BALTIC SEA HYDROGRAPHIC COMMISSION

IHO

Baltic Sea Chart Datum 2000

BSHC Chart Datum, Water level and Currents Working Group

2025-04-28

Thomas Hammarklint

SWEDISH MARITIME ADMINISTRATION

Baltic Sea Hydrographic Commission (BSHC)

BALTIC SEA HYDROGRAPHIC COMMISSION

IHO

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The Baltic Sea Hydrographic Commission,

which is an integrant 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

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SWEDISH MARITIME ADMINISTRATION

Chart Datum, Water level and Currents Working Group (CDWCWG)

Chart Datum, Water level and Currents Working Group (CDWCWG)

"To implement a common reference system, S-104 and S-111 in the Baltic Sea"

Photo: Chart Datum, Water level and Currents Working Group 2nd meeting, 25-26 March 2025, Tallinn, Estonia

https://www.bshc.pro/working-groups/cdwcwg

Members of CDWCWG:

Denmark	Mr Kristian Villadsen Kristmar
Estonia	Mrs Gabriela Kotsulim
Finland	Mr Jyrki Mononen
Finland	Mrs Anni Jokiniemi
Germany	Dr Patrick Westfeld
Latvia	Mr Bruno Špēls
Lithuania	Mr Mindaugas Zakarauskas
Poland	Mr Witold Stasiak
Poland	Mrs Alicja Olszewska
Russia	Mr Leonid Shalnov
Russia	Dr Sergey V. Reshetniak
Sweden	Mr Thomas Hammarklint (Chair)
Sweden	Mr Henrik Tengbert

Observers and Experts:

Estonia	Prof. Artu Ellmann
Estonia	Dr Sander Varbla
Estonia	Dr Nicole Camille Delpeche-Ellmann
Finland	Mr Jarmo Mäkinen
Finland	Dr jani Särkkä
Finland	Dr Mirjam Bilker-Koivula
Finland	Dr Timo Saari
Germany	Dr Xaver Lange
Germany	Mr Thorben Knoop
Germany	Dr Gunter Liebsch
Germany	Dr Joachim Schwabe
Latvia	Mr Armands Murans
Latvia	Mr Krists Dzenis
Lithuania	Mr Emilis Tertelis
Lithuania	Mr Romuald Obuchovski
Norway	Mr Aksel Voldsund
Poland	Mr Krzysztof Pyrchla
Poland	Dr Monika Wilde-Piórko
Poland	Dr Malgorzata Szelachowska
Sweden	Dr Jonas Ågren
Sweden	Dr Per-Anders Olsson
Sweden	Mrs Johanna Linders

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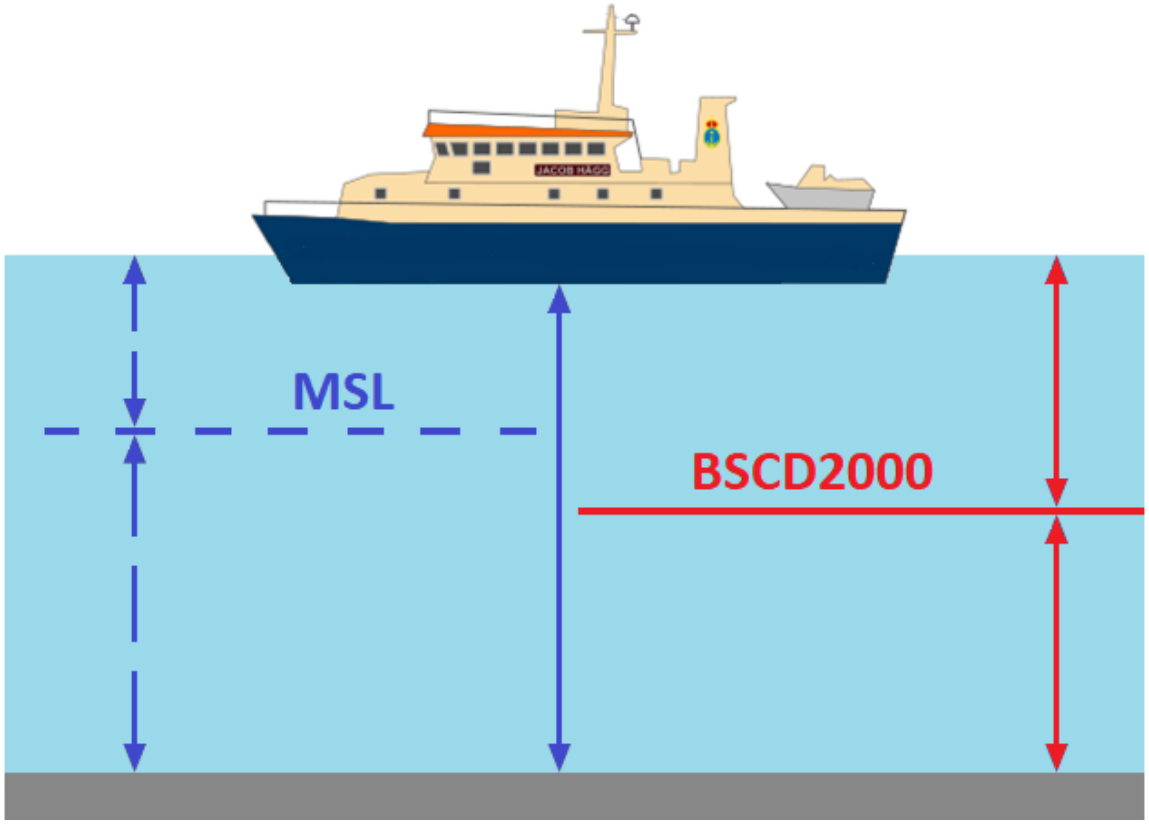
New reference level



The water depth remains!

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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 and water level information:**

Mean Sea Level (Baltic Sea Chart Datum 2000$^{\text{national realization name}}$)
Mean Sea Level (Baltic Sea Chart Datum 2000)
Baltic Sea Chart Datum 2000$^{\text{national realization name}}$
Baltic Sea Chart Datum 2000
BSCD2000 (national realization name)
BSCD2000
National realization name

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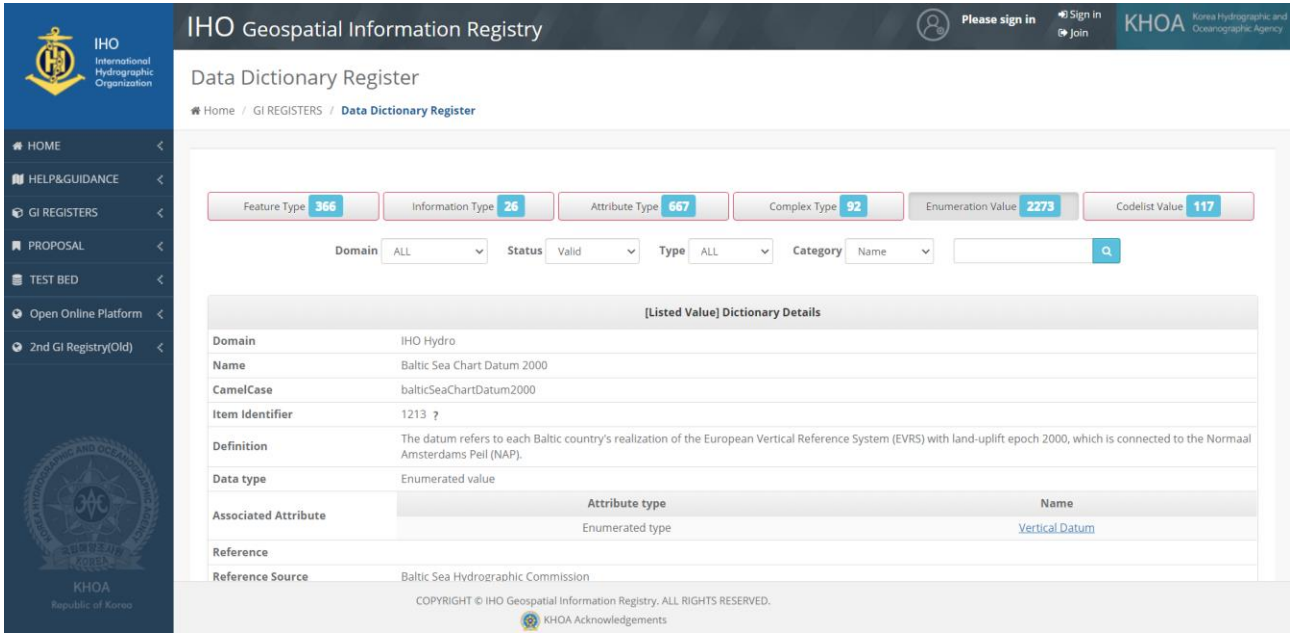
Baltic Sea Chart Datum 2000 in IHO Registry

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



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International Hydrographic Review Article

An article on the CDWCWG work and the implementation of the Baltic Sea Chart Datum 2000 has been published in the International Hydrographic Review (IHR) in May 2020: [THE BALTIC SEA CHART DATUM 2000 (BSCD2000) - Implementation of a common reference level in the Baltic Sea]

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. Schwabe [1], J. Ågren [2], G. Liebsch [3], P. Westfeld [3], T. Hammarklint [4], J. Mononen [5] and O. B. Andersen [6]

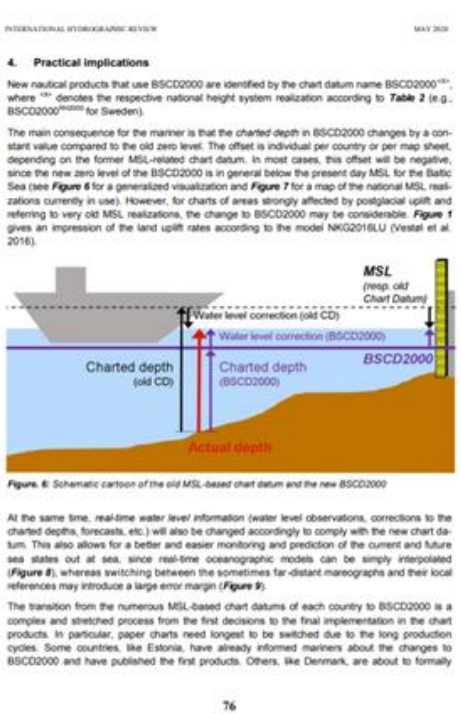
1. Federal Agency for Cartography and Geodesy (Germany)
2. University of Gävle (Sweden) and Lantmäteriet, the Swedish mapping, cadastral and land registration authority (Sweden)
3. Federal Maritime and Hydrographic Agency (Germany)
4. Swedish Maritime Administration (Sweden)
5. Finnish Transport Agency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



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4. Practical implications

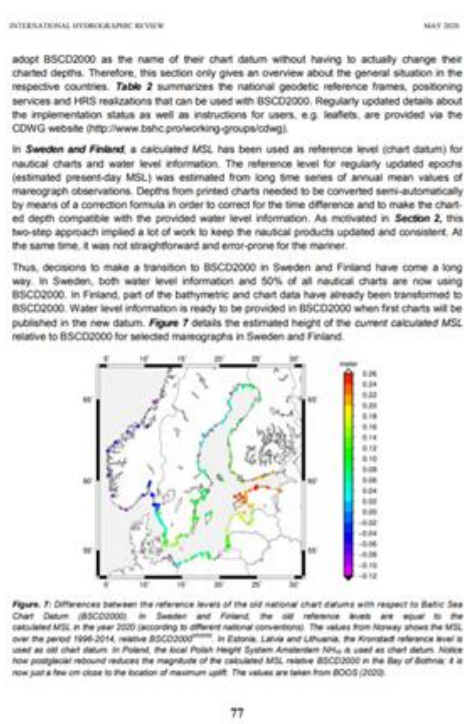
New nautical products that use BSCD2000 are identified by the chart datum name BSCD2000$^{<X>}$, where $^{<X>}$ denotes the respective national height system realization according to ***Table 2*** (e.g., BSCD2000^{RH2000} for Sweden).

The main consequence for the mariner is that the *charted depth* in BSCD2000 changes by a constant value compared to the old zero level. The offset is individual per country or per map sheet, depending on the former MSL-related chart datum. In most cases, this offset will be negative, since the new zero level of the BSCD2000 is in general below the present day MSL for the Baltic Sea (see ***Figure 6*** for a generalized visualization and ***Figure 7*** for a map of the national MSL realizations currently in use). However, for charts of areas strongly affected by postglacial uplift and referring to very old MSL realizations, the change to BSCD2000 may be considerable. ***Figure 1*** gives an impression of the land uplift rates according to the model NKG2016LU (Vestøl et al. 2016).

Figure 6: *Schematic cartoon of the old MSL-based chart datum and the new BSCD2000*

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



INTERNATIONAL HYDROGRAPHIC REVIEW MAY 2020

adopt BSCD2000 as the name of their chart datum without having to actually change their charted depths. Therefore, this section only gives an overview about the general situation in the respective countries. ***Table 2*** summarizes the national geodetic reference frames, positioning services and HRS realizations that can be used with BSCD2000. Regularly updated details about the implementation status as well as instructions for users, e.g. leaflets, are provided via the CDWG website (http://www.bshc.pro/working-groups/cdwg).

In ***Sweden and Finland***, a *calculated MSL* has been used as reference level (chart datum) for nautical charts and water level information. The reference level for regularly updated epochs (estimated present-day MSL) was estimated from long time series of annual mean values of mareograph observations. Depths from printed charts needed to be converted semi-automatically by means of a correction formula in order to correct for the time difference and to make the charted depth compatible with the provided water level information. As motivated in ***Section 2***, this two-step approach implied a lot of work to keep the nautical products updated and consistent. At the same time, it was not straightforward and error-prone for the mariner.

Thus, decisions to make a transition to BSCD2000 in Sweden and Finland have come a long way. In Sweden, both water level information and 50% of all nautical charts are now using BSCD2000. In Finland, part of the bathymetric and chart data have already been transformed to BSCD2000. Water level information is ready to be provided in BSCD2000 when first charts will be published in the new datum. ***Figure 7*** details the estimated height of the *current calculated MSL* relative to BSCD2000 for selected mareographs in Sweden and Finland.

Figure 7: *Differences between the reference levels of the old national chart datums with respect to Baltic Sea Chart Datum (BSCD2000). In Sweden and Finland, the old reference levels are equal to the calculated MSL in the year 2020 (according to different national conventions). The values from Norway shows the MSL over the period 1996-2014, relative BSCD2000^{NN2000}. In Estonia, Latvia and Lithuania, the Kronstadt reference level is used as old chart datum. In Poland, the local Polish Height System Amsterdam NH$_{70}$ is used as chart datum. Notice how postglacial rebound reduces the magnitude of the calculated MSL relative BSCD2000 in the Bay of Bothnia: it is now just a few cm close to the location of maximum uplift. The values are taken from BOOS (2020).*

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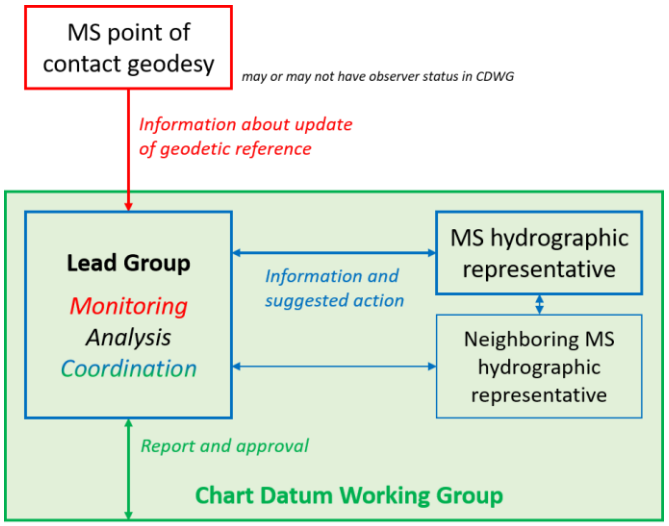
Continuity Management of BSCD2000

Organizational scheme and workflow



BSCD2000 Height Transformation Grid (Geoid Model)

Release note:
https://doi.org/10.58440/ihr-29-2-n11

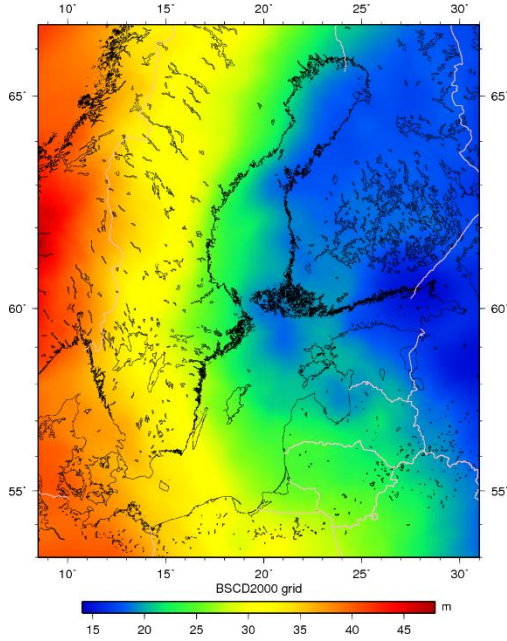
Landing page:
https://www.bshc.pro/iho-bscd2000

Digital Object Identifier (DOI) with download

DOI: 10.58440/iho-bscd2000
URL: https://doi.org/10.58440/iho-bscd2000

The DOI has been configured as type 'database'. In perspective, we can assign any number of ”datasets" to a "database". This means that each new BSCD2000 release can have its own entry.

We can also assign literature references (definition, specification, publications etc.) in the future.



SWEDISH MARITIME ADMINISTRATION

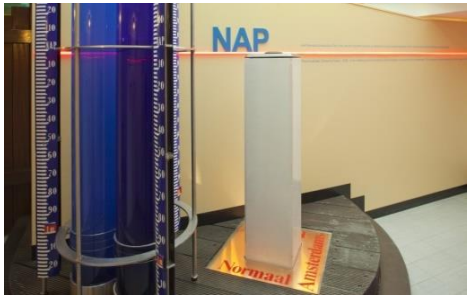
Swedish height systems

- **RH00 National height system 1900**

Official national height system until 1970
Zero-level definied 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 definied by:
NAP is the reference point in the European Vertical Reference System (EVRS)
Epoch year 2000

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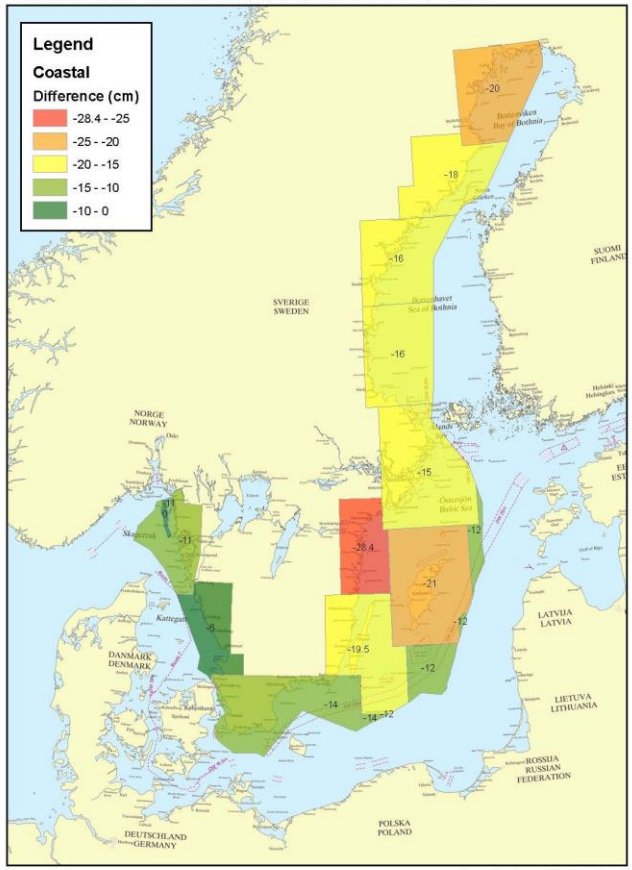
Difference between old chart datum and BSCD2000

