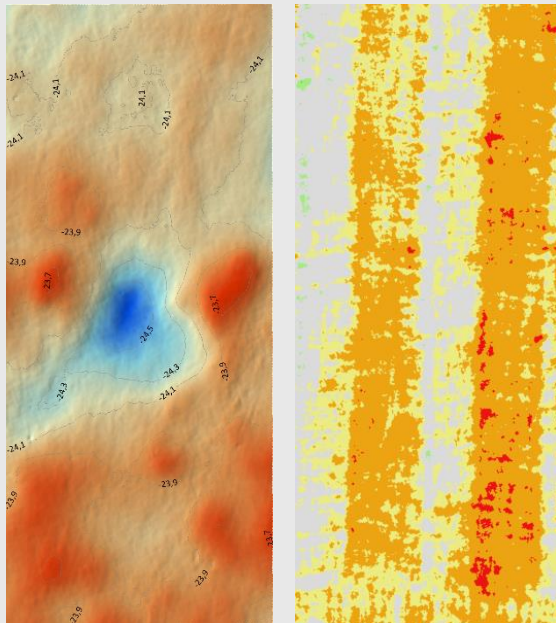


The Belgian KWINTE reference area.

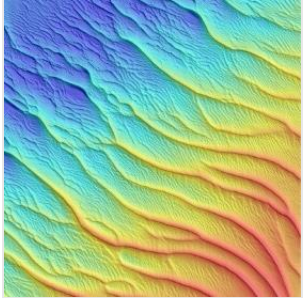
Part A: a bathymetric reference area for quality control of shallow water multibeam echo sounders



Samuel Deleu¹, Marc Roche², Kris Vanparys¹, Koen Degrendele², Florian Barette² & Johan Verstraeten¹

1. Flemish Hydrography, Maritime and Coastal Services, Belgium
2. Continental Shelf Service, FPS Economy, Belgium

Presentation Flemish Hydrography and Continental Shelf Service



AGENTSCHAP
MARITIEME
DIENSTVERLENING en
KUST

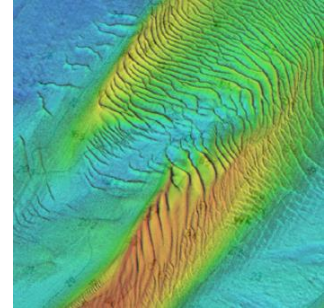
<https://www.agentschapmdk.be/en/flemish-hydrography>



economie

FPS Economy, S.M.E.s, Self-employed and Energy

<https://economie.fgov.be/en/themes/enterprises/specific-sectors/offshore-sand-and-gravel>



The Flemish Hydrography carries out hydrographic measurements in the Belgian part of the North Sea and the Scheldt river and also locates wrecks. All this information is presented in the official sea maps, ENC's and ECS's. Changes are published in the Notices to Mariners.

The team also collects hydrometeorological data, used for tide tables, current atlases and the coastal weather forecast.

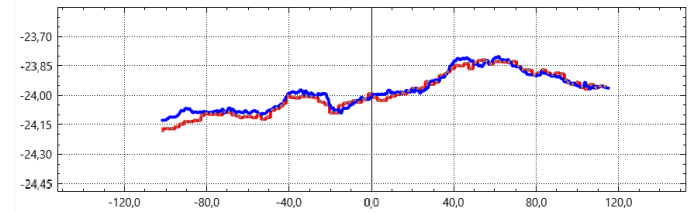
Flemish Hydrography is a member of the International Hydrographic Organization (IHO).

The Continental Shelf Service of the FPS Economy, SMEs, Self-employed and Energy is responsible for sand and gravel mining in the Belgian part of the North Sea.

