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*NATIONAL REPORT  
NORWAY*

## **Executive Summary**

This report gives the summary of the activities and events that have taken place within the Norwegian Hydrographic Service (NHS) since the last report given at the SAIHC18 Conference, May 2022.

### **1. Hydrographic Office**

#### **Norwegian Mapping Authority 250 years**

This year the Norwegian Mapping Authority (NMA) celebrates its 250<sup>th</sup> anniversary. This will be marked by several smaller local arrangements all over Norway through 2023 and will culminate in August with a large event gathering all 800 NMA employees from all NMA district offices. At the hydrographic office in Stavanger, we have arranged two events this summer. Firstly, a family barbecue for local staff, and then with a stand in Stavanger harbor at the annual Stavanger harbor festival.

#### **Marine Base maps for the Coastal Zone**

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 secure funding for a national program, so together with our pilot partners and politicians from coastal municipalities and counties, we continue to work on this. However, Marine Base maps did receive additional funding as a part of an economic stimulation package for Eastern Finnmark (in Northern Norway). Businesses in the region have lost significant parts of their business due to the embargo on Russian ships after the Russian invasion of Ukraine. The new funding is not sufficient to set up a full-scale marine mapping of the municipality Sør-Varanger by the Varangerfjord, but it sends a positive signal regarding the political will to establish a national Marine Base map program in the future.

#### **Status S-100 implementation**

A S-102 production line is set in operation. The 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.

The 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 agreement for our current office location, expires in spring 2025. We have now started a process of studying what type of office solution would fit our future HO work and organization best.

## **2. Hydrographic Surveys**

### **2.1 Internally conducted surveying 2022**

NHS has not conducted surveys in the SAIHC region

### **2.2 The Mareano Programme**

**Background:** Mareano is a multidisciplinary marine mapping and documentation programme 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 management plan for the Norwegian Sea, but in 2022 Mareano started surveying in the North Sea (see figure 3 below). The North Sea has become relevant due to opening of offshore wind farm areas. The aim of the Mareano mapping 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 map services. An important facet of the programme is the web-based geodata distribution, and distributed data management as part of a National Spatial Geodata Infrastructure (NSDI). Mareano makes a significant effort in making data FAIR (Findable, Accessible, Interoperable, Reusable). Mareano has included environmental- and climate requirements in tenders.

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

**Results 2022:** The Mareano program received NOK 99,5 mill in total through earmarked funding. NHS received NOK 23.3 mill. 3 362 km<sup>2</sup> was surveyed. In addition, it was surveyed in transit to contribute to crowd sourcing bathymetry.

**Data distribution:** The multibeam data has been modeled 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](http://www.mareano.no).

**NSDI:** According to the Mareano data policy all geodata from the Mareano programme will be published in the Norwegian spatial data infrastructure; *Geonorge* [www.geonorge.no](http://www.geonorge.no) and [www.dybdedata.no](http://www.dybdedata.no).

