



Kartverket

NHC 67th Meeting Malmö, Sweden

National report Norway



Hydrographic Office

Marine Base Maps

The pilot project has now been concluded and has been deemed a success. The different datasets produced and distributed through the project have proved very valuable to several different users ranging from private users and companies to marine spatial planners. We have not yet been able to launch a national program, so together with our pilot partners and politicians from coastal municipalities and counties, we continue to work on this.

Status S-100 implementation

A S-102 production line is set in operation. NHS have started production of S-102 data for some selected harbours and ports, and we will be releasing these over the coming 18-month period. Distribution of publicly available S-102 datasets will be done through PRIMAR RENC. NHS also produces restricted and not publicly available S-102 data for use by VTS stations and pilots, mainly covering selected anchorage areas and narrow passages.

S-101 work is still in an early phase, focusing on competence and capacity building as well as production planning.

Office location / constellation

The rental contract for our current office location expires in May 2025. We have now concluded a comprehensive process of finding a new and suitable office location. The rental contract on a new office location in the centre of Stavanger was signed in March this year. With this new office we will not only move into a new building, but also move into a new workplace concept. We will move out of individual offices and into an activity based open office plan. This allows us to reduce the overall area of the office space and thus reducing the yearly rent by 20%.

In order for us to fully unlock the potential for cross functional cooperation that lies in an activity based open office plan, we will also need to look at, and assess our current workflow, and reconfigure it if necessary.

We will be moving out of our current office in March 2025.

1 Hydrographic Surveys

Internally conducted survey 2023

During 2023, R/V Hydrograf and its two survey launches have been working in the coastal waters of Norway.

Norwegian coast

The primary survey areas in 2023 have been Hustadvika between Molde and Kristiansund, the areas near Fredrikstad and the areas between Jomfruland and Kragerø. Many smaller areas along the entire coast were surveyed for coastal development or construction purposes. The total area surveyed within the territorial waters of Norway in 2023 was 579 km² for internal nautical surveys and 1811 km² for Mareano surveys (see figure below)

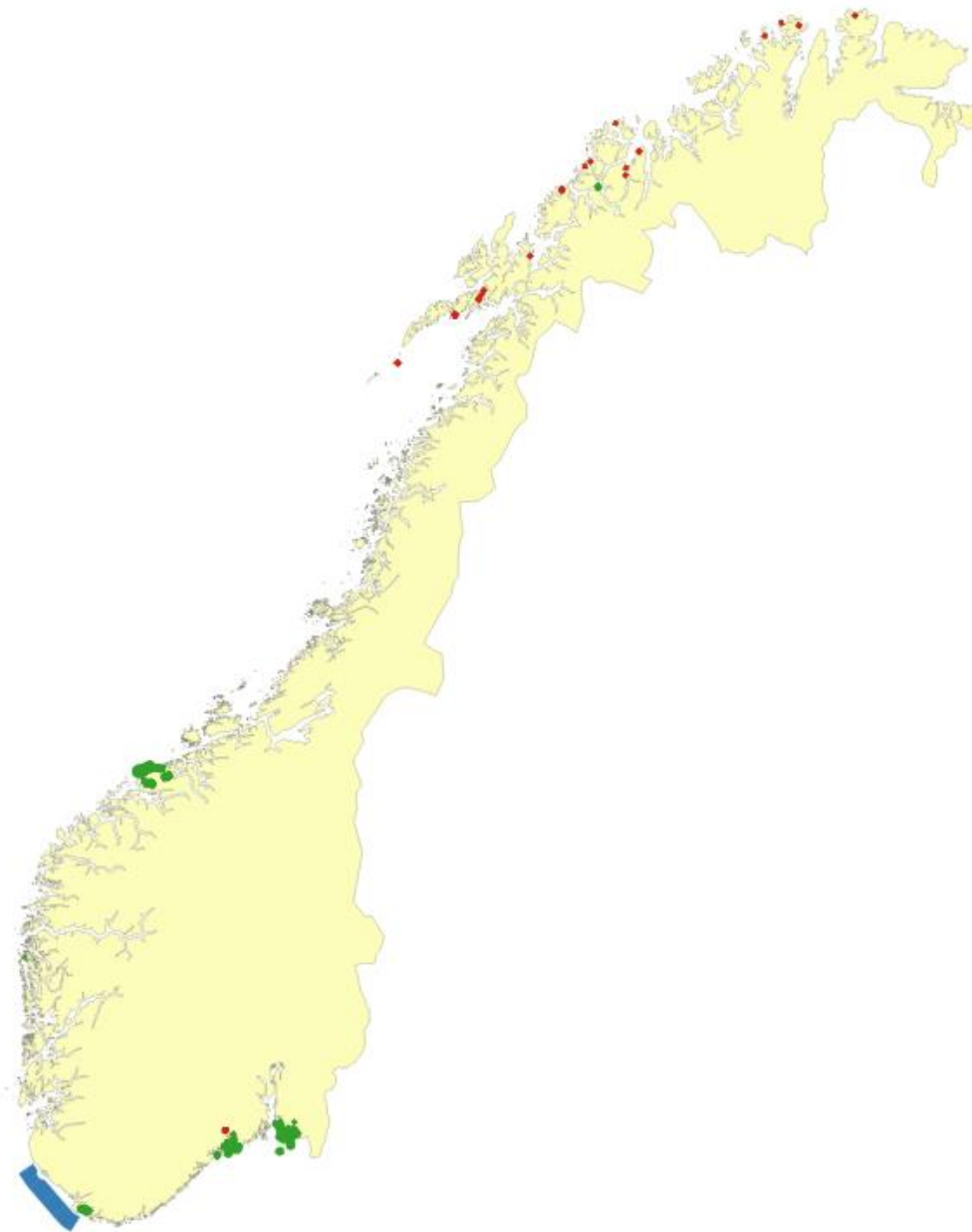


Figure 1 Area surveyed in territorial waters of Norway during 2023. Please note that the area sizes are exaggerated to make the smaller areas visible on the plot. Blue areas are surveyed for MAREANO. Red areas are surveyed on behalf of the Norwegian Coastal Administration. Green areas are internal surveys for nautical charting.

Svalbard

There were no Svalbard surveys in 2023.

Externally conducted survey 2023

Surveys within the MAREANO program were mainly contracted to external companies. The 2023 MAREANO surveys were conducted by Fugro Germany

Marine GMBH in the North Sea and by the Norwegian Defence Research Establishment in the Barents Sea. In addition areas within the territorial boarder in the North Sea was surveyed by the NHS.

The Mareano Programme

Background: MAREANO is a multidisciplinary marine mapping and documentation program aiming at providing the foundation for ecosystem based sustainable management of the Norwegian coastal and sea areas. The primary focus has been The Management plan for the Barents Sea and the last two years the management plan for the North Sea and Skagerrak. The aim is to bridge the knowledge gap in poorly mapped areas. High quality multibeam bathymetry is regarded as a premise for further geological, biological, and chemical investigations. The NHS is responsible for bathymetric data acquisition (including backscatter and water column data), and effective data management and distribution of survey data, derived products, and services. An important facet of the program is the web-based geodata distribution, and distributed data management as part of a National Spatial Geodata Infrastructure (NSDI)

Organization: The NHS is a program partner in the MAREANO Executive Group with the Institute of Marine Research (IMR, program management) and the Geological Survey of Norway (NGU).