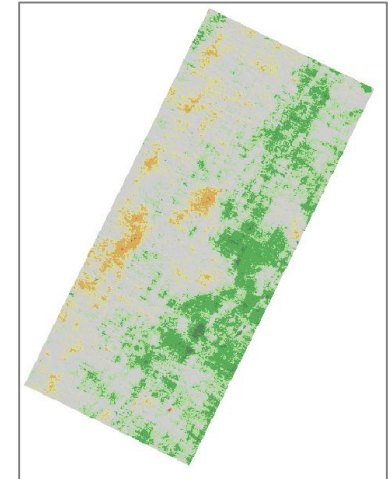
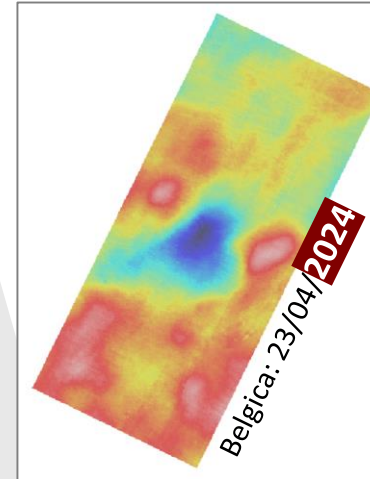
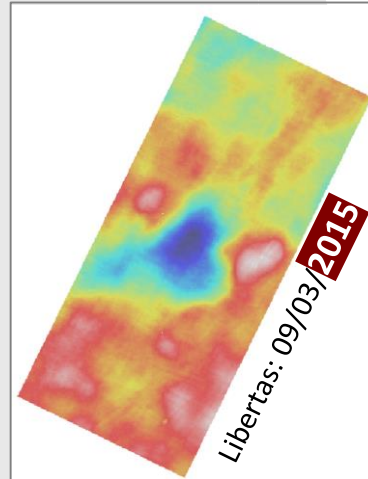
The service's main tasks are:

- issuing permits;
- managing mining concessions;
- control of sand mining;
- updating the associated legislation;
- the management of the "Budget for Sand extraction" (the former Fund for Sand Extraction).

