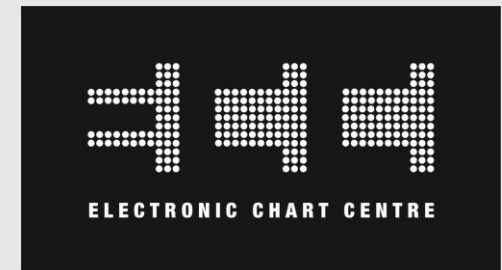


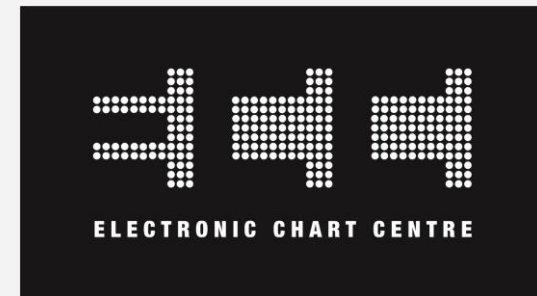
S-100 Demonstrator Project

Norwegian S-100 Testbed Report

Svein S. Skjæveland
Manager International Standardization
Phone +47 92662697
svein.skjaeveland@ecc.no
ecc.no



Electronic Chart Centre AS



Owner: Ministry of Local Government and Regional Development

Established: 1999

Employees: 22

Tasks:

- Contribute to increased safety in the maritime, terrestrial and aerospatial domain.
- Delivery of services to help Norway fulfil obligations related to national/international strategies on safety at sea.

Main Customer: Norwegian Mapping Authority, Hydrographic Service

Main Activity: Development and day-to-day operation of PRIMAR

S-100 Demonstrator Project

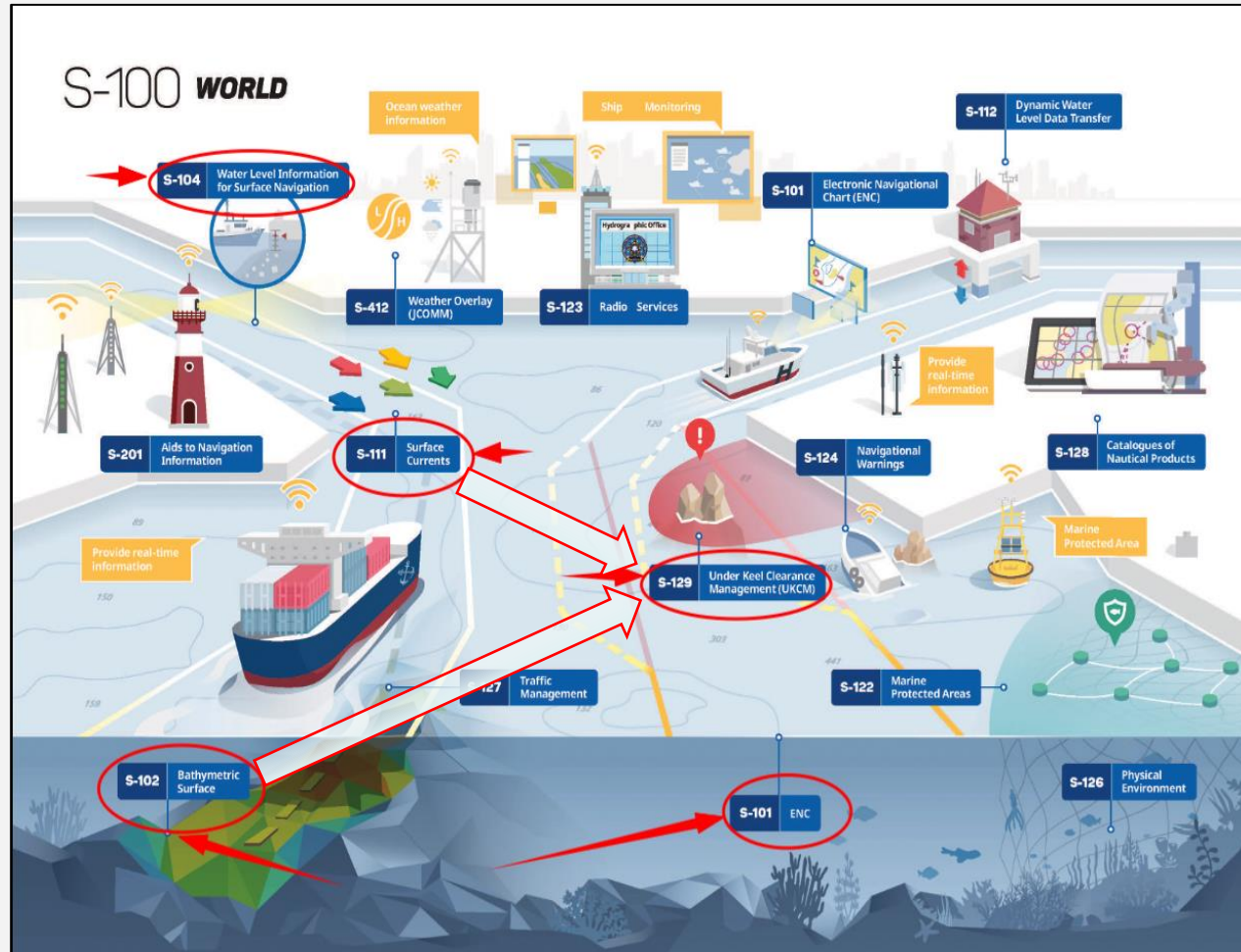
Scope:

To define how the new combined IHO S-100 products can create considerable value for the maritime industry.

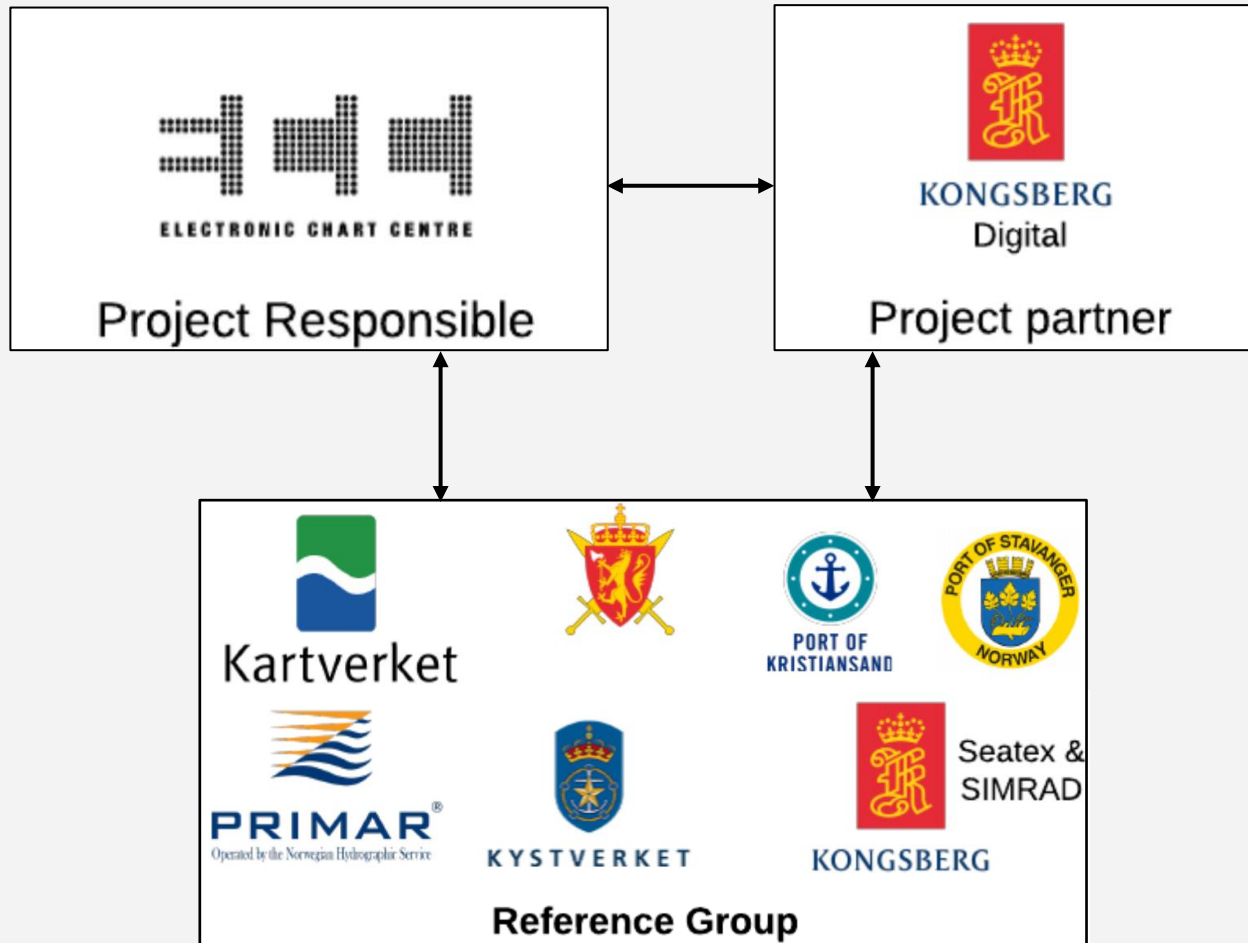
Ports, Navy and Coastal Administration

Period:

