

Baltic Sea Chart Datum 2000

Tidal Working Group 24th meeting
27 September 2022
VTC

Thomas Hammarklint



Baltic Sea Hydrographic Commission (BSHC)



BALTIC SEA HYDROGRAPHIC COMMISSION



[Home](#) [About](#) [Services](#) [Relations](#) [Working Groups](#) [Meetings](#) [Contact](#)



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.

International Hydrographic Organization

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

You are here: [Home](#)

Copyright 2013–2019 Baltic Sea Hydrographic Commission



Chart Datum Working Group (CDWG)



Photo: Chart Datum Working Group 13th meeting, 7 September 2021, VTC

<https://www.bshc.pro/working-groups/cdwg>

Members of CDWG:

Denmark Mrs Gitte Hauerberg Iversen
Estonia Mrs Gabriela Kotsulim
Finland Mr Jarmo Mäkinen
Germany Dr Patrick Westfeld
Latvia Mr Bruno Špēls
Lithuania Mr Mindaugas Zakarauskas
Poland Mr Witold Stasiak
Russia Mr Leonid Shalnov
Russia Dr Sergey V. Reshetniak
Sweden Mr Thomas Hammarklint (Chair)
Sweden Mr Lars Jakobsson
Sweden Mr Henrik Tengbert

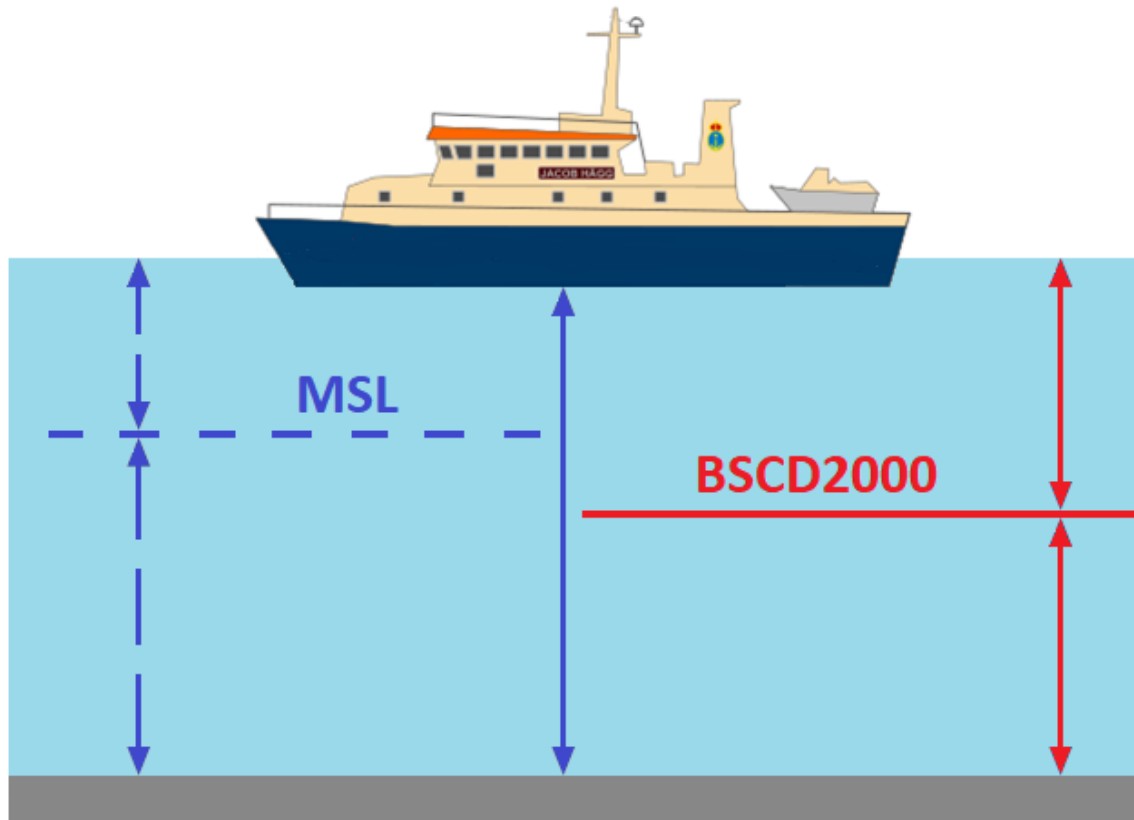
Observers and Experts:

Estonia Prof. Artu Ellmann
Estonia Mr Sander Varbla
Finland Mrs Mirjam Bilker-Koivula
Finland Mrs Anni Montonen
Germany Dr Gunter Liebsch
Germany Dr Joachim Schwabe
Norway Mr Aksel Voldsund
Poland Mr Krzysztof Pyrchla
Poland Mrs Małgorzata Pająk
Poland Dr Monika Wilde-Piórko
Poland Dr Małgorzata Szelachowska
Sweden Dr Jonas Ågren
Sweden Dr Per-Anders Olsson
Sweden Mr Mikael Stenström

Representative of BOOS:

Sweden Mr Thomas Hammarklint

New reference level



The water level remains!

Baltic Sea Chart Datum 2000 (BSCD2000)

➤ 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).

➤ 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 ([specification](#)).

➤ Height systems used as national realization of BSCD2000 (EVRS-based):

Sweden RH2000	Denmark DVR90	Germany DHHN2016
Poland PL-EVRF2007-NH	Lithuania LAS07	Latvia LAS2000,5
Estonia EH2000	Finland N2000	Norway NN2000

➤ Chart datum name to be shown in paper charts:

Mean Sea Level (Baltic Sea Chart Datum 2000^{national realization name})

or

Mean Sea Level (Baltic Sea Chart Datum 2000)

CHART DATUM: Mean Sea Level (Baltic Sea Chart Datum 2000^{RH2000})
REFERENSNIVÅ: Medelvattenyta (Baltic Sea Chart Datum 2000^{RH2000})
SYMBOLS and ABBREVIATIONS: see INT 1
BETECKNINGAR och FÖRKORTNINGAR: se KORT 1



Baltic Sea Chart Datum 2000 in IHO Registry

BSCD2000 is now included in IHO Geospatial Information (GI) Registry, as chart datum number 44:

IHO Geospatial Information Registry

Please sign in | Sign in | Join | KHOA Korea Hydrographic and Oceanographic Agency

Data Dictionary Register

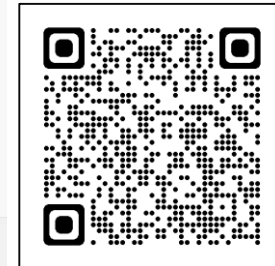
Home / GI REGISTERS / Data Dictionary Register

Feature Type: 366 | Information Type: 26 | Attribute Type: 667 | Complex Type: 92 | Enumeration Value: 2273 | Codelist Value: 117

Domain: ALL | Status: Valid | Type: ALL | Category: Name |

[Listed Value] Dictionary Details					
Domain	IHO Hydro				
Name	Baltic Sea Chart Datum 2000				
CamelCase	balticSeaChartDatum2000				
Item Identifier	1213 ?				
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).				
Data type	Enumerated value				
Associated Attribute	<table border="1"><thead><tr><th>Attribute type</th><th>Name</th></tr></thead><tbody><tr><td>Enumerated type</td><td>Vertical Datum</td></tr></tbody></table>	Attribute type	Name	Enumerated type	Vertical Datum
Attribute type	Name				
Enumerated type	Vertical Datum				
Reference					
Reference Source	Baltic Sea Hydrographic Commission				

COPYRIGHT © IHO Geospatial Information Registry. ALL RIGHTS RESERVED.
KHOA Acknowledgements



International Hydrographic Review Article

An article about the CDWG work and the implementation of the Baltic Sea Chart Datum 2000 has been published in the International Hydrographic Review (IHR) in May 2020, page 63-83: https://iho.int/uploads/user/pubs/ihreview_P1/IHR_May2020.pdf

INTERNATIONAL HYDROGRAPHIC REVIEW MAY 2020

Articles

THE BALTIC SEA CHART DATUM 2000 (BSCD2000)

Implementation of a common reference level in the Baltic Sea
By J. Schwabe¹, J. Ägren², G. Lebesch³, P. Westfeld⁴, T. Hammarik⁵, J. Mononen⁶ and O. B. Andersen⁶

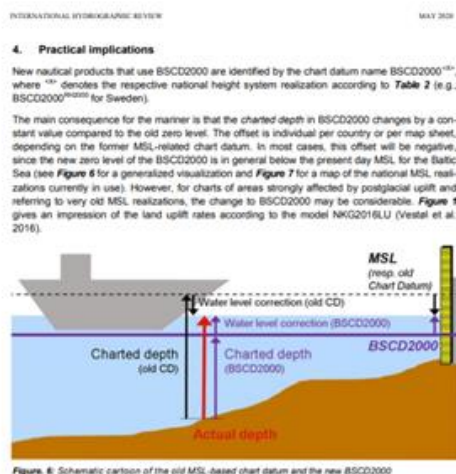
1. Federal Agency for Cartography and Geodesy (Germany)
2. University of Gävle (Sweden) and Lantmäteriet, the Swedish mapping, cadastral and land registration authority (Sweden)
3. Federal Maritime and Hydrographic Agency (Germany)
4. Swedish Maritime Administration (Sweden)
5. Finnish Transport Agency (Finland)
6. DTU Space (Denmark)

Abstract

The Baltic Sea Chart Datum 2000 (BSCD2000) is a geodetic reference system adopted for Baltic Sea hydrographic surveying, hydrographic engineering, nautical charts, navigational publications and water level information. It is based on the common geodetic standards for the height system (EVRS) and the spatial reference system (ETRS89) in Europe. In particular, the zero level of BSCD2000 is in accordance with the Normal Amsterdam Peil (NAP). BSCD2000 is about to be adopted as unified chart datum by all the countries around the Baltic Sea. It agrees with most national height realizations used on land. BSCD2000 will facilitate effective use of GNSS methods like GPS, GLONASS and Galileo for accurate navigation and hydrographic surveying in the future.