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

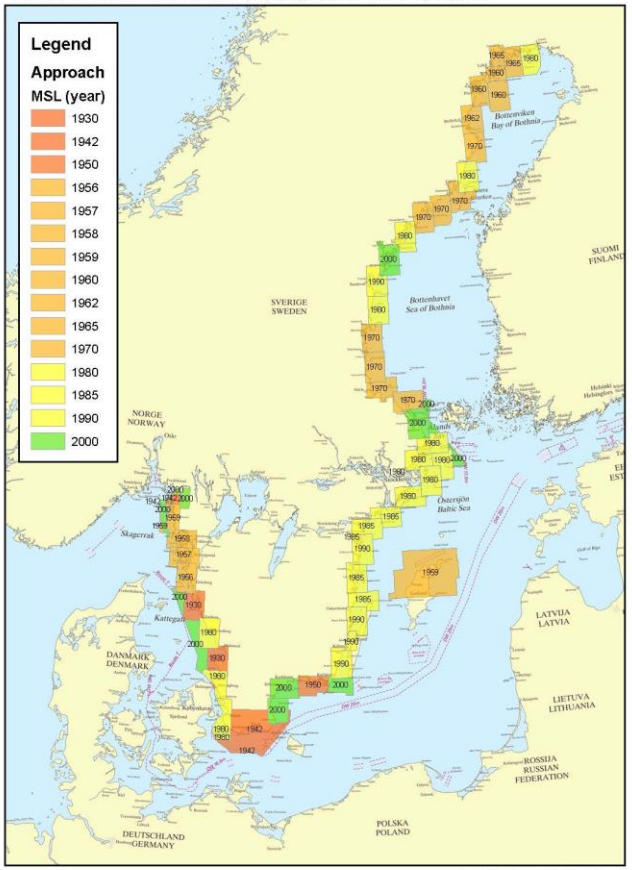


1 centimeters = 60 kilometers

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



1 centimeters = 60 kilometers

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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

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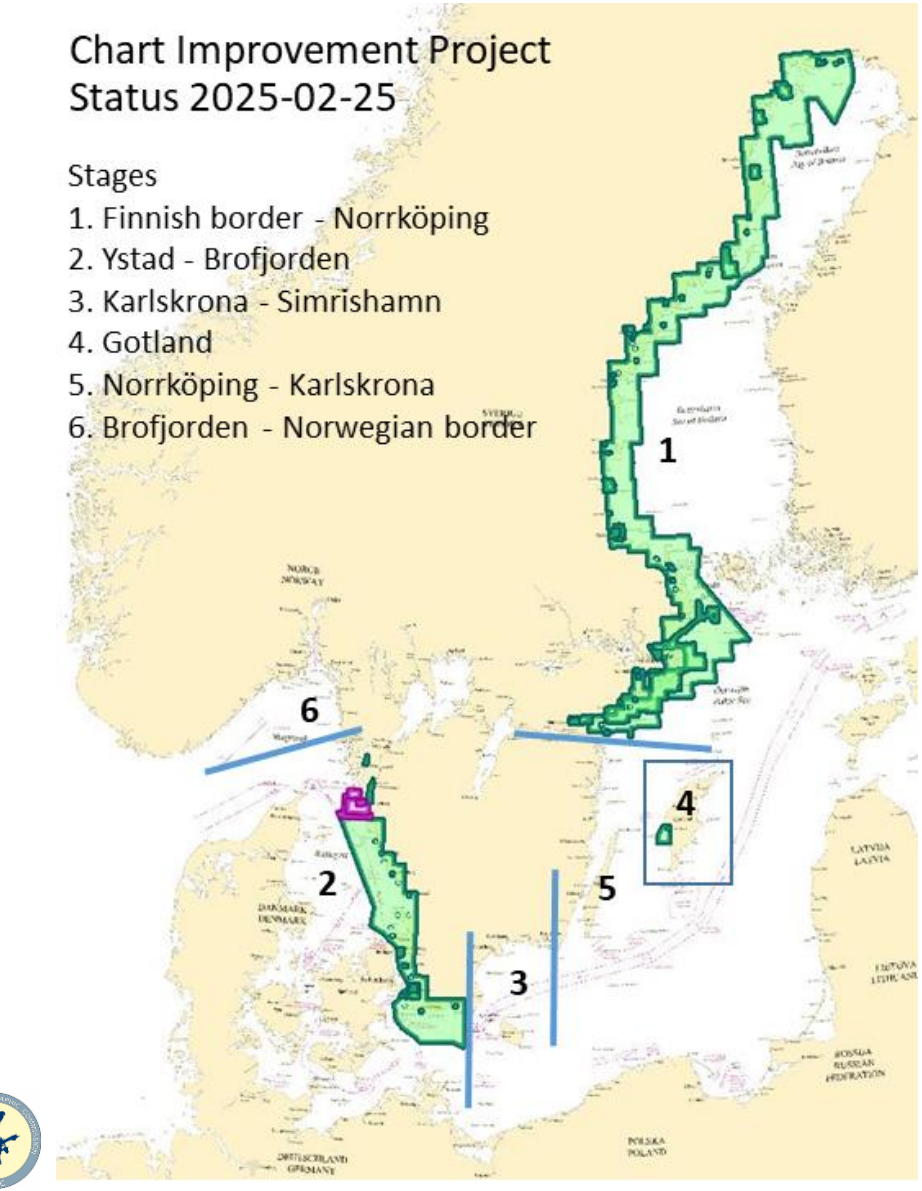
Status transition from MSL to BSCD2000 in nautical charts



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Implementation status 2025

Summary implementation of BSCD2000, S-104 and S-111 status 2025:

Country	Status BSCD2000 for charts	Status BSCD2000 for water level (see mwreg_boos)	Status S-104/S-111
Denmark	Chart datum in practice close to EVRS-based chart datum (DVR90). BSCD2000 is implemented in ENC and will be implemented in paper charts In the order of reprinting.	All Danish water level stations are connected to DVR90 (approx. BSCD2000). Data distributed to BOOS/CMEMS in relation to DVR90. Responsibility of Danish Meteorological Institute (DMI), Danish Coastal Authority (Kystdirektoratet) and Danish Environmental Protection Agency (Miljøstyrelsen).	DMI and FCOO (Forsvaret Center for Operativ Oceanografi) is responsible for water level and current information. Have a plan for S-104 and S-111. DGA and DMI coordinates the work.
Estonia	All decisions are taken and the implementation is ongoing. All Berthing and Harbour cells and larger paper scales are in the new height system BSCD2000. Official use in charts and water level information from 2018-01-01. Notices to Mariners 2022-12-01. Info Sheet. Web application Nutimeri displays Estonian Transport Administration's official electronic navigational charts.	All Estonian water level stations are connected to EH2000 (BSCD2000). Data distributed to BOOS/CMEMS in relation to BHS77 (old system). The difference between BHS77 and EH2000 reaches up to 26 cm in the Gulf of Finland. Responsibility of Taltech Marine Systems Institute (MSI) and Estonian Environmental Agency (EEA).	Discussions are ongoing between EMA and MSI. MSI and EEA are responsible for water level and current information. EMA coordinates the work.
Finland	Ongoing. All decisions are taken already in 2008 and 2015. Approach charts from Tornio to Vaasa have been published. The publication status of N2000 charts and Finnish nautical charts portfolio. New video about the N2000 fairway and nautical chart reform.	Water level information provided in both systems, mean sea level (MSL) and N2000 (BSCD2000). The differences between MSL and N2000 is provided as a Table. Water level observations and forecasts will be available in N2000 for the public simultaneously with Traficom nautical charts. Data distributed to BOOS/CMEMS in relation to MSL. Responsibility of Finnish Meteorological Institute (FMI).	The first test products of S-104 and S-111 will be created by FMI in the Baltic Sea e-Nav-project until 2026. FMI is responsible for water level and current information. Traficom and FMI coordinates the work.
Germany	EVRS realization in use in practice. The vertical chart datum of BSCD2000 is close to the national height system of Germany (ETRS1989+DHHN2016). All published products will refer to this datum. In August 2021, BSCD2000 was officially introduced as chart datum for German waters in the Baltic Sea. The official introduction was decreed in January 2018 and is binding for all institutions coming under the jurisdiction of the Federal Waterways and Shipping Administration (WSV).	All German water level stations refers to the national height system DHHN2016 (BSCD2000). Data distributed to BOOS/CMEMS in relation to DHHN2016, but metadata refers to SNN76/Kronstadt (old system). Responsibility of Federal Waterways and Shipping Administration (WSV).	BSH is responsible for water level and current information. BSH coordinates the work.
Latvia	All Paper Charts of Latvia are already implemented to BSCD, LAS-2000,5 since 24.01.2024. All approach and other scale band ENC's are implemented to BSCD2000, LAS-2000,5. Further planned actions are to continue production in BSCD2000, LAS-2000,5 and to implement it into S-100 standard.	All water level stations is connected to LAS-2000,5 (BSCD2000). Data distributed to BOOS/CMEMS in relation to LAS-2000,5. Responsibility of Latvian Environment, Geology and Meteorology Centre (LVGMC).	Meeting between MAL and LVGMC officials has been held about S-104 and S-111. MAL coordinates the work.
Lithuania	National height system LAS-07 (BSCD2000) came into force 2016-01-01. BHS-77 still used. The difference between BHS-77 and LAS-07 is well known (about 13 cm) and is also written in nautical charts.	All water level stations is connected to LAS-07 (BSCD2000). Data distributed to BOOS/CMEMS in relation to BHS-77 (old system). Responsibility of Lithuanian Hydrometeorological Service (LHMS).	Data owner has been identified. LHMS is responsible for water level information and Klaipeda University (KU) for currents. LTSA coordinates the work.
Poland	The implementation of BSCD2000 in PL waters are completed. All charts have been updated to the BSCD2000 (PL-EVRF2007-NH). The last chart (chart No. 500 – general band) was updated in December 2024. All bathymetric data have earlier been transferred to the vertical reference system PL-EVRF2007-NH.	All water level stations is connected to PL-EVRF2007-NH (BSCD2000). Data distributed to BOOS/CMEMS in relation to Amsterdam NN55, but metadata refers to BHS77. The difference between the NN55 and PL-EVRF2007-NH is less than 9 cm. Responsibility of Institute of Meteorology and Water Management (IMGW-PIB).	Agreement with IMGW and Institute of Oceanology of the Polish Academy of Sciences (IOPAN) to provide observed and modelled water level and surface currents data, respectively. HOPN coordinates the work.
Sweden	Ongoing. All decisions are taken. Many charts (ca 50%) already published. Implementation is a part of the "Chart Improvement Project", to be concluded at the latest in 2030. Information compaigns is ongoing for ports, pilots and other interested parties. Notices to Mariners 2019-05-15. Several articles written in magazines and on webpages.	All water level information is presented in relation to RH2000 (BSCD2000), since 2019-06-03. Some applications can also present data in relation to mean sea level (MSL). The differences between MSL and RH2000 is provided in this Table. Data distributed to BOOS/CMEMS in relation to BSCD2000. Responsibility of Swedish Maritime Administration (SMA) and Swedish Meteorological and Hydrological Institute (SMHI).	Discussions started between SMA and SMHI. SMA and SMHI take part in the BS e-Nav-project in cooperation with FMI on this. We will take further actions in 2025. SMA coordinates the work.

2025-03-25

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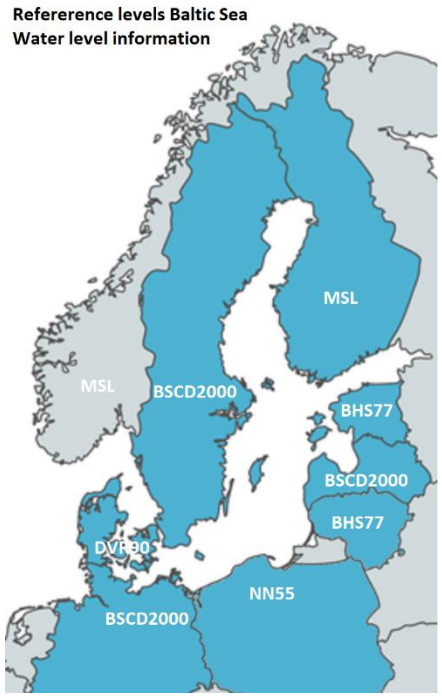
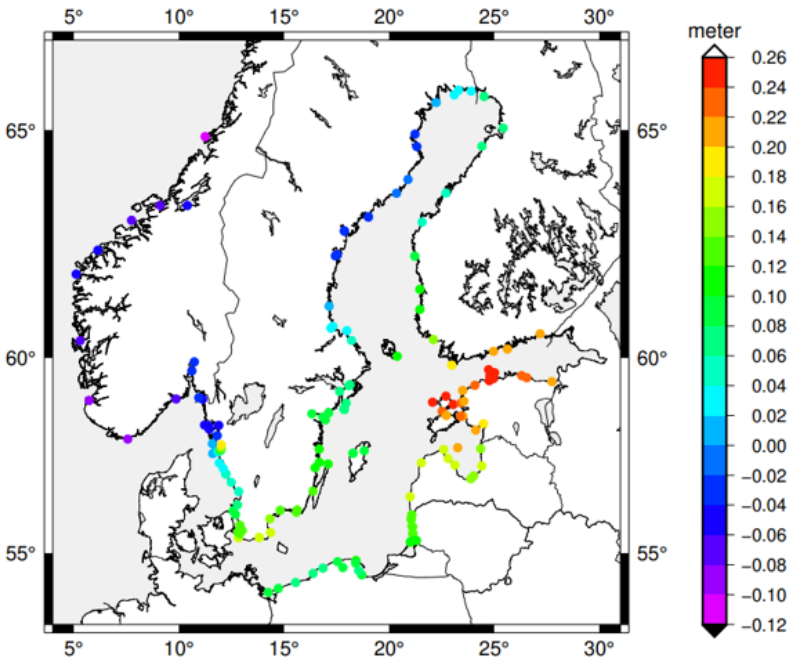
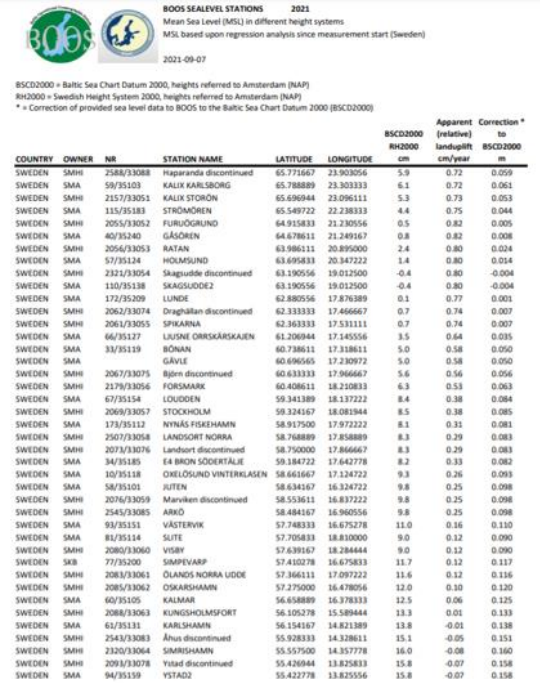
Reference levels in the Baltic Sea







BOOS SEALEVEL STATIONS 2021
Mean Sea Level (MSL) in different height systems
MSL based upon regression analysis since measurement start (Sweden)
2021-09-07

BSCD2000 = Baltic Sea Chart Datum 2000, heights referred to Amsterdam (NAP)
RH2000 = Swedish Height System 2000, heights referred to Amsterdam (NAP)
* = Correction of provided sea level data to BOOS to the Baltic Sea Chart Datum 2000 (BSCD2000)

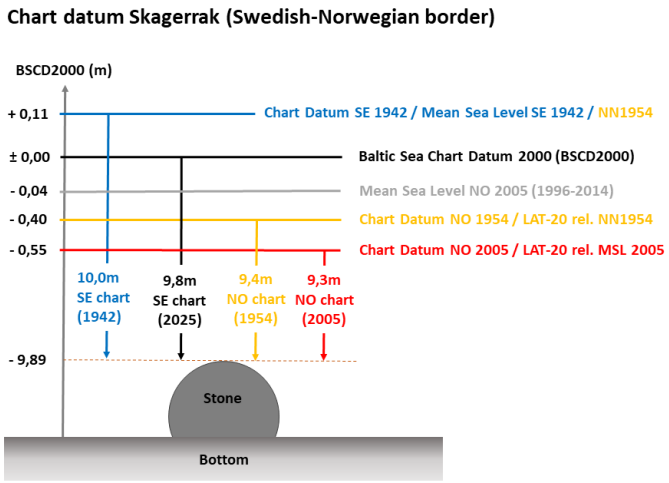
COUNTRY	OWNER	NR	STATION NAME	LATITUDE	LONGITUDE	BSCD2000 RH2000 cm	Apparent (relative) landuplift cm/year	Correction * to BSCD2000 m
SWEDEN	SMHI	2588/33088	Haparanda discontinued	65.771667	23.903056	5.9	0.72	0.059
SWEDEN	SMA	59/35103	KALIX KARLSBORG	65.788889	23.303333	6.1	0.72	0.061
SWEDEN	SMHI	2157/33051	KALIX STORÖN	65.696944	23.096111	5.3	0.73	0.053
SWEDEN	SMA	115/35183	STRÖMÖREN	65.549722	22.238333	4.4	0.75	0.044
SWEDEN	SMHI	2055/33052	FURUÖGRUND	64.915833	21.230556	0.5	0.82	0.005
SWEDEN	SMA	40/35240	GÄSÖREN	64.678611	21.249167	0.8	0.82	0.008
SWEDEN	SMHI	2056/33053	RATAN	63.986111	20.895000	2.4	0.80	0.024
SWEDEN	SMA	57/35124	HOLMSUND	63.695833	20.347222	1.4	0.80	0.014
SWEDEN	SMHI	232/33054	Skagsudde discontinued	63.190556	19.012500	-0.4	0.80	-0.004
SWEDEN	SMA	110/35138	SKAGSUDDE2	63.190556	19.012500	-0.4	0.80	-0.004
SWEDEN	SMA	172/35209	LUNDE	62.880556	17.876389	0.1	0.77	0.001
SWEDEN	SMHI	2062/33074	Draghällan discontinued	62.333333	17.466667	0.7	0.74	0.007
SWEDEN	SMHI	2061/33055	SPIKARNA	62.363333	17.531111	0.7	0.74	0.007
SWEDEN	SMA	66/35127	LJUSNE ORRSKÄRSKAJEN	61.206944	17.145556	3.5	0.64	0.035
SWEDEN	SMA	33/35119	BÖNAN	60.738611	17.318611	5.0	0.58	0.050
SWEDEN	SMA		GÄVLE	60.696565	17.230972	5.0	0.58	0.050
SWEDEN	SMHI	2067/33075	Björn discontinued	60.633333	17.966667	5.6	0.56	0.056
SWEDEN	SMHI	2179/33056	FORSMARK	60.408611	18.210833	6.3	0.53	0.063
SWEDEN	SMA	67/35154	LOUDDEN	59.341389	18.137222	8.4	0.38	0.084
SWEDEN	SMHI	2069/33057	STOCKHOLM	59.324167	18.081944	8.5	0.38	0.085
SWEDEN	SMA	173/35112	NYNÄS FISKEHAMN	58.917500	17.972222	8.1	0.31	0.081
SWEDEN	SMHI	2507/33058	LANDSORT NORRA	58.768889	17.858889	8.3	0.29	0.083
SWEDEN	SMHI	2073/33076	Landsort discontinued	58.750000	17.866667	8.3	0.29	0.083
SWEDEN	SMA	34/35185	E4 BRON SÖDERTÄLJE	59.184722	17.642778	8.2	0.33	0.082
SWEDEN	SMA	10/35118	OXELÖSUND VINTERKLASEN	58.661667	17.124722	9.3	0.26	0.093
SWEDEN	SMA	58/35101	JUTEN	58.634167	16.324722	9.8	0.25	0.098
SWEDEN	SMHI	2076/33059	Marviken discontinued	58.553611	16.837222	9.8	0.25	0.098
SWEDEN	SMHI	2545/33085	ARKÖ	58.484167	16.960556	9.8	0.25	0.098
SWEDEN	SMA	93/35151	VÄSTERVIK	57.748333	16.675278	11.0	0.16	0.110
SWEDEN	SMA	81/35114	SLITE	57.705833	18.810000	9.0	0.12	0.090
SWEDEN	SMHI	2080/33060	VISBY	57.639167	18.284444	9.0	0.12	0.090
SWEDEN	SKB	77/35200	SIMPEVARP	57.410278	16.675833	11.7	0.12	0.117
SWEDEN	SMHI	2083/33061	ÖLANDS NORRA UDDE	57.366111	17.097222	11.6	0.12	0.116
SWEDEN	SMHI	2085/33062	OSKARSHAMN	57.275000	16.478056	12.0	0.10	0.120
SWEDEN	SMA	60/35105	KALMAR	56.658889	16.378333	12.5	0.06	0.125
SWEDEN	SMHI	2088/33063	KUNGSHOLMSFORT	56.105278	15.589444	13.3	0.01	0.133
SWEDEN	SMA	61/35131	KARLSHAMN	56.154167	14.821389	13.8	-0.01	0.138
SWEDEN	SMHI	2543/33083	Ånus discontinued	55.928333	14.328611	15.1	-0.05	0.151
SWEDEN	SMHI	2320/33064	SIMRISHAMN	55.557500	14.357778	16.0	-0.08	0.160
SWEDEN	SMHI	2093/33078	Ystad discontinued	55.426944	13.825833	15.8	-0.07	0.158
SWEDEN	SMA	94/35159	YSTAD2	55.422778	13.825556	15.8	-0.07	0.158