2019 - 2023

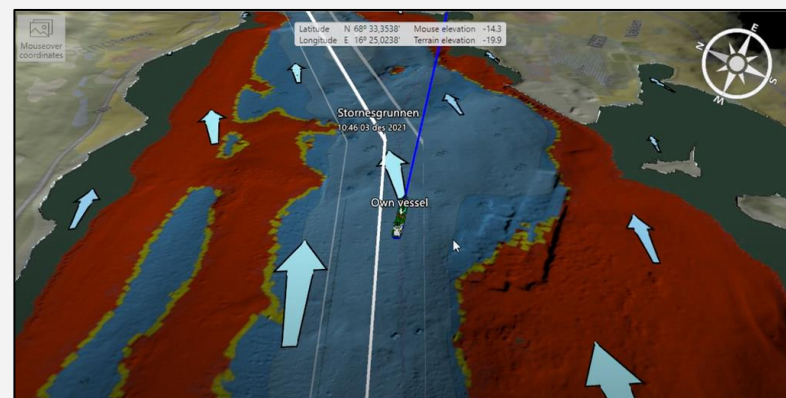
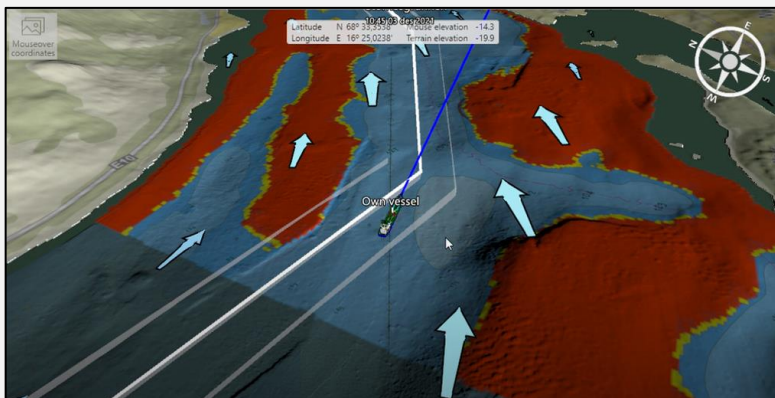


S-100 Demonstrator Project - participants

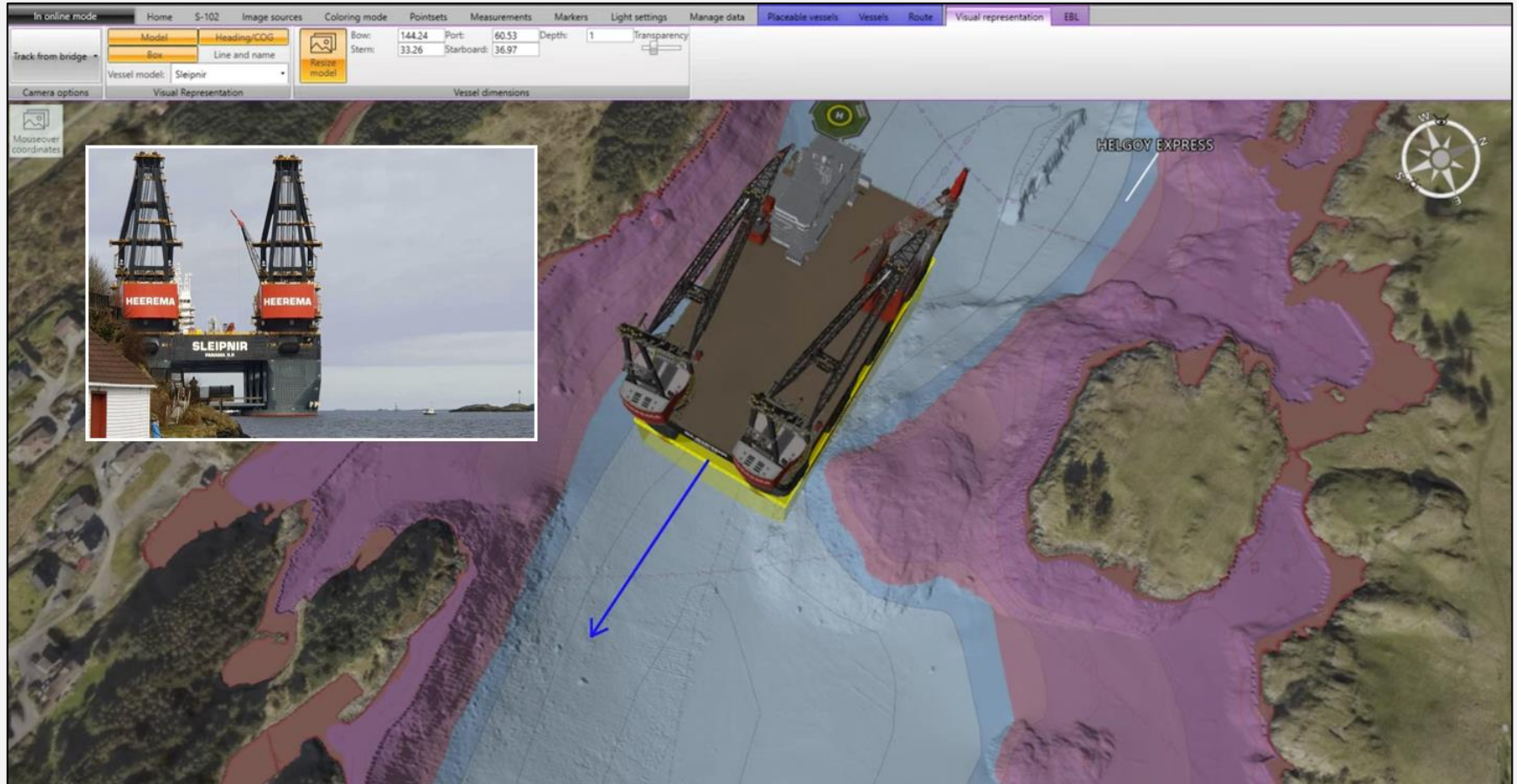


The Basic Approach

1. Identify challenging maritime operations.
2. Produce S-100 data where these operations are conducted.
3. Develop end user application – **S-100 Demonstrator**.
4. Conduct operations and ingest S-100 data in the S-100 Demonstrator application.
5. Gain experience on potential added value.

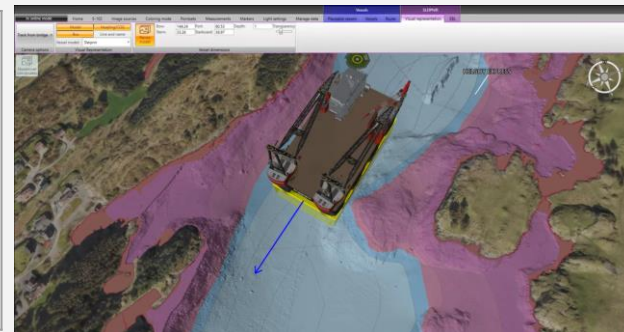


Operational test - Sleipnir to Haugesund



Test reports, videos and more: <https://s-100.no/>

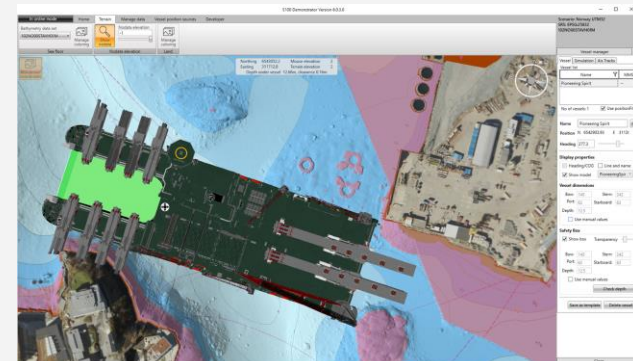
Test	SLEIPNIR to Haugesund
Focus	The world's largest crane vessel through narrow shallow waters to pickup module to oil platform.
Data	ENC , S-102, Land info
Involved parties	Heerema, Crew - Sleipnir, Insurance company, Equinor Aibel, Port of Karlsund, Coastal Administration, Norwegian Hydrographic Service & the project team
End user systems	S-100 Demonstrator, SEAiq + (Njord Pilot)
Results	<p>The operation not possible without the use of S-102 data and the use of them in S-100 Demonstrator.</p> <p>Operation conducted safely - huge economic benefit for the customer.</p>



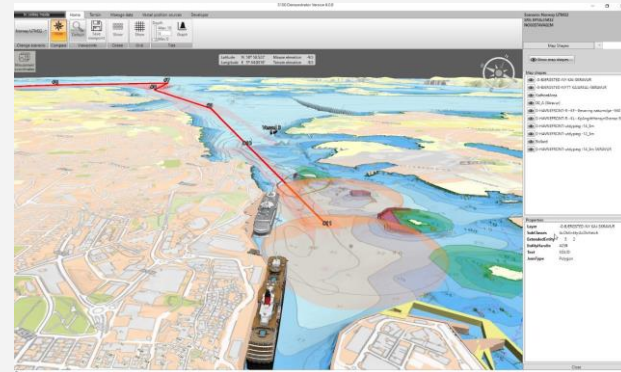
Test	<u>Historical Voyages to Port of Kristiansand based upon AIS tracks</u>
Focus	Identify how far margins were stretched before having access to new S-102 data - 3 vessels\ Voyages (Federal Nakagawa, Balkan, Haven)
Data	ENC , S-102, Land info, Historical AIS traacks
Involved parties	Port of Kristiansand, Norwegian Coastal Agency, Norwegian Hydrographic Service & the project team In addition ship owner companies
End user Systems	S-100 Demonstrator
Results	<p>The involved parties gained increased understanding of how S-102 data used in S-100 Demonstrator could have been used for:</p> <ul style="list-style-type: none"> • Ensurance of acceptable depth along quay. • Avoiding grounding (which did happen in one occasion)

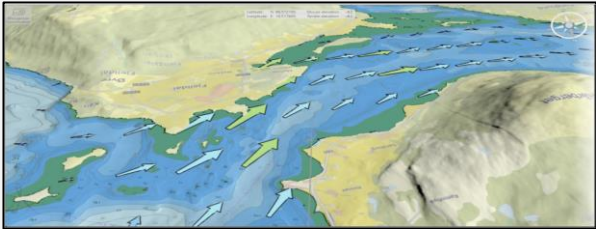


Test	<u>Pioneering Spirit in narrow waters - Port of Stavanger and Kristiansand</u>
Focus	World's largest catamaran crane vessel into areas of limited depth and breadth
Data	ENC, S-102, Land info
Involved parties	AllSeas, Bergen agent, Norwegian Coastal Agency, Ports Quays, onboard crew, Project team
End user Systems	S-100 Demonstrator, SEAiq + (Njord Pilot)
Results	Improvements done to original sailing plans based upon the improved information provided by the S-102 data.