Results 2023: The MAREANO program received NOK 111,6 mill in total through earmarked funding. In 2023 a total of 2886.7 km² MBES (multi beam echo sounder data) were surveyed in the North Sea outside the Norwegian territorial waters and 1810 km² within the Norwegian territorial waters. In the Barents Sea a total of about 2200 km². In 2023 MAREANO included surveying in transit to contribute to crowd sourcing bathymetry.

Data distribution: The multibeam data has been modelled in digital terrain models with grids of various resolutions. The terrain is visualized through shaded relief maps as a Web Map Service included in the map services on the MAREANO webpage www.mareano.no.

NSDI: According to the MAREANO data policy all geodata from the MAREANO program will be published in the Norwegian spatial data infrastructure; *Geonorge* www.geonorge.no.

MAREANO will be a major undertaking for the NHS in the years to come and is mainly aimed at non-navigational purposes.

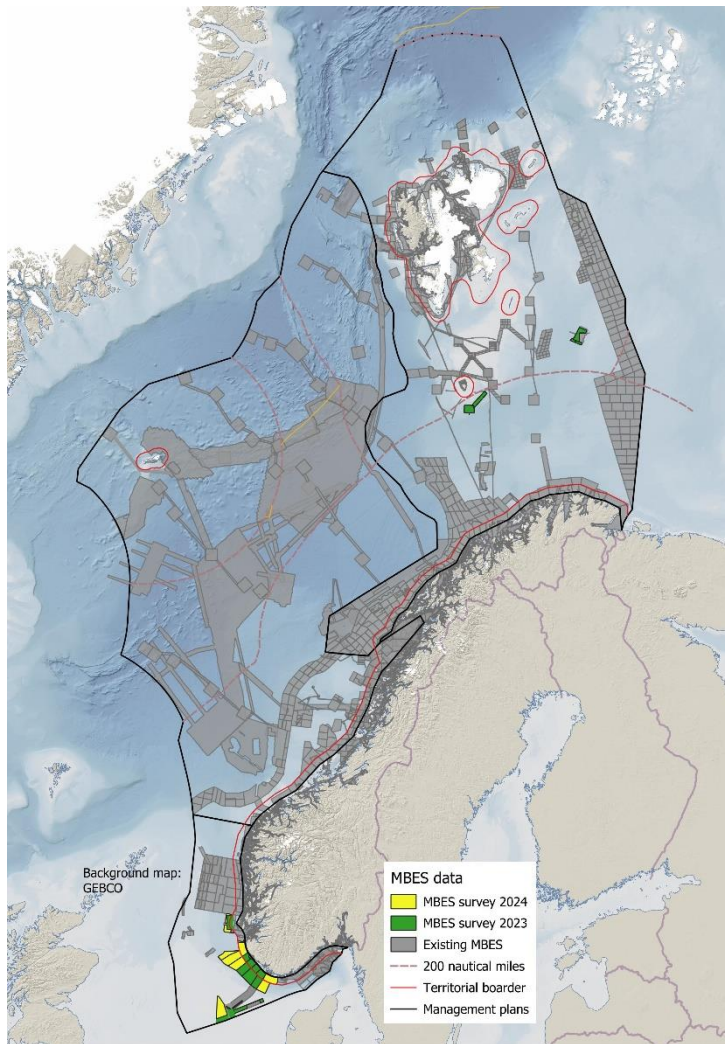


Figure 3. The Management plan areas and coverage of multi beam echo sounder data.

Nautical Charts

NHS has covered the Norwegian coast with ENCs and modernised paper charts. In the Arctic and Antarctic waters, there are still areas without any coverage. The NHS production department has been concentrating on replacing areas with old survey data with new data. NHS prioritize these areas based on safety of navigation and economic benefit to society.

ENC coverage, production and management

The total number of Norwegian ENCs was 1223 at the end of 2023.

	Usage Band	Compilation scale	No of ENCs
1	Overview	< 1:1 499 999	3
2	General	1:350 000 – 1:1 499 999	70
3	Coastal	1:90 000 – 1:349 999	84
4	Approach	1:22 000 – 1:89 999	765
5	Harbour	1:4 000 – 1:21 999	222
6	Berthing	> 1: 4 000	79

Table above: Number of ENCs in each usage band per 31 Dec. 2023.

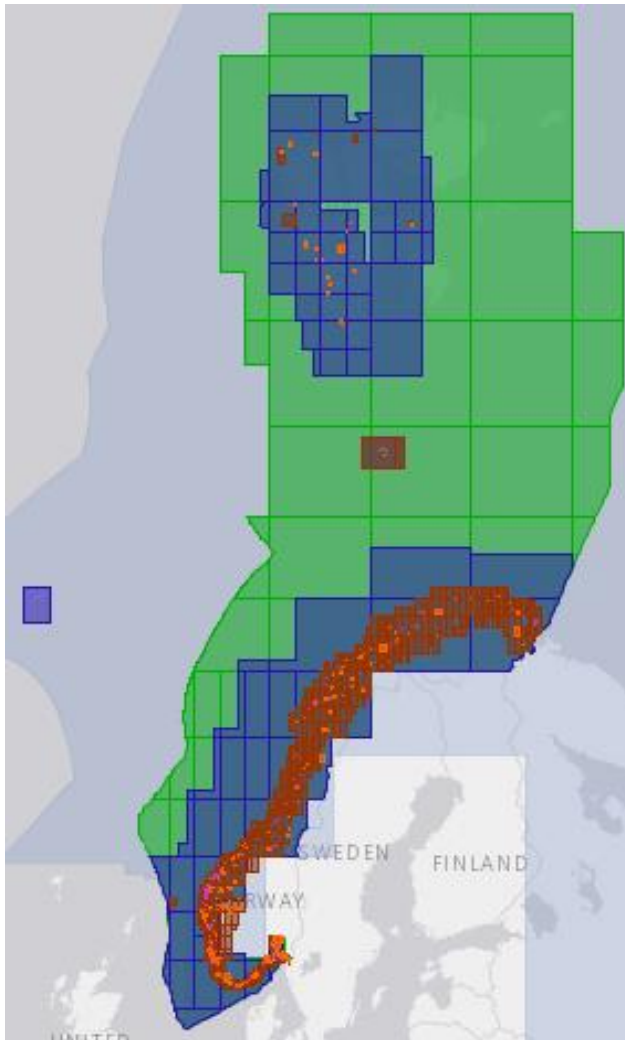


Figure 4. ENC coverage for the Norwegian coastal waters (ENCs in Usage Bands 2-6).