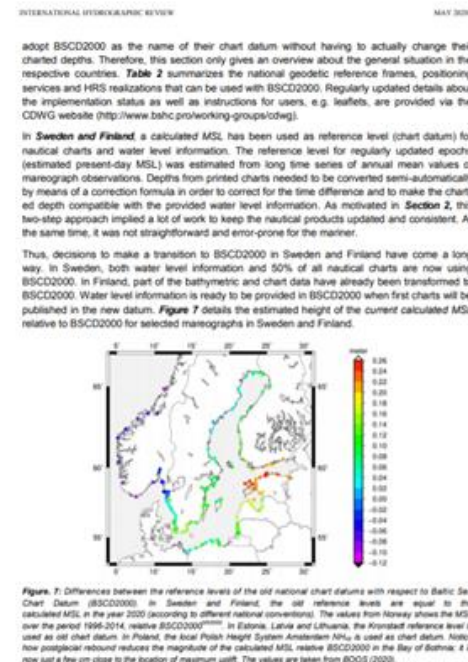
Résumé

Le Baltic Sea Chart Datum 2000 (BSCD2000) est un système de référence géodésique adopté pour les levés hydrographiques, l'ingénierie hydrographique, les cartes marines, les publications nautiques et les informations sur le niveau de l'eau de la mer Baltique. Il est basé sur les normes géodésiques communes au Système de Référence Vertical Européen (EVRS) et au système de Référence Terrestre Européen (ETRS89). En particulier, le zéro hydrographique du BSCD2000 est conforme au Normaal Amsterdam Peil (NAP). Le BSCD2000 est sur le point d'être adopté en tant que niveau de référence des cartes commun par l'ensemble des pays bordant la mer Baltique. Il correspond à la plupart des mesures de hauteur nationales utilisées sur terre. Le BSCD2000 facilitera l'utilisation efficace des méthodes du GNSS comme le GPS, GLONASS et Galileo pour une navigation et des levés hydrographiques précis à l'avenir.



At the same time, real-time water level information (water level observations, corrections to the charted depths, forecasts, etc.) will also be changed accordingly to comply with the new chart datum. This also allows for a better and easier monitoring and prediction of the current and future sea states out at sea, since real-time oceanographic models can be simply interpolated (Figure 8), whereas switching between the sometimes far-distant mareographs and their local references may introduce a large error margin (Figure 9).

The transition from the numerous MSL-based chart datums of each country to BSCD2000 is a complex and stretched process from the first decisions to the final implementation in the chart products. In particular, paper charts need longest to be switched due to the long production cycles. Some countries, like Estonia, have already informed mariners about the changes to BSCD2000 and have published the first products. Others, like Denmark, are about to formally



Swedish height systems



➤ RH00 National height system 1900

Official national height system until 1970

Zero-level defined by:

Normal height point in Stockholm from 1886

Placed +11,800 m above mean sea level in Stockholm 1900

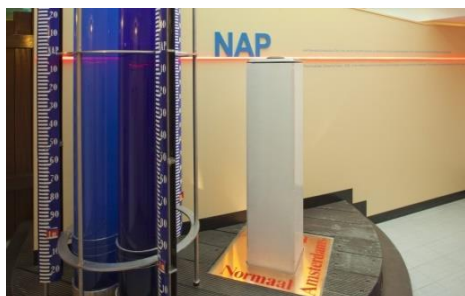


➤ RH70 National height system 1970

Official national height system 1970-2005

Zero-level defined by:

Normaal Amsterdams Peil (NAP), a reference point in Varberg placed +4,234 m above NAP



➤ RH 2000 National height system 2000

"Baltic Sea Chart Datum 2000 (BSCD2000)"

Official national height system since 2005

Zero-level defined by:

NAP is the reference point in the European Vertical Reference System (EVRS)

Epoch year 2000

Swedish Chart Improvement project



CHART DATUM: Mean Sea Level (Baltic Sea Chart Datum 2000^{RH2000})

REFERENSNIVÅ: Medelvattenyta (Baltic Sea Chart Datum 2000^{RH2000})

SYMBOLS and ABBREVIATIONS: see INT 1

BETECKNINGAR och FÖRKORTNINGAR: se KORT 1

Referensnivå



Status transition to BSCD2000 in nautical charts



Updated 2021-11-19



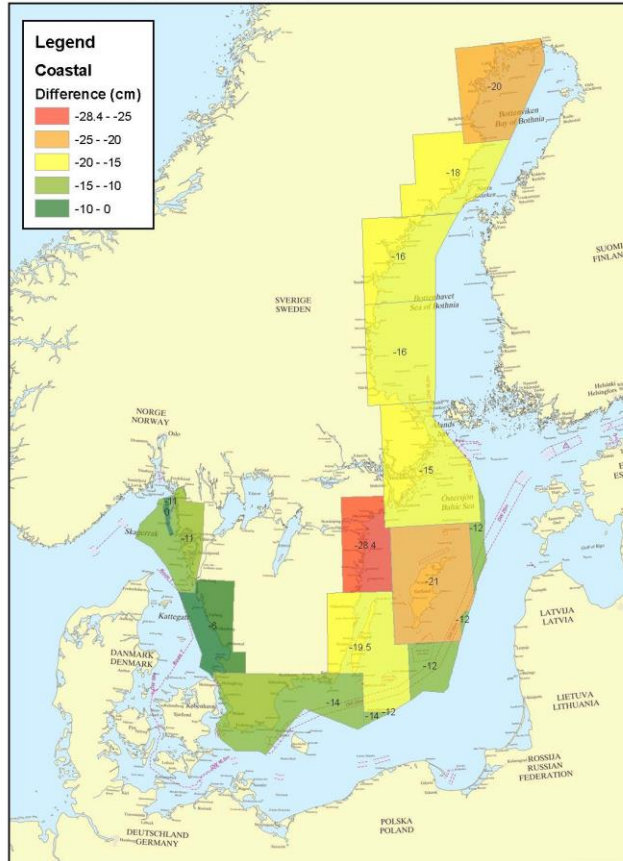
Difference between old chart datum and BSCD2000

Annex 1 To Questionare, BSHC CDWG

Page 2 (4)

Difference between existing chart datum and RH 2000 - Coastal

Swedish Maritime Administration, Hydrographic Office, May 16, 2013

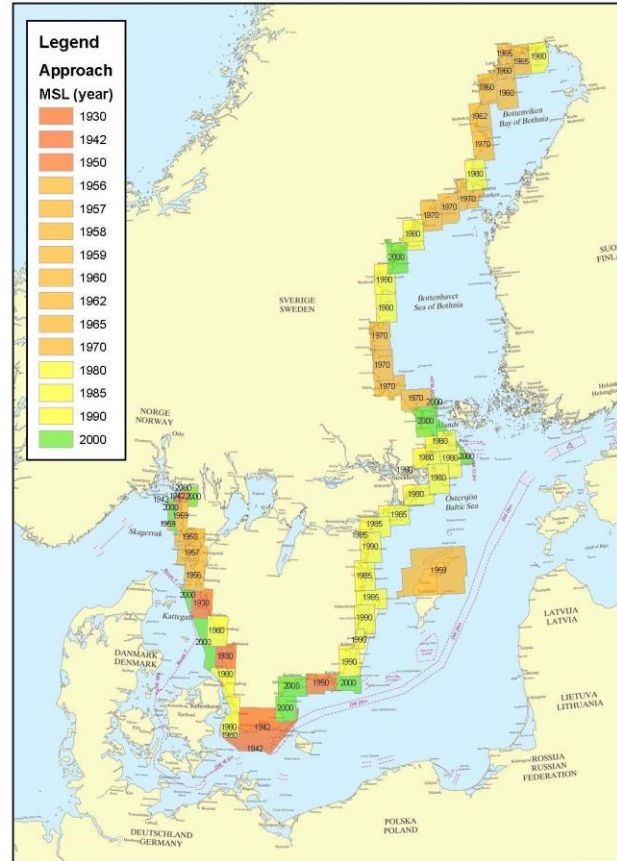


Annex 1 To Questionare, BSHC CDWG

Page 3 (4)

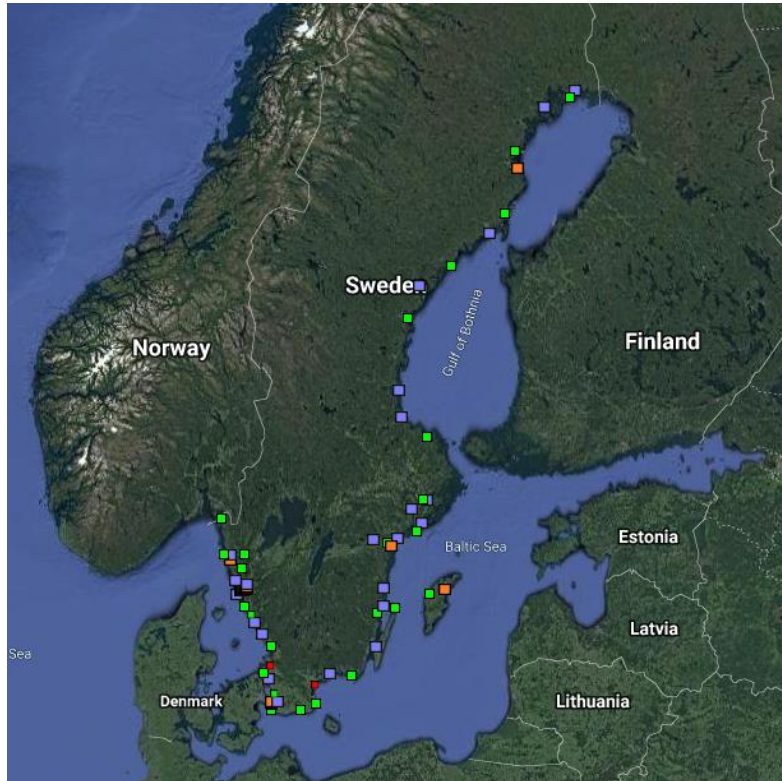
Year of MSL in Swedish chart database - Approach (Swedish water)