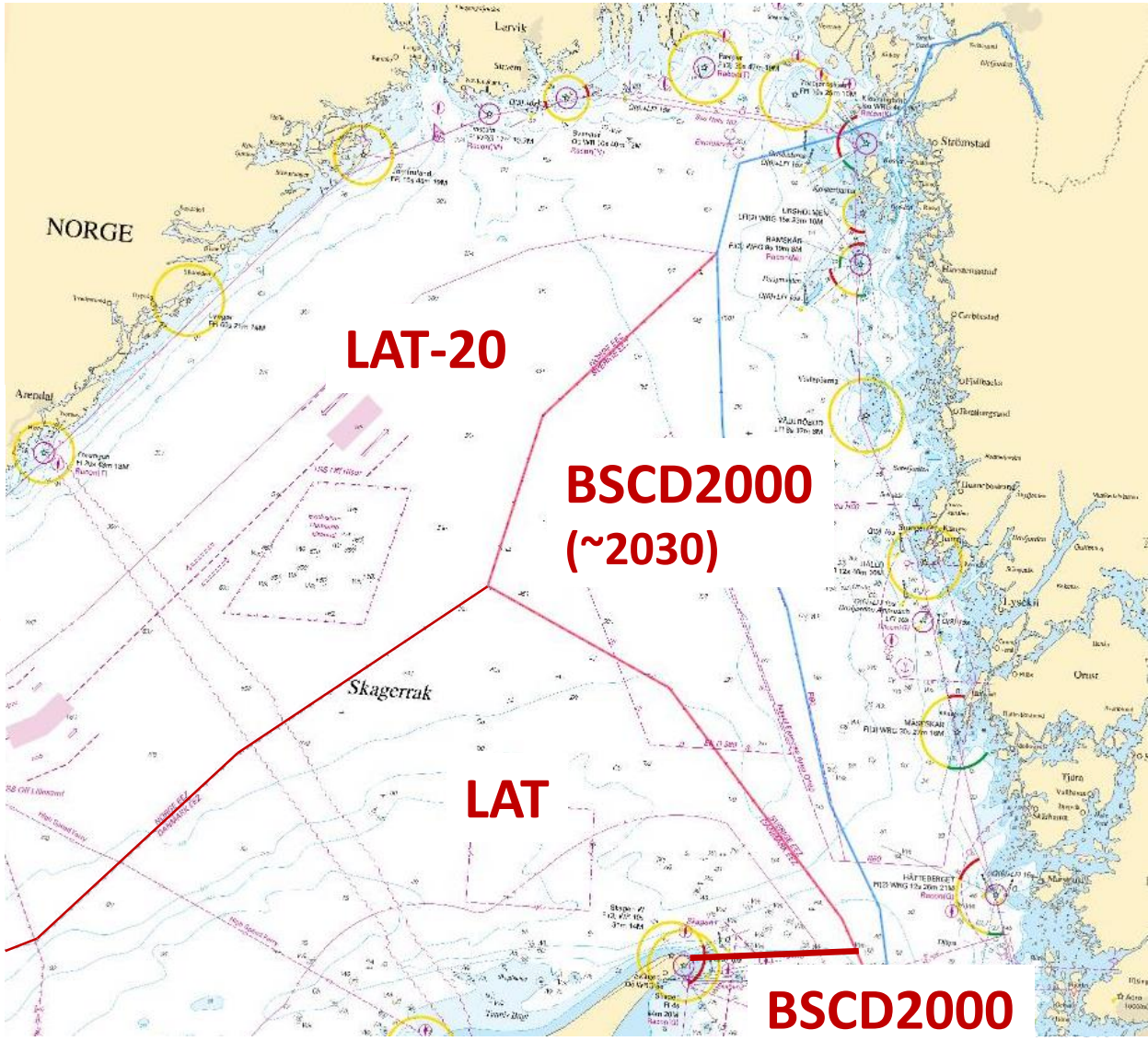
Reference levels used in the Baltic Sea and differences with respect to the Baltic Sea Chart Datum 2000 (BSCD2000). In Sweden and Finland, the old reference levels are equal to Mean Sea Level (MSL) transferred to year 2025 (according to different national conventions). The values from Norway shows the MSL over the period 1996-2014, relative NN2000/BSCD2000. In Estonia, Latvia and Lithuania, the Kronstadt datum was previously used as chart datum. In Poland, the local Polish Height System Amsterdam NN_{55} was used as chart datum. Notice how postglacial rebound reduces the magnitude of the MSL in the Bay of Bothnia. The values are shown in this Table.

SWEDISH MARITIME ADMINISTRATION

Reference levels in Skagerack

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





New reference level in Sweden

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

SWEDISH MARITIME ADMINISTRATION

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

SWEDISH MARITIME ADMINISTRATION

Notices to Mariners (NtM)

*** 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

SWEDISH MARITIME ADMINISTRATION

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

Svensk

English

SWEDISH MARITIME ADMINISTRATION

A uniform reference system from land to sea

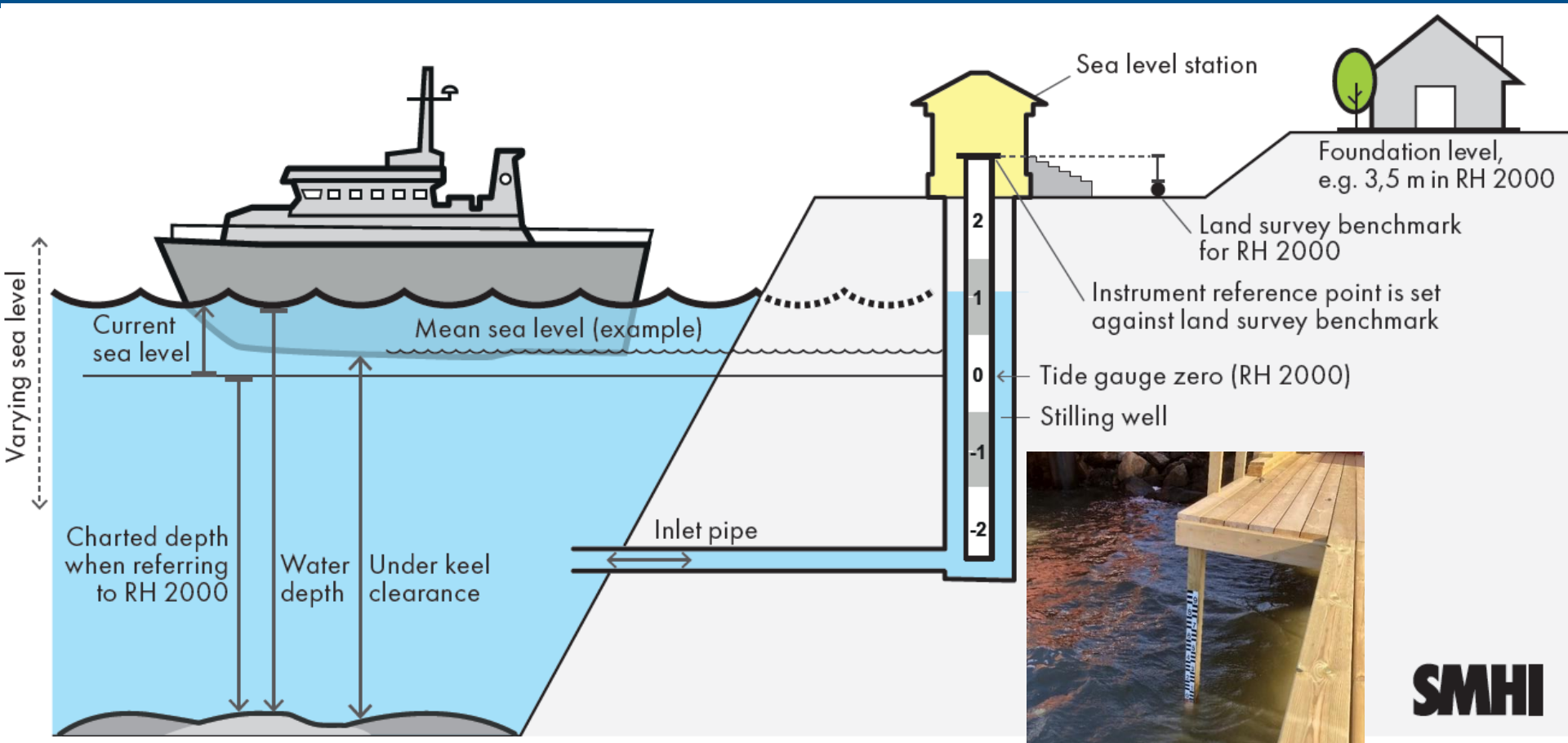


Illustration Veronica Wärn SMHI

SWEDISH MARITIME ADMINISTRATION

Co-financed by the European Union
Connecting Europe Facility

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

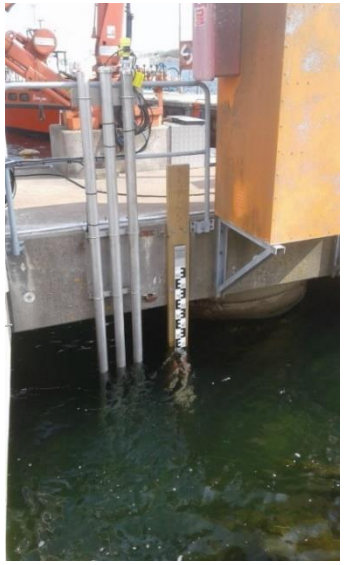
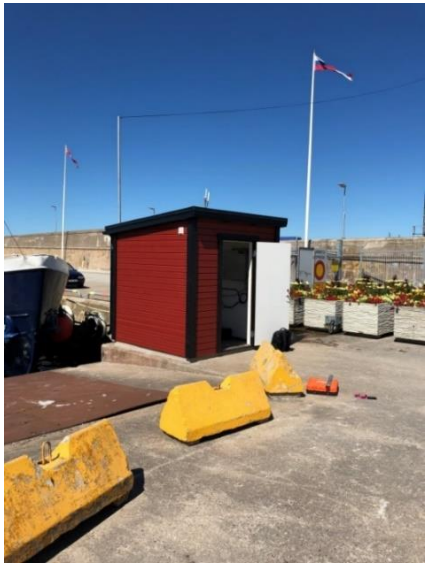
Class I	Upgrade with battery backup	27 stations (23 SMHI, 3 SMA, 1 CTH)
Class II	Upgrade without battery backup	27 stations (23 SMA, 3 GBG, 1 SKB)
Class III	Unchanged, temporary	6 stations (6 SMA)

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

SWEDISH MARITIME ADMINISTRATION

Upgrade of the Swedish Sea Level network 2017-2019

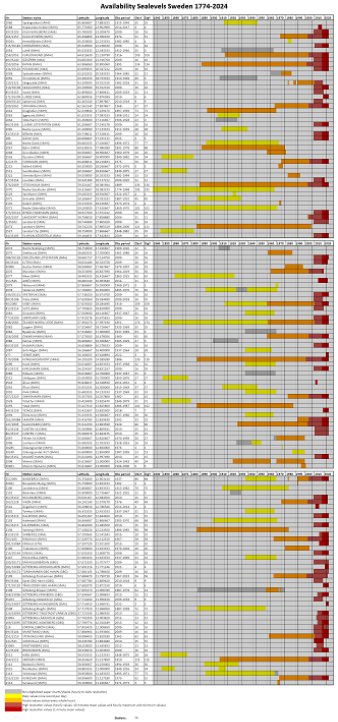
- One common and harmonised Swedish Sea Level network
- Upgrade and modernize 53 stations in the new network, two new sensors at all stations
- Sea level data of better accuracy, continuous time series
- Open and faster access to quality controlled real-time and archive data
- All stations connected 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 MARITIME ADMINISTRATION

Swedish Sea Level observations 1774-2025

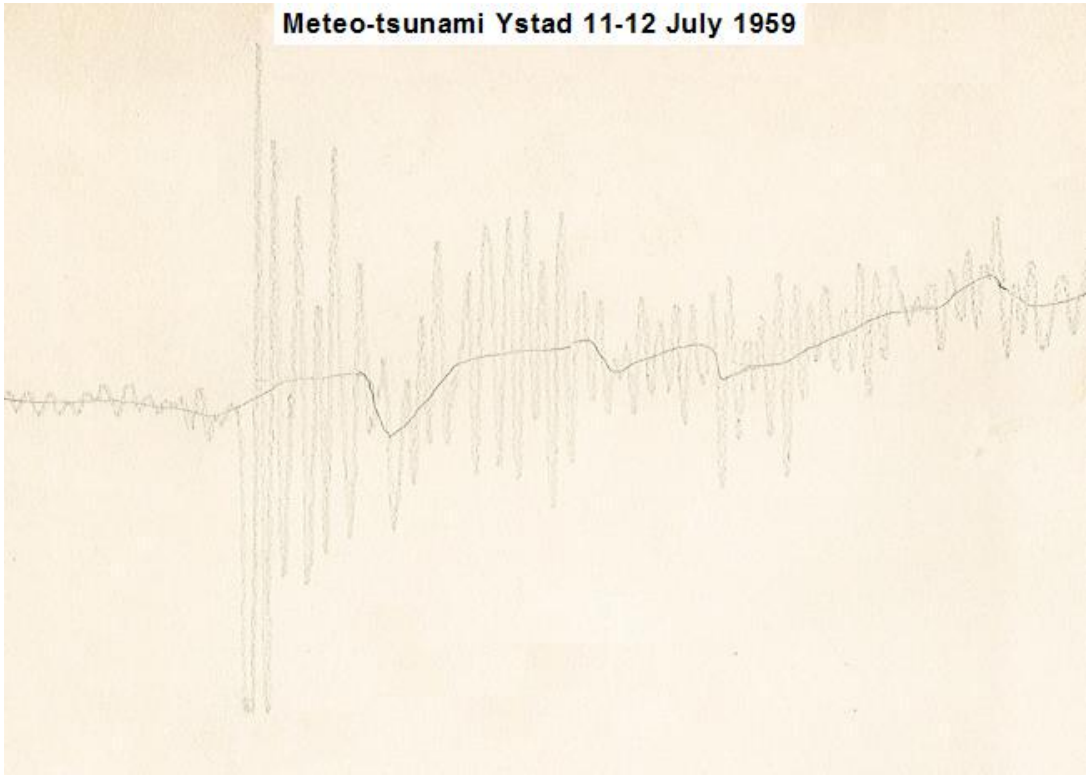
- First observations started in Stockholm 1774
- 141 sea level stations/records, 60 stations are active (2024)
- 5067 years of observations, 4699 years of data are digitalized (93%)
- 2305 years from continued stations, 100% digitalized
  - High-Resolution data (1-15 minutes)
  - Hourly values
  - Daily values



SWEDISH MARITIME ADMINISTRATION

Phenomena in Swedish Sea Level data

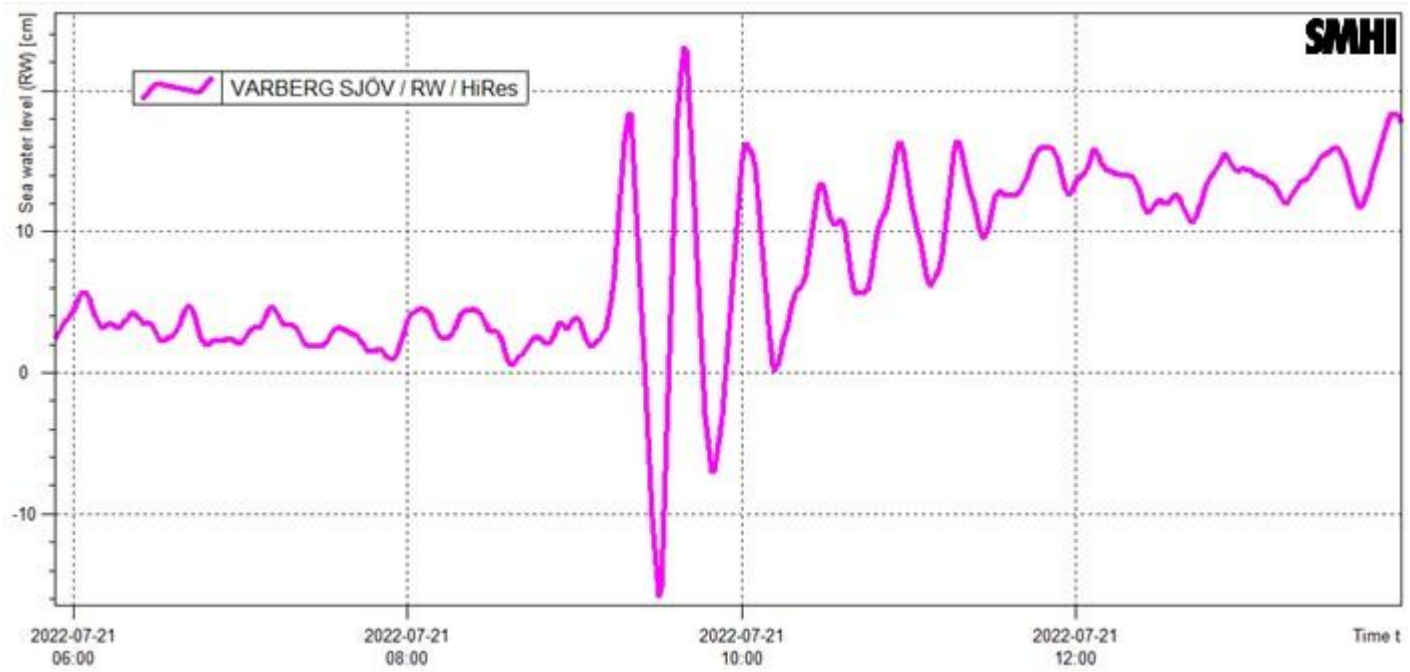
Meteo-tsunami Ystad 11-12 July 1959

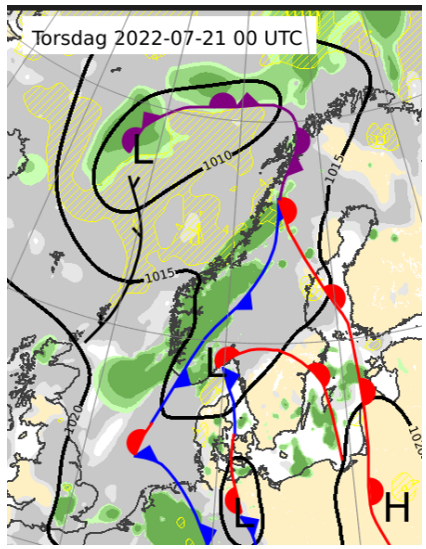


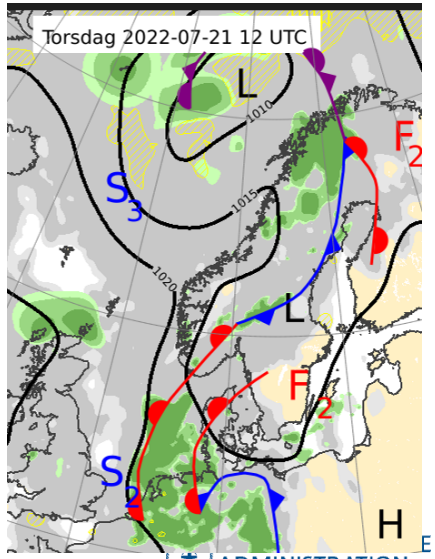
Disturbance lasted about: 6 hours
Largest difference between high and low: 132 cm
Time between two highs or lows (period): 10 minutes