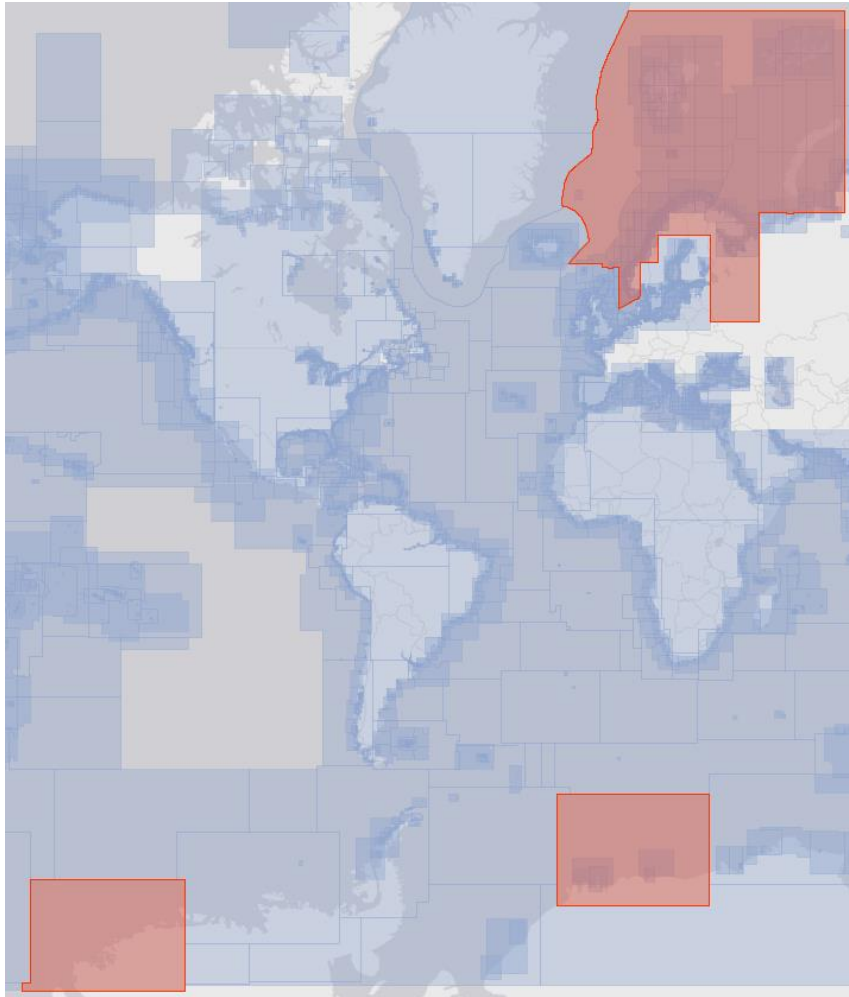


Figure 5. ENC coverage in Usage Bands 1.

In 2023, existing ENC's in several major- and most important fairways from Møre to Finnmark are updated with multibeam survey (Asenleia, Bergsøya, Kvernesfjorden-Frei, Rørvik, Risværffjorden-Dolmsundet, Kunna, Meløyvær, Gisundet, Bussesundet).

The ENC NO4H1209 is released as new edition fully covered with new surveys. In addition, other small parts of existing ENC's along the Norwegian coast have been updated with new surveys based on request from users. In total 48 cells. 5 new ENC's (ed 1) are produced in small areas where users needed a larger scale or high density ENC (HD ENC).

In 2023 NHS has produced new HD ENC's for det ports of Arendal, Narvik, Sjursøya Oslo, Husøy Karmsundet. HD ENC in Kristiansand has been expanded with a larger area.

In Svalbard, multibeam survey in Ny-Ålesund has been updated in existing ENC-s. A new activity to improve consistency between all Usage Bands further north than 73°N has startet. 21 cells have been updated in 2023 in connection with this task.

In 2023 a total of 2800 ER files and NE were issued as part of the continuous maintenance of the ENC-s. All reported corrections are processed consecutively based on priority and deadlines. Important updates are released within 17 days after they have been reported. Included Temporary (T) and Preliminary (P) notices.

RNCs

The Norwegian Mapping Authority, Hydrographic Service is not producing Raster navigational charts.

INT Charts

Norway has 23 INT-charts in the chart portfolio. Most of them are small-scale charts (general and coastal charts). No New Charts in 2023. 4 New Editions. These were:

Chart No.	Title	Scale
1. 307	INT 1401 / Stavanger - Florø	1:350 000
2. 309	INT 1403 / Smøla - Sklinna	1:350 000
3. 310	INT 1404 / Sklinna - Tennholmen	1:350 000
4. 313	INT 9316 / LoppHAVet - Mehamn	1:350 000

National Paper Charts

Norway has 209 National Paper Charts. A total of 32 new editions of national charts were issued in 2023 due to updates from new surveys. 8 harbour charts and 24 main charts.

National charts, new editions with new survey data published in 2023.

Chart No.	Title	Scale
1. 6	Jomfruland - Risør	1:50 000
2. 8	Arendal - Lillesand	1:50 000
3. 8	Arendal - Lillesand	1:50 000
4. 9	Lillesand - Ny-Hellesund	1:50 000
5. 10	Ny-Hellesund - Lindesnes	1:50 000

6. 11	Lindesnes - Lista	1:50 000
7. 12	Lista - Svåholmen	1:50 000
8. 17	Karmsundet - Ryvarden - Skjoldafjorden	1:50 000
9. 20	Sunnhordlandsfjordene	1:50 000
10. 25	Sognesjøen - Stavenes	1:50 000
11. 26	Håsteinen - Batalden	1:50 000
12. 27	Sunnfjord	1:50 000
13. 35	Hustadvika	1:50 000
14. 43	Agdenes - Lauvøya	1:50 000
15. 48	Gjæslingen - Dolmsundet	1:50 000
16. 48	Gjæslingen - Dolmsundet	1:50 000
17. 51	Dolmsundet - Lyngvær	1:50 000
18. 64	Støtt - Saltfjorden	1:50 000
19. 77	Tjeldsundet - Harstad - Lavangen	1:50 000
20. 79	Risøysundet - Kvæfjorden - Harstad	1:50 000
21. 80	Harstad - Sjøvegan - Dyrøya	1:50 000
22. 128	Kristiansund - Sunndalsøra	1:50 000
23. 131	Trondheimsfjorden- Lavanger - Steinkjer	1:50 000
24. 135	Rødøya - Støtt	1:50 000
25. 451	Grimstad	1:20 000
26. 453	Arendal havn med innseilinger	1:20 000
27. 456	Ålesund havn	1:20 000

28. 457	Mandal havn	1:20 000
29. 462	Svolvær - Kabelvåg	1:10 000
30. 483	Fedje - Mongstad	1:25 000
31. 487	Harstad havn	1:10 000
32. 491	Kårstø og Karmsundet	1:20 000

Other charts, e.g. for pleasure craft

NHS does not produce any other charts than the official paper charts and ENC's for navigation, but are distributing S-57-cells (derived from the official ENC's) for use in charts and maps e.g. for the leisure boat marked.