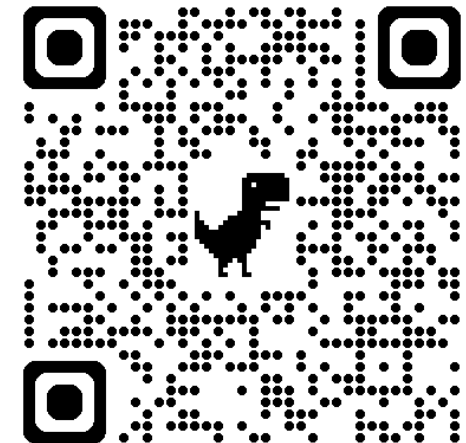
Introduction

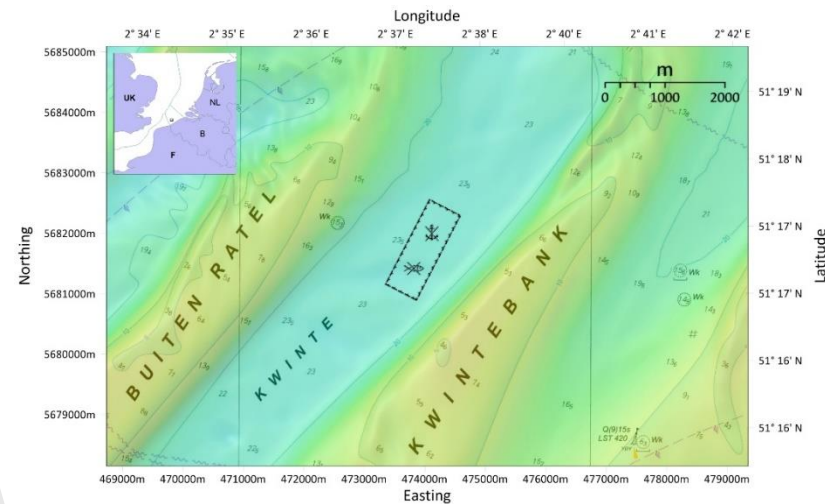
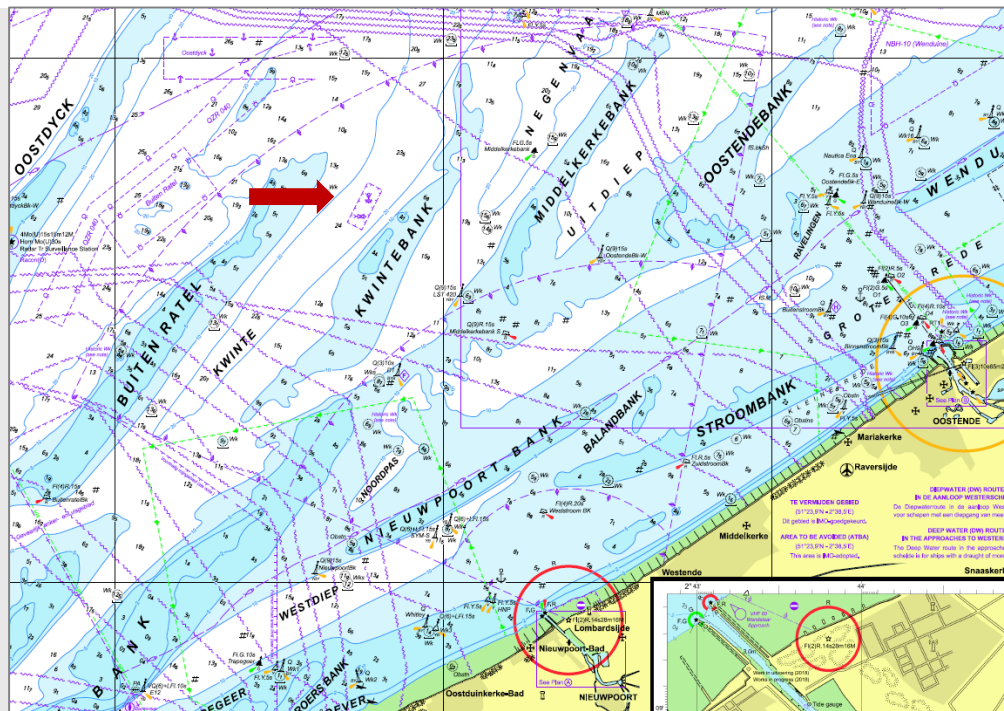


- Origin: control area for COPCO during sand extraction phase on Kwintebank
- Need: for own and contractor's survey => acceptance tests and control areas
- History: after several surveys area seems very stable, both for bathy and for BS



- This led to the common project by Flemish Hydrography (Belgian Hydrographic Office) and COPCO (Continental Shelf Service)
- => paper in Hydro International
- => short presentations at Geohab
- => website with all the info





Where?

17km from the coast in the gully between two sandbanks with a length of 1,5km and a width of 650m, and with depths ranging from 23-26m LAT

What?