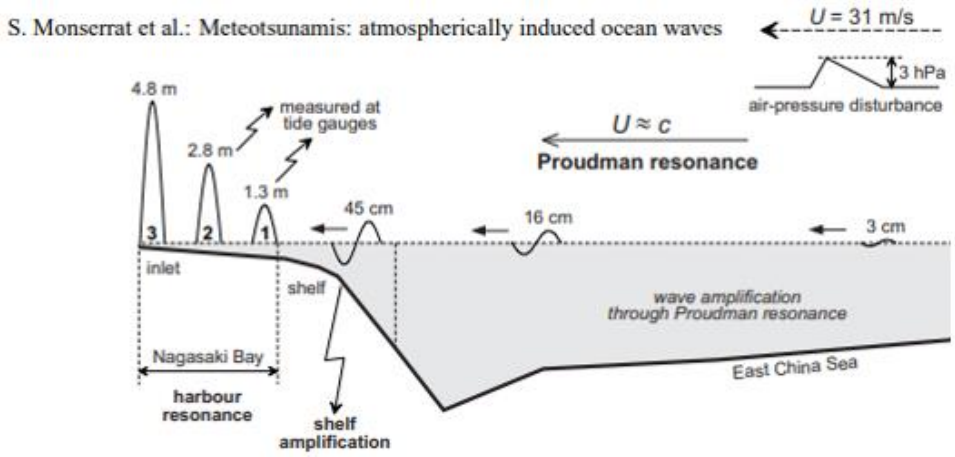
SWEDISH MARITIME ADMINISTRATION

Meteo-tsunami Varberg 21st July 2022

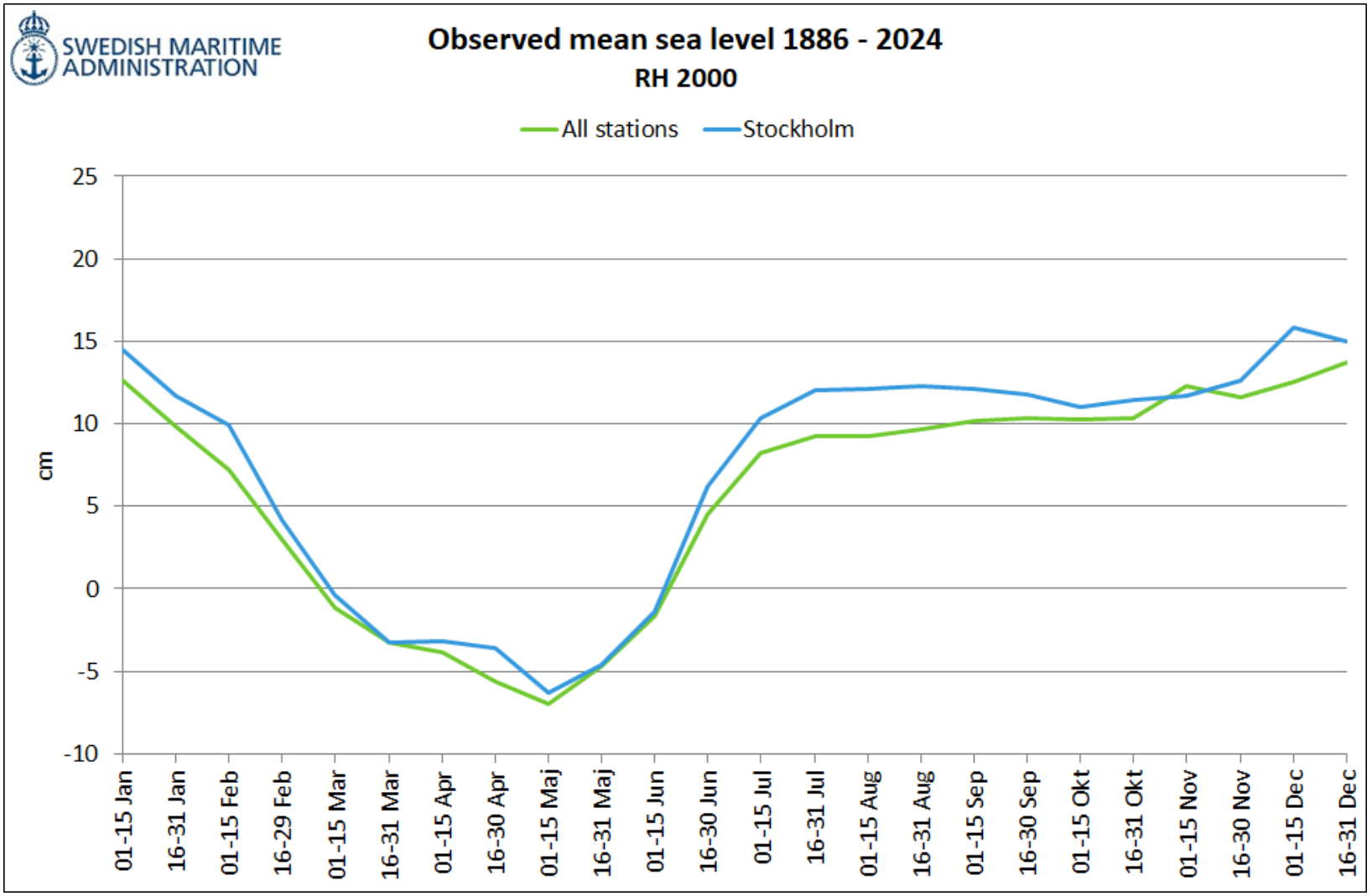




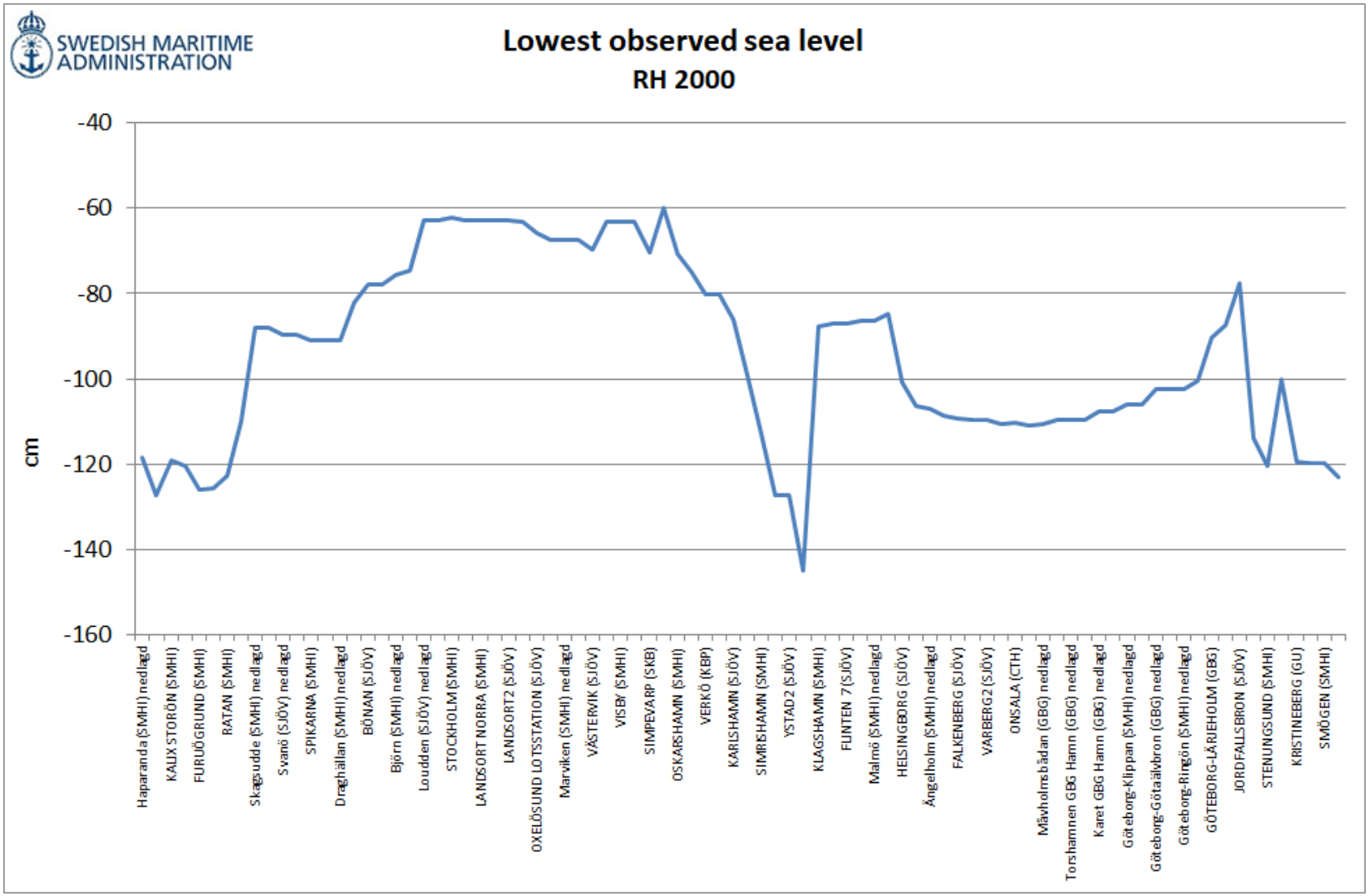




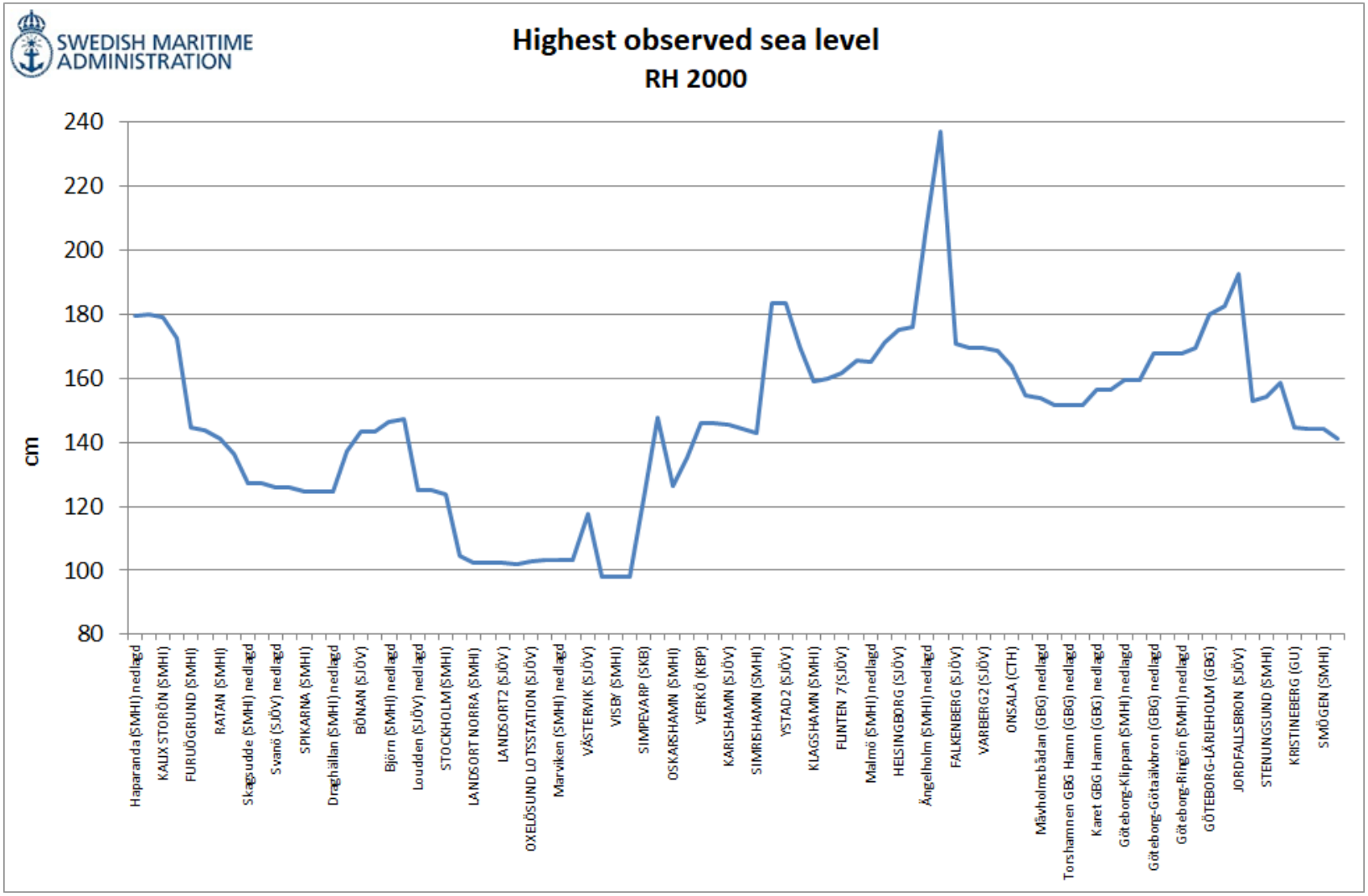
Observed mean sea level



Lowest observed sea level

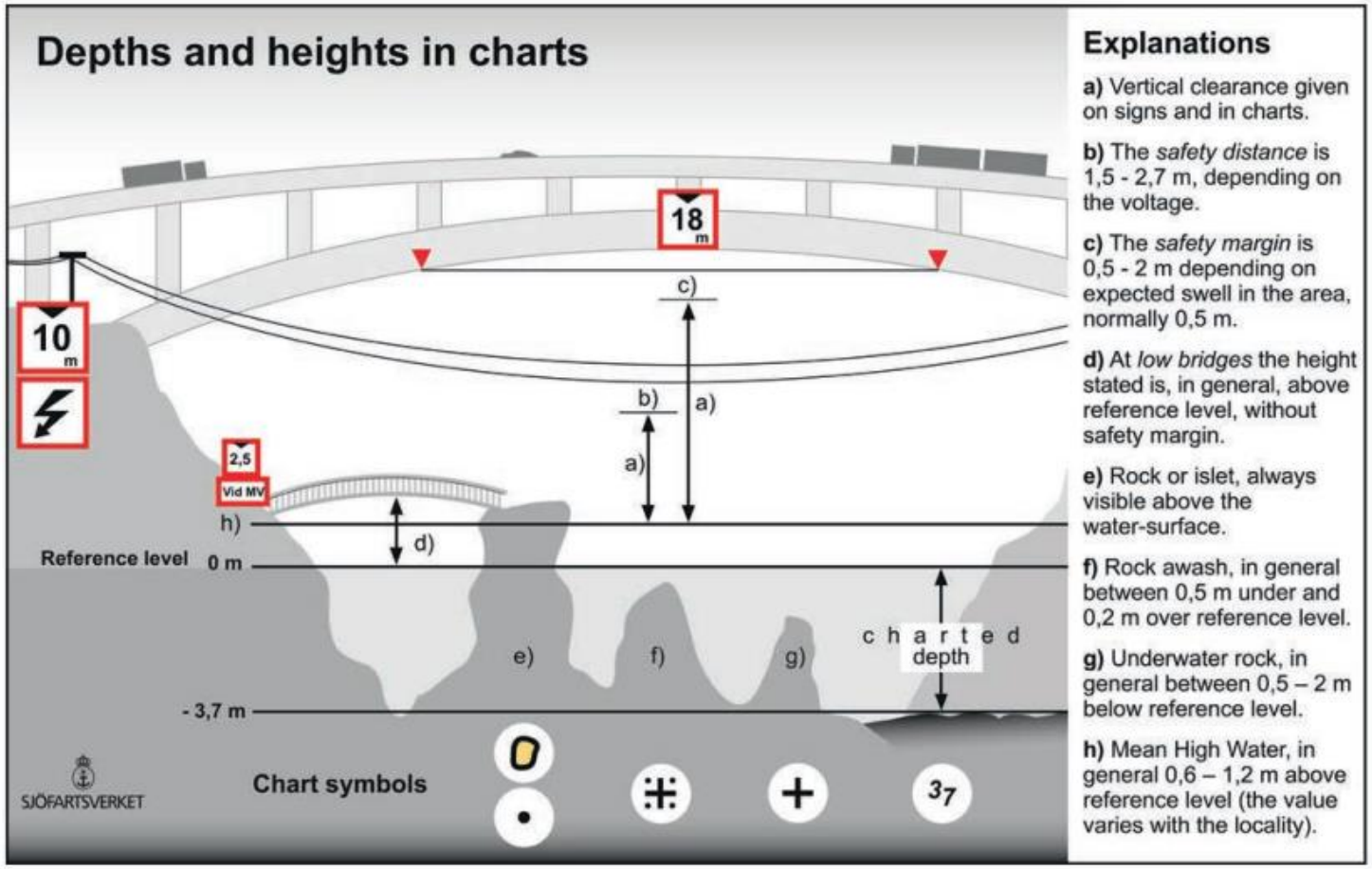


Highest observed sea level



SWEDISH MARITIME ADMINISTRATION

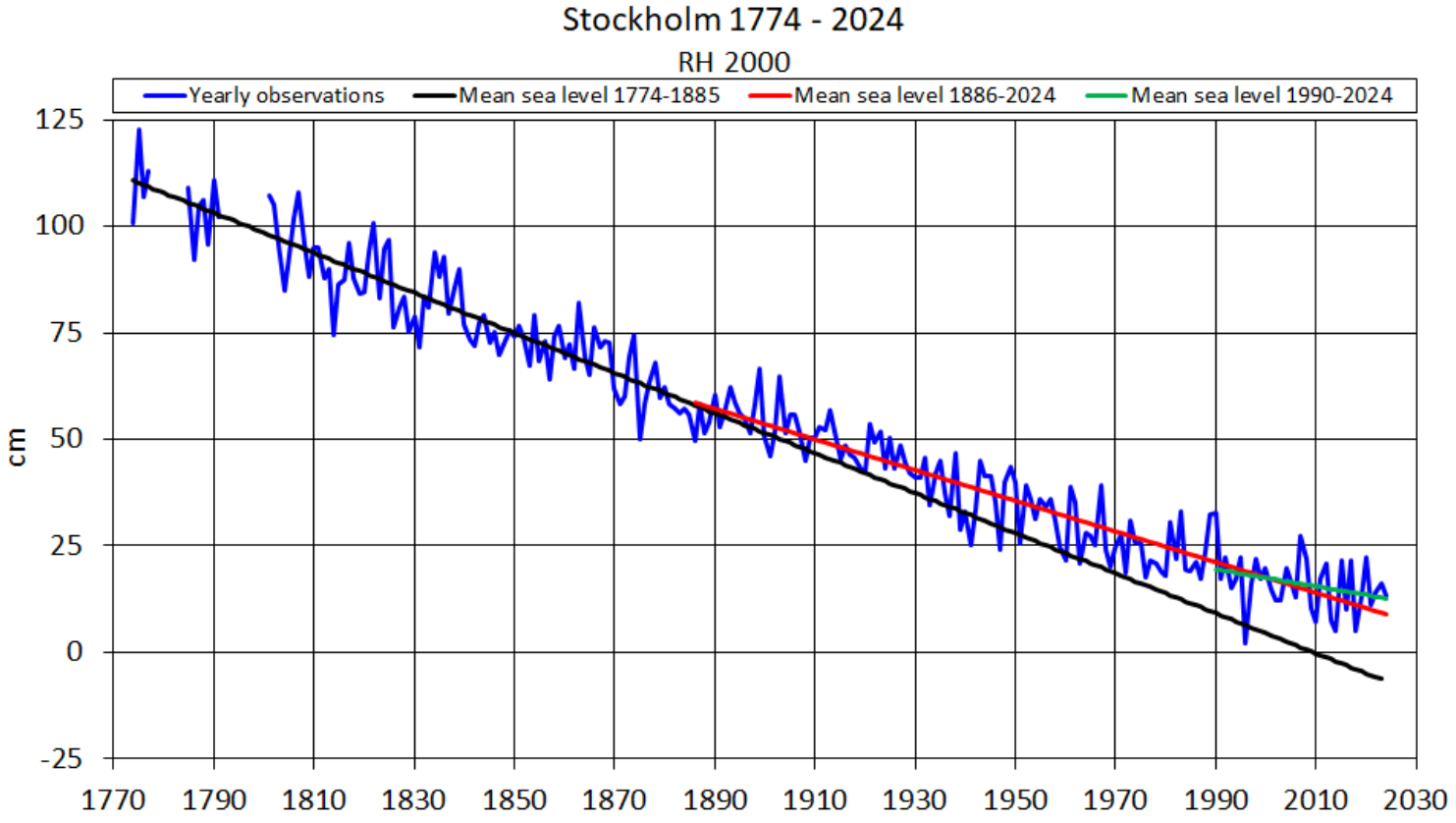
Vertical clearance and mean high water

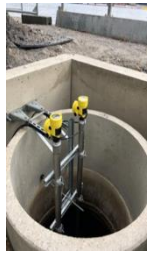


Calculated mean high water (MHW)