S-102

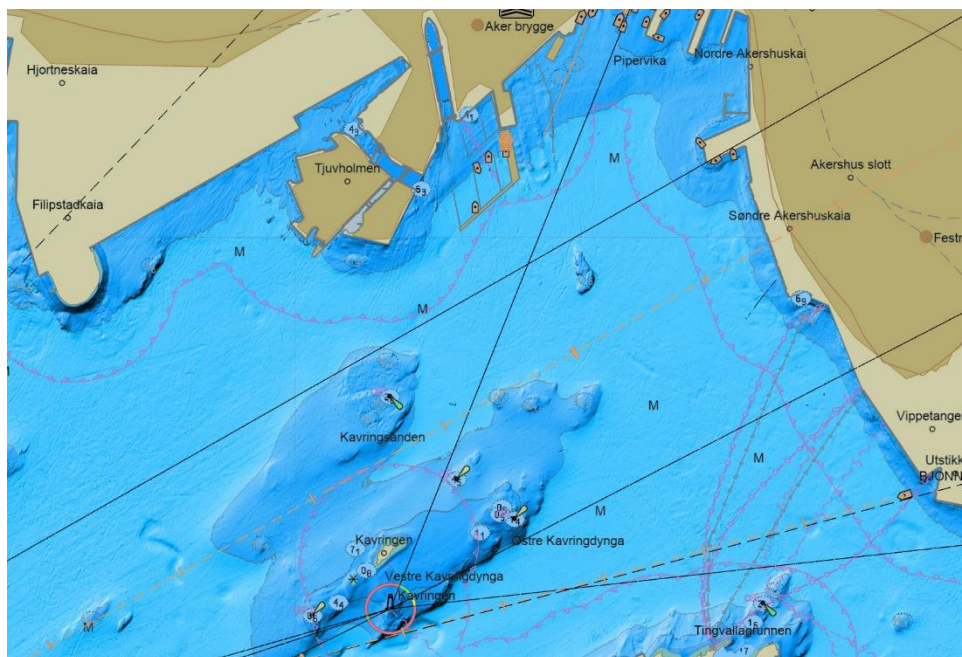


Illustration: S-102 of Oslo harbour presented in the SEAiq app.

In 2023 NHS continued the production of S-102. NHS strategic S-102 coverage is in areas where there is a particular need for precise navigation, such as ports, harbours, particularly narrow or shallow waters, anchorage areas etc.

The S-102 coverage prioritization is an assessment made based on reported user needs. The NHS sends a request to the Norwegian Armed Forces for permits to publish detailed terrain data for navigation (S-102).

As of 31st of December 2023 the following ports have S-102 coverage:

- Port of Tromsø
- Port of Bergen
- Port of Stavanger
- Mekjarvik
- Risavika

New 2023 S-102 sites:

- Port of Oslo
- Port of Drammen
- Port of Arendal
- Honningsvaag
- Narvik
- Port of Trondheim
- Port of Egersund

- Mandal
- Sarnesfjorden
- Port of Narvik
- Aalesund
- Haugesund
- Arendal
- Fosenøy
- Karmsundet
- Kristiansund
- Port of Kristiansand
- Breivik
- Florø

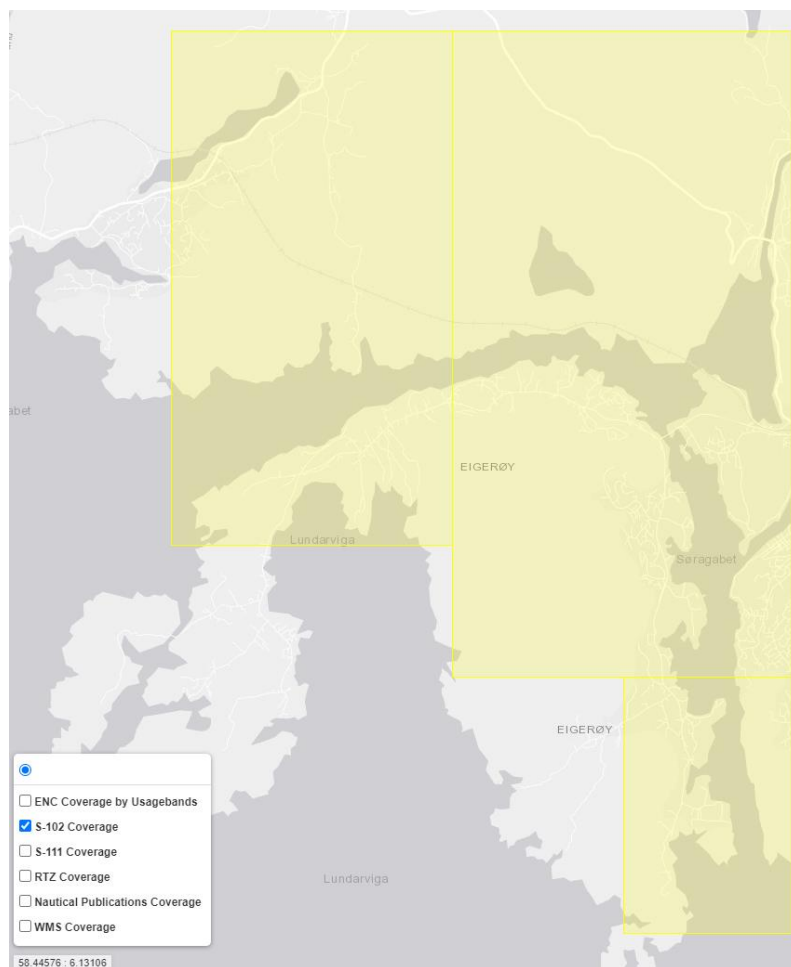


Illustration: S-102 coverage Egersund in the PRIMAR portal.

Challenges and achievements

In 2023, NHS continued producing S-102 and high density ENC's (HD ENC's) products for selected harbours and distributed through Primar. Continued focus on main- and important fairways from west to north coast of Norway by updating them with multibeam surveys.

In 2021 NHS acquired a new Hydrographic Data Management system, from vendor/supplier Teledyne CARIS. Due to severe operational and performance issues, system restrictions and other limitations that was not resolved nor proven resolvable, NHS was forced to terminate the contract with Teledyne CARIS, uninstall and return the proposed system. NHS has, following the contractual termination, established some alternative solutions for bathymetric datamanagement. This is based on open-source technologies and in-house development. This will work will continue in 2024.

In December 2023 the Ministry of Defense released the new regulation for the classification act for high density bathymetric data, that now defines the vast majority of bathymetric data between 0-30 m depth as unclassified data. This change comes with obligations, ownership and the establishment of new data value processes to the hydrographic office.

Nautical Publications

By digitizing the Norwegian pilot we had to develop a new national port data standard. In 2020 the standard was used to collect port data from 17 ports in Norway. The digital port data is stored in a common map database. A registration document has been prepared in Norwegian and an English version, so that all ports can register data themselves. The standard was approved in 2023 as an official SOSI-standard and is available in Norwegian and English.

Efforts are being made to get more ports to register the data themselves. The goal is that the ports keep their port data updated and quality check their data. This can be done through plug-in developed for the open source GIS-application QGIS, for easy access directly in the database hosted by the Norwegian Mapping Authority.

The data will be displayed in the Norwegian pilot guide, but can also be downloaded as a dataset in our national geoportal, Geonorge, or accessed by services such as WMS and WFS. By compiling the data into a common map database based on port information, we will have all the information in one place, which means that all information is correct and continuously updated. It is also desirable to expand the database with more port data from several more ports in Norway.