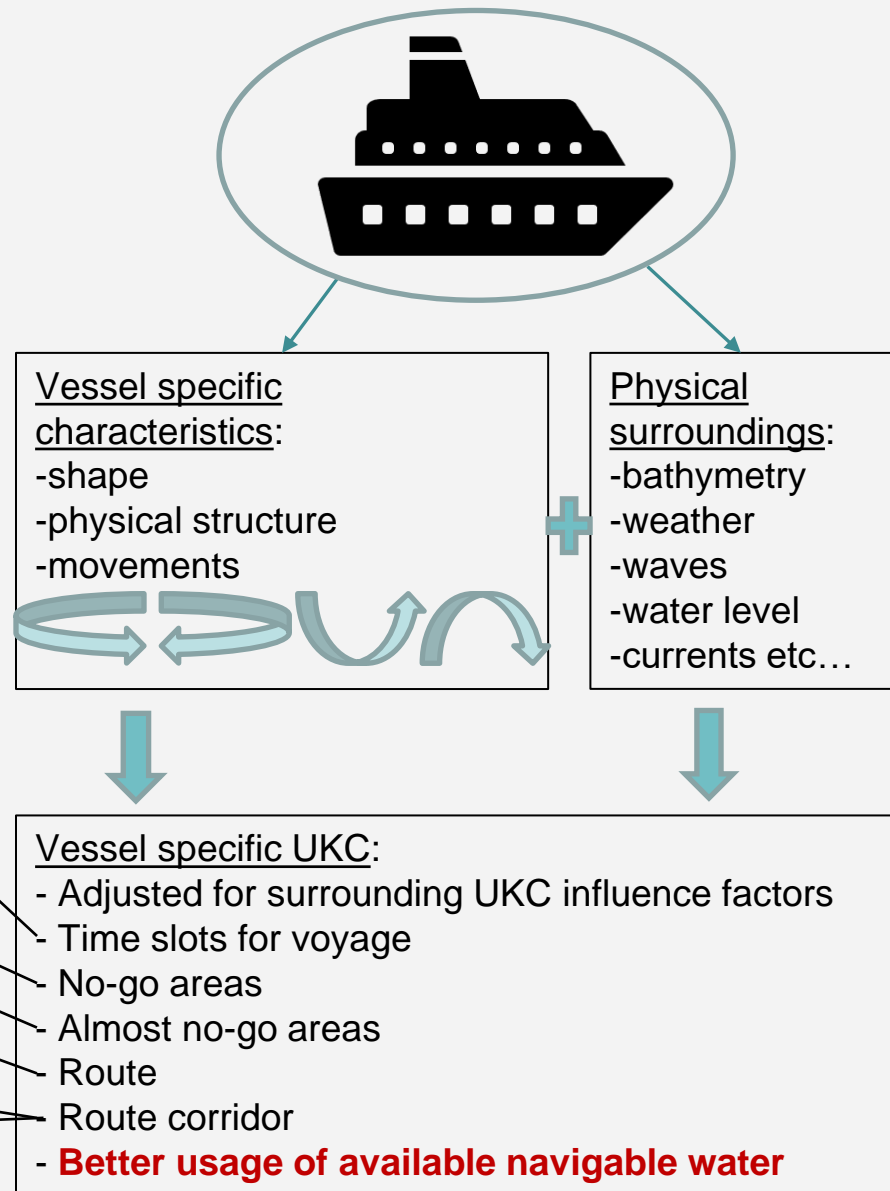
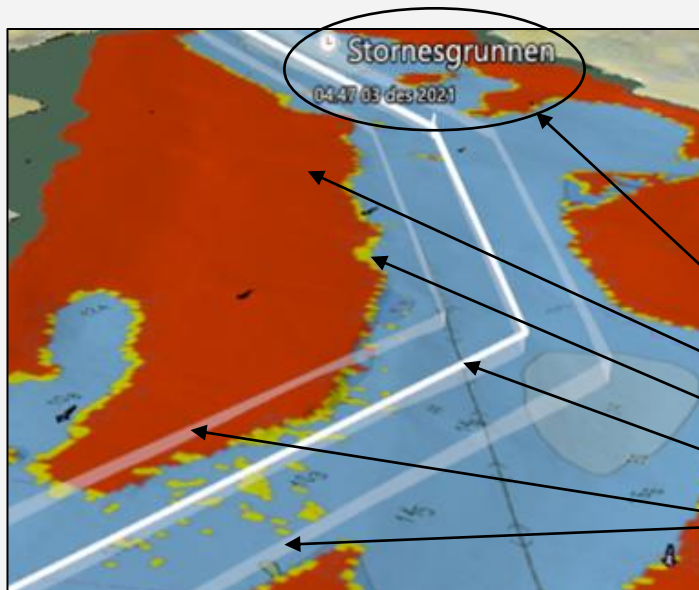
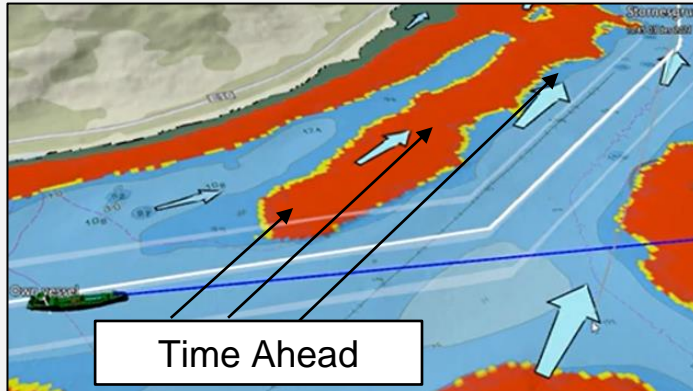


Test	<u>New harbour simulation - Port of Stavanger</u>
Focus	Simulation using a model of the world's largest cruiseship (Oasis of the Seas) when entering narrow waters into new planned quay in Bjergsted
Data	ENC, S-102, Land info, additional critical area information , quay plans
Involved parties	Port of Stavanger, Norwegian Coastal Agency, Captain Oasis of the Seas, Norwegian Hydrographic Service & the project team (film crew)
End user Systems	S-100 Demonstrator
Results	<p>A movie displaying the challenges in the narrow waters when accommodating new infrastructure for arrival of this type of large vessels.</p> <p>Used for input to governmental authorities and national Transport Plan.</p>



Test	<u>Under Keel Clearance Management- Tjeldsundet</u>
Focus	Use S-129 (UKCM) to navigate through narrow and challenging waters through Tjeldsundet to Port of Harstad.
Data	ENC(S57), S-101, S-102, S-111, S-129, PRIMAR RTZ, Sehavnivå (water level information), seabed area information
Involved parties	Terntank (ship owner), Crew Tern Ocean, Norwegian Coastal Agency, OMC International, Norwegian Hydrographic Service, Norwegian Meteorological Institute, Project team
End user Systems	S-100 Demonstrator, SEAiq, (Njord Pilot)
Results	<p>Tested on commercial voyage. Economical benefits and increased navigational safety</p> 

S-129 Concept



S-129 Under Keel Clearance Management Operational Test - Tjeldsundet



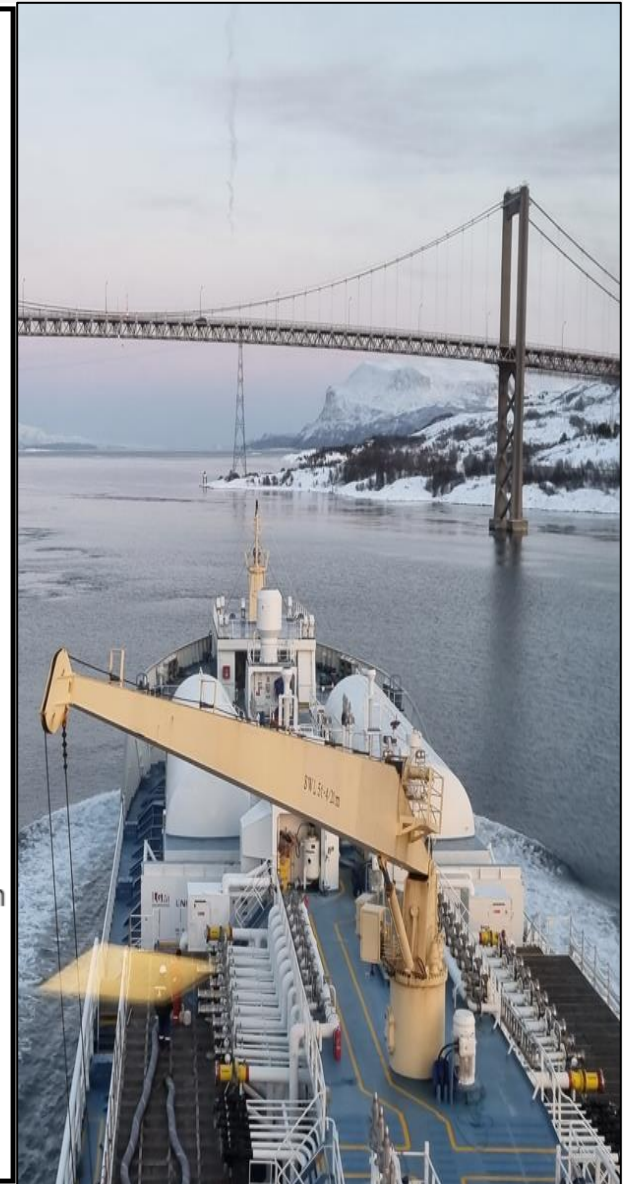
- Produce S-129.
- Produce S-1xx products.
- Use S-1xx products (S-102 and S-111) for S-129 generation.