SWEDISH MARITIME ADMINISTRATION

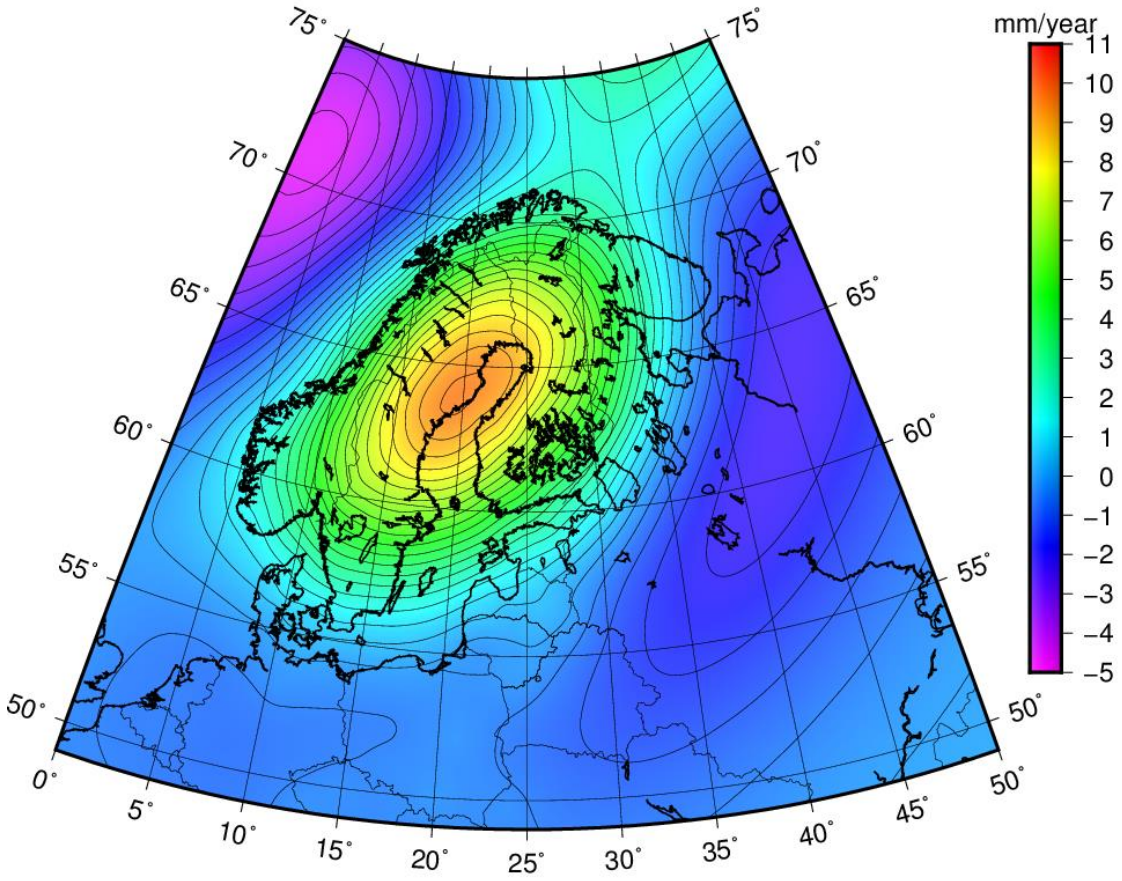
Stockholm
”World’s longest sea level record”





SWEDISH MARITIME ADMINISTRATION

Land-uplift

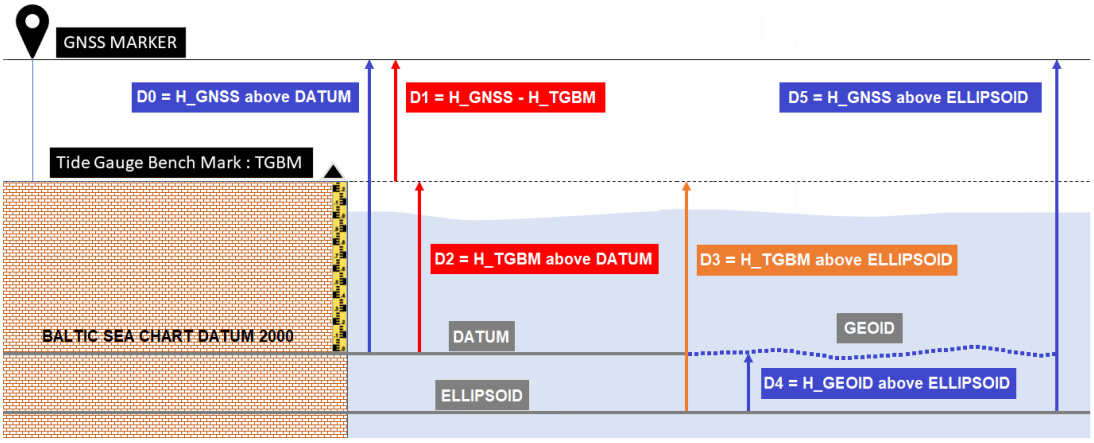


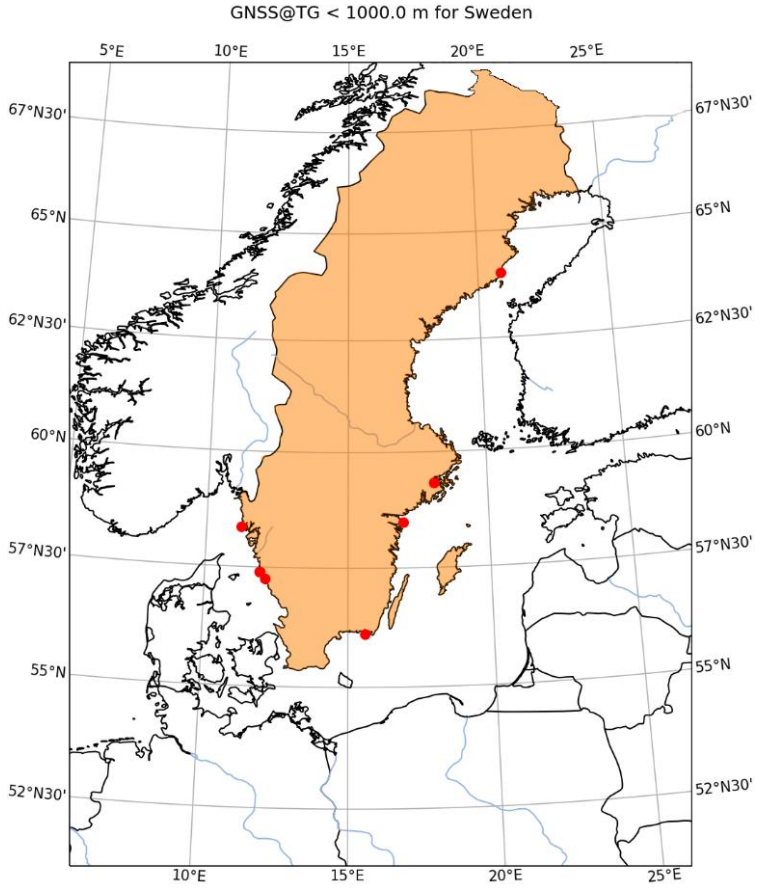
Levelled land-uplift (relative the geoid, NKG2016LU_lev) from the Nordic Geodetic Commission´s (NKG) land-uplift model NKG2016LU

SWEDISH MARITIME ADMINISTRATION

Co-location of sea level stations and GNSS

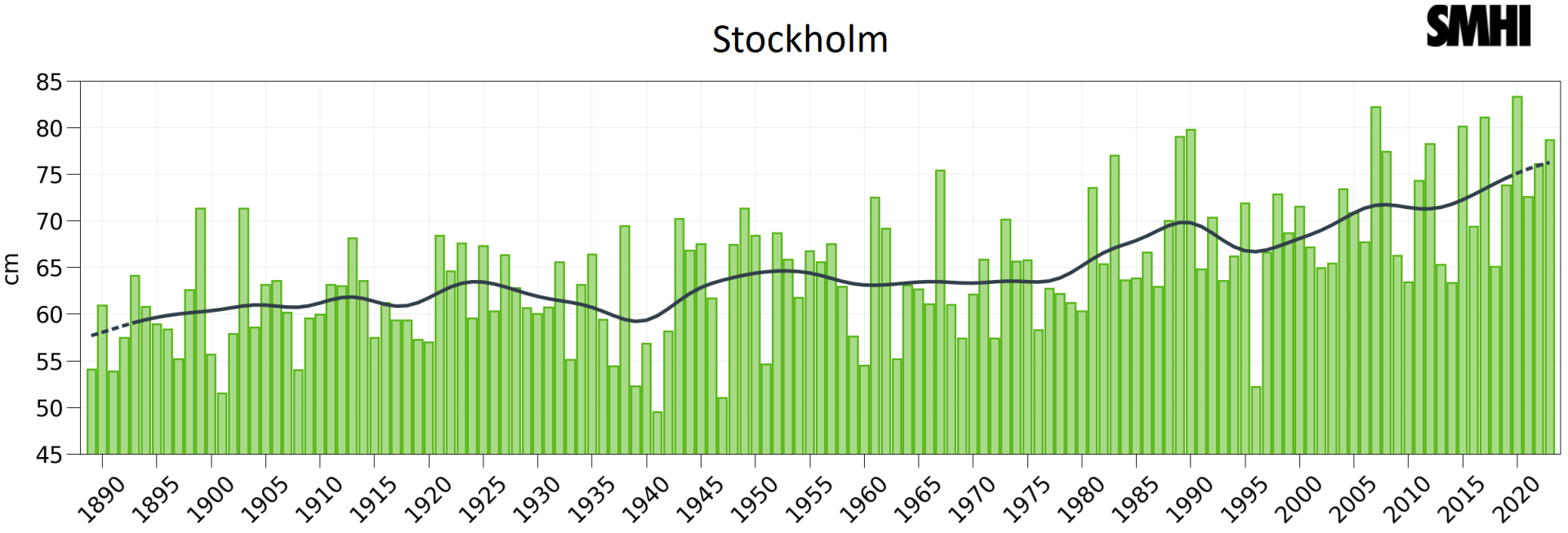
RESPONSIBLE AGENCY		TIDE GAUGE COORDINA		CO-LOCATED INSTRUMENTS			GNSS COORDINATES		CO-LOCATED CRITERIA		LEVELING INFORMATION	
RESPONSIBLE FOR GNSS	RESPONSIBLE FOR TG	LON	LAT	TIDE_GAUGE	GNSS_SONEL	GNSS_SWEPOS	LON	LAT	INSTALLED	GNSS->TG HORIZONTAL DISTANCE (m)	TGBM_ID	DATUM DEFINITION
SWEPOS-LMV	SMHI	20.895031	63.986056	RATAN	RAT0	RATA.0	20.89556580	63.98558831	2006-06-09	58	h	BSCD2000/RH2000
SWEPOS-LMV	SMHI	18.081944	59.324167	STOCKHOLM	0MOS	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	0ARK	ARKO.1	16.96265021	58.48327049	2019-08-26	158	101	BSCD2000/RH2000
SWEPOS-LMV	SMHI	15.589444	56.105278	KUNGSHOLMSFORT	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	ONSALA	ONSA	ONSA.0	11.92551310	57.39529604	1993-07-01	533	827a	BSCD2000/RH2000
SWEPOS-LMV	Chalmers	11.919167	57.391944	ONSALA	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





SWEDISH MARITIME ADMINISTRATION

Sea level rise



Observed sea level change in Stockholm since 1889

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

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

SWEDISH MARITIME ADMINISTRATION

Future sea levels

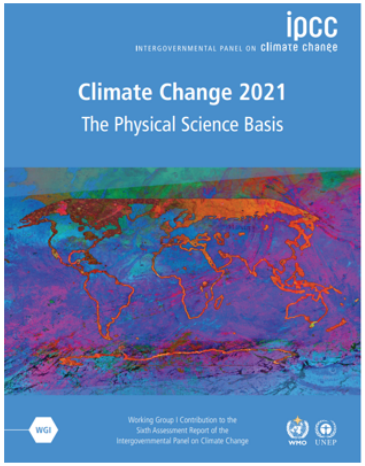
SWEDISH MARITIME ADMINISTRATION

PM

Thomas Hammarklint
Hydrographic Office

Published 2019-11-30
Updated 2024-08-16

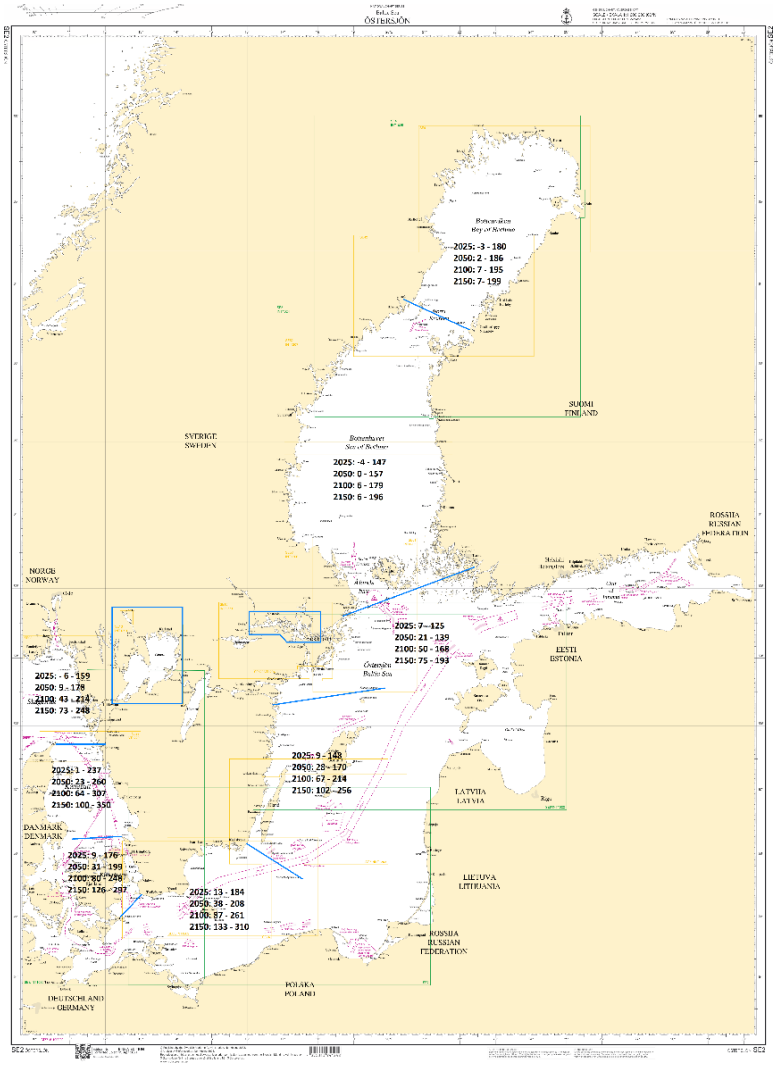
Future sea levels in Sweden



In 2021, the Intergovernmental Panel on Climate Change (IPCC) released the Sixth Assessment Report; AR6 Interim Report 1 - The Physical Science Basis [IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change] (AR6 WG1), where they present the latest calculations, including on future sea levels. SMHI has compiled data for probable projections for the years 2050, 2100 and 2150 municipality by municipality on its website (SMHI Future mean sea levels), which has been used in the calculations in this memorandum.

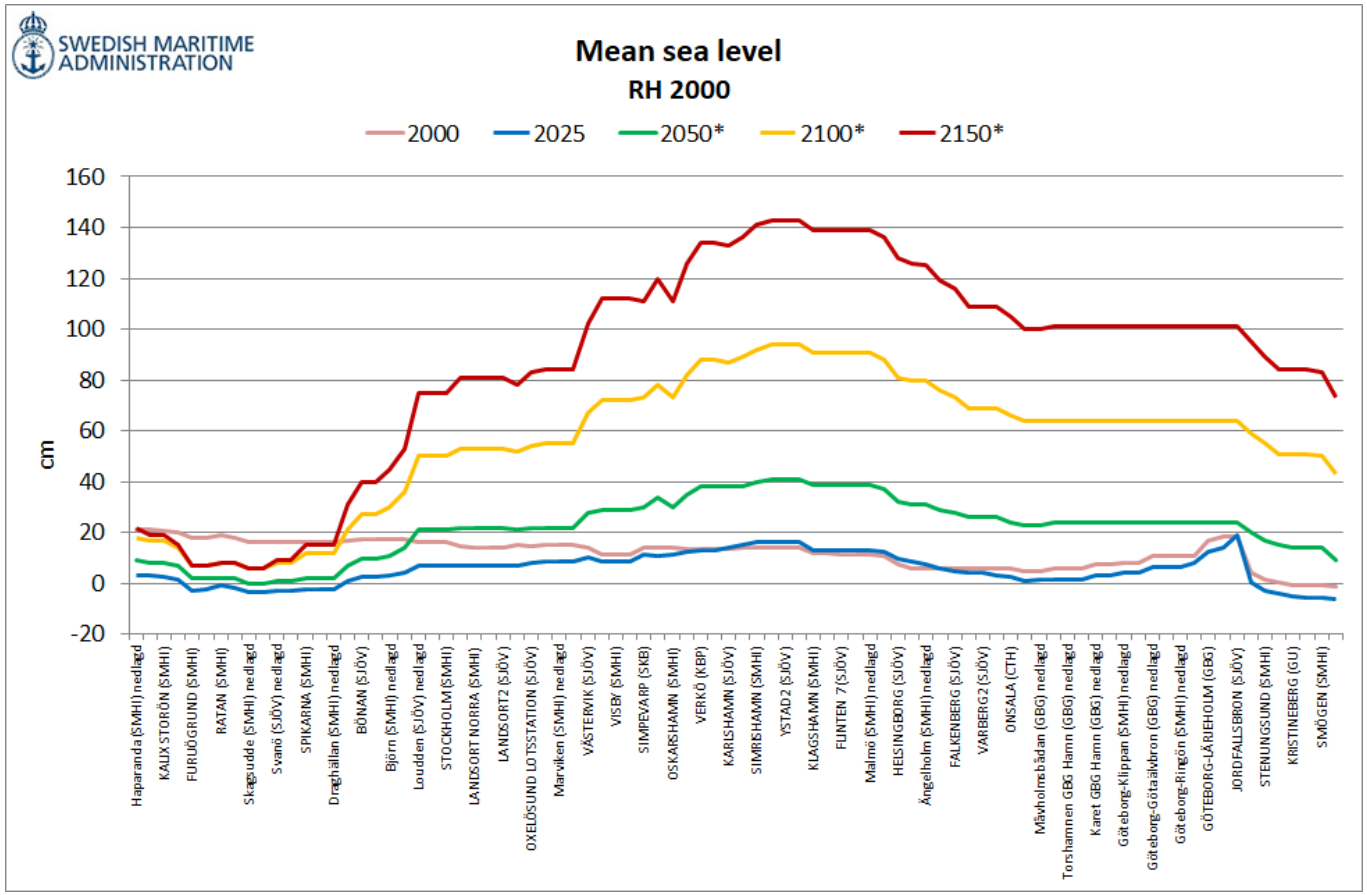
Summary

Calculations of mean sea levels and highest sea levels for the years 2024, 2050, 2100 and 2150 have been conducted for 86 Swedish stations (Figures 5, 6, 7 and Appendix Table 1). The results are based on analysis of historical observational data from 1886 through 2023 (SMHI Open Data Service, Availability Swedish sea levels) and extreme levels calculated at SMHI (SMHI Extreme levels) regional data on global sea level rise from the SSP5-8.5 projection (Figure 4, median values, likely scenario) in the Intergovernmental Panel on Climate Change (IPCC) projections presented in AR6 Interim Report 1 - The Scientific Basis ((AR6 WG1) and total (aggregated) land uplift data compiled by SMHI (SMHI Future mean sea levels), which is based on the Nordic Commission for Geodesy (NKG) land uplift model (NKG2016LU). All results are reported in Sweden's national reference system for depths, heights and water levels; Land Survey Datum 2000 (RH 2000) or Baltic Sea Chart Datum 2000 (BSCD2000).