From 2021 until current year, several ports have collaborated in different projects (with the Norwegian Mapping Authority as project leader) to collect data from the port, and develop software tools that utilizes port data, for more

efficient port administration tasks and easier planning of the daily operations in the port.

We have done a gap analysis between the Norwegian port data standard and S-131. The aim for the gap analysis was to see if Port data could be used "as is" as an input to produce S-131, and how the mapping between the standards can be done. The gap analysis discovered certain inconsistencies in both the port data standard and S-131. The gap analysis has been shared with NIPWG.

The Norwegian Pilot Guide in new version

During spring 2024, the Norwegian Mapping Authority will launch version 2.0 of the Norwegian pilot guide "Den norske los". "Den norske los" 2.0 includes a new basemap, available in several scales and zoom levels, that provides more detailed map information. The map works according to the principles of official electronic nautical charts (ENC) but looks like a paper chart. The Norwegian Coastal Administration's reference routes will be included. When using the reference routes in the web service, you can create a report with content from "Den norske los". You can download or save the report as a favorite.

MSI

The Norwegian Maritime Directorate is the responsible body for MSI in Norway.

C-55

The last update of C-55 was sent to IHB in April 2024.

Capacity building

Norway participated in and chaired both the annual (May 2023) and intersessional (Jan 2024) meeting of the IHO Capacity Building Sub-Committee. The IRCC and the CBSC encourage Member States from the most developed regions to be involved in capacity building by assisting CBSC activities or by other means.

Oceanographic activities

As of end 2023, the Norwegian permanent tide gauge network consists of 30 stations. Six of those have been installed in the last 3 years, with two new additions in 2023. This has been done as a part of our initiative to improve the basis of existing and future products and services. The process will continue in 2024, with an additional focus on modernizing the solution for short-term water level measurements and solutions for water level measurements in Svalbard.

The oceanography department has been contributing to a new report, Sea Level Change for Norway, downscaling the global results for sea level change given by IPCC AR6 to regional conditions. The report and related datasets and services will be published in the spring of 2024.

In 2023 a focus for the oceanography department has been to improve the metadata of the products, particularly related to quality. In the end of 2023, a first quality assessment based on the [L20 Seadatanet measurand qualifier flags](#) has been performed on the water level and tidal prediction products.

During 2023, NHS and collaborators started planning the implementation of S-104 and S-111. This work will be continued, and the focus on implementation increased in 2024.

Spatial Data Infrastructures

MSDI is an integrated component of the [national SDI in Norway](#). The cooperation [Norway digital](#) counts for more than 600 organizations, where over 50% are involved in coastal and/or offshore activities. NHS is a key player in the development of relevant collaboration arenas between data owners, service providers and end-users to improve the user-value of marine and maritime geospatial services to society.

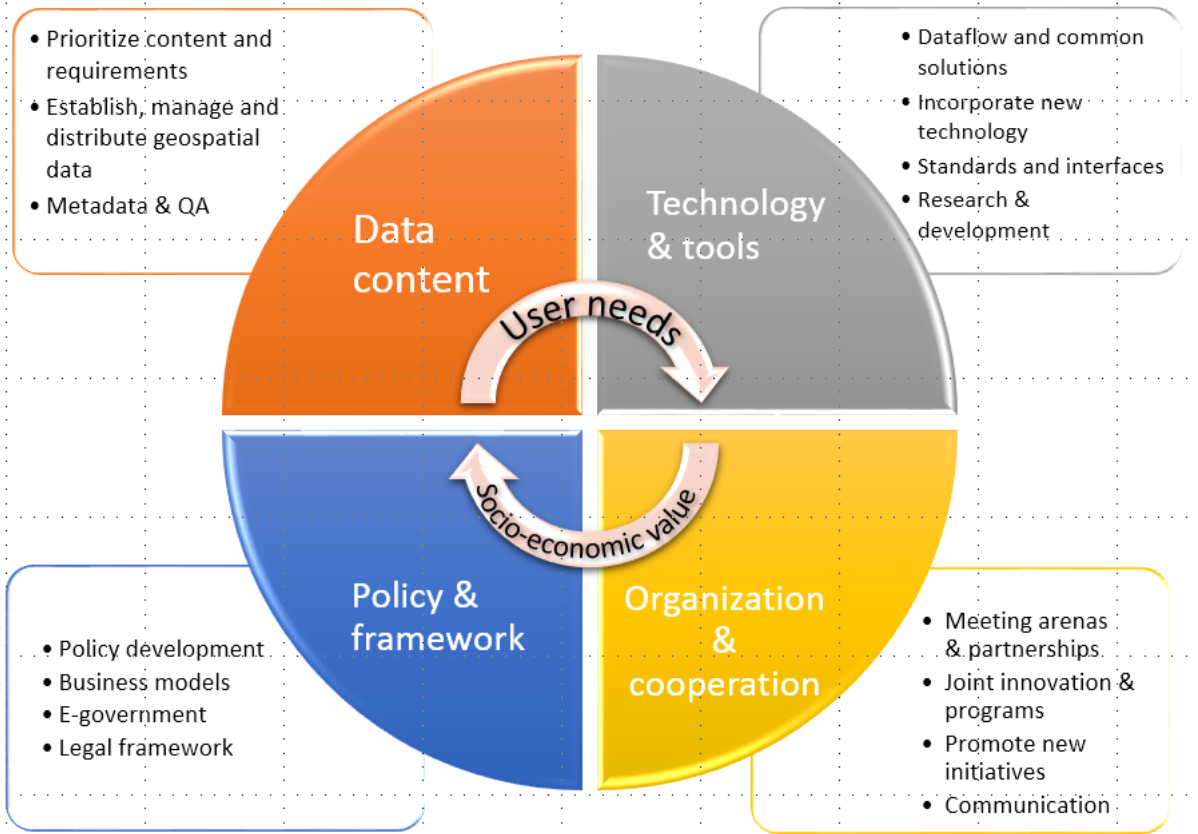


Fig.8 Norwegian SDI approach.

A national governmental geospatial strategy, "[Everything happens somewhere](#)", has the ambition to improve the value of geospatial information and its usefulness to society in Norway. The primary objectives for this strategy is to:

- Offer a national knowledge base of geospatial information accommodating important societal needs and user-priorities
- Incorporate technological tools and improve interoperability to increase interaction, efficiency and innovation
- Improve and further develop cross-sectorial cooperation and collaboration arenas between both public and private sector
- Adapt policies and framework conditions to meet the challenges within geospatial infrastructure, e-governmental services and the digital society in general

A yearly revised national action plan supports this strategy with prioritized objectives and cross-sectoral activities to improve and extend the national SDI.