- Integrate data in end user tool
- Use for voyage planning.
- Use for voyage execution.
- Commercial voyage.

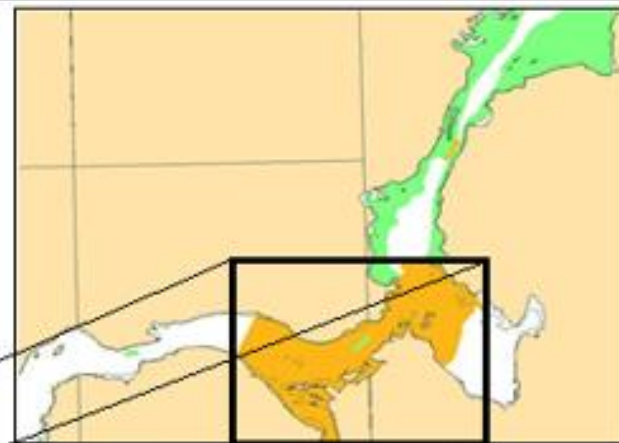
Participants

Participants:

- **OMC International:**
 - Chris Hens - General Manager Product Design & Development
- **Terntank:**
 - Claes Møller - Chief Executive Officer
- **Norwegian Coastal Administration:**
 - Odd Sveinung Hareide - Senior Adviser
 - Andor Dagfinn Antonsen - Pilot
 - Karl Helge Ness Haagensen - Pilot
 - John Morten Klingsheim - Senior Engineer
- **Norwegian Hydrographic Service:**
 - Hilde Sande Borck - Chief Engineer
 - Geir Gunnleiksrud - Senior Engineer
- **Kongsberg Digital:**
 - Thomas Hammer - Team Lead 3D Visualization at Kongsberg Digital
 - Trygve Aasen - Software Developer at Kongsberg Oil & Gas Technology
 - Terje Henriksen - Software Developer at Kongsberg Oil & Gas Technology
- **The Norwegian Meteorological Institute:**
 - Gjermund Haugen - Assistant Manager, The Weather Forecast in Northern Norway
- **ECC:**
 - Svein Skjæveland - Manager International Standardization
 - Sølvi Tunge - Key Account Manager
 - Kirsten Bøe - Managing Director
 - Kjetil Andersen - Sr. Systems Developer

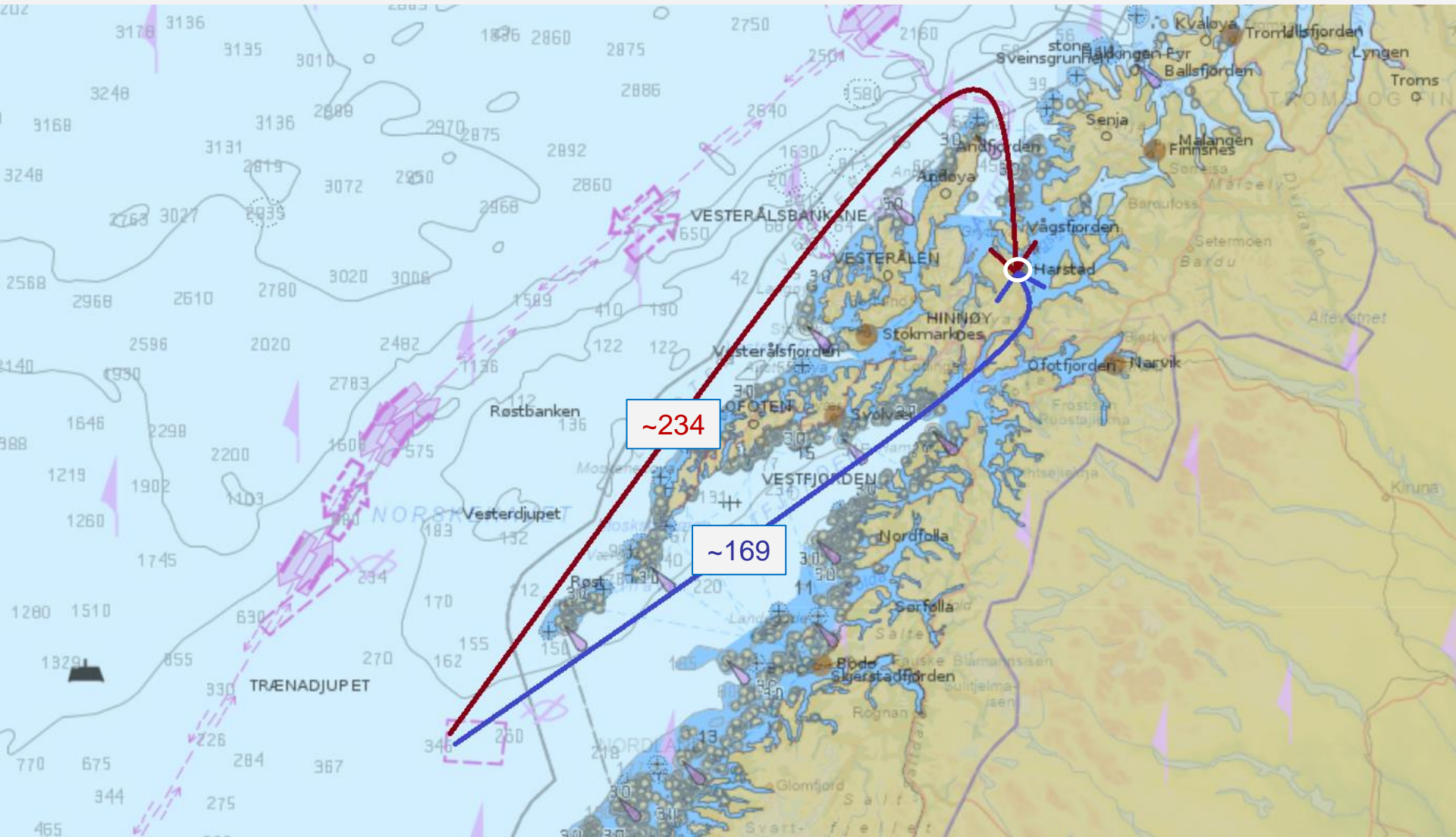


Location: Tjeldsundet



- Available data sources
- Piloted
- Strong surface currents
- Narrow strait
- Challenging
- Shortcut destination

Tjedsundet Distances



Vessel: Tern Ocean

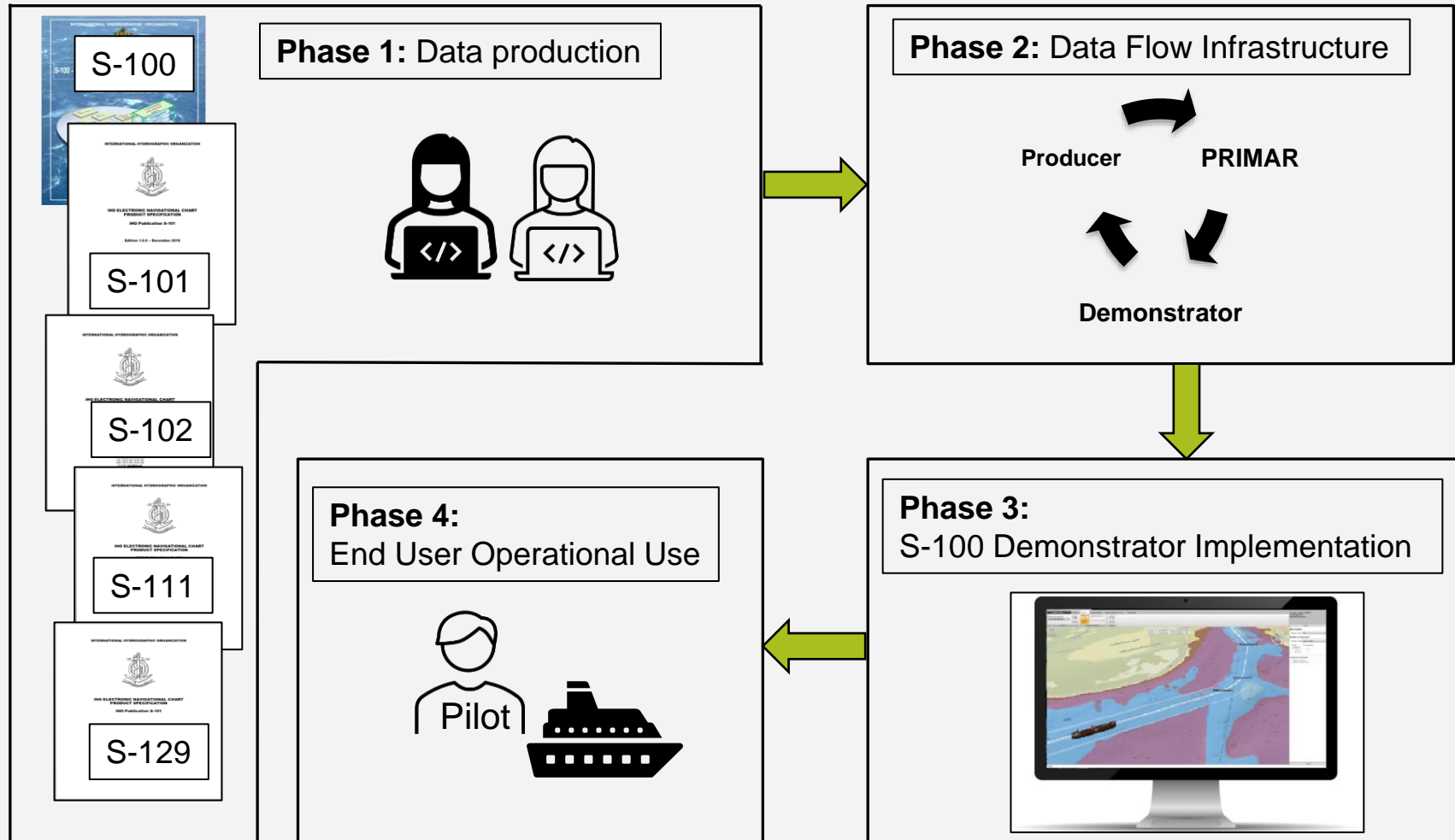
IMO no	9747986
Length Overall	147.00 m
Breadth (moulded)	22.00 m
Depth (moulded)	11.70 m
Draught (scantling)	9.00 m
Deadweight	14.827 t
Gross tonnage	11.374 t