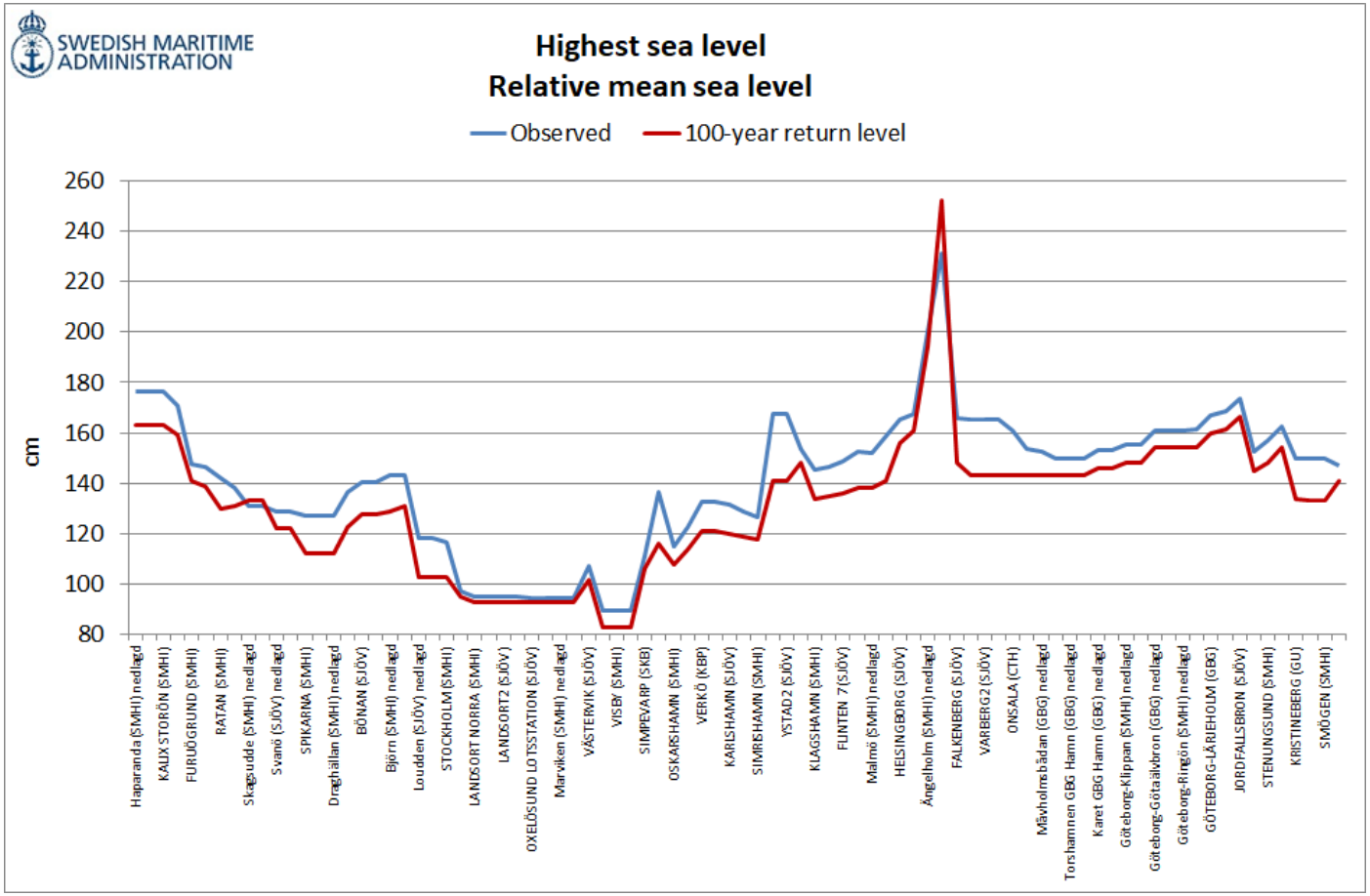
SWEDISH MARITIME ADMINISTRATION

Mean sea level



Calculated mean sea level in RH 2000 (cm) for the years 2000, 2025, 2050*, 2100* and 2150* at 86 Swedish stations, * incl. sea level rise according to IPCC´s projection SSP5-8.5 median values (IPCC, AR6 WG1) and total land uplift (SMHI Future mean sea levels)

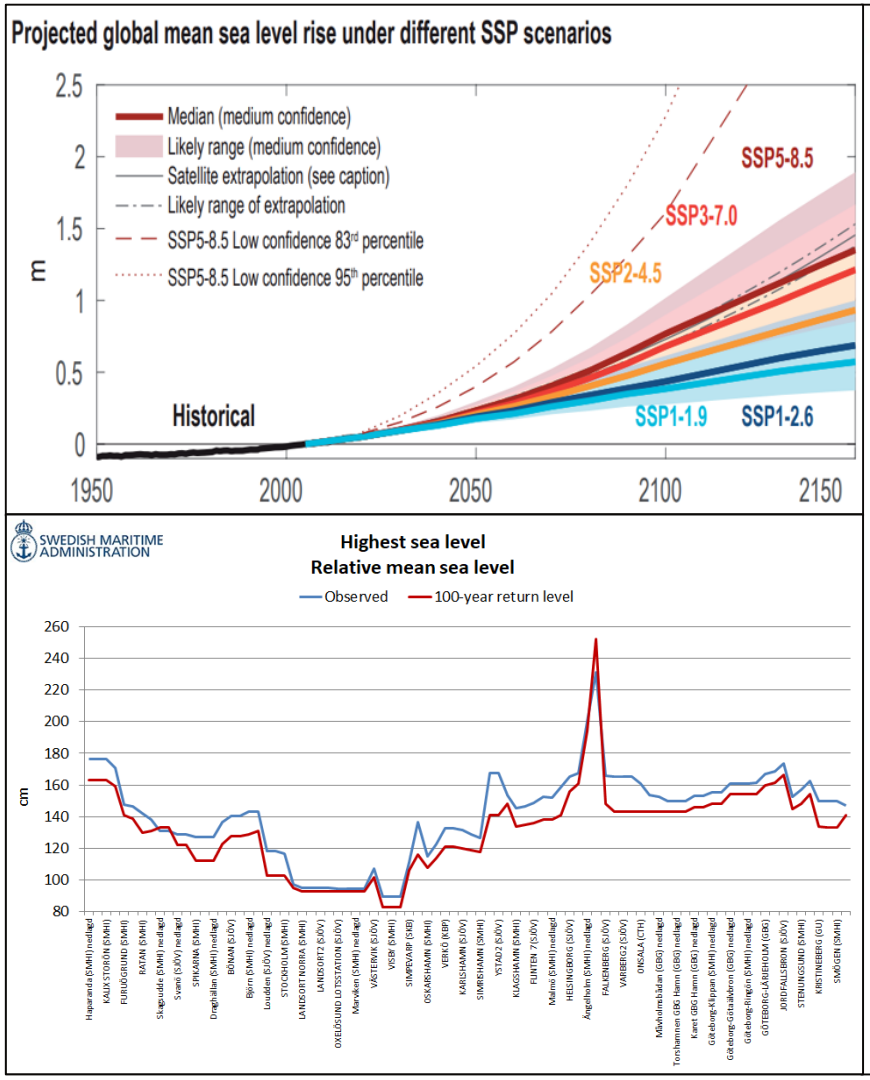
Highest sea level

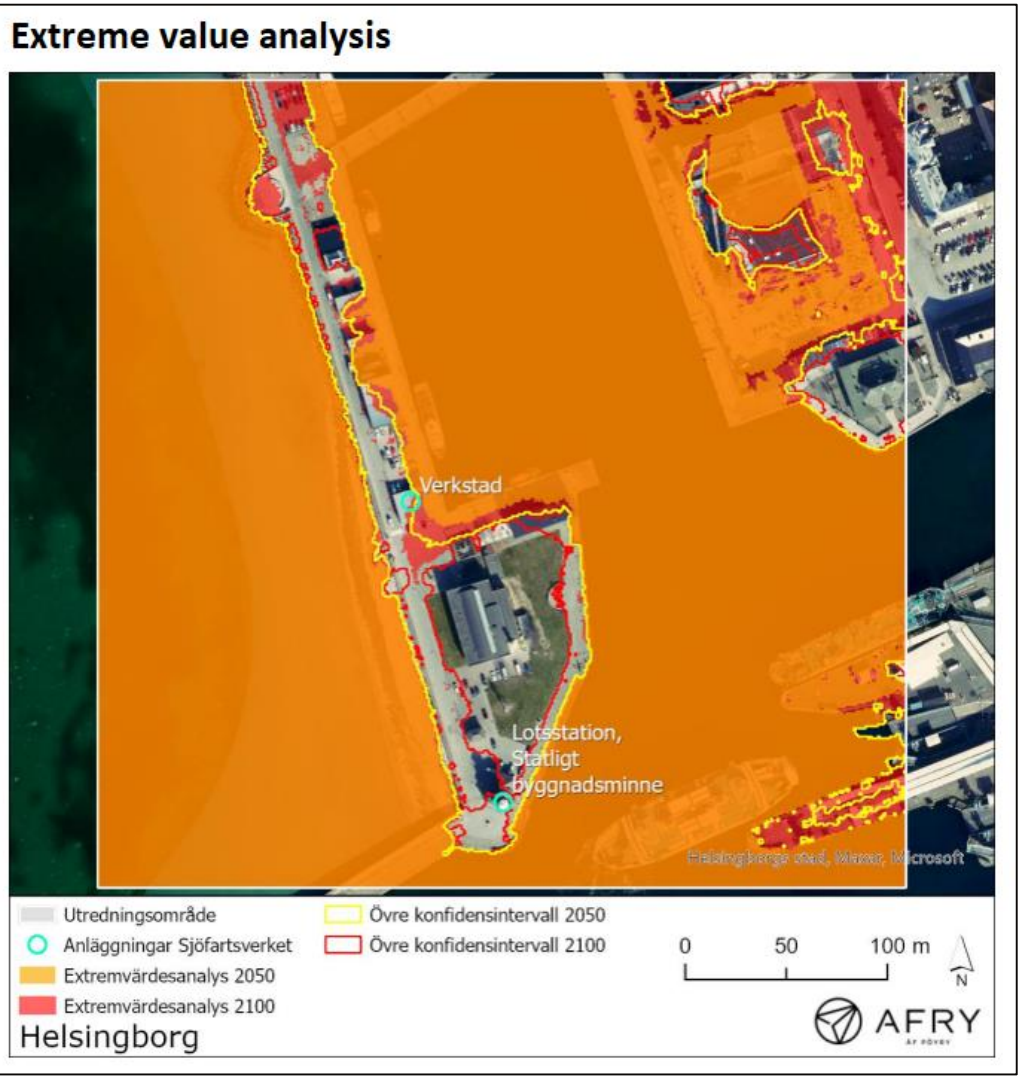


Highest observed sea level and 100-year return level, relative mean sea level, at 86 Swedish stations

SWEDISH MARITIME ADMINISTRATION

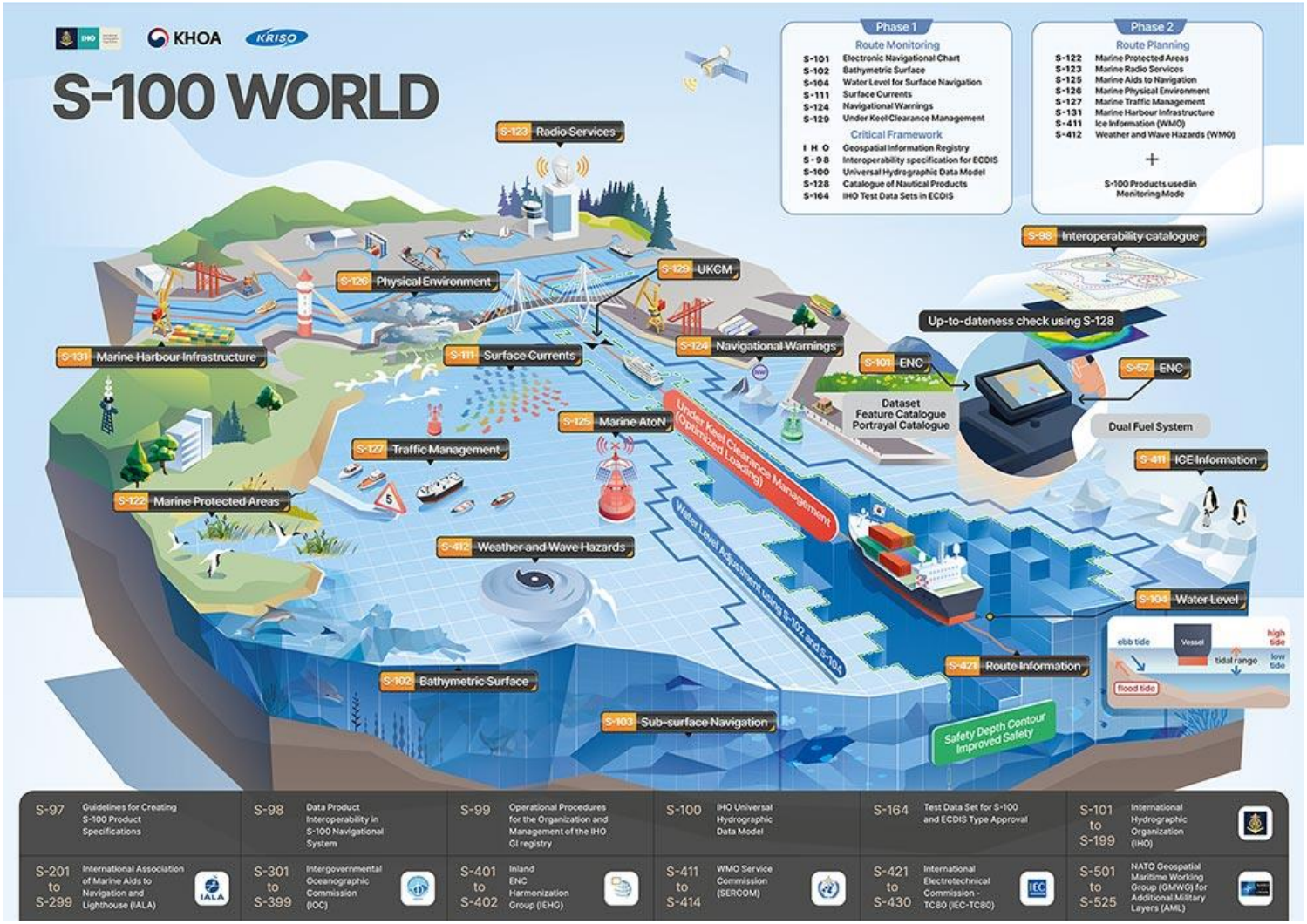
Future sea levels / climate adaptation





SWEDISH MARITIME ADMINISTRATION

Future Maritime Services S-100

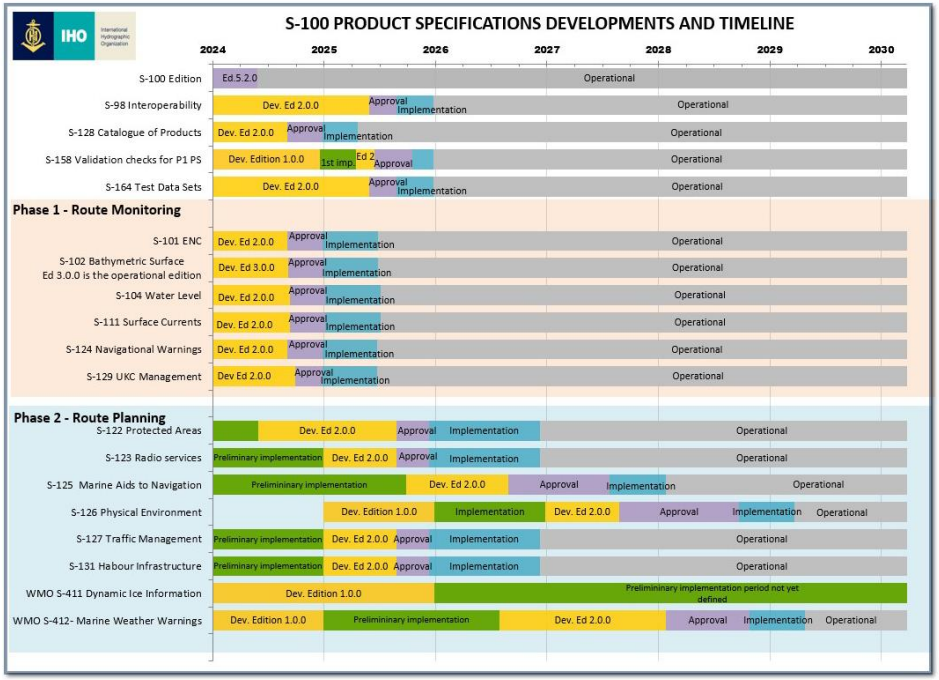


SWEDISH MARITIME ADMINISTRATION

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



This S-100 timeline is updated: 02 07 2024

2025 → **2026** Ships allowed to use S-products → **2027** → **2028** → **2029** S-products are mandatory

SWEDISH MARITIME ADMINISTRATION

S-100 Implementation Sweden

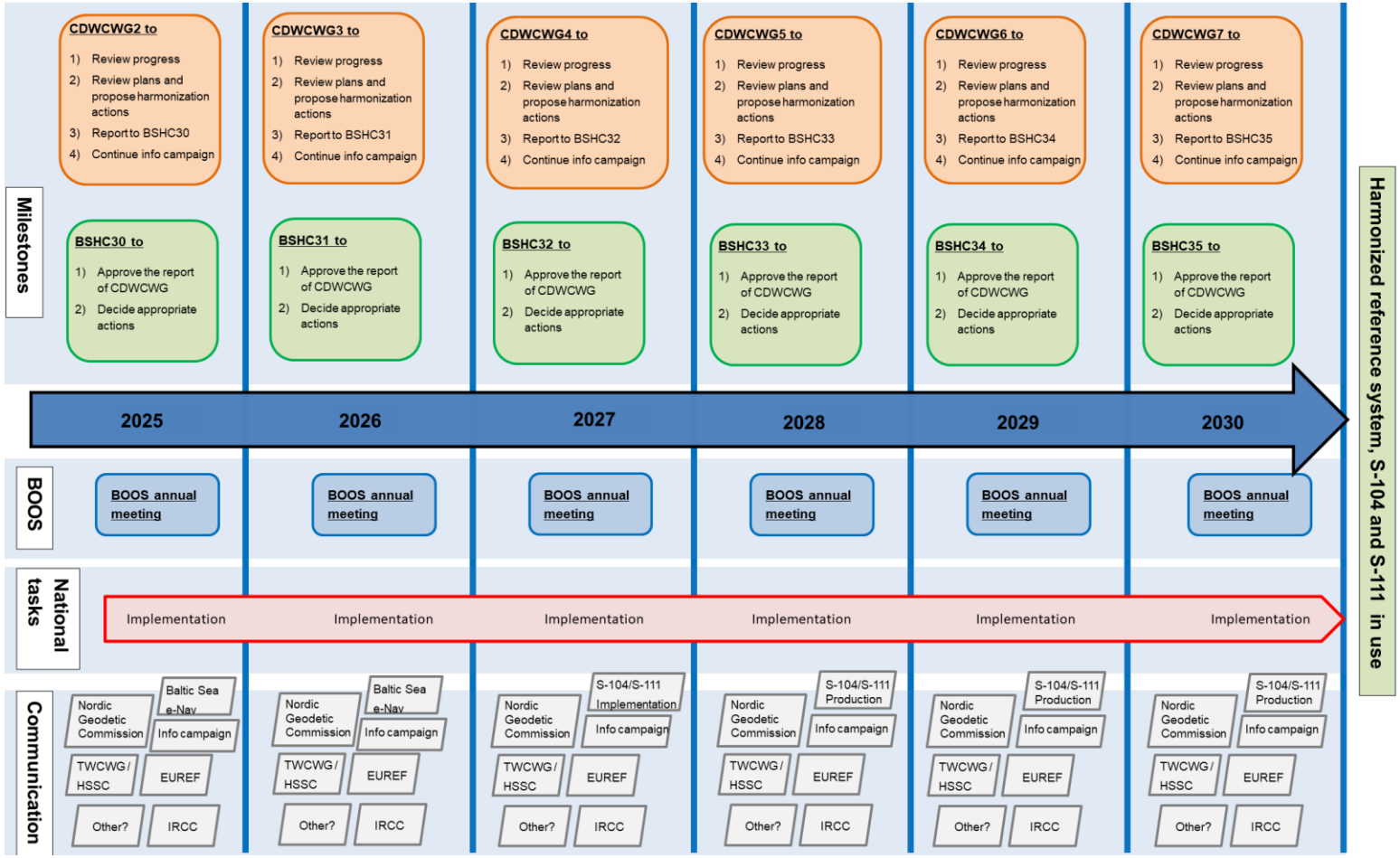
Products	2024	2025	2026	2027	2028	2029	2030	2031	2032
ENC S-101									
Bathymetry S-102									
Ensuring confidentiality rules for S-102									
Catalogue of Nautical Products S-128 via PRIMAR									
Water Level S-104 (in cooperation with SMHI*)									
Surface Currents S-111 (in cooperation with SMHI*)									
Navigational Warnings S-124									
Marine Protected Areas S-122 (in cooperation with SwAM*)									
Marine Radio Services S-123									
Marine Traffic Management S-127									
Marine Harbour Infrastructure S-131									

*SMHI – Swedish Meteorological and Hydrological Institute, SwAM – Swedish Agency Marine and Water Management