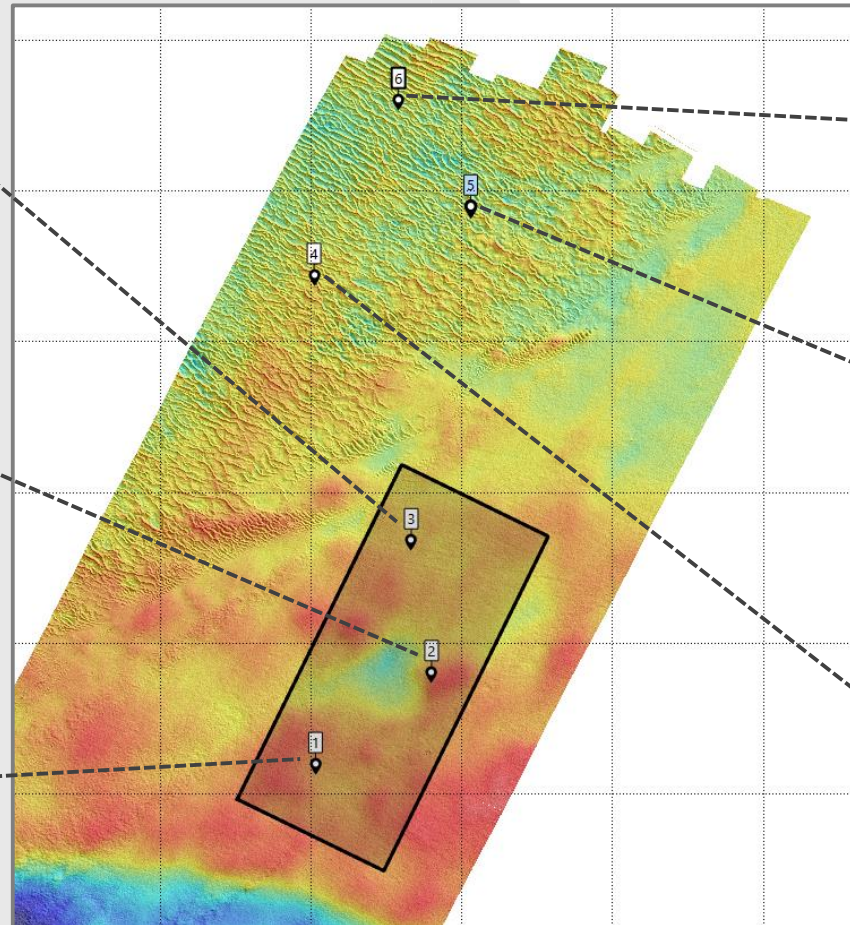
Small area which is defined in the Marine Spatial Plan 2020-2026 and in the new Spatial Plan coming as an area on the Belgian Continental Shelf where seabed disturbing activities are prohibited

Why?

Validate the bathymetry and backscatter values of MBES measurements by any ship on a well known area

Seabed

Small to medium dunes in NW part, SE part relatively flat.
Mostly gravely sand and sandy gravel with shells



Van Veen samples taken by COPCO

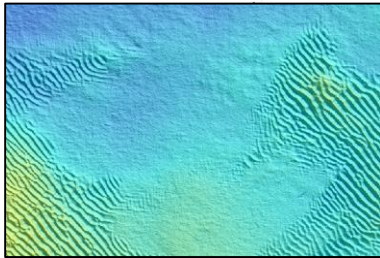
5682500N



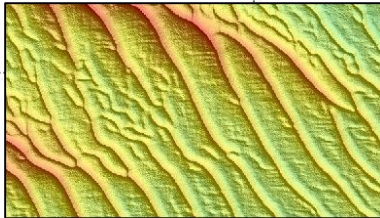
A typical survey

Survey 43: 07/05/2024 by ARCA (RWS)