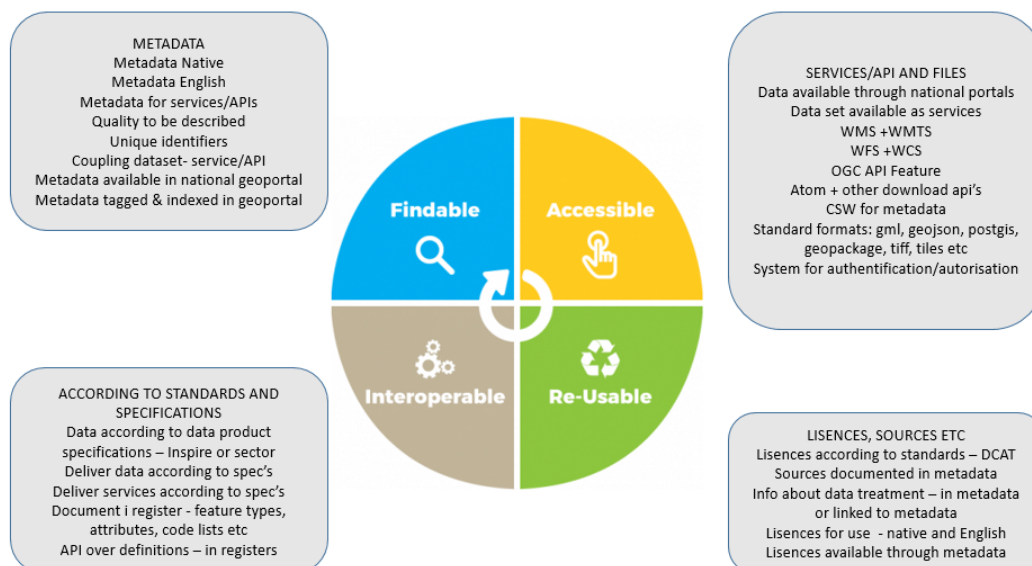
The national SDI of Norway is continuously seeking connections to other relevant infrastructure platforms to enhance the usefulness of geospatial data within a larger ecosystem of digital governance and digital economy. The NMA's involvement with [EMODnet](#), [INSPIRE](#) and [Artic SDI](#), are examples of such SDI-connections.

FAIR

The FAIR-principles provide guidelines to improve the Findability, Accessibility, Interoperability, and Reuse of digital assets.

The Norwegian Mapping Authority is leading the FAIR working group of the MAREANO-programme, which aims to enhance the FAIRness of collected data to the benefit of the users. A key approach is to implement the FAIR-indicators on top of the existing components of the NSDI-arrangements to make them operational within an SDI-context.

FAIR implementation by using geospatial infrastructure standards, technologies and routines



The results from the FAIRness assessment process are published through the [status registry](#) in the national geoportal Geonorge. The FAIR WG is continuously working with improvements and extensions on behalf of the users.

Innovation

HYDRIS - Hydrographic Information System (earlier NAUTILUS - New Hydrographic Infrastructure)

The NHS is actively upgrading its bathymetric and marine geo-data management system to enhance service for both current and ongoing future users. This upgrade is embracing new data formats, standards, and products, while also adapting to the continuous demands for automation, machine learning, enhanced quality, and reduced lead times.

The NHS established the Hydrographic Information System (HYDRIS) product organization, a progressive product organization with dedicated product development teams aimed at revitalizing existing hydrographic management systems. In line with the Ministry's directive for digitalization and efficiency enhancements, HYDRIS is steering its efforts towards modernization and automation, thereby fulfilling society's expectations for efficient marine geodata dissemination.

HYDRIS stands as a pivotal component of the digital transformation agenda within the Norwegian Mapping Authority. By forming cross-functional product

development teams, it fosters collaboration and leverages standardization and a shared infrastructure to boost efficiency significantly.

The ongoing development, scheduled across a five-year span (2022 – 2026), with an allocated budget of approximately €13.5 million EUR, was fully funded through the national budget starting from 2022. HYDRIS is set to implement substantial organizational and technological shifts.

HYDRIS is interested in any opportunities for collaboration.

HYDRIS Data Management System

One of the primary tasks for the product organization involves implementation and development of a new data management system.

The new system is expected to be an integrated and complete data management solution supporting effective preparation and dissemination of a broad range of marine geodata, including bathymetric and derived bathymetric products. The solution will ensure an effective production of authorized nautical products.

The new solution will be based on a modern technological platform that supports:

- FAIR principles emphasizing machine-actionability
- support a more efficient nautical production
- multiple digitization and data sharing solutions
- fast data access and effective bathymetric production (short processing time / increased automation)
- layered services and functional structure (allowing algorithmic, AI/ML, production etc. processes to run on top of the data)
- an integrated metadata management
- management of complete and original data (no or minimum generalization required)
- integrated product and data sharing solutions (machine-to-machine, APIs, etc.).

HYDRIS achieved a critical milestone at the end of 2022 by implementing a new management system within a closed environment dedicated to handling classified data. This pivotal development was anchored on the utilization of Teledyne Caris Commercial Off-The-Shelf (COTS) software and components. However, upon initiating the data migration process, several challenges surfaced, including issues with slow performance, an unsatisfactory backup solution, and system instability. Following a thorough testing and troubleshooting phase, the decision was made to adopt an alternative approach to data management. The transition involved moving from a Caris Bathy database server for handling point

clouds to a file server, with metadata now being managed in a PostgreSQL database.

Currently, the alternative and new system are successfully undergoing data reception and migration processes. The plan is to deactivate the old system once the migration process reaches completion. This strategic shift reflects HYDRIS's commitment to addressing challenges promptly and ensuring the optimal performance of its data management systems.

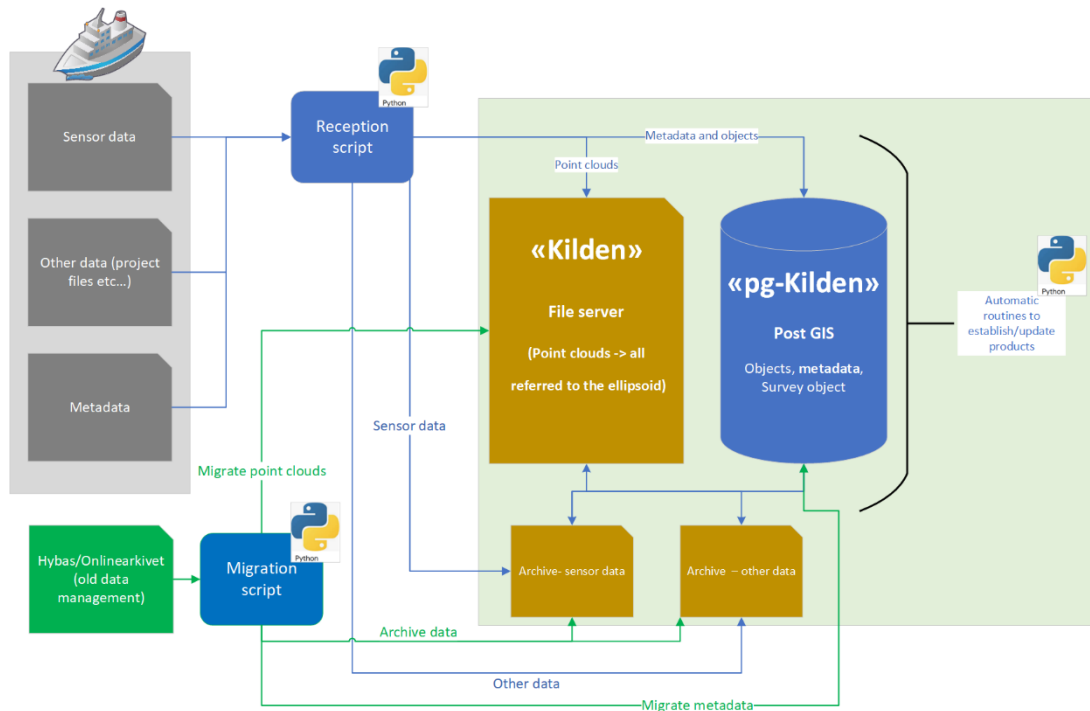


Figure 10. New data management solution

The strategy of NHS is aligned with the Mapping authority's overall approach of using open-source software where appropriate. This alignment underscores a shared commitment to leveraging open-source solutions in instances where they offer optimal benefits, emphasizing a collaborative and innovative approach to technology adoption.