Swedish Maritime Administration, Hydrographic Office, May 16, 2013





Swedish Sea Level Network



- Real-time data relative BSCD2000 from 60 stations
- 1-minute values with 1 cm accuracy
- Real-time and delayed mode quality control



Class I	Upgrade with battery backup
Class II	Upgrade without battery backup
Class III	Unchanged, temporary

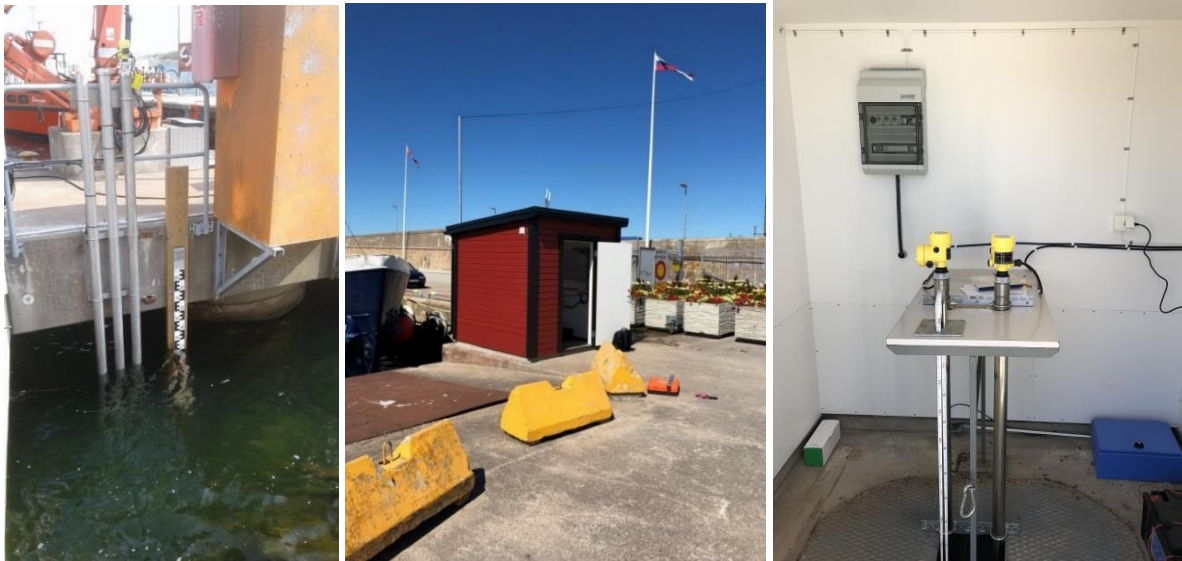
27 stations (23 SMHI, 3 SMA, 1 CTH)
25 stations (21 SMA, 3 GBG, 1 SKB)
8 stations (7 SMA, 1 SMHI)

Present water level information are shown in Wind- and Water Information ([ViVa](#))



Upgrade of the Swedish Sea Level network 2017-2019

- One common and harmonised Swedish Sea Level network
- Upgrade and modernize 53 stations in the new network, two new sensors at all stations
- Sea level data of better accuracy, continuous time series
- Open and faster access to quality controlled real-time and archive data
- All stations connected to the land survey datum (RH 2000/BSCD2000)
- Partly financed by the EU-project FAMOS Odin. Leads to that the objectives of the FAMOS Odin is achieved: safer and more cost effective shipping routes



Swedish Sea Level observations 1774-2022

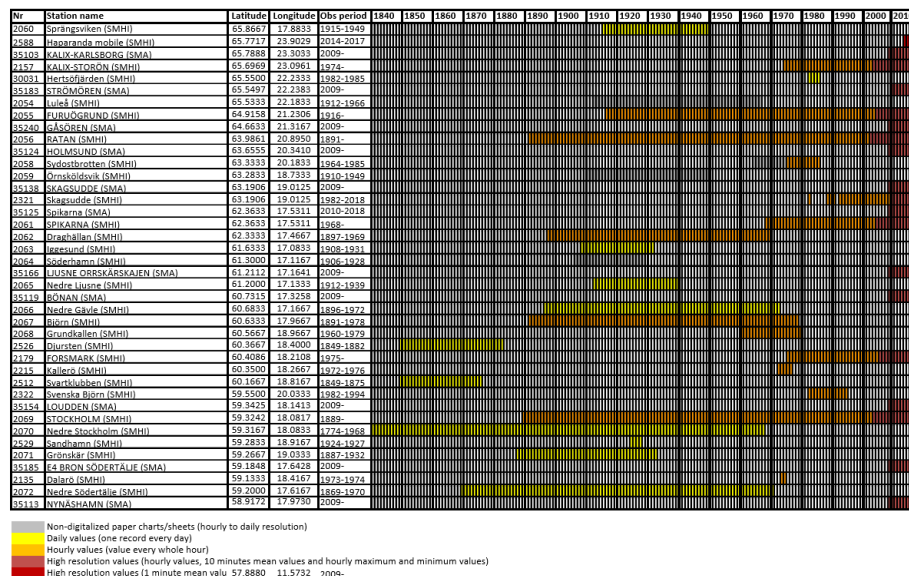
- First observations started in Stockholm 1774
- 140 sea level stations/records, 60 stations are active (2022)
- >4900 years of observations, 4500 years of data are digitalized (92%)
- >2100 years from continued stations, 100% are digitalized

High-Resolution data (1-15 minutes)