Terntank – Shipping, Chartering, Ship management

<https://terntank.com/>

Test Phases



Phase 1 Products

- ✓ S-57 Traditional ENC
- ✓ S-101 Future ENC
- ✓ S-102 High resolution bathymetry
- ✓ S-111 Surface current (**dynamic**)
- ✓ S-129 Under keel clearance (**dynamic**)
- ✓ S-104 Water level
- ✓ S-421 Routes

- Experience
- Challenges
- Standardization
- Production tools
- Automation
- Static vs Dynamic
- Validation



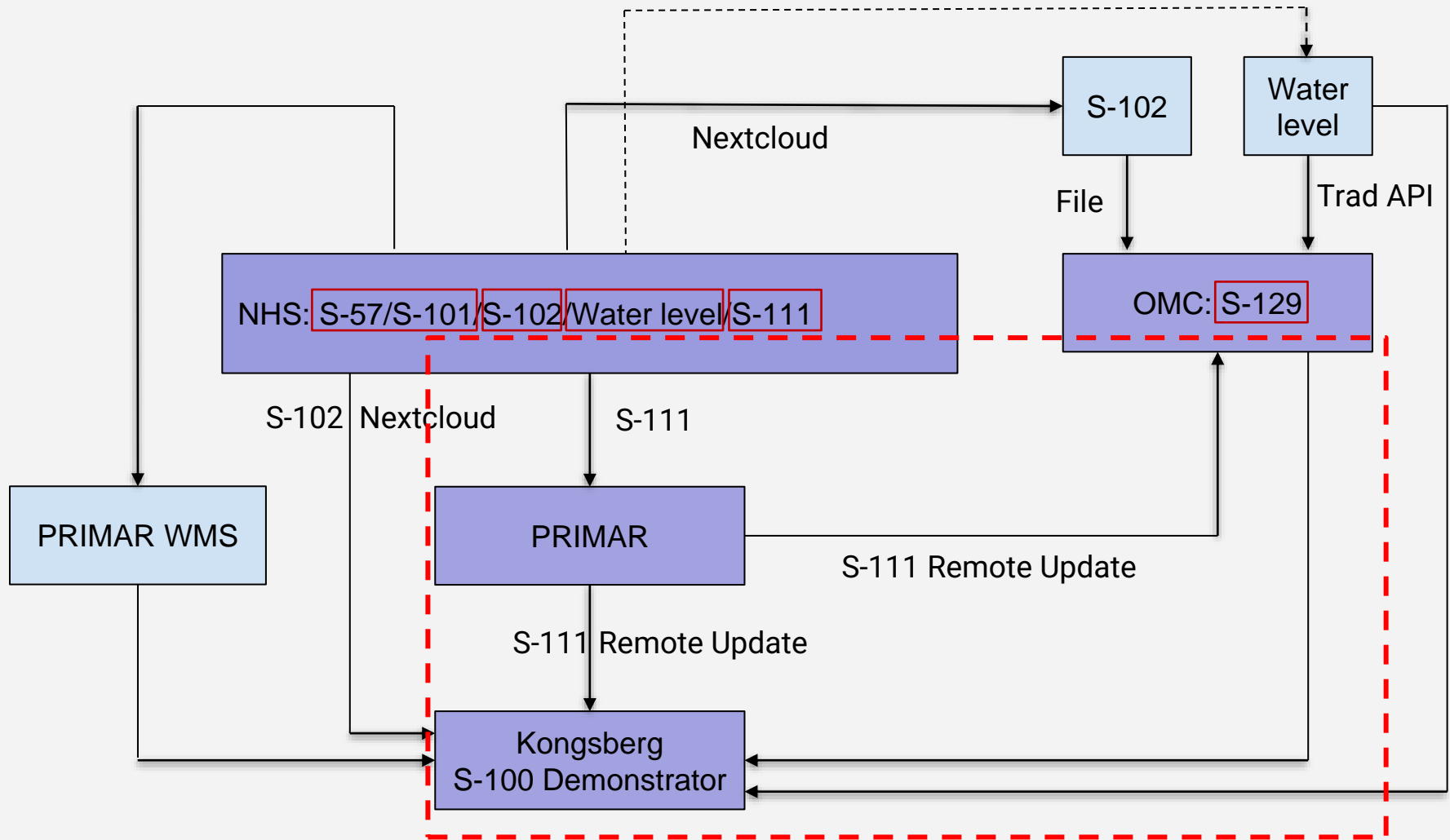
Phase 2 Dataflow

- ✓ Between participating entities
- ✓ PRIMAR Remote Update Protocol
- ✓ APIs
- ✓ S-100 Part 15 Data protection
- ✓ IHO application process

- Experience
- Challenges
- Testdata and documentation
- OEM Experiences
- QA for test purpose



Phase 2 Dataflow



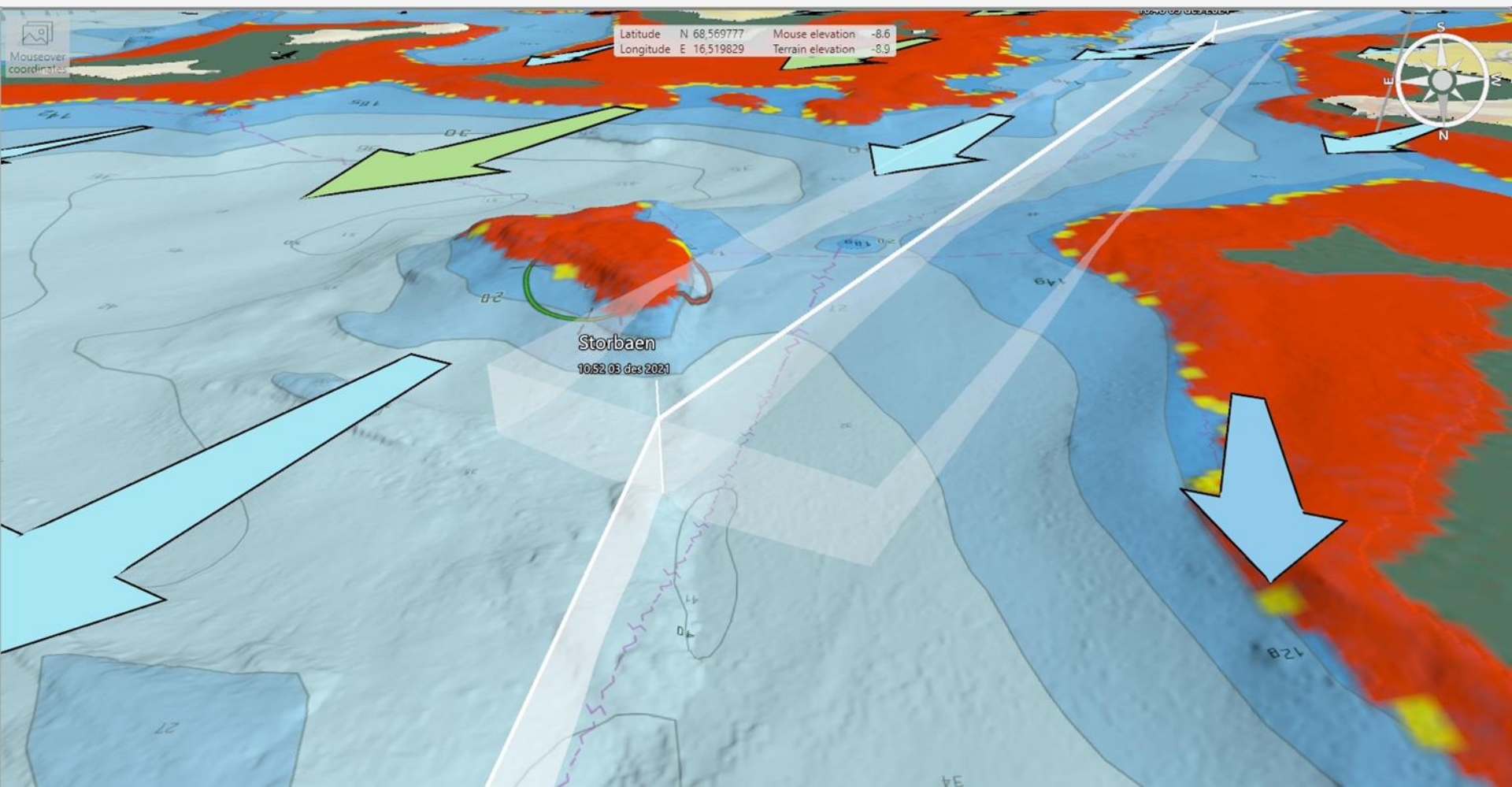
Phase 3 Demonstrator implementations

- ✓ S-101 interface
- ✓ S-102 integration
- ✓ S-111 interface - remote update
- ✓ S-129 interface
- ✓ Water level extension
- ✓ Terntank vessel model