HYDRIS Digitalization of Survey Specifications

In autumn 2022 HYDRIS performed a successful pilot on building a software stack for fully automatic and effective production of Analysis Ready Data (ARD). On top of this stack, we have built a software product to validate survey datasets by implementing a machine-readable MAREANO survey specification.

Validating that data collection and processing adheres with the specifications has been a time-intensive challenge. This was recognized as a key opportunity for enhancing efficiency through digitalization. The HYDRIS team began developing a

machine-readable interpretation of the specification. The software can automatically validate a dataset against many of the specification's criteria (variable resolution grid definition, point density, point count and data gap definition to name a few, Figure 1). The output is a deviation map that shows areas where the survey deviates from the specification and a report with detailed statistics from the survey.

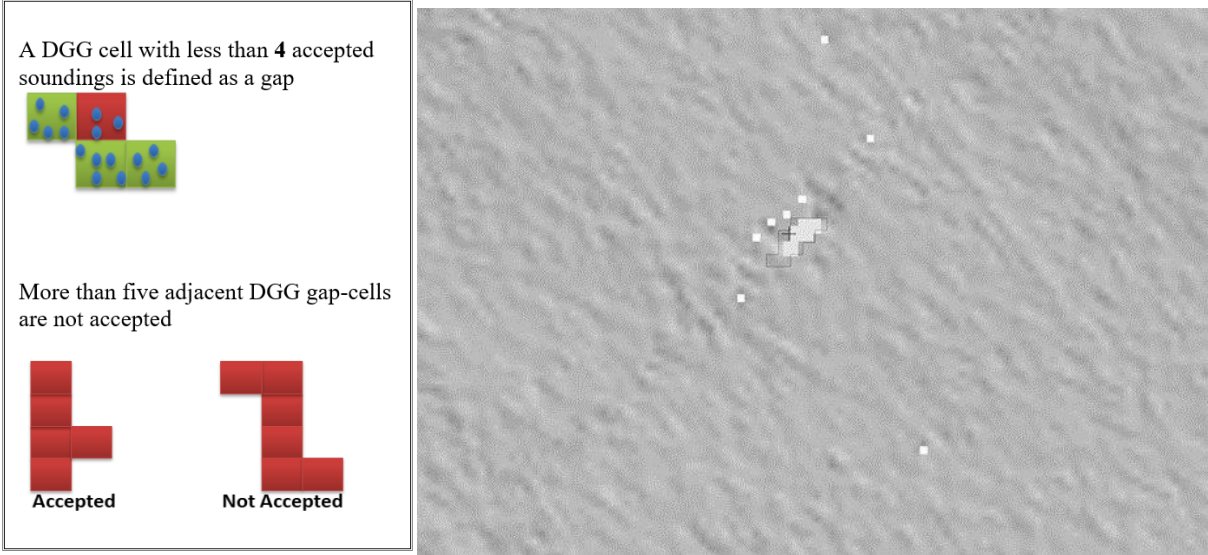


Figure 1 From the MAREANO technical specification. Left: data gap definition. Right: deviation map

Similarly, the vertical uncertainty is calculated and compared to the requirement in the specification.