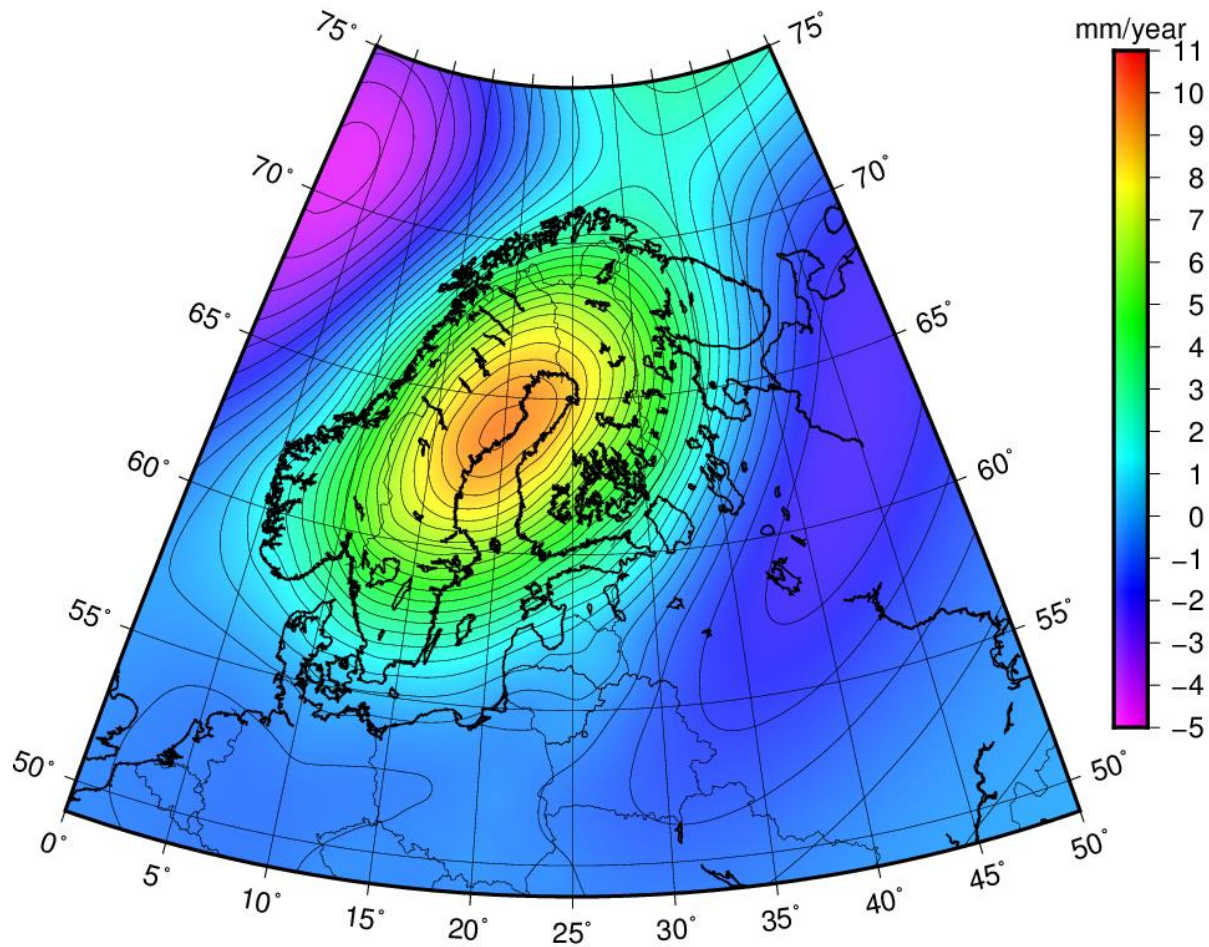
Hourly values

Daily values

Availability Sealevels Sweden



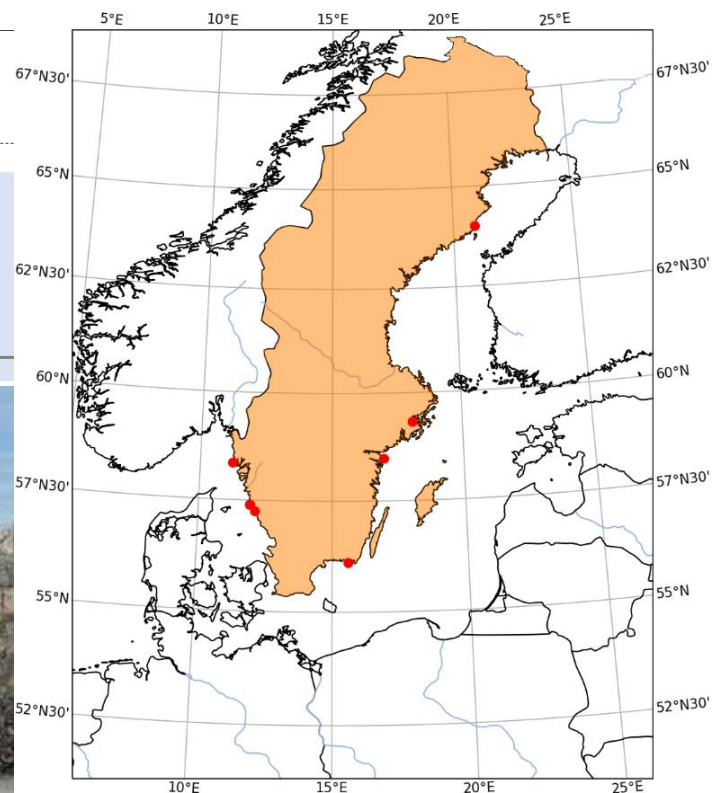
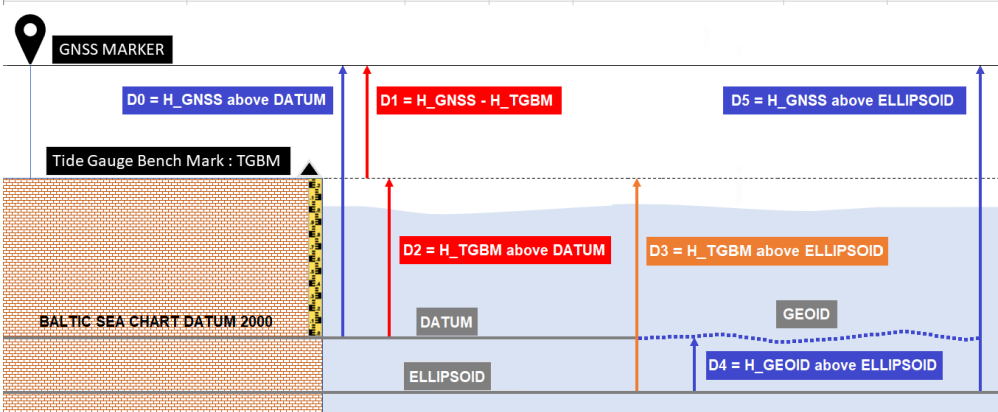
The land-uplift lowers the mean sea level



Co-location of sea level stations and GNSS in Sweden

RESPONSIBLE AGENCY		TIDE GAUGE COORDINATE		CO-LOCATED INSTRUMENTS			GNSS COORDINATES		CO-LOCATED CRITERIA		LEVELING INFORMATION	
RESPONSIBLE FOR GNSS	RESPONSIBLE FOR TG	LONGITUDE	LATITUDE	TIDE GAUGE	GNSS SONEL	GNSS SWEPOS	LONGITUDE	LATITUDE	INSTALLED	GNSS->TG HORIZONTAL DISTANCE (m)	TGBM_ID	DATUM DEFINITION
SWEPOS-LMV	SMHI	20.895031	63.986056	RATAN	RATO	RATA.0	20.89556580	63.98558831	2006-06-09	58	h	BSCD2000/RH2000
SWEPOS-LMV	SMHI	18.081944	59.324167	STOCKHOLM	OMOS	MOSE.0	18.07420578	59.31842324	2013-07-11	373	a (LMV 108*2*6503)	BSCD2000/RH2000
SWEPOS-LMV	SMHI	16.960556	58.484167	ARKO	OARK	ARKO.1	16.96265021	58.48327049	2019-08-26	158	101	BSCD2000/RH2000
SWEPOS-LMV	SMHI	15.589444	56.105278	KUNGSHOLMSFÖRT	KUN0	KUNG.0	15.58903022	56.10423868	2004-12-31	108	a (LMV 035*2*3704)	BSCD2000/RH2000
SWEPOS-LMV	Chalmers	11.919167	57.391944	ONSA	ONSA	ONSA.0	11.92551310	57.39529604	1993-07-01	533	827a	BSCD2000/RH2000
SWEPOS-LMV	Chalmers	11.919167	57.391944	ONSA	ONS1	ONSA.1	11.92453692	57.39533058	2012-01-28	496	827a	BSCD2000/RH2000
SWEPOS-LMV	SMHI	11.217778	58.353611	SMOGEN	SMO0	SMOG.0	11.21792382	58.35346156	2002-08-26	18	g	BSCD2000/RH2000

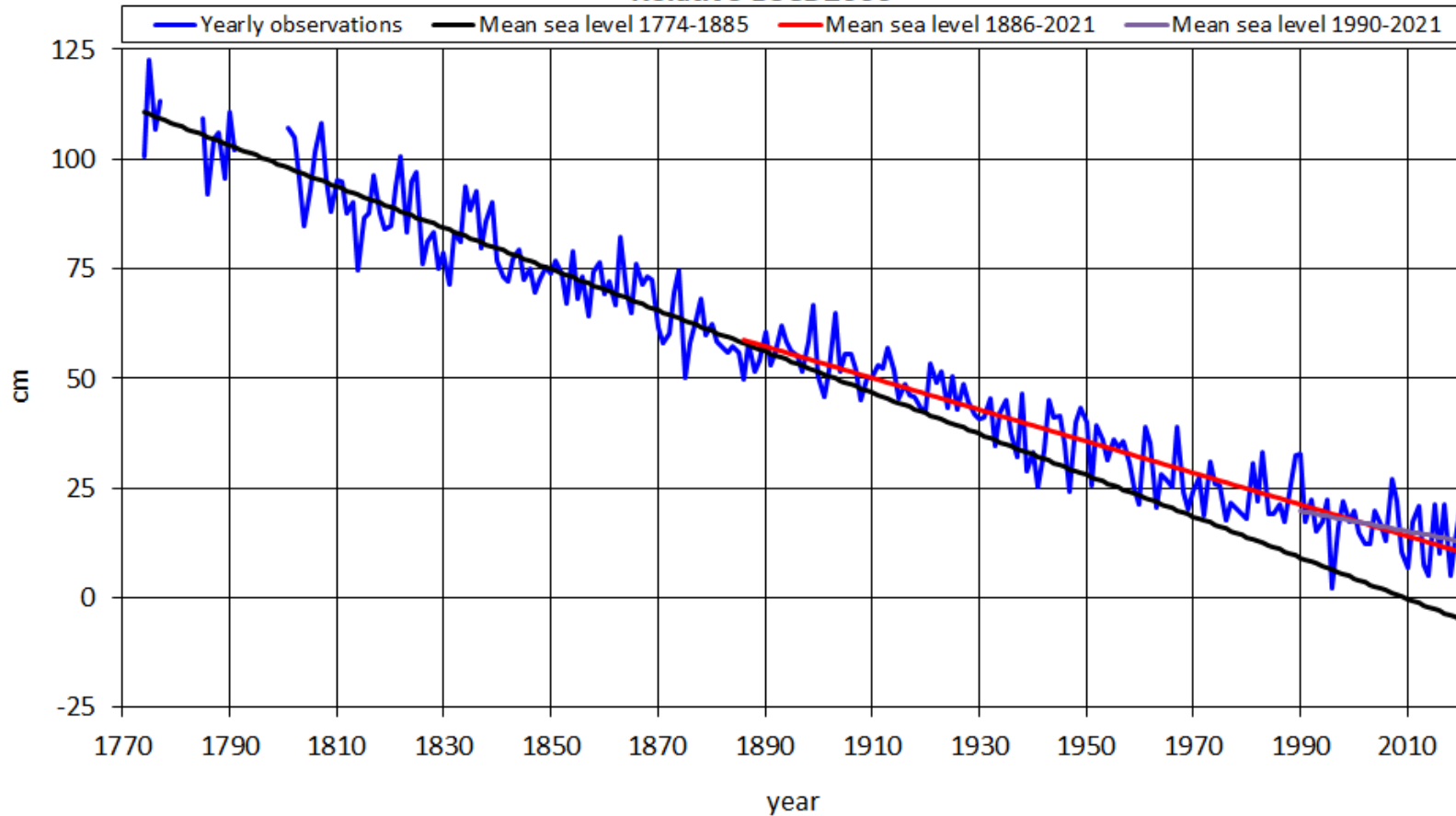
GNSS@TG < 1000.0 m for Sweden



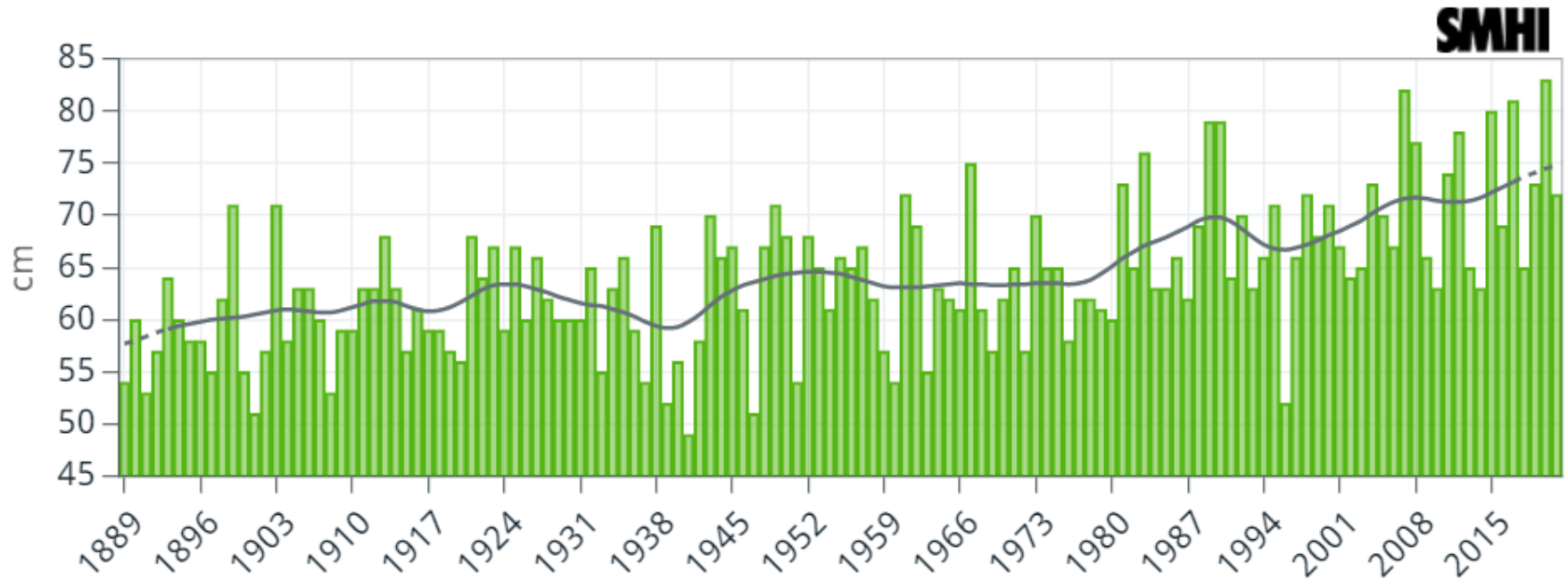
Stockholm

“World’s longest sealevel record”