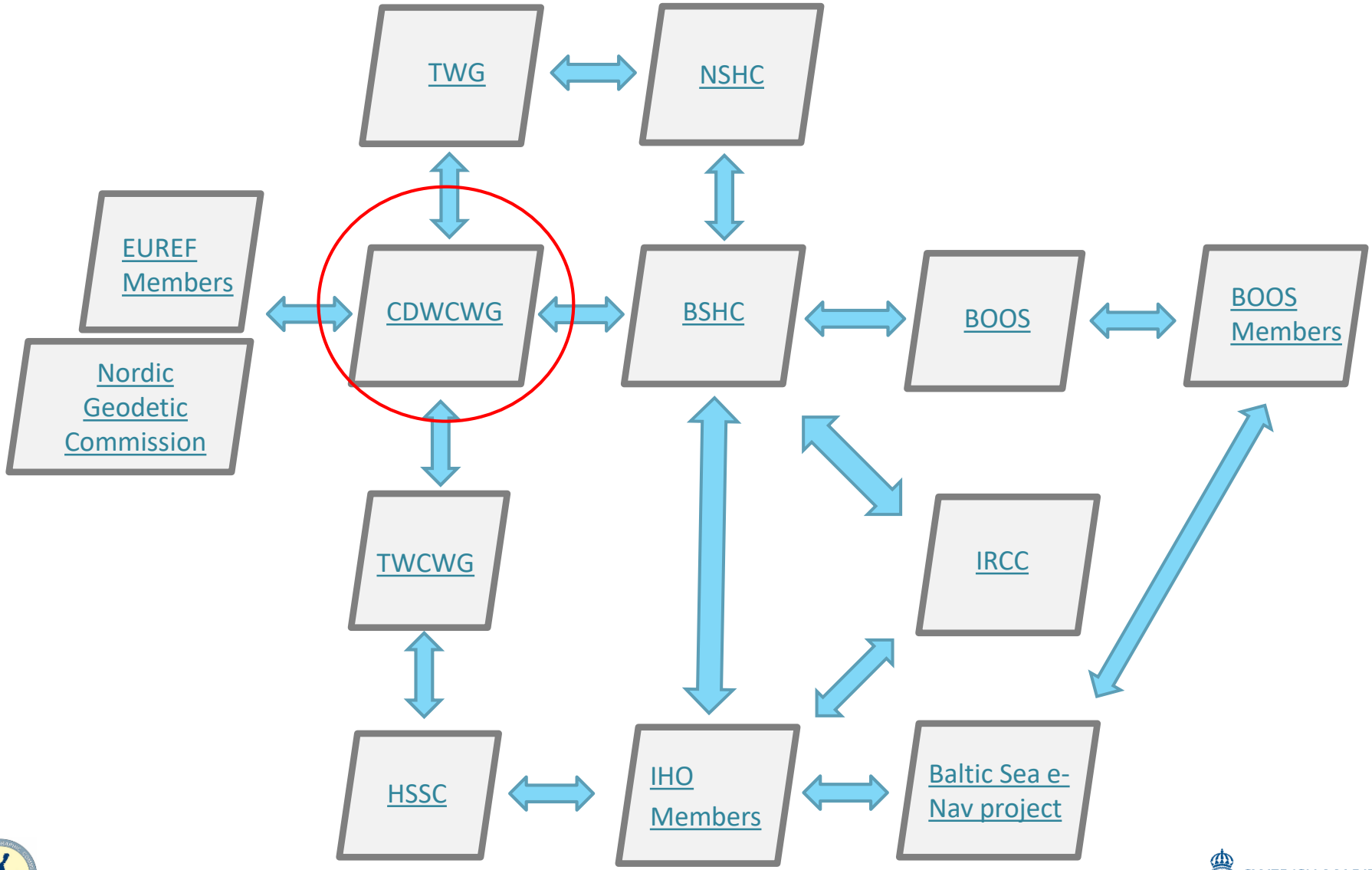
SWEDISH MARITIME ADMINISTRATION

CDWCWG Roadmap

RoadMap
BSHC CDWCWG / Harmonized Reference System / S-104 and S-111 Implementation / Time Line
2024-10-11



CDWCWG International relations



SWEDISH MARITIME ADMINISTRATION

Real Time Hydrographic and Environmental Information Service

Infrastructure

Co-financed by the Connecting Europe Facility of the European Union

Gravity surveys

Hydrographic surveys

Geoid model

Baltic Sea Chart Datum 2000

Bathymetry database

Oceanographic observations

Oceanographic model

COPERNICUS
MARINE ENVIRONMENT MONITORING SERVICE
Providing PRODUCTS and SERVICES for all marine applications

S-100 products

Bathymetry

S-101 ENC
S-102 Bathymetric Surface

Water Level

S-104 Water Level Information for Surface Navigation

Surface Currents

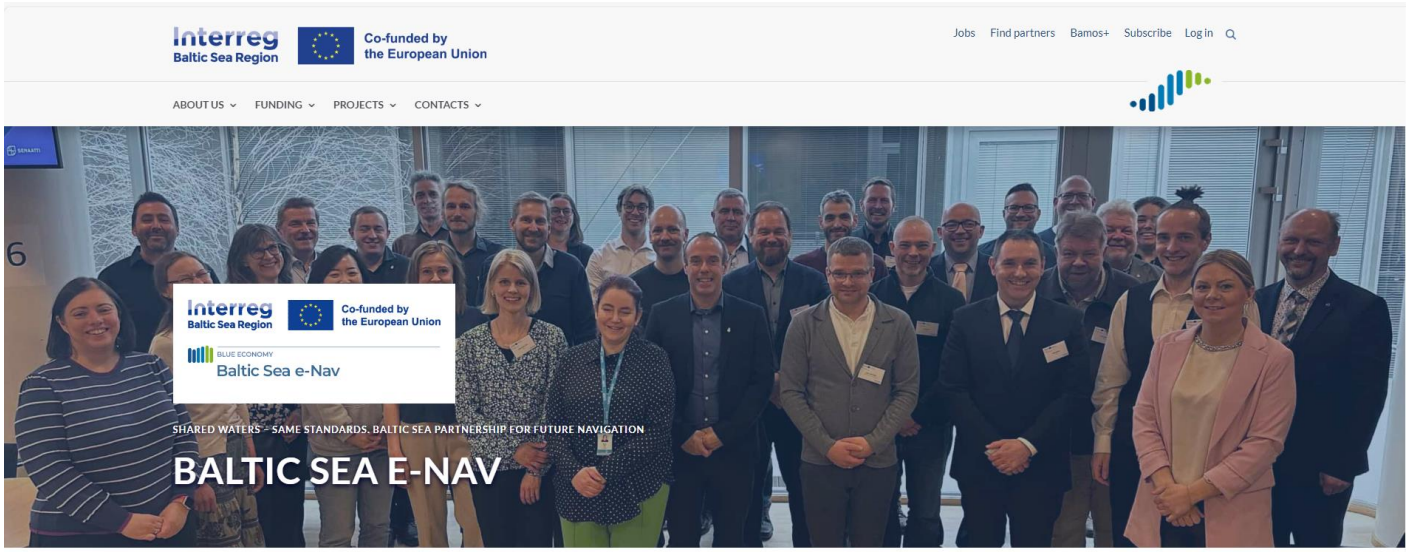
S-111 Surface Currents

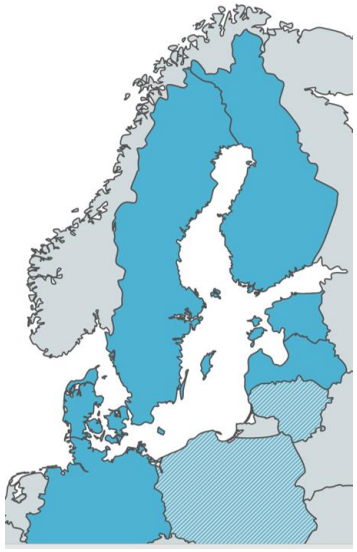
Under Keel Clearance

S-129 Under Keel Clearance Management (UKCM)

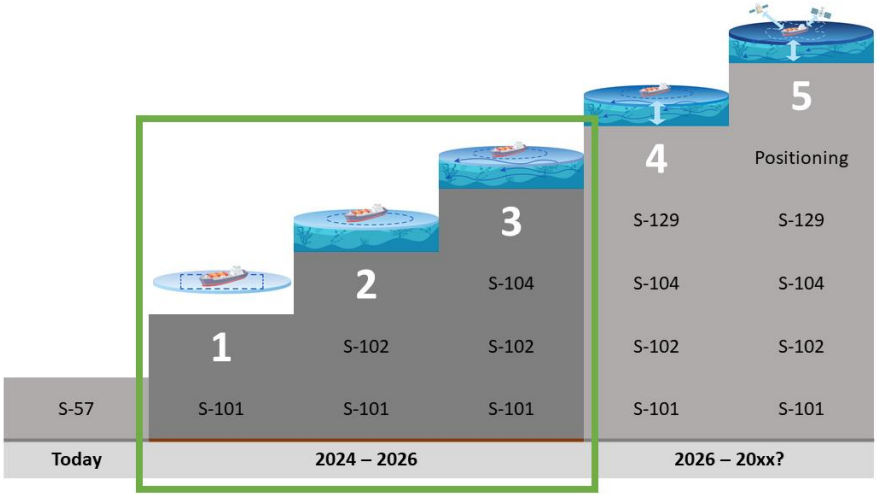
SWEDISH MARITIME ADMINISTRATION

Baltic Sea e-Nav Interreg project 2023-2026



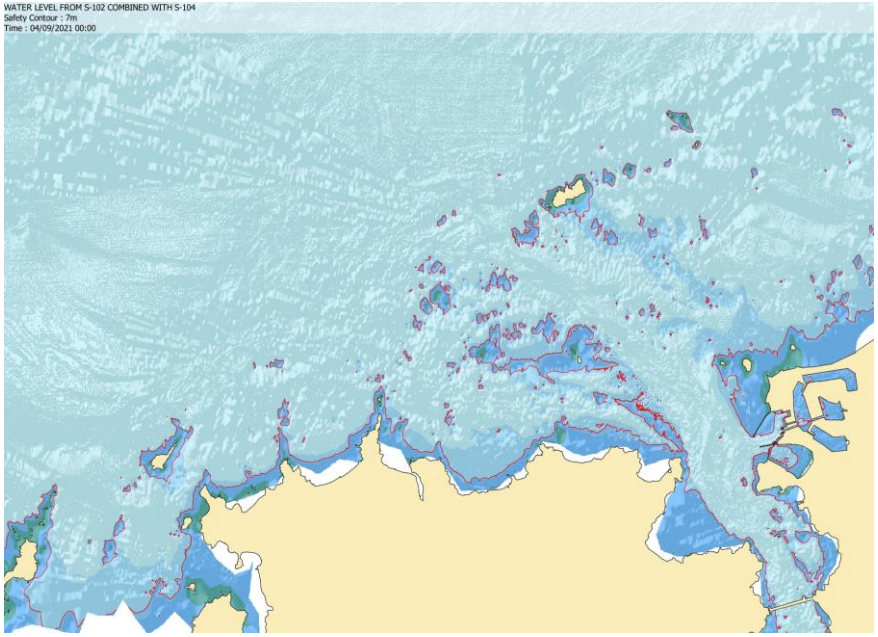


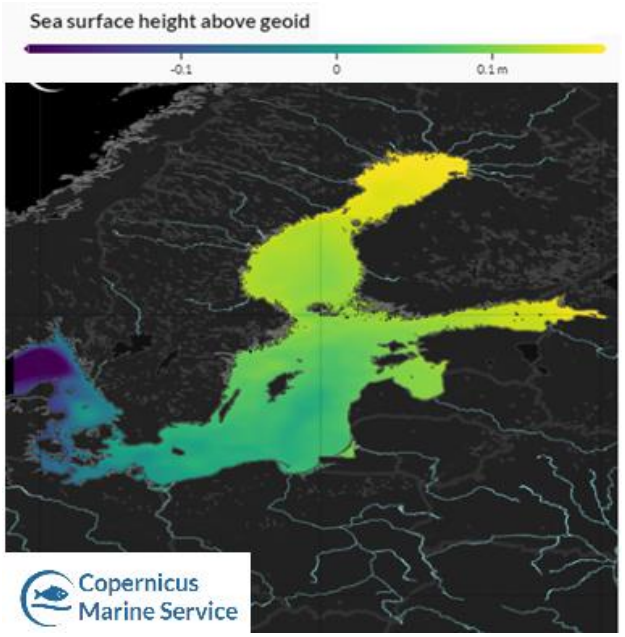
Goal	Period
Develop production capabilities for S-101 ENC, S-102 bathymetry and to some extent S-104 water level	2023-2025
Establish **harmonization rules** for S-10x-products, under the BSHC umbrella	2024-2026
Test, evaluate and refine the S-10x products	2025
Commercial rollout for S-101 and S-102 in the Baltic Sea. S-104 in parts of FI.	2026

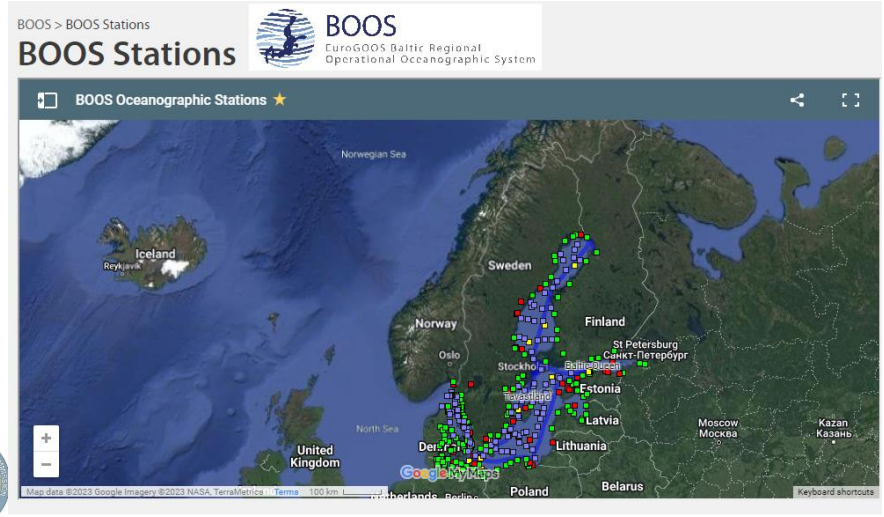


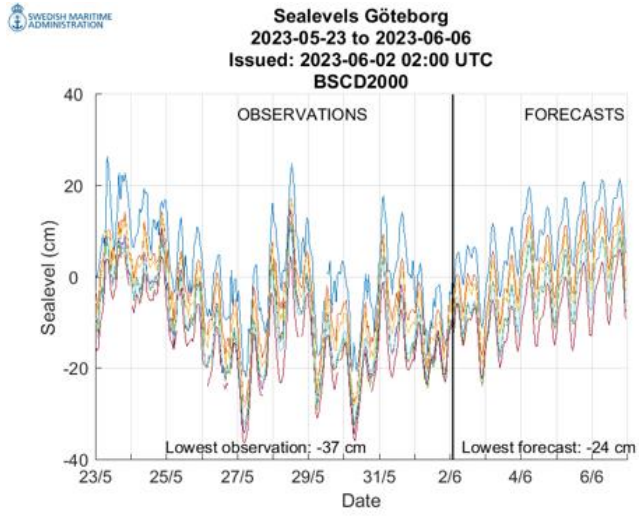
SWEDISH MARITIME ADMINISTRATION

S-104 Water Level









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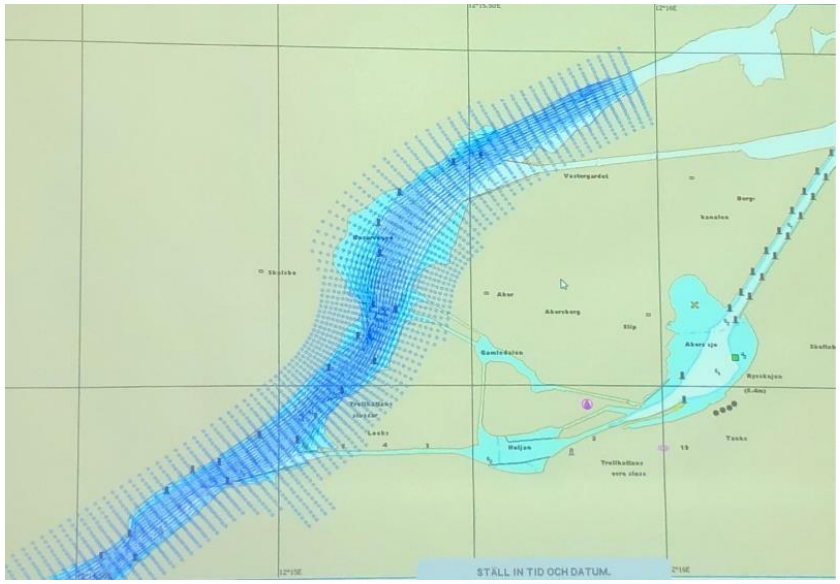
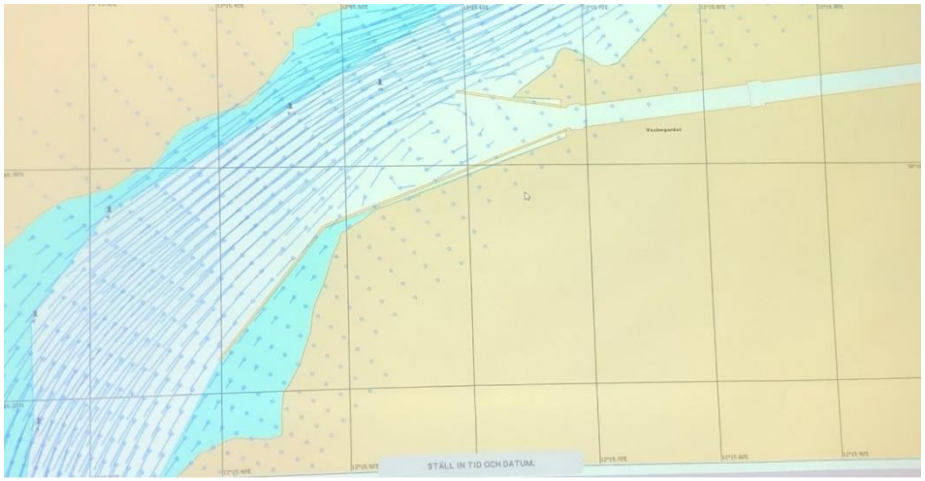
S-111 Surface Currents