- Experience
- Challenges
- Usability
- New ideas



Phase 3 Demonstrator implementations



Phase 4 Test execution

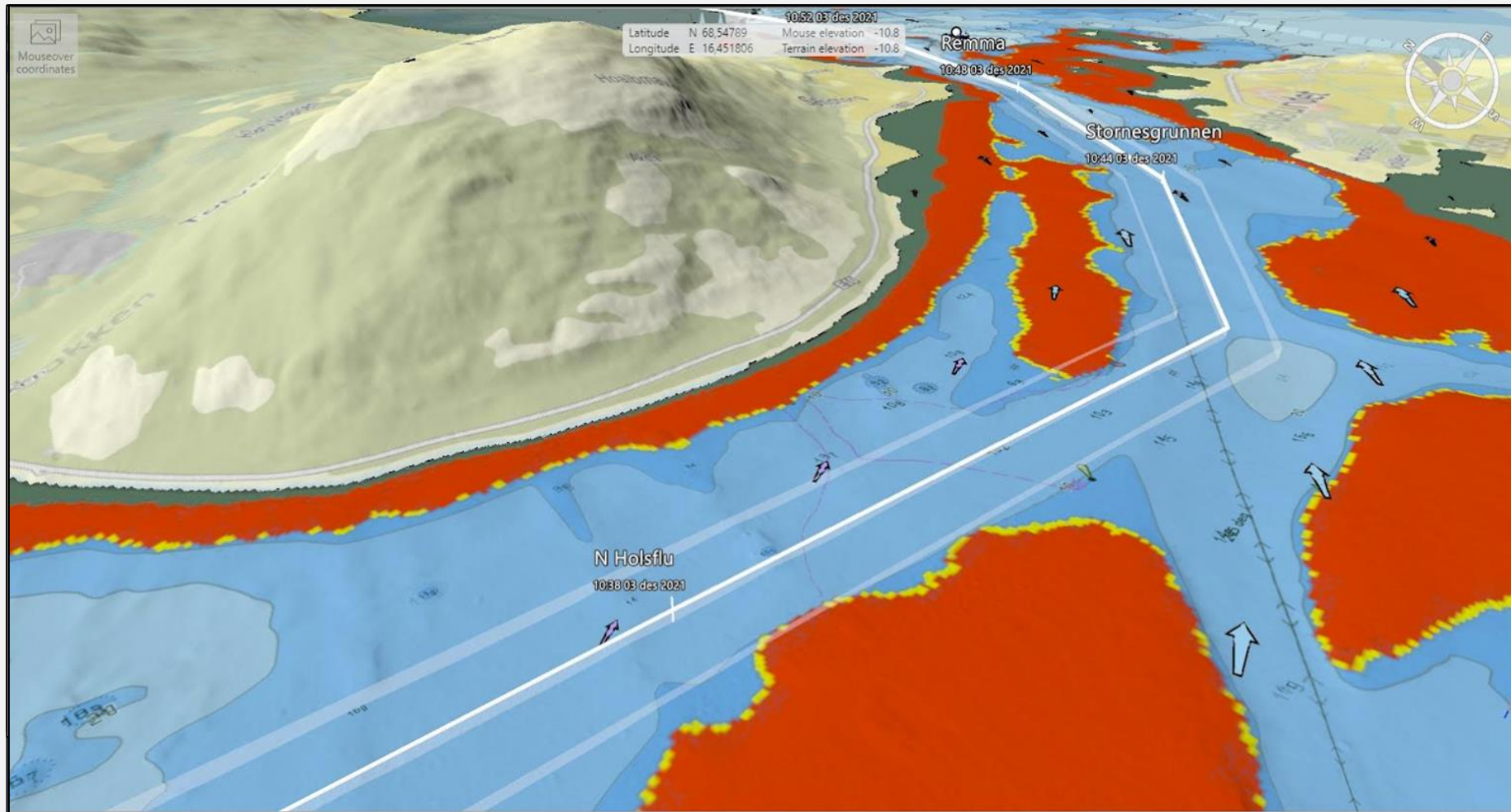
- ✓ **Planning purpose**
- ✓ **Operational purpose**
- ✓ Single product usability
- ✓ Product combination
- ✓ S-129 live updates

- Experience
- Challenges
- Usability
- New ideas
- Situational awareness
- Safety of nav.



Phase 4 Test execution

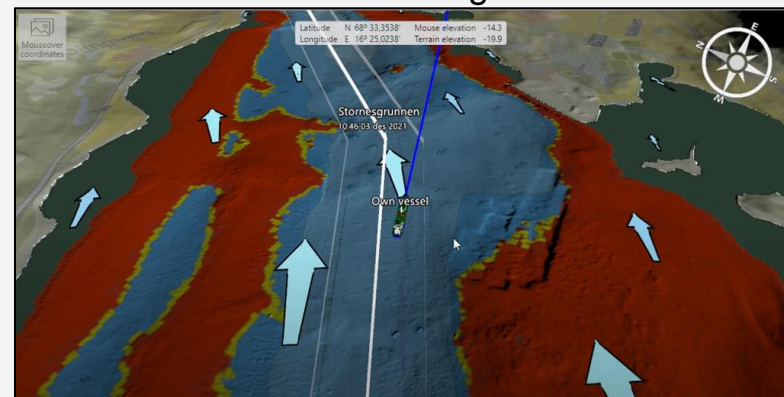
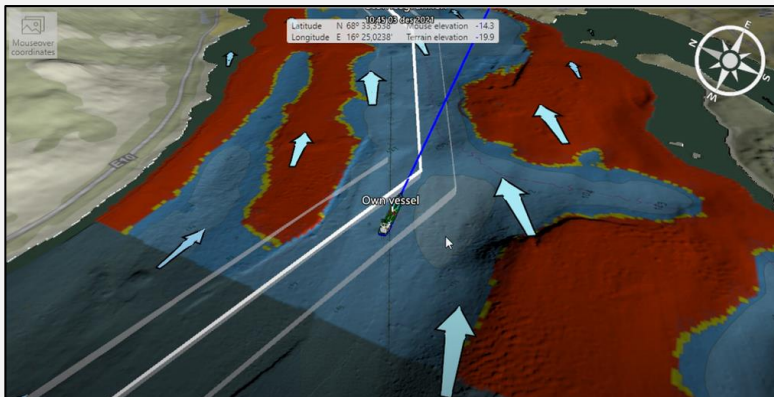
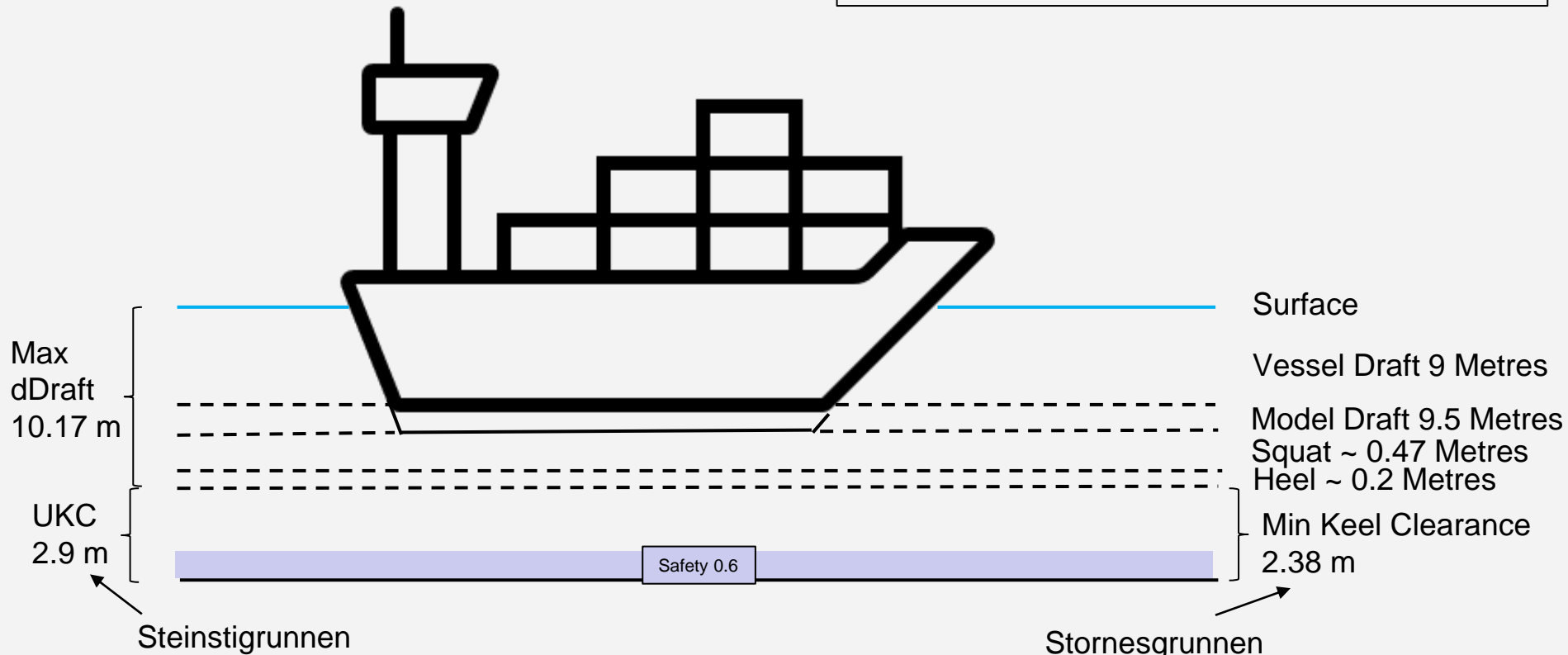
Water Level difference: 2.41 meter