Sealevel Stockholm 1774 - 2021
Relative BSCD2000



The sea level rise raises the mean sea level



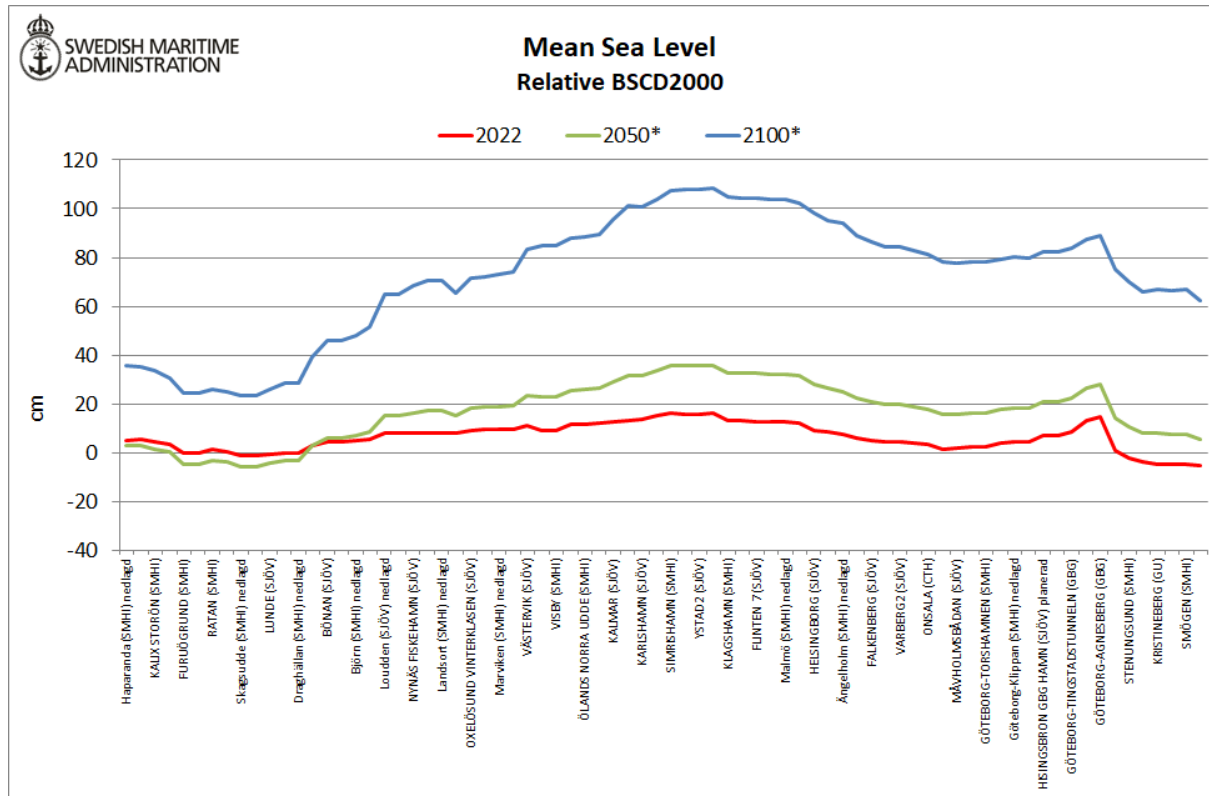
Observed sea level change in Stockholm since 1889

Sea level corrected for the levelled land-uplift (glacial isostatic adjustment)

The black line shows the gauss-filtered (smoothed) average



Changing mean sea level



Calculated mean sea level for the years 2022, 2050 and 2100. * incl. a predicted sea level rise, +1 m over the years 2020-2100 (IPCC 8,5) and correction for the leveled land-uplift.

[Mean sea level relative BSCD2000](#)

Difference between old reference system and BSCD2000

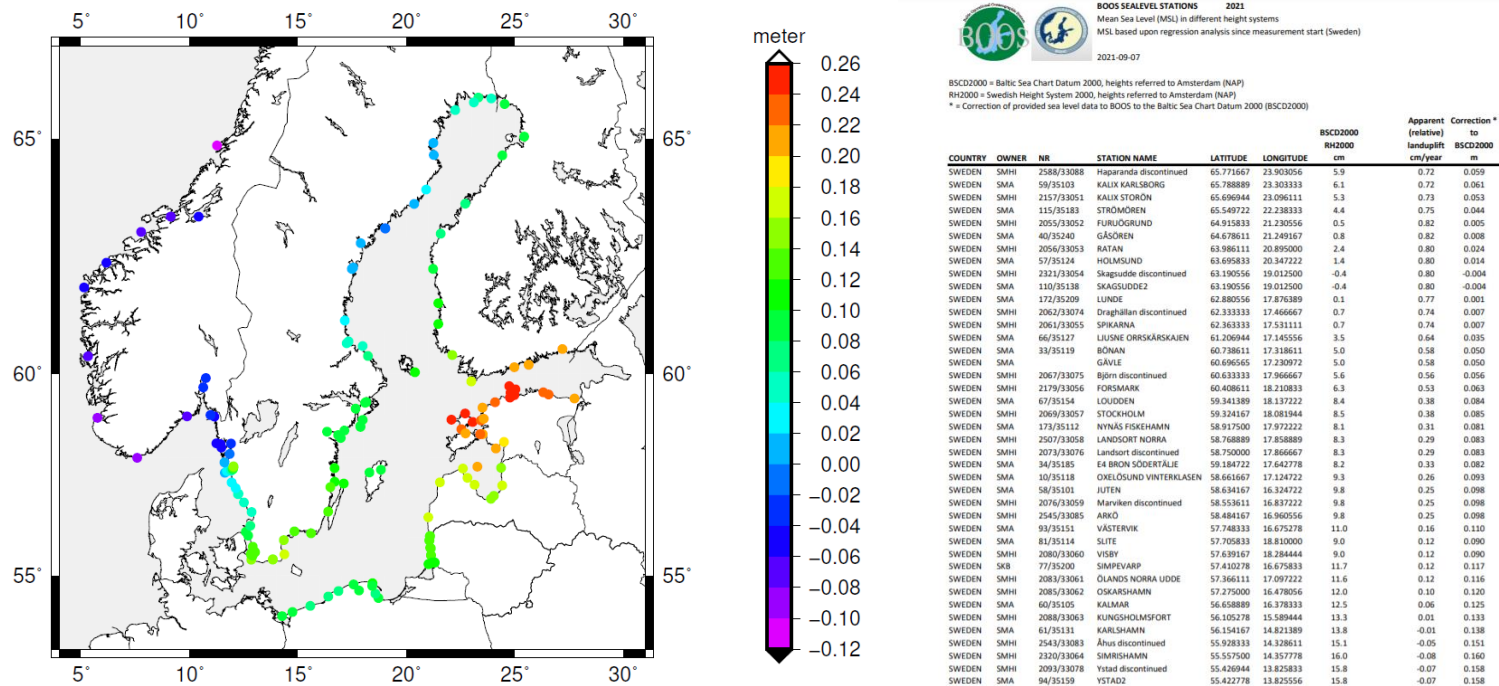
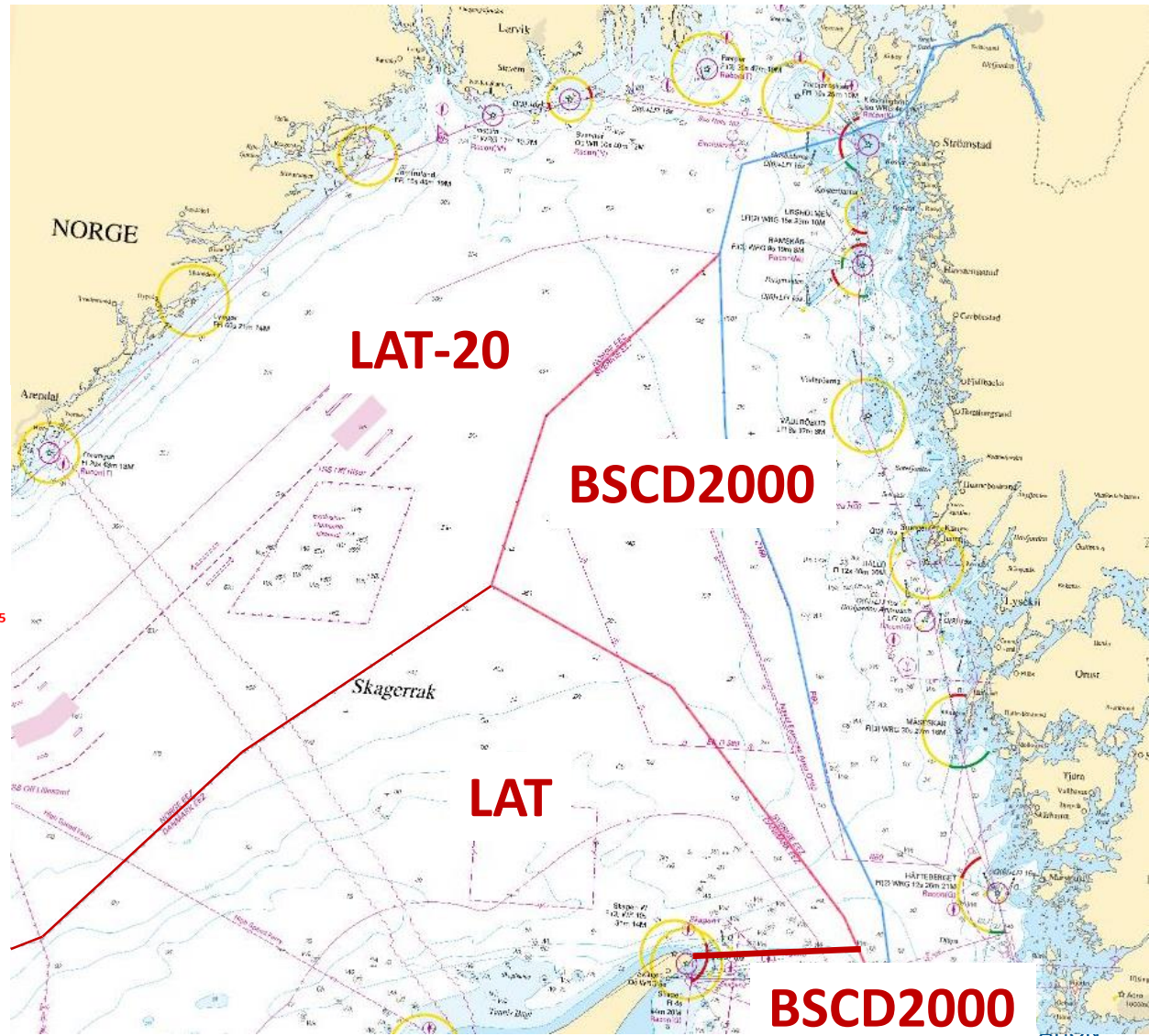
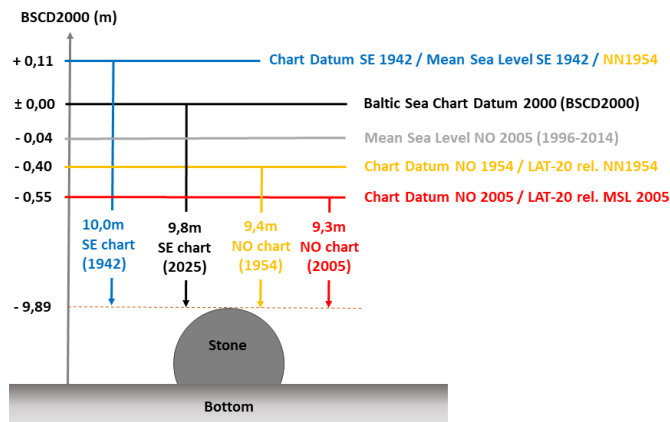


