS partners in different countries
- Gravimetric surveys will be continued during FAMOS Odin and Tor
- Geoid calculations based on new and old gravimetric data
- Good international and inter-organizational cooperation => efficiency and results



Co-financed by the European Union
Connecting Europe Facility





Conclusions

Present challenge in the Baltic Sea: No common vertical reference system for hydrographic or navigational tasks

Solution: Common European Vertical Reference System (EVRS) will be adopted as a vertical datum for nautical charts

Goal: Implementation by 2020

Expected benefits of common EVRS-based reference system:

Easier, safer and more efficient shipping and navigation => depths, navigational and water level information related to one datum in the Baltic Sea

Wider use of a bathymetric data

Nautical charts and topographical maps in same system



Thank you!

Questions and comments