5682000N



5681500N



5681000N



472500E



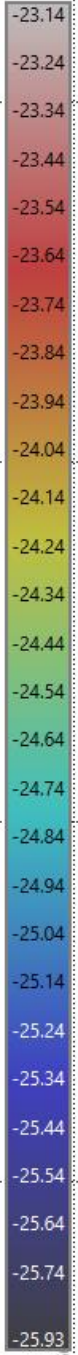
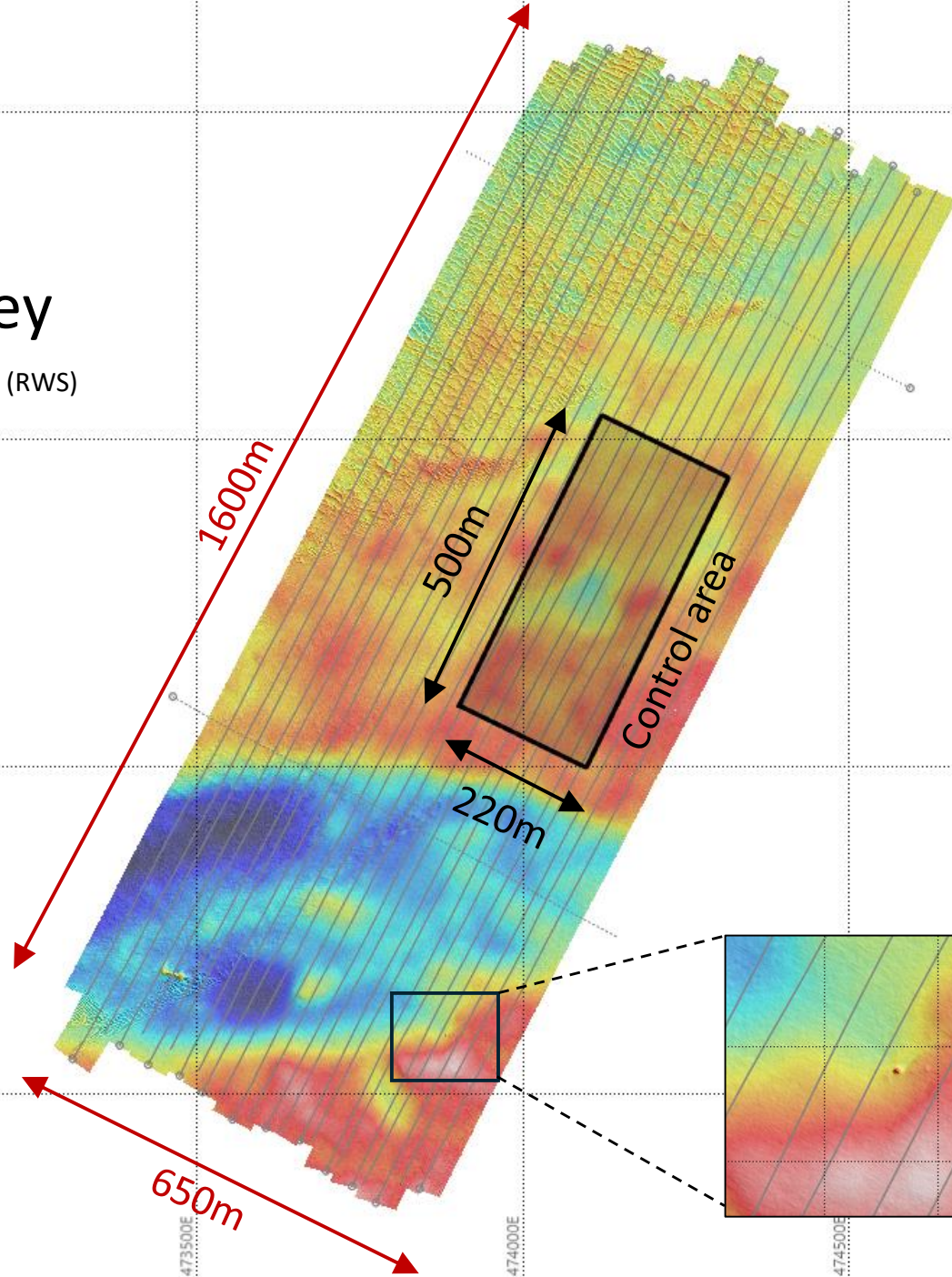
473000E

473500E

474000E

474500E

475000E



IHO Exclusive Order

From the S-44 Edition 6.1.0 IHO Standards for Hydrographic Surveys

Criteria	Exclusive Order
Area description (Generally)	Areas where there is strict minimum underkeel clearance and manoeuvrability criteria
Depth <u>THU</u> [m] + [% of Depth]	1 m *Ba10
Depth <u>TVU</u> (a) [m] and (b)	a = 0.15 m b = 0.0075 *Bc12, Bd8
<u>Feature Detection</u> [m] or [% of Depth]	Cubic features > 0.5 m *Be9
<u>Feature Search</u> [%]	200% *Bg12
<u>Bathymetric Coverage</u> [%]	200% *Bh12