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

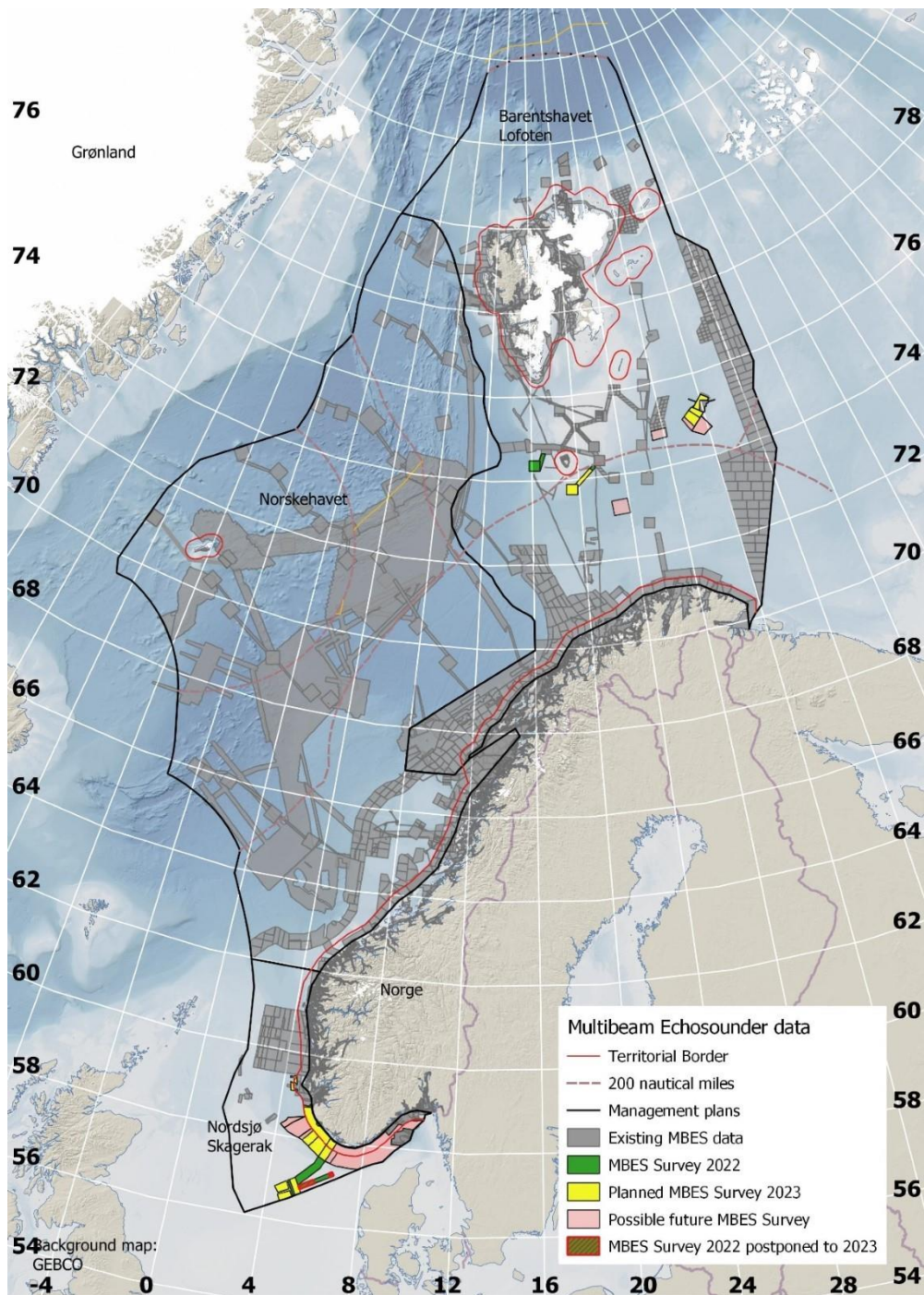


Figure 3. The Management plan areas and coverage of multi beam echo sounder data.

## 2.4 Marine Base Maps for the Coastal Zone

Marine base maps for the coastal zone is all about gathering detailed information and boosting the knowledge of the seabed and marine coastal systems along Norway's coast. The aim is to provide new business opportunities, stimulating and/or optimizing the growth of industries, better public administration and effective coastal zone management. Marine base maps in Norway (i) maps on a large scale the seabed's physical, biological and chemical environments (ii) analyses the data and (iii) distributes a set of standardized products. The products can be combined with other datasets.

It is a cooperation project with 3 partners: The Norwegian Hydrographic Service (leading the project), Geological Survey of Norway and the Institute of Marine Research. This

cooperation allows for a streamlined process from data collection to distribution. It also has the added advantage of better coordination and management of resources.

We have completed a pilot project in three pilot areas along the coast for a 3-year period 2020-2022. The budget for the 3-year pilot was NOK 84,6 mill. The pilot projects investigated and tested new technology for data collection and processing and, in addition, developed a cost-effective model for the implementation of a program for Marine base maps in Norway.

Workshops have been held in three pilot areas with planning staff of municipalities and provinces, government agencies and industry / commercial actors. Results have been used for many purposes and user cases are documented.

A proposal for a national program starting in 2024 has been send to the Ministry of Local Government and Regional Development.

NHS received in 2023 NOK 3 mill to start the work in the municipality Sør-Varanger.

## **2.5 FAIR-principles**

The FAIR-principles provide a set of defined guiding principles and practices that enable both machines and humans to find, access, interoperate and re-use digital assets.

(FAIR = **F**indability, **A**ccessibility, **I**nteroperability, and **R**eusability)

**The Mareano programme and Marine Base Maps for the Coastal Zone** have decided that all datasets collected and processed by the collaborating partners, shall be evaluated and adapted according to these FAIR-principles. An initial FAIR-implementation guide has been worked out to support ongoing activities, in accordance with relevant national infrastructures like [Geonorge](#) and [NMDC \(Norwegian Marine Data Center\)](#). The aim is to ensure that information pertaining to the seabed is made easily available to all who will benefit from its use, including those engaged in research, management and business ventures. An online status register has been developed within Geonorge to keep current track on the various dataset's fulfillment of the FAIR principles as well as other requirements from the NSDI. Ref. [Mareano Status Register](#). This project will continue until the end of this year after which we will evaluate and draft a bet way forward.

See also chapter 9 Spatial Data Infrastructures.

### 3. Nautical Charts (Gjermund)

NHS has covered the Norwegian coast with ENC's 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, gaps and overlaps

The total number of Norwegian ENC's was 1218 at the end of 2022.

	Usage Band	Compilation scale	No of ENC's
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	221
6	Berthing	> 1: 4 000	75

Table above: Number of ENC's in each usage band per 31 Dec. 2022.