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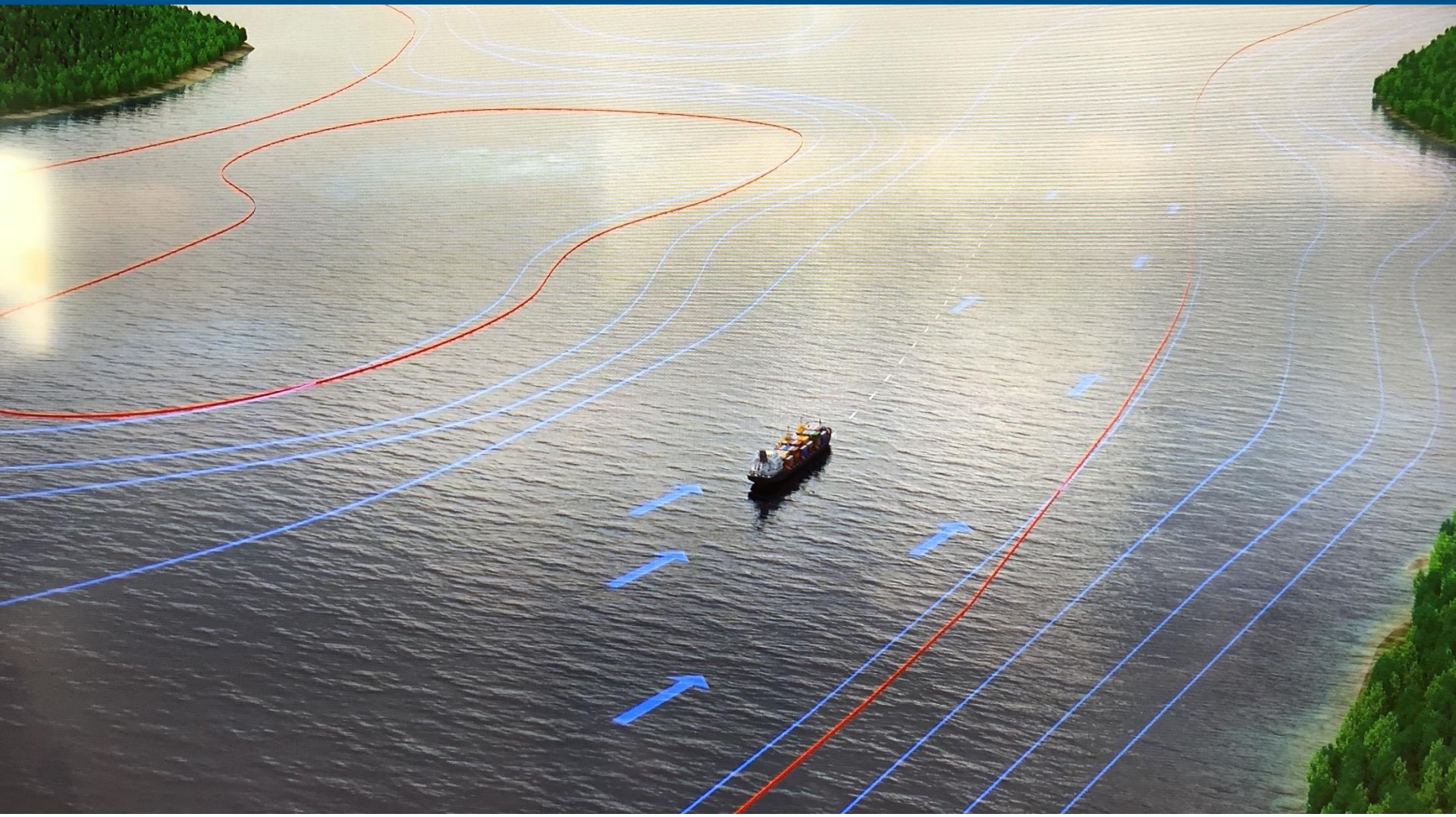
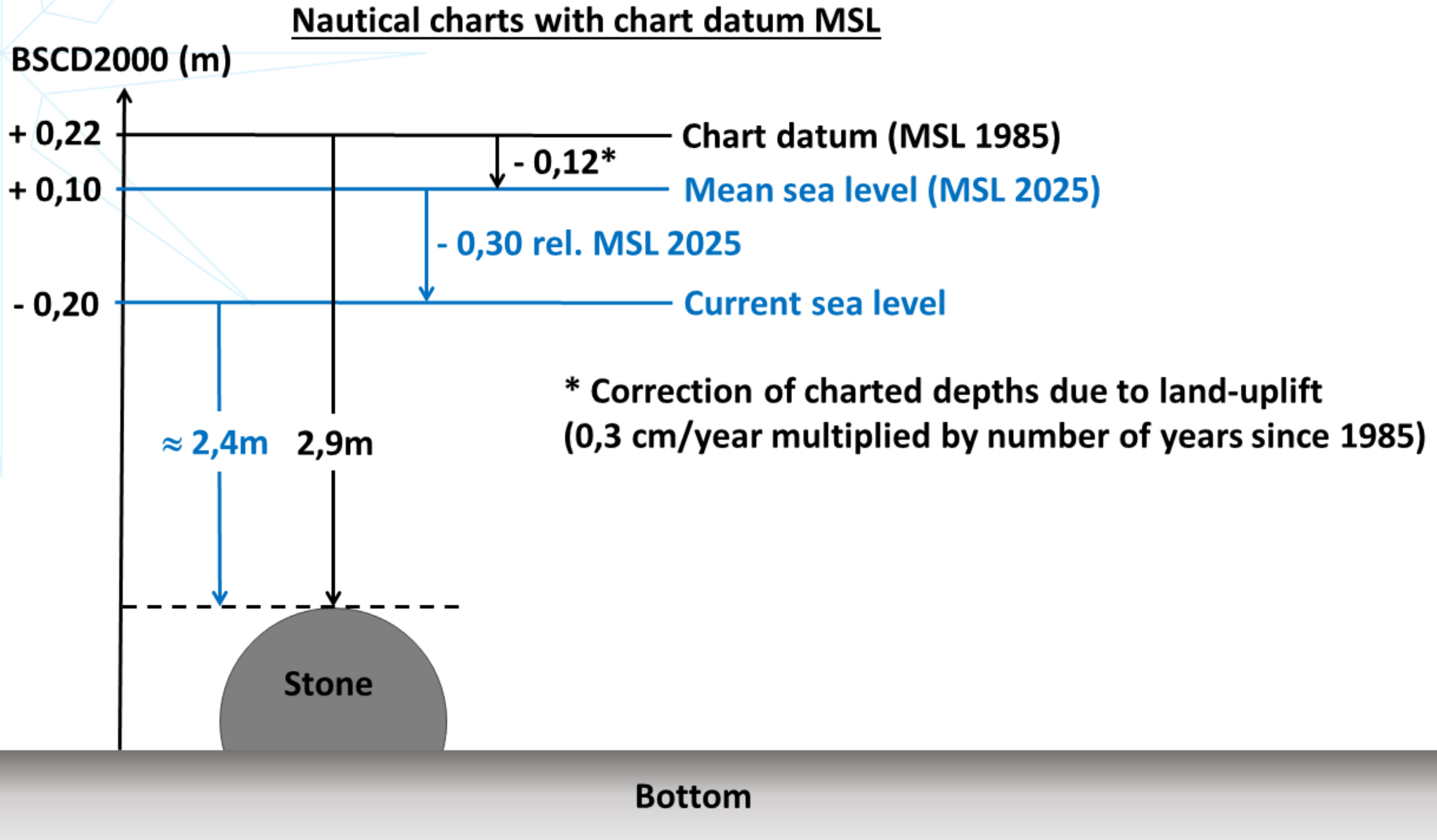
Future navigation



SWEDISH MARITIME ADMINISTRATION

Nautical charts with chart datum MSL

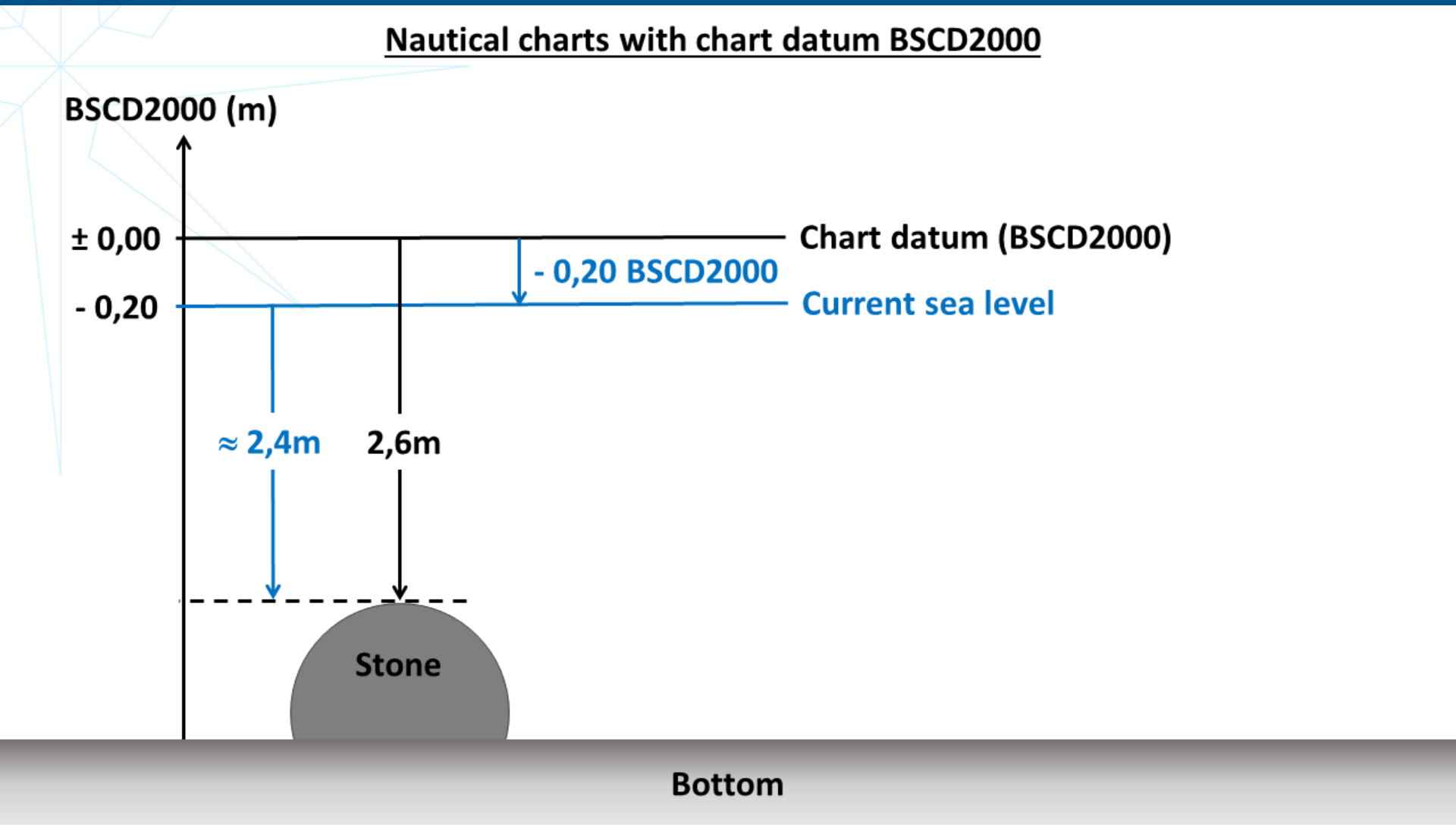
CHART DATUM: Mean Sea Level (MSL) 1985
REFERENSNIVÅ: Medelvattenyta (MVY) 1985
LAND UPLIFT/LANDHÖJNING 0.3 cm annually / per år
SYMBOLS and ABBREVIATIONS: see INT 1
BETECKNINGAR och FÖRKORTNINGAR: se KORT 1



SWEDISH MARITIME ADMINISTRATION

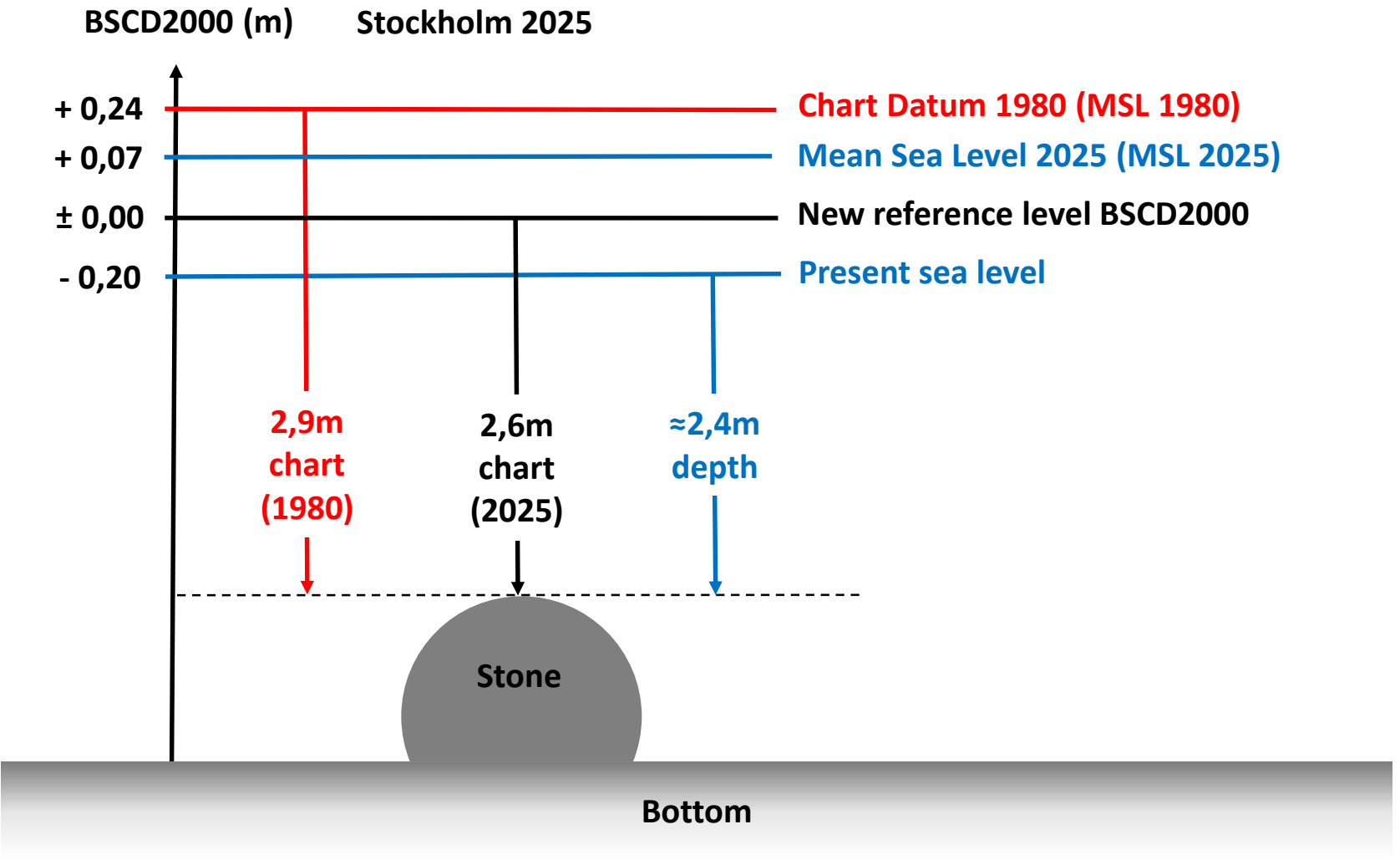
Nautical charts with chart datum BSCD2000

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



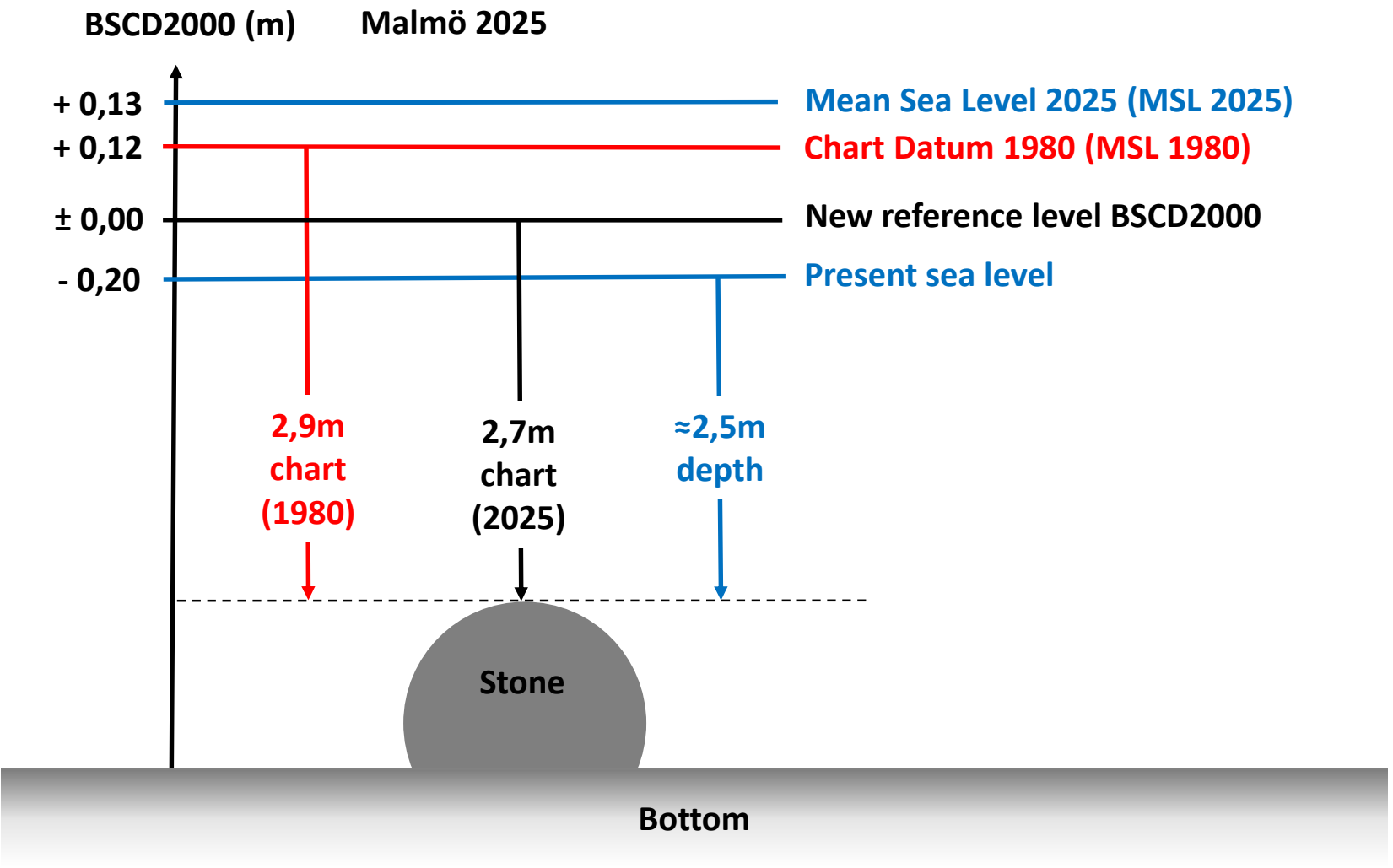
SWEDISH MARITIME ADMINISTRATION

Transition to RH 2000/BSCD2000 in charts and sea level



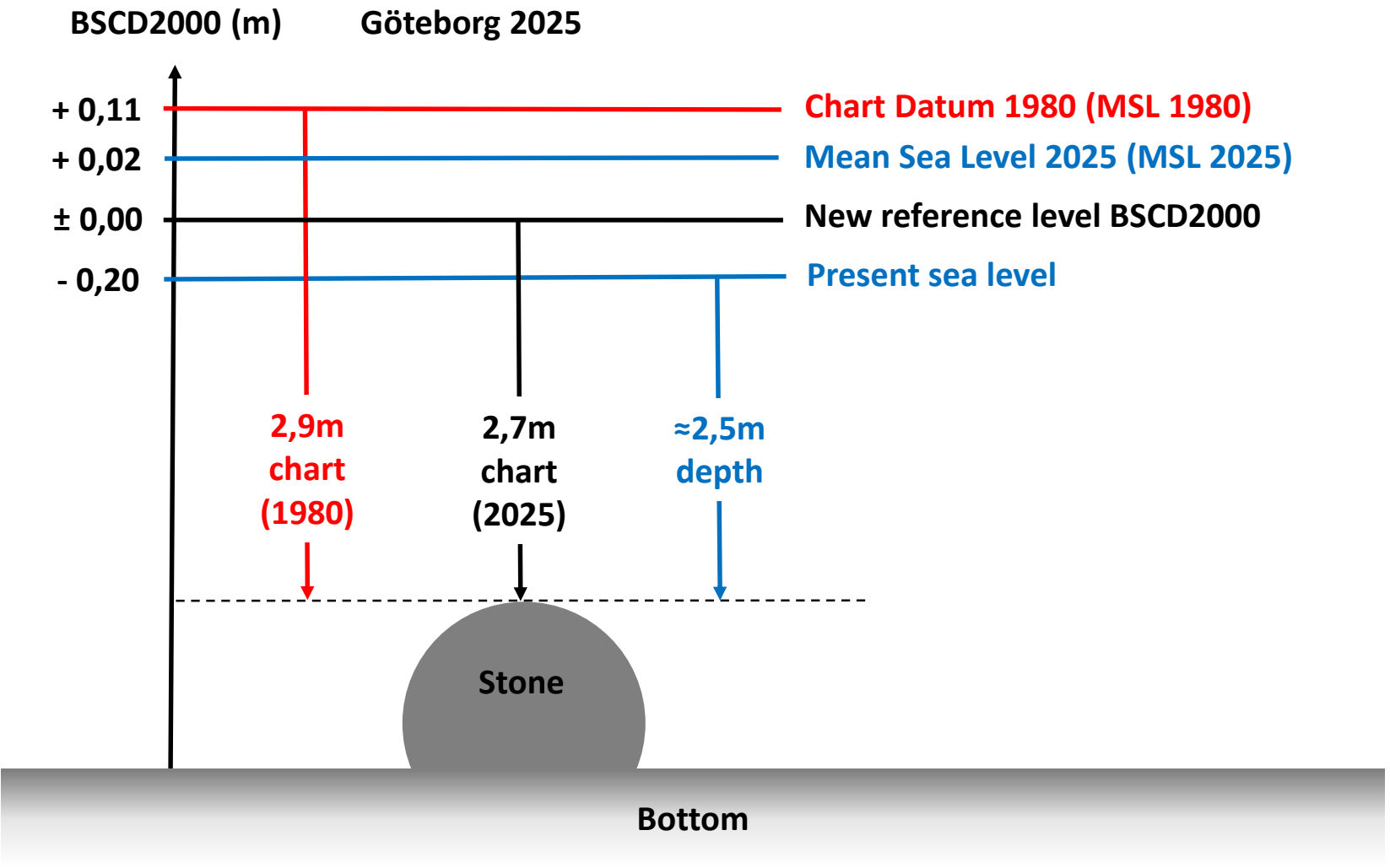
SWEDISH MARITIME ADMINISTRATION

Transition to RH 2000/BSCD2000 in charts and sea level



SWEDISH MARITIME ADMINISTRATION

Transition to RH 2000/BSCD2000 in charts and sea level



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Thanks!

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