For this project we use the Matrix Reference (brown codes)

See next slide

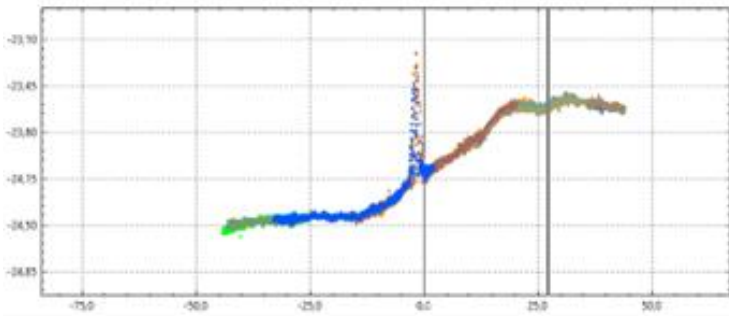
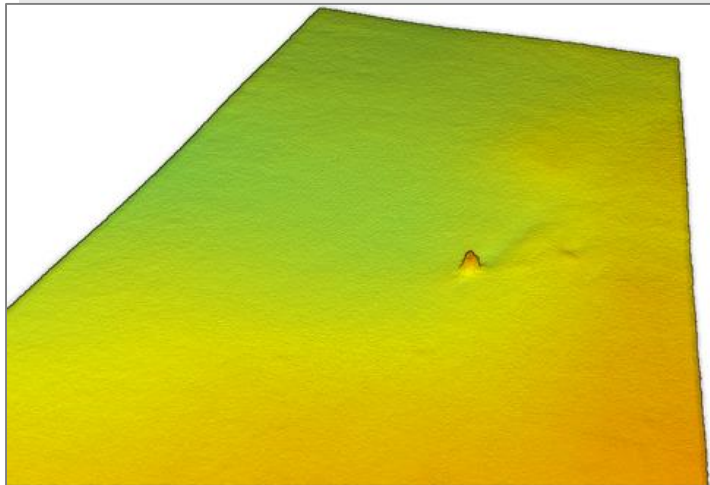
$$TVU_{max}(d) = \sqrt{a^2 + (b \times d)^2} \quad \text{Mean depth in control area is -24m LAT} \Rightarrow TVU_{max} = 0,234\text{m}$$