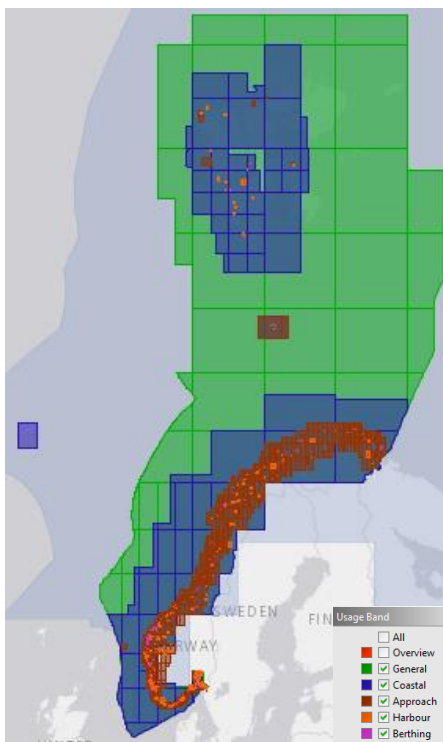


Figure 4. ENC coverage for the Norwegian coastal waters (ENC's in User Bands 2-6).



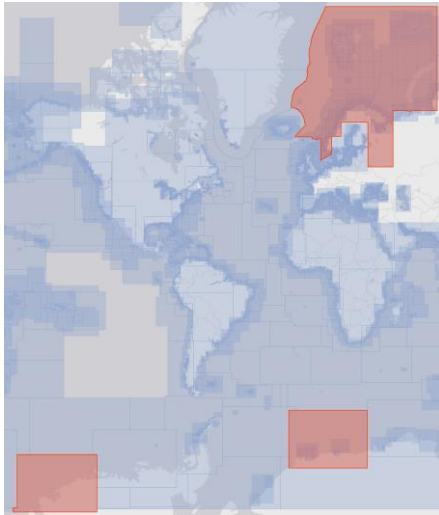


Figure 5. ENC coverage in User Bands 1.

In 2022 a total of 2668 ER files and NE were issued as part of the continuous maintenance of the ENC. All reported corrections are processed consecutively based on priority and deadlines. Important updates are released within 7 days. Included Temporary (T) and Preliminary (P) notices.

In 2022, NHS has established a new production line for high density ENC (HD ENC). New HD ENCs were created for the ports of Stavanger, Bergen, Kristiansand and Mandal.

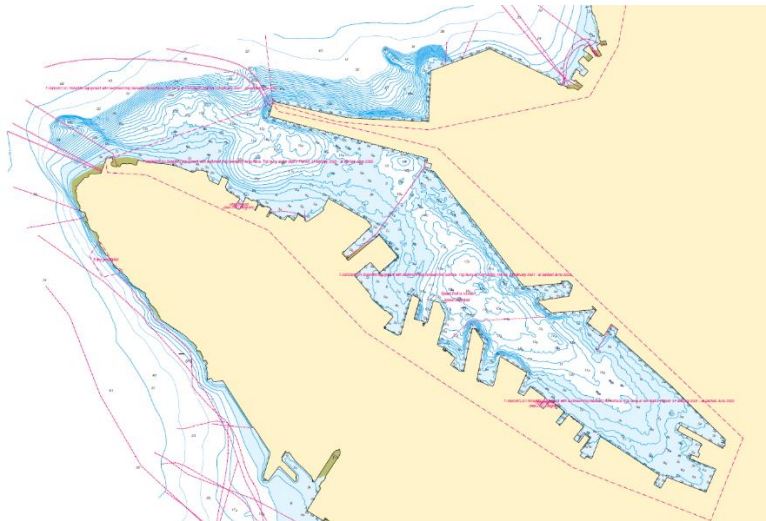


Figure 6. HD ENC for the port of Bergen.

## 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 2022. 2 New Editions. This was:

Chart No.	Title	Scale
1. 505	INT 9311 / Svalbard	1:700 000
2. 507	INT 9313 / Svalbard. Nordstvalbard	1:700 000

## 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

In 2022 we established a production line for S-102 and started producing the first S-102 products. NHS is planning S-102 coverage 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).

## Challenges and achievements

In 2022, NHS began producing S-102 products for distribution through Primar.

Major- and most important fairways from Vestland to Norland Norway have been updated with multibeam surveys. On Svalbard, existing corridors in Storfjorden were expanded.

In 2022, NHS established a new production line for high density ENC's (HD ENC's).

A major challenge in working with high-density bathymetry is the current Norwegian classification regime. We are still waiting for a change of this regime. The indications are a release of detailed depth information inside the 0-30m depth area, but no date has been set.