“After review, it turns out that ship must be postponed. This occurs when using the S-100 Demonstrator. New departure 0930”.

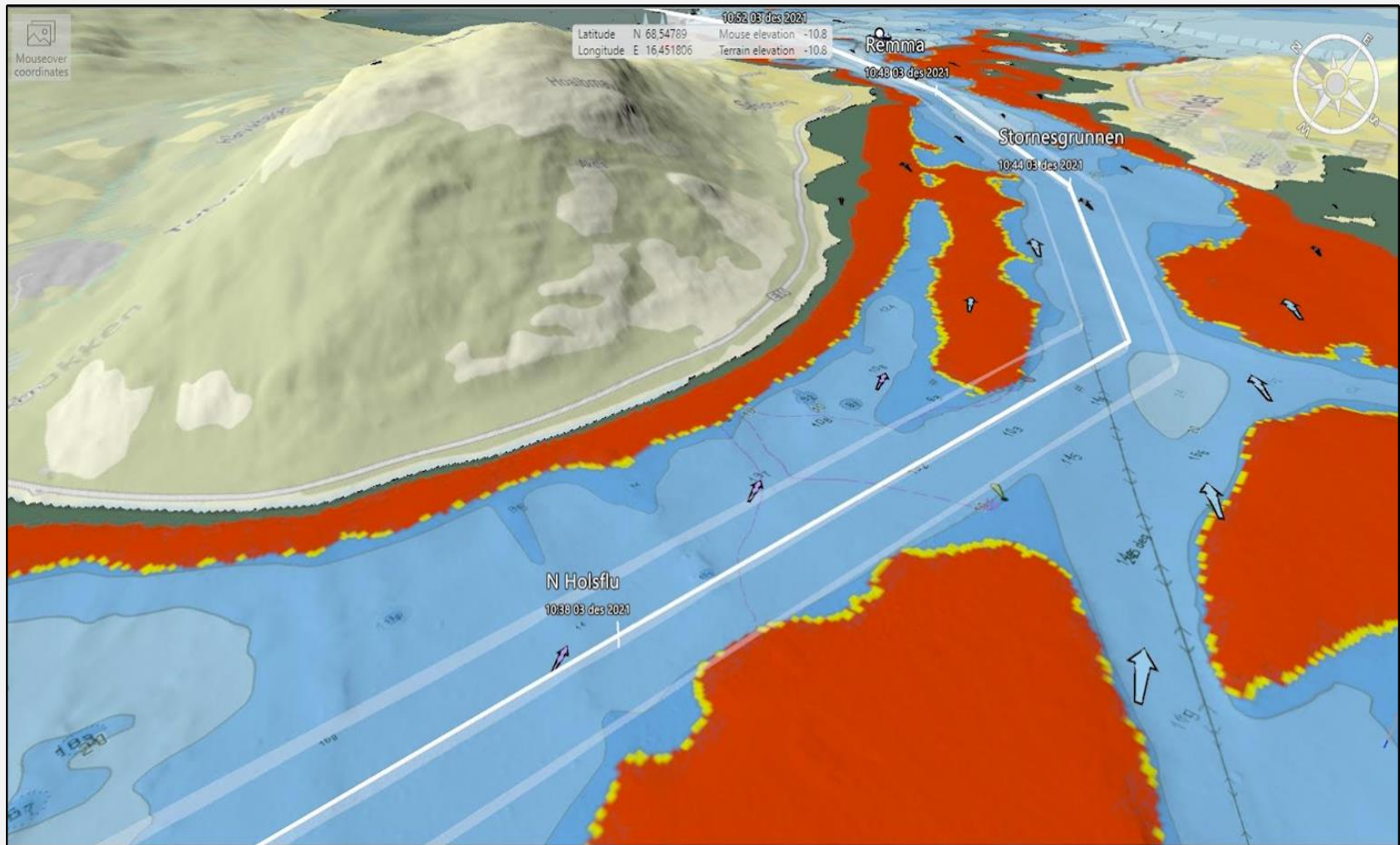
Phase 4 Test execution

Water Level difference: 2.41 meter



Conclusions

- S-129 used in end user application expanding navigable available space.



Conclusions Planning Purpose

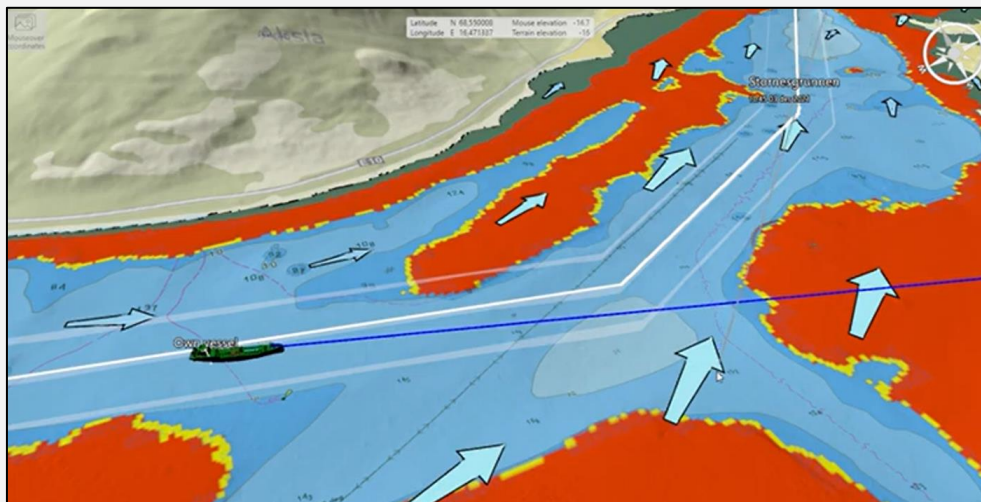
- Perception and understanding of available navigable space.
- Useful for safe passage considerations – identify optimal conditions.
- Unfamiliar waters.
- Assist the Pilot in his area of responsibility.
- Information sharing Pilot – Captain.

“For planning purposes, the products available in the S-100 Demonstrator would be of good use when familiarizing with the circumstances and conditions in the area of planned voyage”.

“The S-100 demonstrator gives all the information I need in one place, so it gives added value to assist me in my area of responsibility”.

“If the pilot makes a plan for the voyage, and then is able to show the captain how the sailing will be done, this may improve the cooperation between the pilot and the captain”.

“In general, the more relevant information that is available, the better it is for decision making during voyage planning and voyage monitoring”.



Expected Benefits accomplishment

Expected Benefits	
Benefit 1 <i>Fuel reduction</i> ✓	More cargo onboard and a shorter sailing route will contribute to reduction in fuel consumption.
Benefit 2 <i>Environmental savings.</i> ✓	The CO2 and NOx emission will be reduced due to reduction in sailing distance. More cargo onboard reduces the number of voyages necessary to transport a fixed size cargo, and as such contribute to emission reduction.
Benefit 3 <i>Economical savings.</i> ✓	A reduction in fuel consumption and a potential reduction in necessary voyages indicates potential cost savings.
Benefit 4 <i>Better vessel exploitation.</i> ✓	A demonstrated potential for better exploitation of vessels operating in narrow waters.
Benefit 5 <i>Increased situational awareness and information sharing</i> ✓	S-100 Demonstrator is expected to portray navigational significant information being more human recognizable than traditional tools by using 3D portrayal on the underlying S-102 data model. As such it is deemed to be more suitable for information sharing/understanding of the situation. <u>E.g.</u> between Pilot and Captain/crew.
Benefit 6 <i>Uptake of S-1xx production.</i> ✓	Increased knowledge within national and commercial data producing organisations on production of data on the S-100 format.