Fig. 4b: Differences between the reference levels of the old national chart datums with respect to Baltic Sea Chart Datum 2000 (BSCD2000). In Sweden and Finland, the old reference levels are equal to Mean Sea Level transferred to year 2022 (according to different national conventions). The values from Norway shows the Mean Sea Level over the period 1996-2014, relative to NN2000/BSCD2000. In Estonia, Latvia and Lithuania, the Kronstadt reference level is used as old chart datum. In Poland, the local Polish Height System Amsterdam NN₅₅ is used as 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. The values are shown in this [Table](#).

Reference levels in Skagerack

- Norwegian reference datum (LAT-20) ca 50-60 cm below BSCD2000
- Danish LAT ca 30 cm below BSCD2000

Chart datum Skagerrak (Swedish-Norwegian border)






New reference level in Sweden

SMA and SMHI presents sea level data relative BSCD2000 since 3rd June 2019



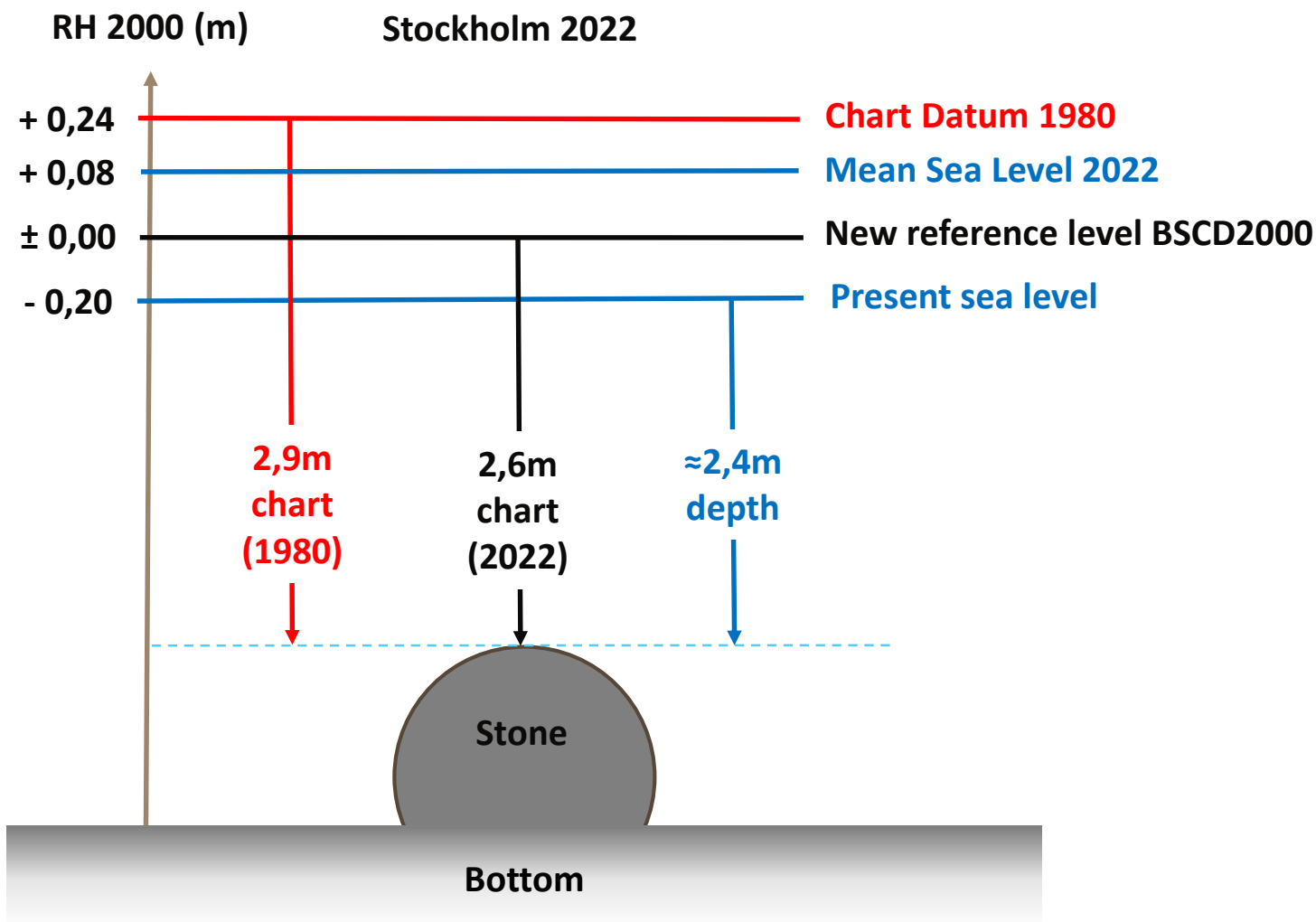
SMHI oceanographic warning and forecasting service

- A transition to BSCD2000 (RH 2000) has been implemented at SMHI, where forecasts, warnings and current sea level are issued relative BSCD2000.
- A new impact-based and regional adapted warning system has also been introduced, which includes yellow, orange and red warning, where red is the most serious.