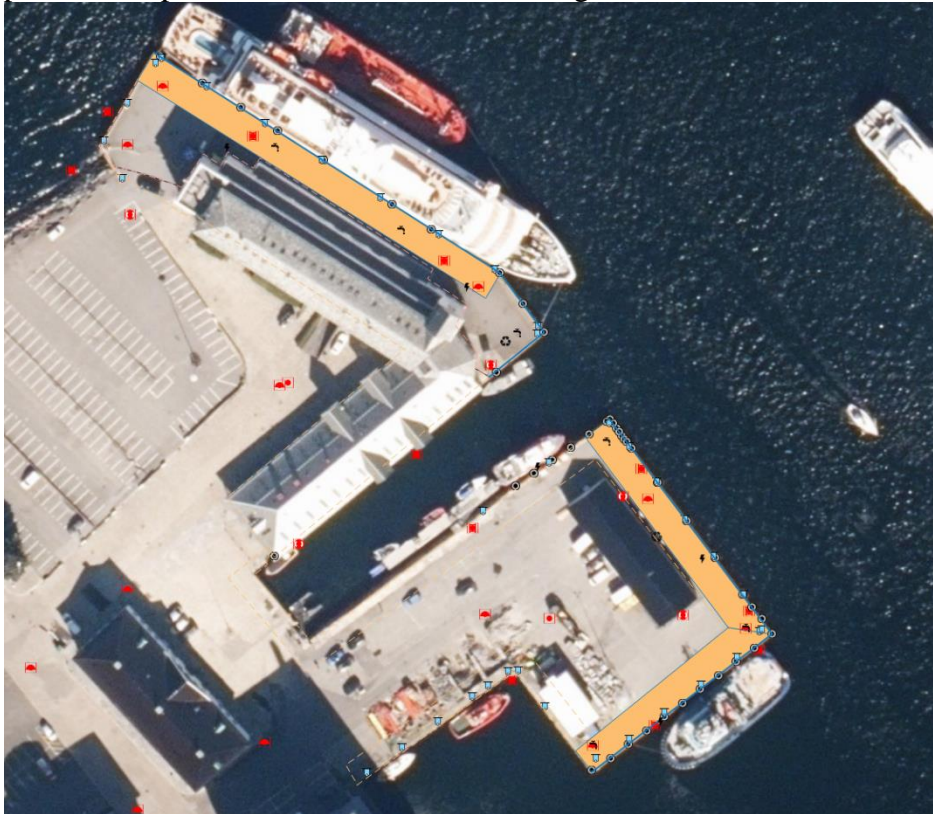
The indication is a release of detailed depth information inside the 0-30m depth area.

## 4. Nautical Publications

By digitizing the Norwegian pilot we had to develop a new national port data standard. The standard and a standardized product specification were approved in March 2023. The standard is used to collect port data from approximately 20 ports in Norway. The data is stored in a common map database. In addition to the product specification, a registration document has been prepared – a guidance document on how the data should be captured/mapped. The purpose of this guidance document is to obtain a uniform and standardized registration of the data. It also makes it possible for ports to register data themselves. The standard and the registration document are available in Norwegian and English.

Based on experiences and feedback from survey's in 2020 (and adaptations to the marine harbour infrastructure (S-131)) there has been revisions and improvement to the standard. The newly approved product specification is now published in version 3.0.

There has been great interest in port data from many parties, both private businesses, the ports themselves and other public or governmental agencies. There has been written a user needs report, with an analysis of the need and interest to the various stakeholders present in a port. This report has been used when working with version 3.0 of the standard.



*Figure 7 Example updated drawing rules (Port of Bergen)*





*Figure 8 Example updated drawing rules (Port of Bergen)*

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 a 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. The data can also be downloaded as a dataset in our national geoportal, Geonorge. You can also view the data with WMS/WFS-services. 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.

In 2021 a project which is a collaboration between 9 major ports in Norway started up. The port of Oslo is project owner, and the Norwegian Mapping Authority is project leader. Accurate port data is a key component for success of this project. Port data can be used to develop tools for more efficient and easier management and planning of the daily operations in the port. This project was completed in the spring of 2023.

## **5. MSI**

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

## 6. C-55

The last update of C-55 was sent to IHB in January 2022

## 7. Capacity building

Norway participated in and chaired both the annual (June 2023) and intersessional (March 2023) 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.