Specified in the survey requirements

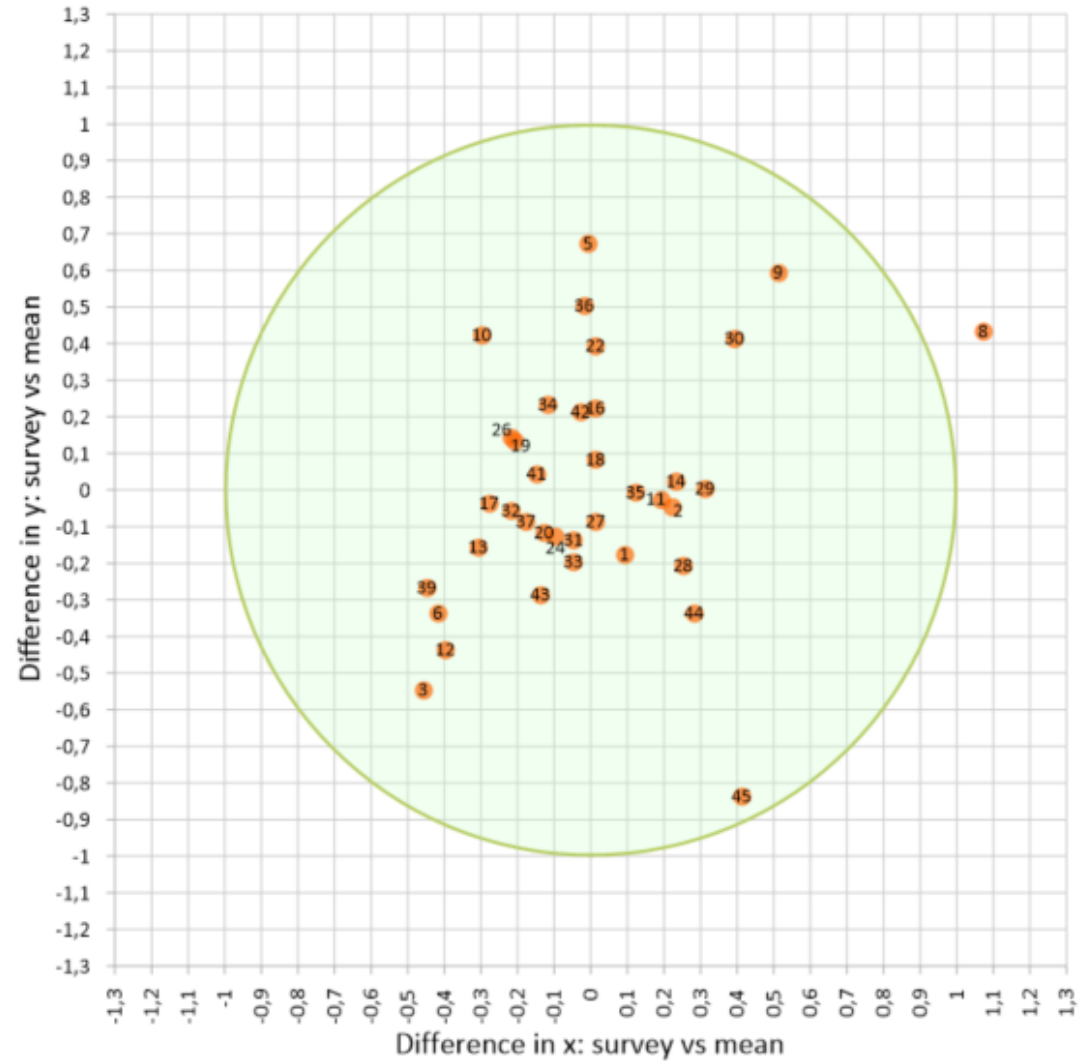
Specified in the survey requirements

Specified in the survey requirements