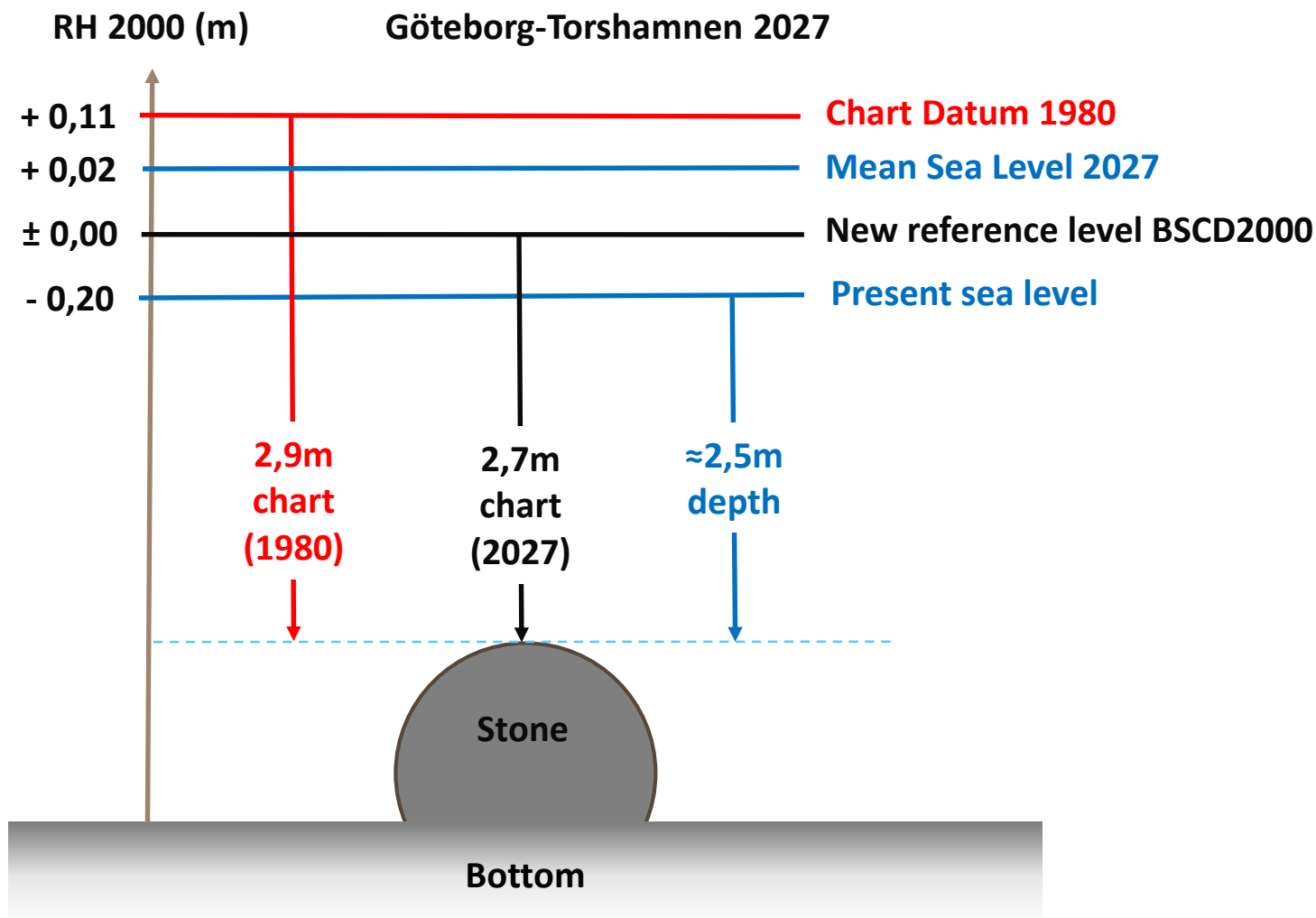
Högt vattenstånd   			
Varningsnivå	Gul	Orange	Röd
Område	cm i RH 2000		
Grupp 1 (Västra Götalands län, Hallands län, Skåne län)	90	130	180
Grupp 2 (Kalmar län, Östergötlands län, Gotlands län, Södermanlands län, Stockholms län)	80	110	-
Grupp 3 (Blekinge län, Uppsala län, Gävleborgs län, Västernorrlands län)	90	130	-
Grupp 4 (Västerbottens län, Norrbottens län)	100	150	-

Lågt vattenstånd 	
Varningsnivå	Gul
Område	cm i RH 2000
Skagerrak, Kattegatt, Södra Östersjön, Mellersta Östersjön, Norra Östersjön, Ålands hav	-80
Sydvästra Östersjön, Öresund, Bälten	-50
Södra Bottenhavet, Norra Bottenhavet, Norra Kvarken, Bottenviken	-90

Transition to RH 2000/BSCD2000 in charts and sea level



Transition to RH 2000/BSCD2000 in charts and sea level



Notices to mariners

Example from Sweden, 2019-05-15

* 14040

**Sweden. not area bound. New reference system for sea level, nautical charts and warnings.
BSCD2000 / RH 2000.**

Expired notices: 2019:754/13917

See: 2018:716/13140

As of June 3, 2019, the Swedish national height system 'Rikets Höjdsystem 2000', or RH 2000 (international name 'Baltic Sea Chart Datum 2000', BSCD2000) will constitute the reference level for observations and forecasts of the water level in Swedish waters.

The zero level in RH 2000 is fixedly linked to land, and is not affected by land uplift, changes in sea level or geographical variations.

The change means that observations, forecasts, and warnings in the Swedish Maritime Administration's and Swedish Meteorological and Hydrological Institute's (SMHI) viewing services from 3 June 2019, or soon thereafter, refer to the new reference level and no longer to the 'mean sea level'.

The Swedish Maritime Administration is gradually adapting the charts to the new reference system. This is a time consuming process which will take several years to complete. During the transition period, it is important to know which reference level is used in the different charts. If the text 'Baltic Sea Chart Datum 2000', or 'BSCD2000' is printed in the chart, the update has been performed.