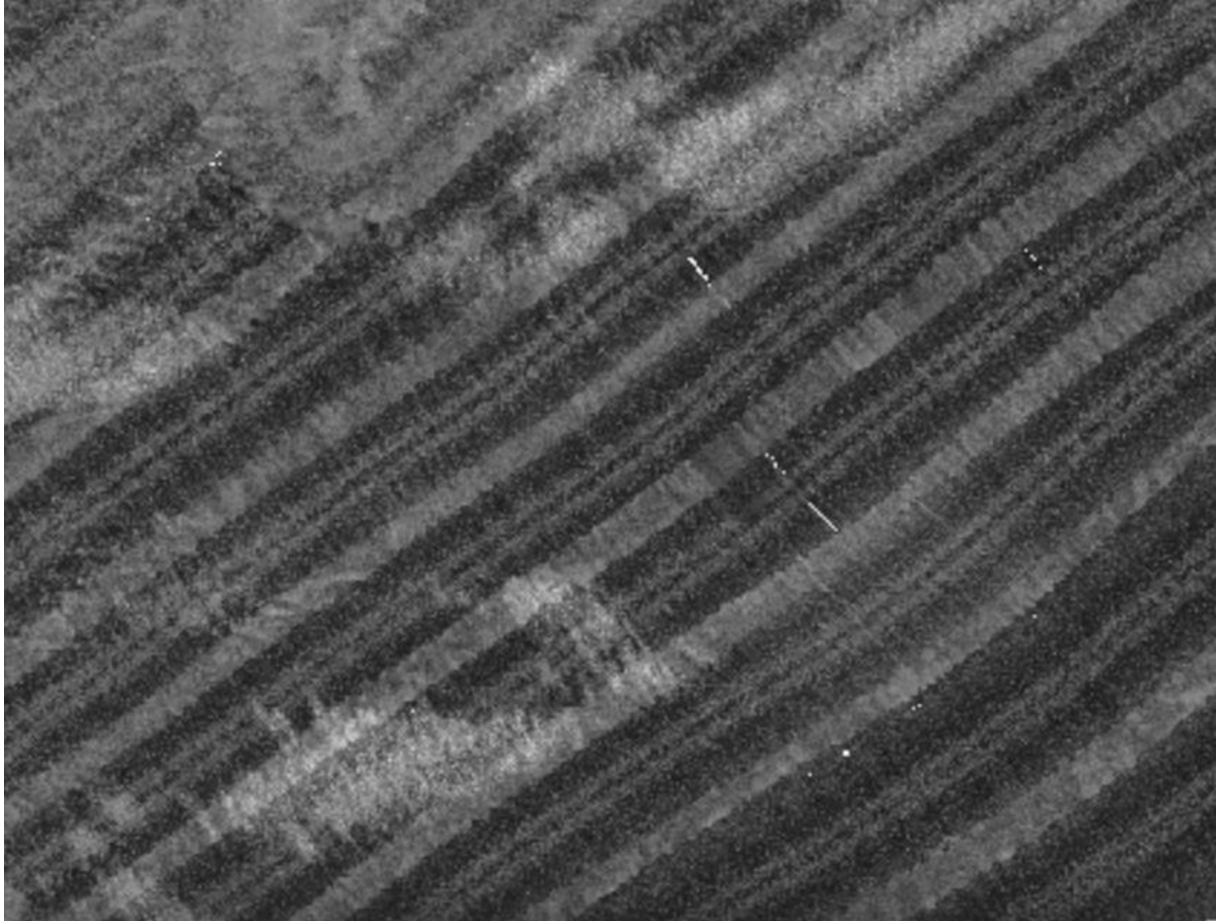
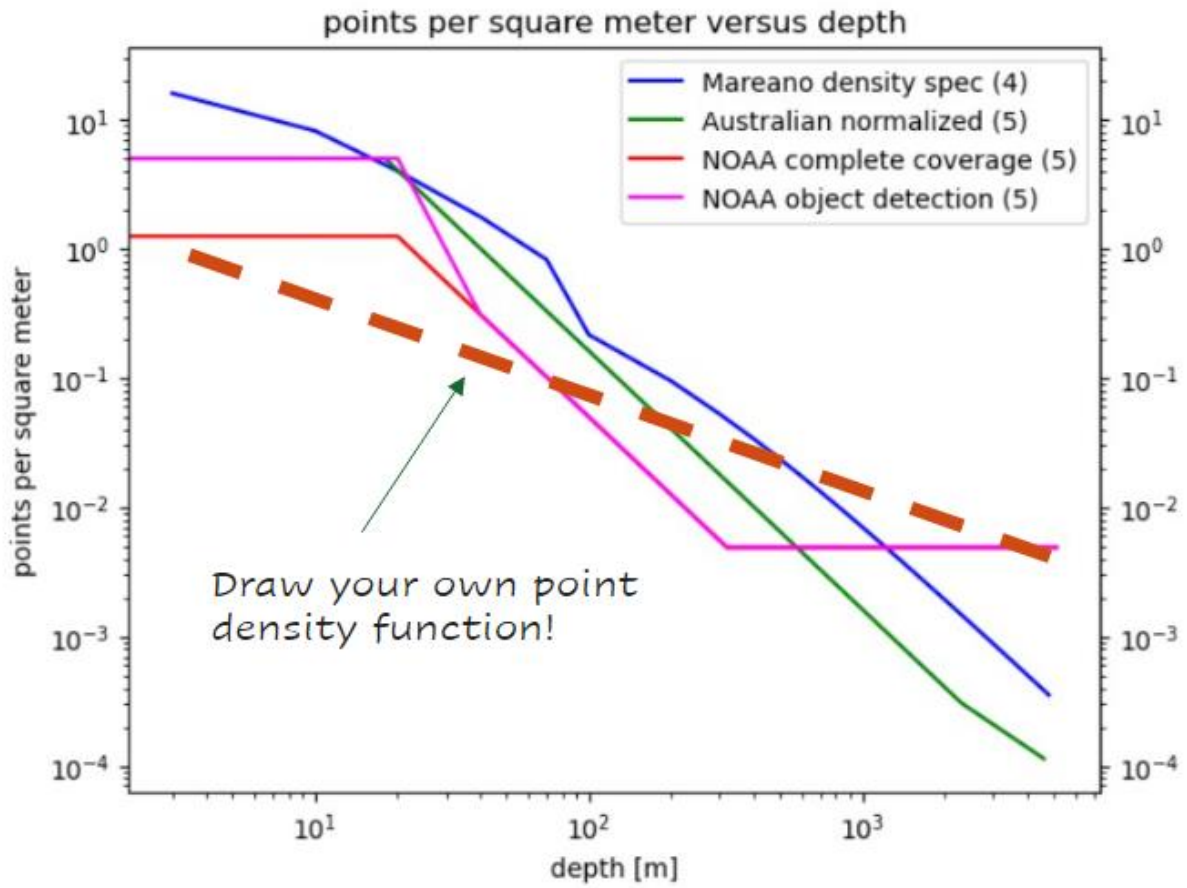


Figure 2 Vertical uncertainty validated according to specification. Noisy grid cells appear brighter in colour than the surrounding cells. We can clearly spot more noise in overlapping areas parallel to the tracklines.

HYDRIS Open Source

In line with the Norwegian Mapping Authority's commitment to share internally developed software as open source, the machine-readable edition of the Mareano specification will be made available on GitHub in 2024. This allows contractors and other users to download, modify and run the software on their own datasets.

The software architecture is modular, so it will be possible to plug in custom specifications to fit other survey requirements (Figure 3).



Figur 3 Mareano point density function compared to a few others [NOAA22¹], [AUS23²]

¹ https://nauticalcharts.noaa.gov/publications/docs/standards-and-requirements/specs/HSSD_2022.pdf

² <https://australian-multibeam-guidelines.github.io/data-processing>

Other activities

International activities

The NHS is involved in several Working Groups, Committees and Commissions related to IHO. Norway chairs the IHO CBSC, the IOC IHO GEBCO Guiding Committee and the IHO e-Learning center Steering Committee and has representatives in the following Sub-Committees and Working Groups: IHO Council (including IHO SPRWG), S-100, DQ, ENC, NC, NIP, TWC, IEN, MSDI, CSB and WEND. We have participated in the HSSC and the IRCC meetings in 2023. Norway is actively participating in 5 Hydrographic Commissions: ARHC, HCA, NHC, NSHC and SAIHC.

The NHS is a member of the UN-GGIM Working Group on Marine Geospatial Information, and actively contributes to the Seabed 2030 project and the GLOSS Group of Experts. NHS is an active partner in EMODNet.

As operator of Primar, we participate in all related meetings.

PRIMAR

NHS is the operator of PRIMAR RENC on a non-profit basis. The NHS uses a Norwegian state-owned company, Electronic Chart Centre AS (ECC), to deliver services within database operations/validation, sales and distribution, infrastructure, and R&D to PRIMAR through a service provider agreement. NHS is responsible for the daily operation within the framework of strategies and policies decided by the PRIMAR Advisory Committee (PAC). The Cooperating Hydrographic Offices (CHO), through PAC, decides on the overarching policy and strategy of PRIMAR.

PRIMAR is quickly adapting to the S-100 decade as defined by IHO, offering the infrastructure, tools, and services necessary to distribute S-100 products. PRIMAR has developed an operational S-100 service and is further developing and testing an S-101 service for data delivery from CHOs, validation and quality control, and catalogue services for product visibility and distribution. This also includes data security and digital signatures in accordance with S-100 part 15 data protection. PRIMAR has also developed a "Remote Update Protocol", enabling users to effectively access encrypted data and updates for use in their end-user systems.

PRIMAR's efficient delivery of S-100 data, innovative and flexible solutions, tailored collaboration with our global network of distributors, is providing all players in the maritime field the freedom to choose ENCs and S-100 products, best suited for their needs.



Kartverket
www.kartverket.no

Postadresse: Postboks 600 Sentrum, 3507 Hønefoss

Telefon: 32 11 80 00

Telefaks: 32 11 81 01

E-post: post@kartverket.no

Organisasjonsnummer: 971 040 23