## 8. Oceanographic activities

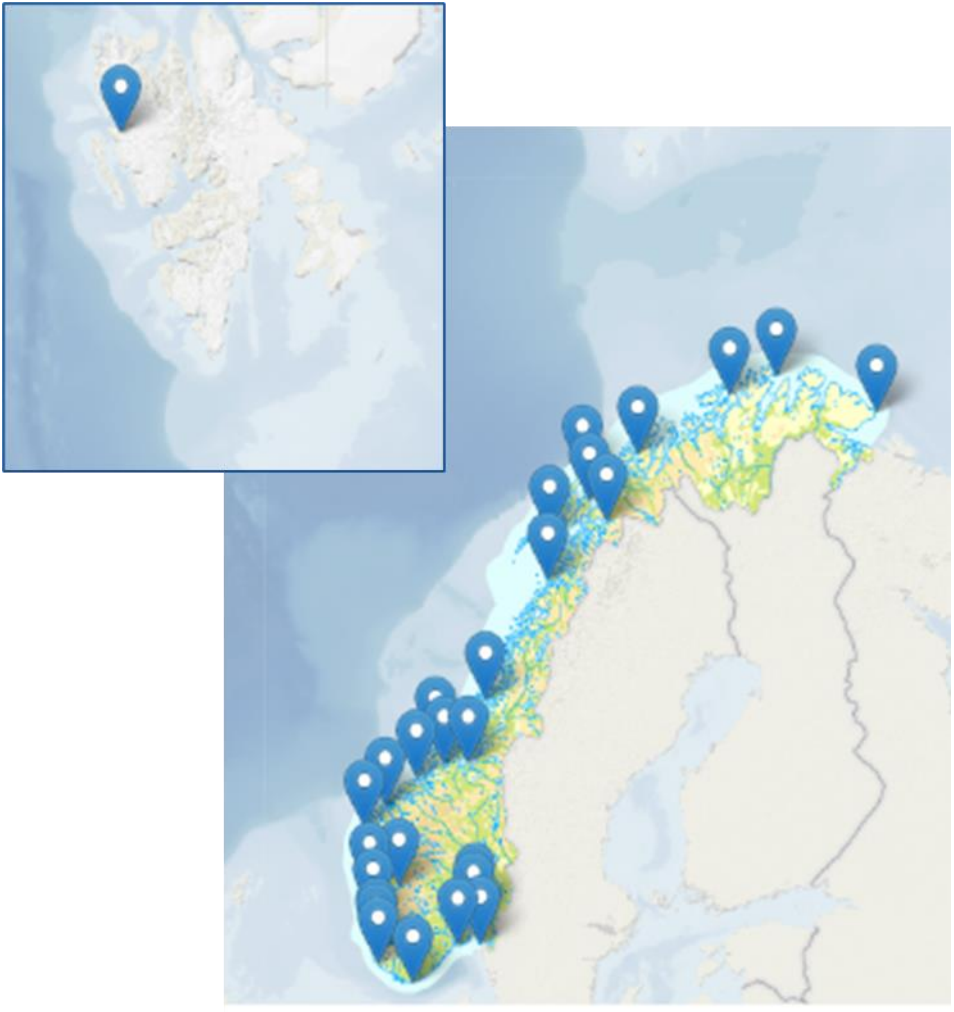
The permanent tide gauge network in Norway consists of 28 gauges including one in Ny-Ålesund at Spitsbergen. Figure 4 shows the Norwegian tide gauge network per July 2023. In addition to the permanent network, temporary measurements are performed at locations between the permanent gauges. These are used to construct a model based on tidal zones. This model is used to provide water level data and information for most places along the Norwegian coast. Professional users can download data from an [API](#) directly. Our website [Se havnivå](#) provides observed water level, water level forecast for 5 days (from a model run by the Norwegian Meteorological Institute) and tide tables. We also distribute and visualize vertical datums, such as the Norwegian vertical datum (NN2000), Chart datum and return periods for extreme high and low water (up to 1000 years). The website is used both by professional users and the public.

To increase the use of water level observations and water forecasts instead of only tidal predictions, from 2022 the official Norwegian tide tables are no longer published as a separate publication. All necessary information is available on the web pages.

In 2022 the national models describing the relation between the different datums; Chart Datum, the Norwegian vertical datum (NN2000), Mean Sea Level and the ellipsoid were further developed. Even models for Spitsbergen are now available. These models facilitate, among others ellipsoidally referenced surveying. The models are available at [Geonorge](#).

In 2021 and 2022 the Norwegian Mapping Authority installed 4 new permanent water level gauges in Sandnes, Sirevåg, Leirvik and Bruravik. The new tide gauges consist of radar sensors for water level monitoring and geodetic sensors for land movement monitoring and were installed in close collaboration with the Geodetic institute. In addition to this, the Norwegian Mapping Authority upgraded the infrastructure (communication system and data loggers) on all existing tide gauges, thus making the network more robust and providing data in more real-time than before.