More information: www.sjofartsverket.se/RH2000 and www.smhi.se

www.sjofartsverket.se/RH2000 www.smhi.se

SMHI och Sjöfartsverket. Publ. 15 May 2019



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

Svensk



English



A uniform reference system from land to sea

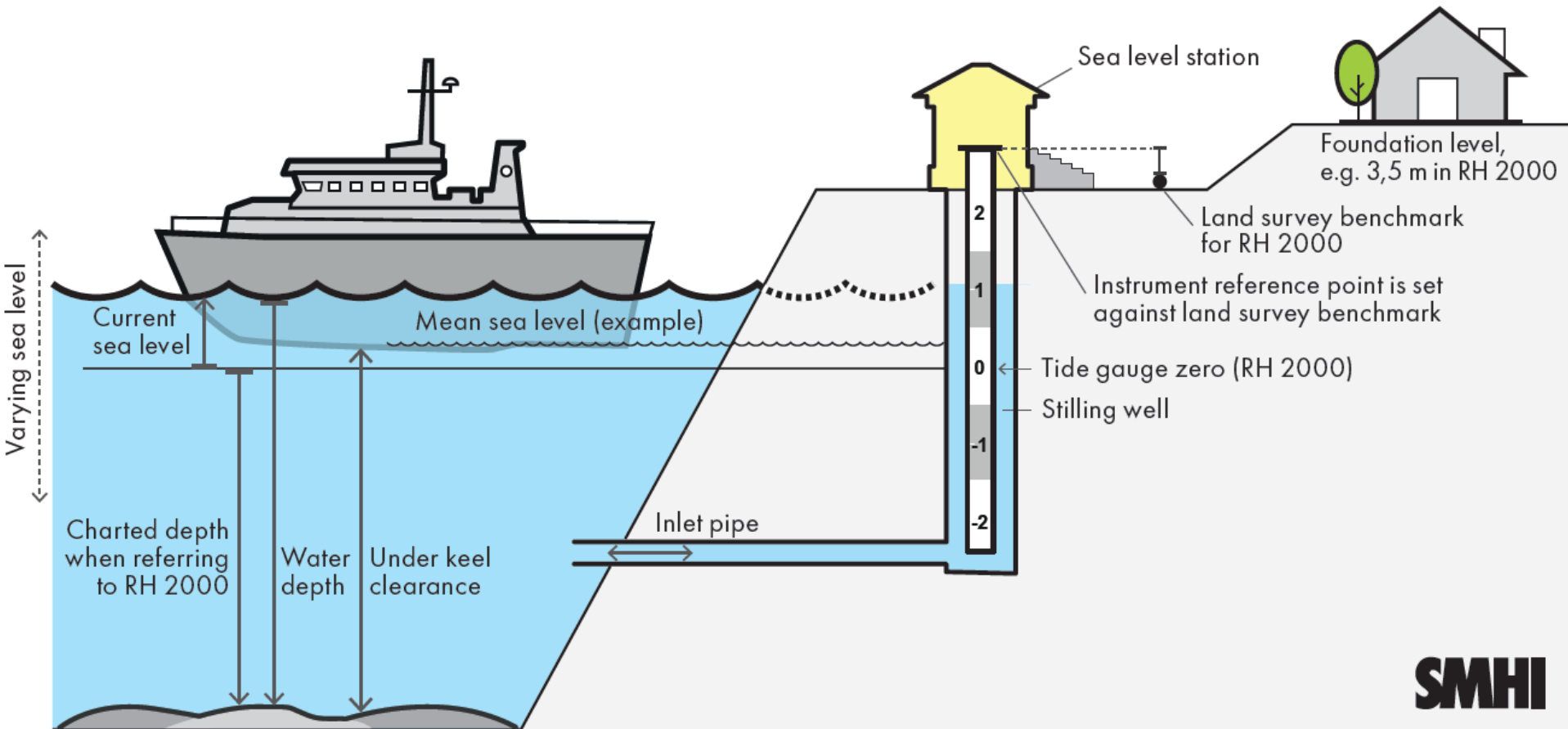


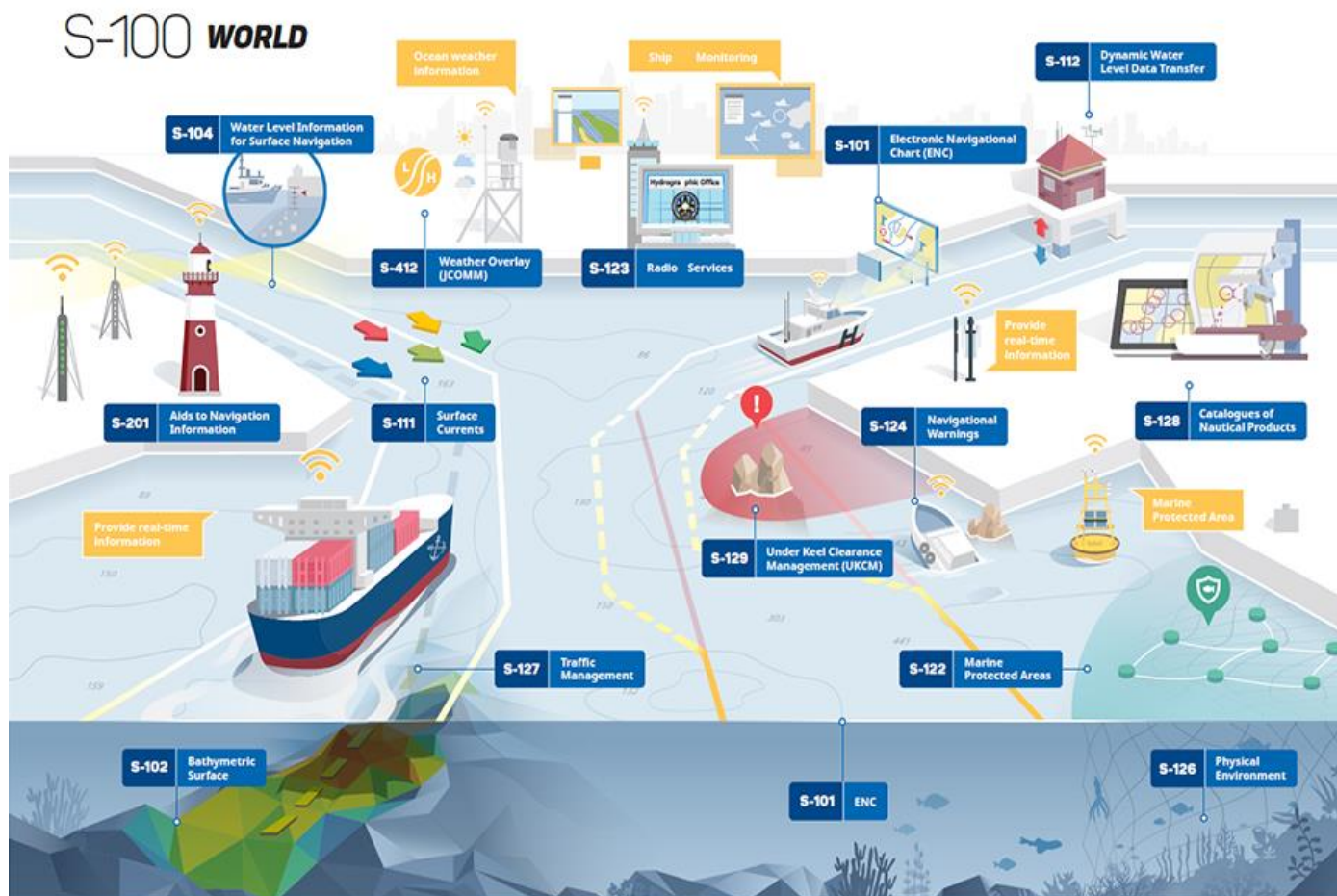
Illustration Veronica Wörn SMHI

SMHI

Future Maritime Services S-100



IHO



IHO S-100 Implementation

IHO S-100 Implementation Strategy

Table A – IHO list of S-100 products with special focus	
First step – Route monitoring mode	
S-101	Electronic Navigational Chart (ENC)
S-102	Bathymetric Surface
S-104	Water Level Information for Surface Navigation
S-111	Surface Currents
S-124	Navigational Warnings
S-129	Under Keel Clearance Management
Critical Framework	
	IHO Geospatial Information Registry
S-98	Interoperability Specification
S-100	Universal Hydrographic Data Model
S-128	Catalogue of Nautical Products
S-164	Test Data Set for S-100 and ECDIS Type Approval
Second step – Route planning mode	
S-122	Marine Protected Areas
S-123	Marine Radio Services
S-125	Marine Aids to Navigational (AtoN)
S-126	Marine Physical Environment
S-127	Marine Traffic Management
S-131	Marine Harbour Infrastructure

S-100 Timeline for the prioritized IHO Product Specifications

The S-100 timeline is maintained by the IHO Secretariat as a version controlled Gantt Diagram and is updated and reported annually to the IHO Council.

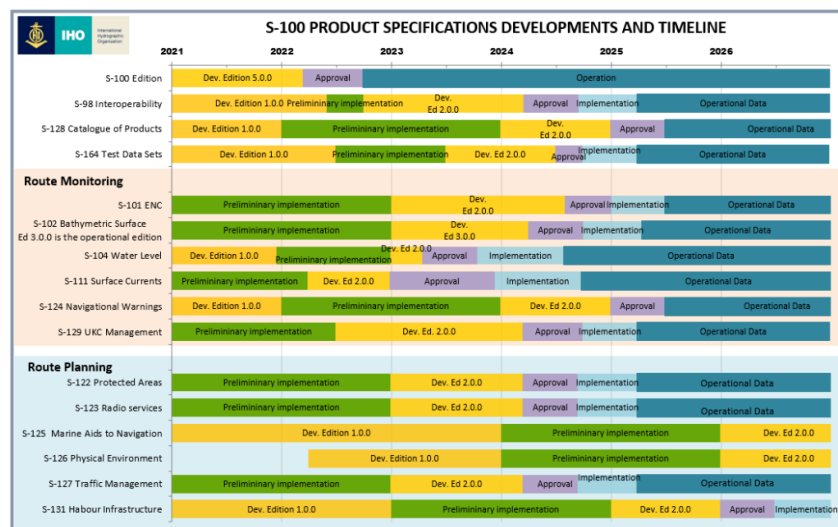
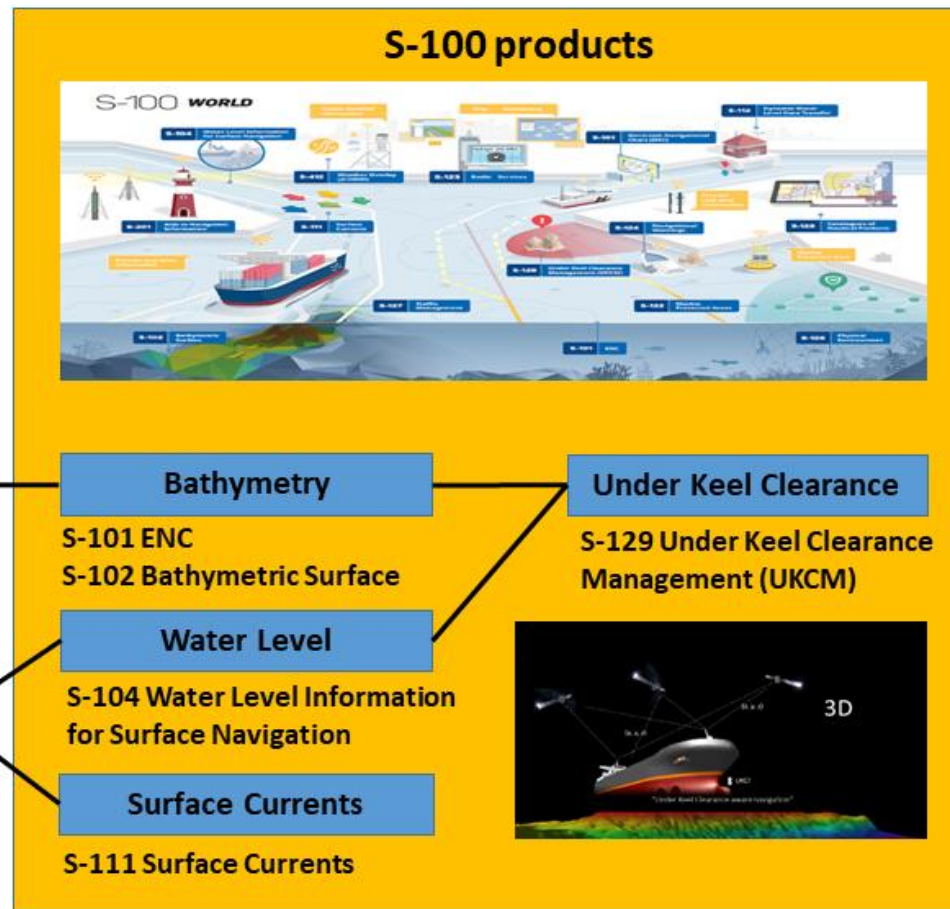
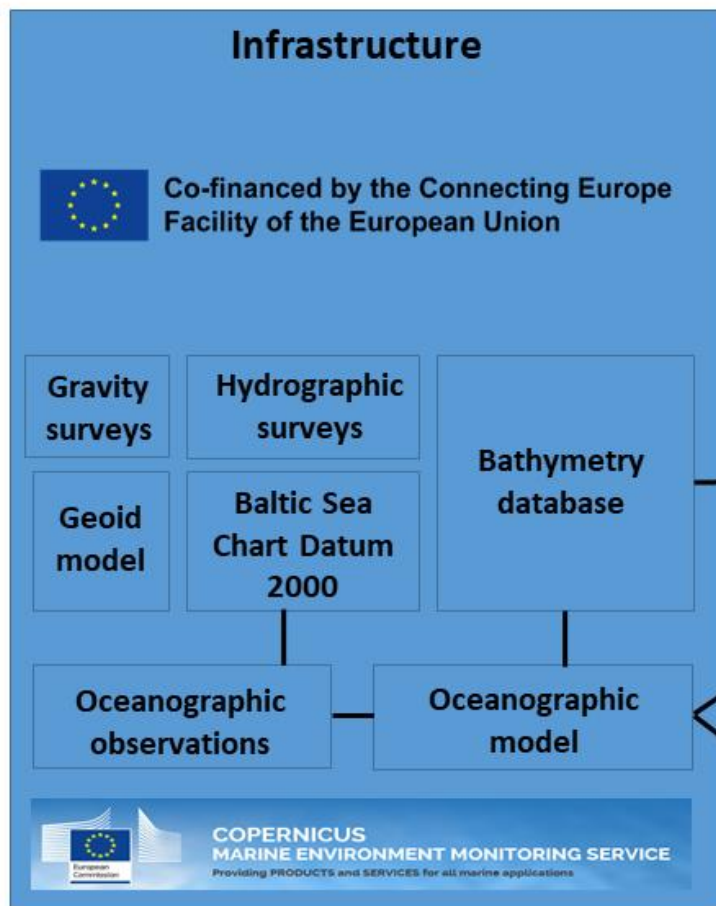


Figure 3 This S-100 timeline is updated: 12 July, 2022.

Dynamic S-100 products

Real Time Hydrographic and Environmental Information Service



Thanks!



Thomas Hammarklint

Swedish Maritime Administration (SMA)

Thomas.Hammarklint@sjofartsverket.se