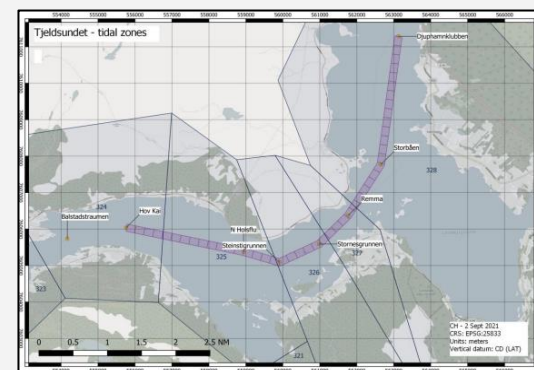
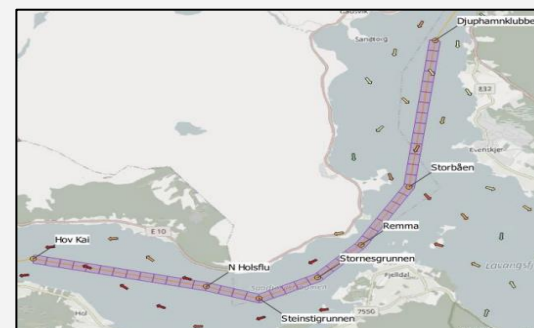
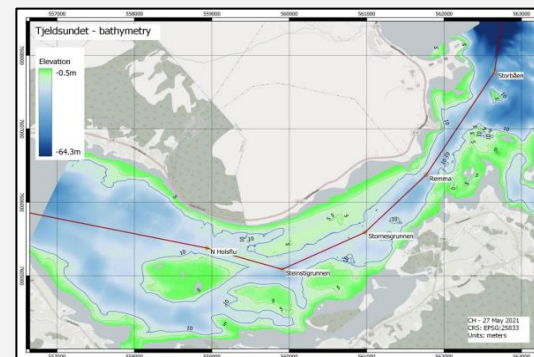
Lessons learnt

- Take time to define the scope.
 - Expected Benefits.
 - Targets.
- Brainstorming.
 - New ideas and input to a certain point.
 - Make decisions and stick to them.
- Dissemination of results.
 - Don't bury result in long, endless reports only.
 - Focus on online information sharing.
- Visualization is always good.
 - Draws attention and interest.
 - Video/model feed of test scenarios.

Targets		
Target 1	Demonstrate how S-102 and S-111 products can be produced.	
Target 2	Demonstrate how an S-129 product is calculated partly based on other S-100 products such as S-102 and S-111, in addition to water level information on traditional format.	
Target 3	Demonstrate how an S-129 product can be used in an end user application (S-100 Demonstrator) to provide more available space, both vertically and horizontally, for navigation during a commercial voyage.	
Target 4	Demonstrate how extended navigational space can be used to load more cargo on a commercial voyage.	
Target 5	Demonstrate how extended navigational space can be used to shorten the transportation distance significantly.	
Target 6	Demonstrate the potential social economic benefits when the use of S-129 widens the navigational space in a narrow area.	
Target 7	Demonstrate how a graphical representation of navigational significant information can improve the mariner's situational awareness – and as such add benefit to the safety of navigation.	
Target 8	Demonstrate how S-100 products used together in combination in a single end user application can create value for the maritime industry.	
Target 9	Demonstrate how a tool like S-100 Demonstrator with support for S-129 is useful during the voyage planning process.	
Target 10	Demonstrate how a tool like S-100 Demonstrator with support for S-129 is useful during the voyage execution process.	
Target 11	Demonstrate how the precursor to S-421 (route plan based on S-100),	
	Expected Benefits	
Target 1	Benefit 1 <i>Fuel reduction</i>	More cargo onboard and a shorter sailing route will contribute to reduction in fuel consumption.
	Benefit 2 <i>Environmental savings.</i>	The CO2 and NOx emission will be reduced due to reduction in sailing distance. More cargo onboard reduces the number of voyages necessary to transport a fixed size cargo, and as such contribute to emission reduction.
Target 2	Benefit 3 <i>Economical savings.</i>	A reduction in fuel consumption and a potential reduction in necessary voyages indicates potential cost savings.
Target 3	Benefit 4 <i>Better vessel exploitation.</i>	A demonstrated potential for better exploitation of vessels operating in narrow waters.
	Benefit 5 <i>Increased situational awareness and information sharing</i>	S-100 Demonstrator is expected to portray navigational significant information being more human recognizable than traditional tools by using 2.5D portrayal on the underlying S-102 data model. As such it is deemed to be more suitable for information sharing/understanding of the situation. E.g. between pilot and captain/crew.
	Benefit 6 <i>Uptake of S-1xx production.</i>	Increased knowledge within national and commercial data producing <u>organisations</u> on production of data on the S-100 format.

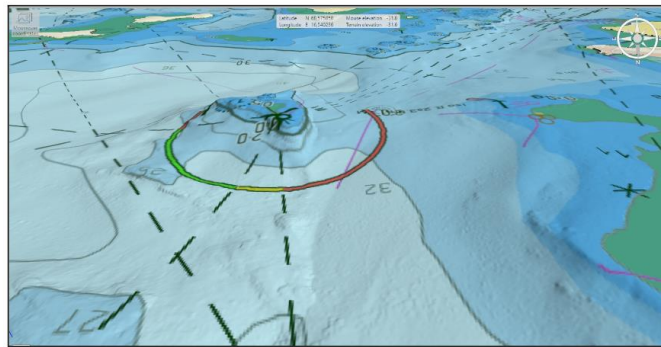
Challenges

- Funding.
 - Research Council Application
 - Participants willingness to invest time and resources.
- Knowledge sharing.
 - Allocate enough time.
 - Build common knowledge base.
- Covid 19.
 - S-129 only through online VTC interaction.
 - 2 full years from start to end.
- Compilation.
 - Bringing all components together.
 - Time consuming.
- Retain momentum involved participants.
 - Follow up.



Project management

- Common understanding.
 - All onboard.
 - Towards common goal.
- Defined assignments.
 - Test descriptions.
 - Development descriptions.
- Time aspect.
 - Define target date(s).
 - Interact and progress.
 - Effective test routines.
 - (Iterative development).
- Involvement.
 - Engage everybody.
 - Encourage.
- Report.
 - Document issues thoroughly.
 - As you move along.

C1: S-101 WMS integration	
Description	Connect to S-101 WMS
Test parameters	<p>A: Connect to S-101 WMS Purpose: Verify url connection</p> <p>B: Display S-101 as an overlay product. Purpose: Visualization between S-101 and S-57</p>
Responsible	Kongsberg
Test result	<p>A: Connection to PRIMAR trial S-101 WMS service tested ok.</p> <p>B: Upon implementing support for the PRIMAR S-101 WMS service the S-101 could be displayed as an overlay on the bathymetry model in the S-100 Demonstrator.</p>
	 <p>Figure X: S-101 as an overlay on the bathymetry model.</p> <p>An issue from the implementation was the lack of data at different zoom levels:</p> <ul style="list-style-type: none"> • Due to the lack of available S-101 ENCs in all usage bands covering the test area, challenges related to zoom-logic in the S-100 Demonstrator appeared. This led to different ENCs from different usage bands being displayed when switching between S-57 and S-101 at equal zoom-level in the S-100 Demonstrator.
Conclusion	1. S-100 Demonstrator zoom-logic implies that ENCs in all usage bands are present.
Outcome	<ul style="list-style-type: none"> • For future S-100 Demonstrator use of S-101: Have all usage bands of S-101 ENCs available. • Report back to Kongsberg Digital a potential need for changing the zoom-logic in the S-100 Demonstrator, to cater for areas where ENCs in all usage bands do not exist.

S-100 Demonstrator:

- <https://s-100.no/>

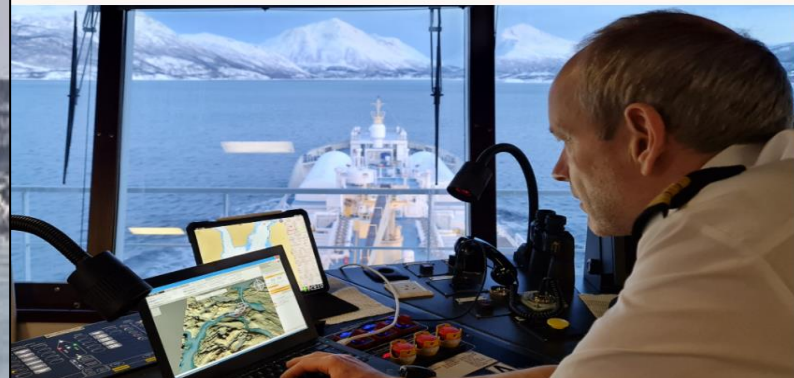
S-129 Operational Test:

- <https://s-100.no/operational-test-s-129-under-keel-clearance-management-tested-in-tjeldsundet-norway/>
 - Summary
 - Full test report download.
 - OMC public report.

Articles and video:

- <https://blog.ecc.no/iho-s-129-test-proves-situational-achievements-in-maritime-operation>
- <https://www.kystverket.no/en/news/pilot-tests-new-digital-tools/>
- https://www.youtube.com/watch?v=yVtc_0wFeso

Pilot tests new digital tools



Pilot Karl Helge Haagensen during pilotage when new digital tools were tested in Tjeldsundet. Photo: Svein Skjæveland, ECC.

The pilot service recently took part in a successful test of the digital product S-129. This new technical aid calculates where it is safe to sail at any given time, especially in shallow areas.

Published 12/15/2021 By Haugen, Lill Therese Opsahl.

New digital tools will help make voyages even safer and more efficient in the future. Karl Helge Haagensen of the Norwegian Coastal Administration was recently the pilot on board M/T Tern Ocean through the narrow and shallow Tjeldsundet sound. Here the digital tool "S-100 Demonstrator", with live updates from S-129, was tested on a commercial voyage – the world's first such test.

The aim of S-129 is to ensure good clearance in areas where depths are marginal.

Contact:

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Manager International Standardization

Electronic Chart Centre

Email: svein.skjaeveland@ecc.no

Phone: +47 92662697