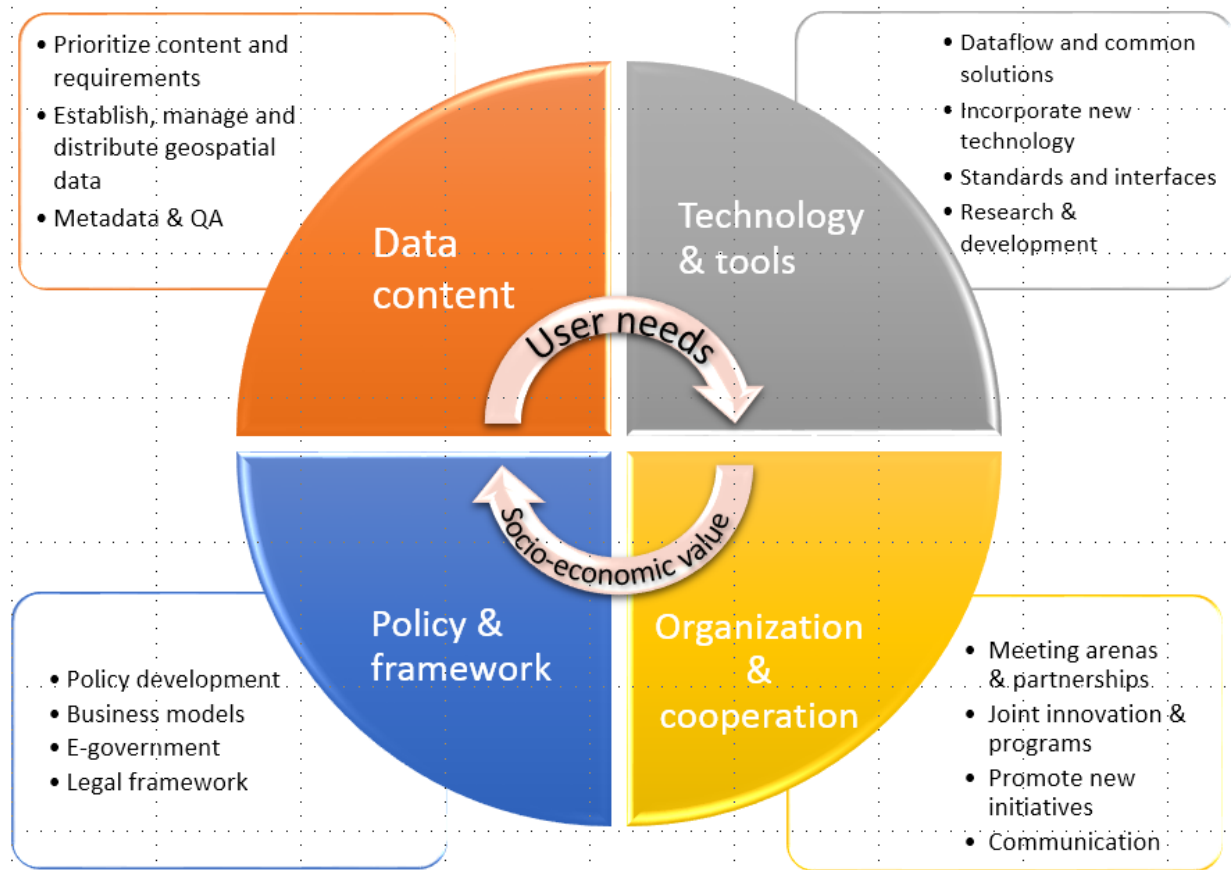
The Norwegian Mapping Authority will continue the expansion of the tide gauge network and plans to install at least two new tide gauges in 2023.



**Figure 4:** Map showing location of existing permanent tide gauges along the Norwegian coast.

## 9. 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.9 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:

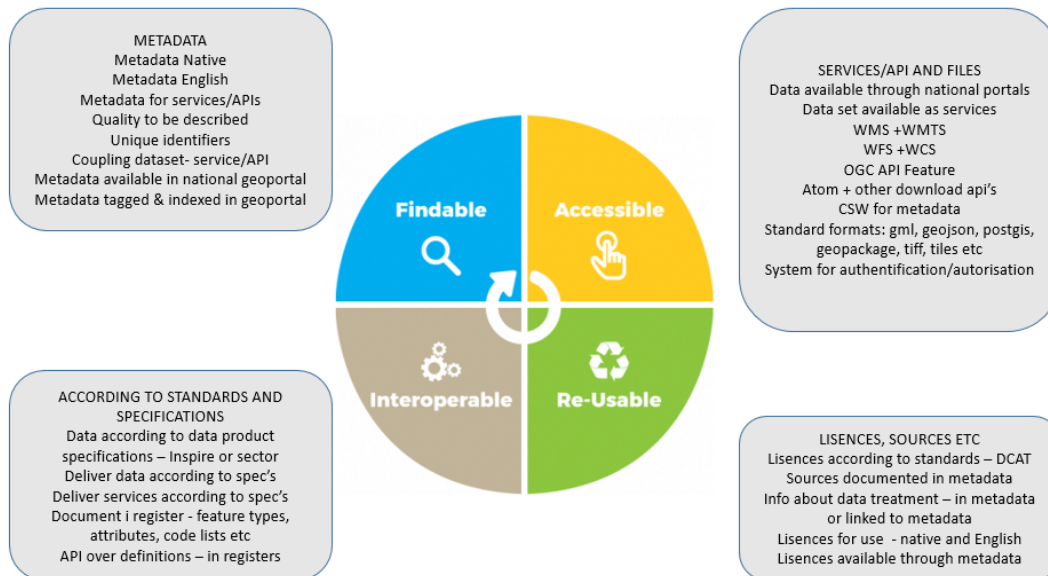
- Offer a national knowledge base of geospatial information that meets important societal needs and user-priorities
- Incorporate technological tools and improve interoperability to increase interaction, efficiency and innovation
- Improve and further develop cross-sectorial cooperation and collaboration 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 more detailed descriptions on where and how to improve the national SDI.

## FAIR

The Norwegian Mapping Authority is leading the FAIR working group of the MAREANO-programme which aims to enhance the findability, accessibility, interoperability and reusability of all data financed under this programme, to make it easier for the user to discover and make use of data most suitable for purpose. A key approach is to develop FAIR-supportive solutions on top of existing components of the NSDI.

### FAIR implementation by using geospatial infrastructure standards, technologies and routines



The project has established a registry in the national geoportal (Geonorge) containing all datasets from MAREANO. A FAIR assessment tool to automatically assess the FAIRness of the data registered is developed and is being evaluated for further improvement. Valuable quality improvements to metadata content, data flows, OGC compliant services, data content offerings, and data management / value chain awareness have been achieved.



## 10. Innovation

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

NHS requires to renew its management, storage and processing system for bathymetric and miscellaneous marine geo data in order to:

- more effectively serve existing and future users
- support new data formats, standards and products
- meet future requirements for automation, machine learning, quality and lead time

To address these goals, NHS have therefore established a new product organization Hydrographic Information System (HYDRIS) with a Product Development Team responsible for renewing the existing hydrographic data management solution, automating parts of the product production pipeline and building the technical architecture to achieve the aforementioned goals.

The assignment from the Norwegian government, same as last year, prioritize digitalization and efficiency improvement. HYDRIS respond to it, with its aligned goals for modernization and automation in order to meet society expectations for efficient Marine Geodata dissemination.

HYDRIS is part of digital transformation strategy that is being implemented within Norwegian Mapping Authority. The number of cross-functional product development teams are established across the divisions with the aim for collaboration that is supported by Digital Leader Team. In addition, the focus is set on standardization and common infrastructure where possible for maximizing the profits. HYDRIS development team that operates in NHS consist of technical-oriented squads working with technology, but also support group that is working actively towards internal and external users/stakeholders to unsure right focus and response to the needs of society.

The new system is expected to be an integrated and complete management solution supporting effective preparation and dissemination of a broad range of marine geodata, including bathymetric and derived bathymetric products. The solution must/shall 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/various 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 off 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 critical milestone at the end of 2022 setting into production new management system for the closed environment where classified data are maintained and processed. The core of the solution is based on Teledyne Caris COTS software/components. The system is under further development according to the specific requirements and focusing on automation as well as increase of efficiency. In addition, implemented infrastructure fulfilling FAIR principles that emphasize machine-actionability. The system is being tested

for migration of the data from old system that will be sunset after the migration process is completed.

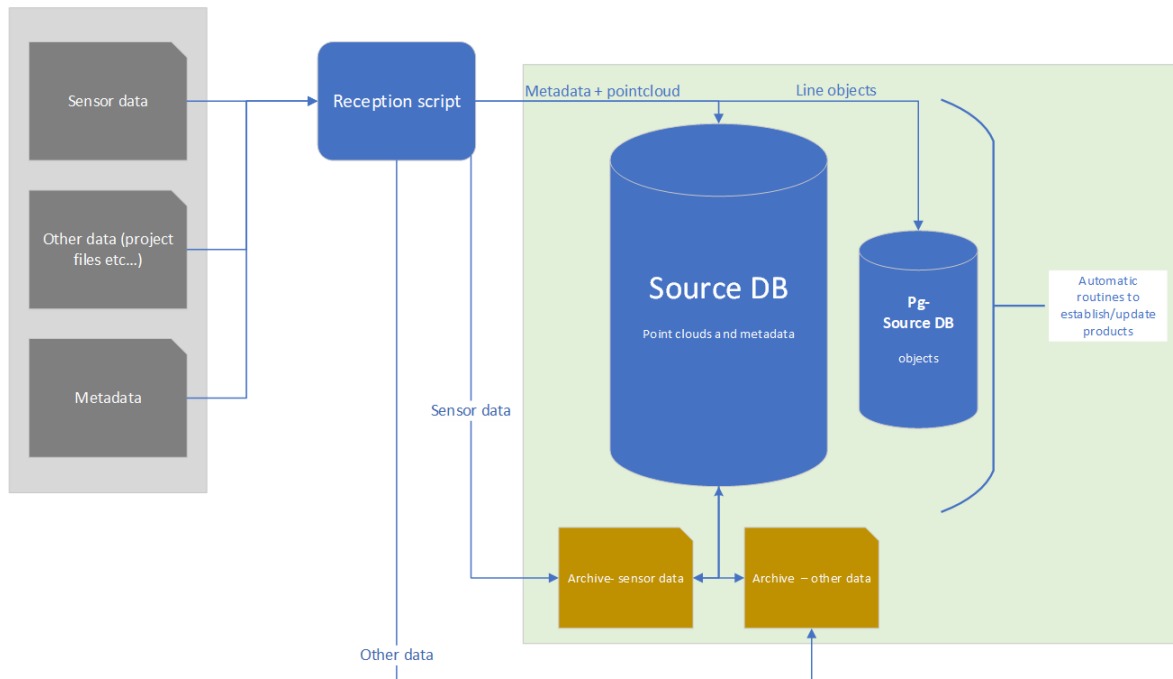


Figure13. New data management solution

Another key achievement for HYDRIS was establishing a new computing infrastructure for automation and processing. This is built with open-source components, and capabilities to read sensor-data, process points, grids, and vector data, and output to various standard spatial formats. All these components are connected to an orchestration engine that can automatically run processing pipelines based on events from the data storage. After a 6-month pilot project that resulted in fully automatic and effective data pipeline that produced digital elevation models (DEMs) from raw dataset. The Pilot showed possibilities with data orchestration tools based on open-source and cloud technology.

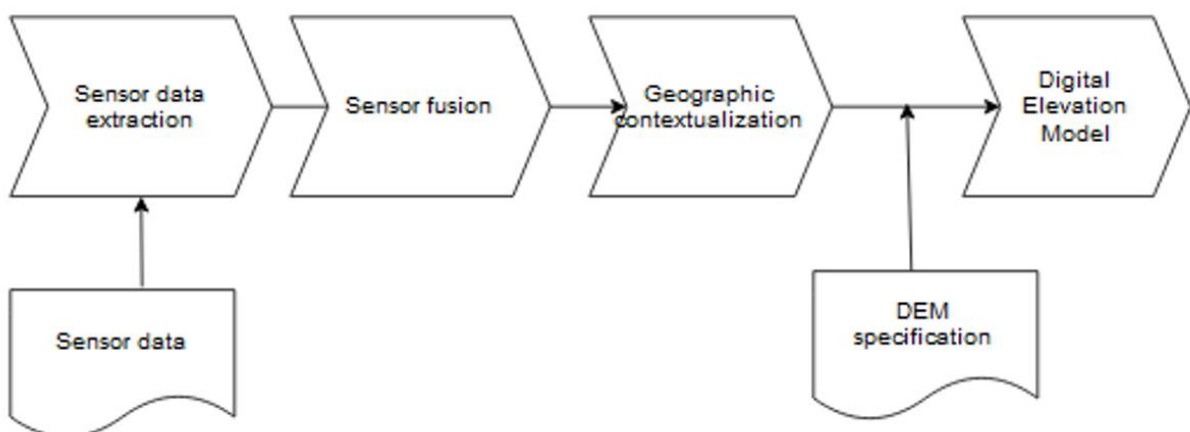


Figure 14. General processing pipeline for automated bathymetry processing.

We are currently building new pipelines in order to automatically validate that survey data is delivered according to specification. This is expected to save a lot of time in survey data quality control and processing.

HYDRIS product organization has been existing and evolving for more than a year. Presently, it comprises four functional product teams serving the production department: Data Management, Automation, Data Product Creation as well as Business Development. The teams work as multi-disciplinary, autonomous teams in an agile fashion towards agreed upon OKRs. We have found this a remarkably effective way of organizing such highly technical work.

The development (as scoped) is planned to take 5 years to complete (period 2022 – 2026), has an estimated total cost of appr. €13.5 Mill. EUR and has received full funding over the national budget from 2022. The implementation will include organizational as well as technological changes.

#### **HYDRIS News:**

Just before summer, HYDRIS and Geodatastyrelsen (Danish Geodata Agency) held a meeting in Aalborg. The meeting was particularly promising as both entities are utilizing the CARIS management system, revealing numerous opportunities for collaboration.

Furthermore, HYDRIS got acceptance of an artificial intelligence project with the Norwegian University of Science and Technology (NTNU). The project is titled “Anomaly screening for MAREANO Bathymetric Surveys” and will use deep neural networks to classify multibeam echo sounder data. This screening is expected to identify anomalies in the dataset to direct the processing operators to areas that needs investigation. The project will start in August 2023 with 7 dedicated master’s students in computer science that will collaborate with HYDRIS on machine learning techniques for multibeam sonar data collected in the MAREANO programme.

## **11. Other activities**

### **International activities**

The NHS is involved in several Working Groups, Committees and Commissions related to IHO. Norway chairs the IHO CBSC and the IOC IHO GEBCO Guiding Committee and has representatives in the following Sub-Committees and Working Groups: IHO Council, 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 both directly and through EMODNet.

NHS is a member of the IOC UN Decade Ocean Data Coordination group and has actively contributed to the Data & Information Strategy for the UN Ocean Decade.

As operator of Primar we participate in all related meetings.

NHS is an active partner in EMODNet.