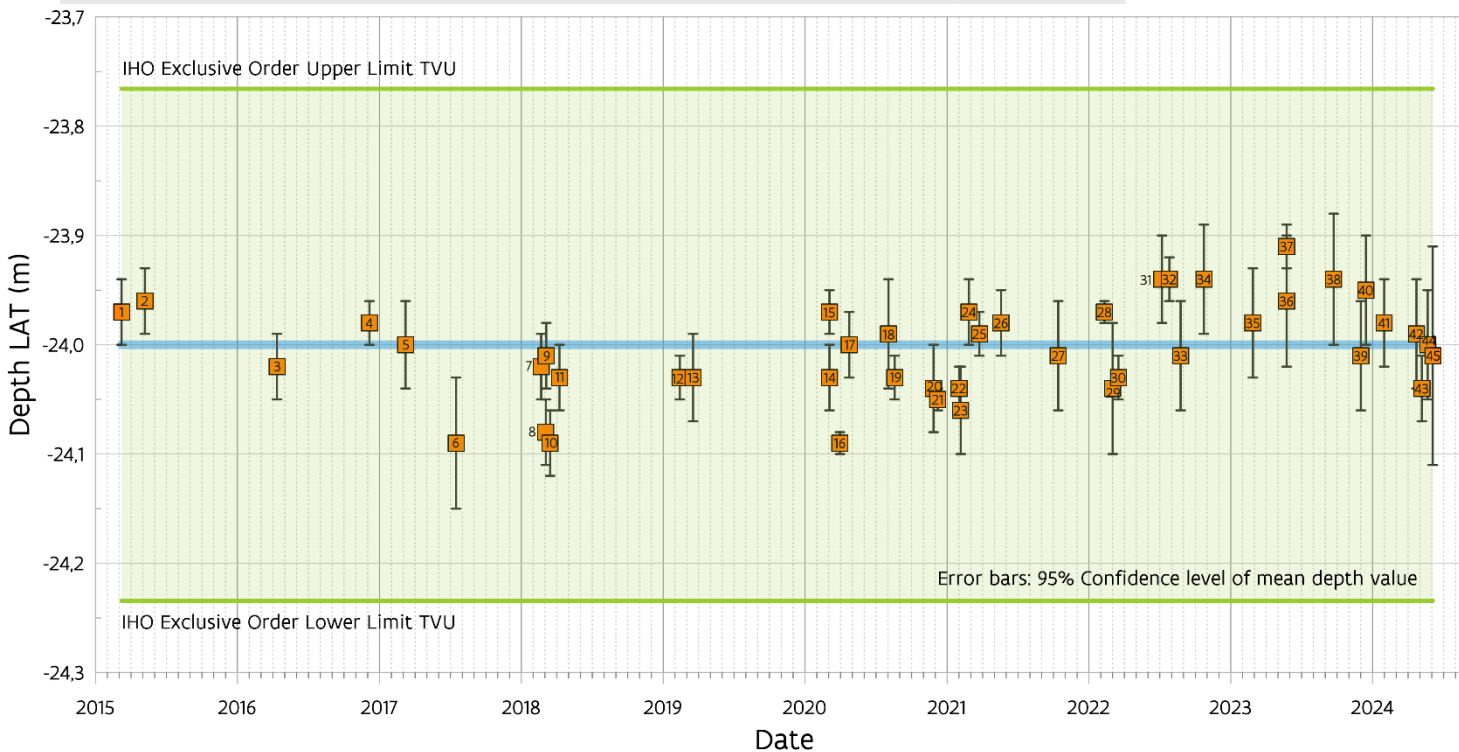
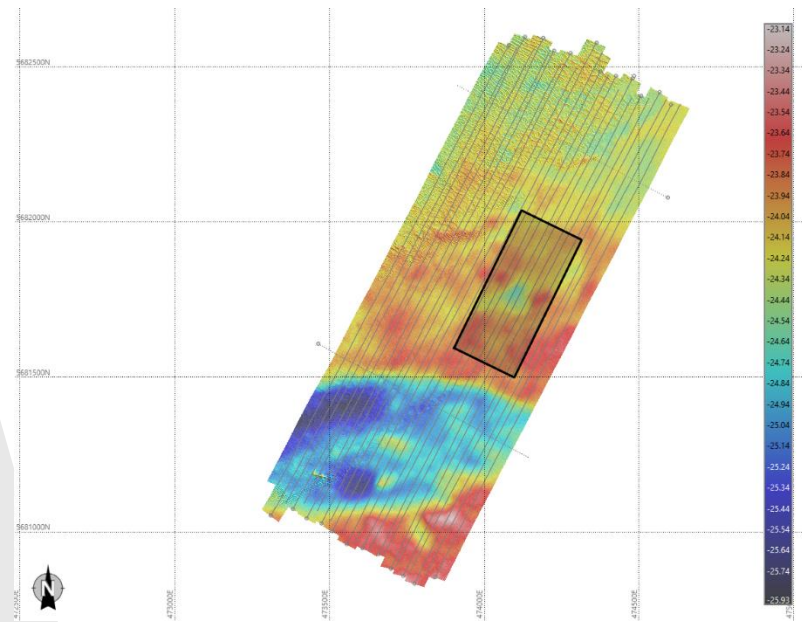
Position check (~THU)



Horizontal Uncertainty IHO Exclusive Order

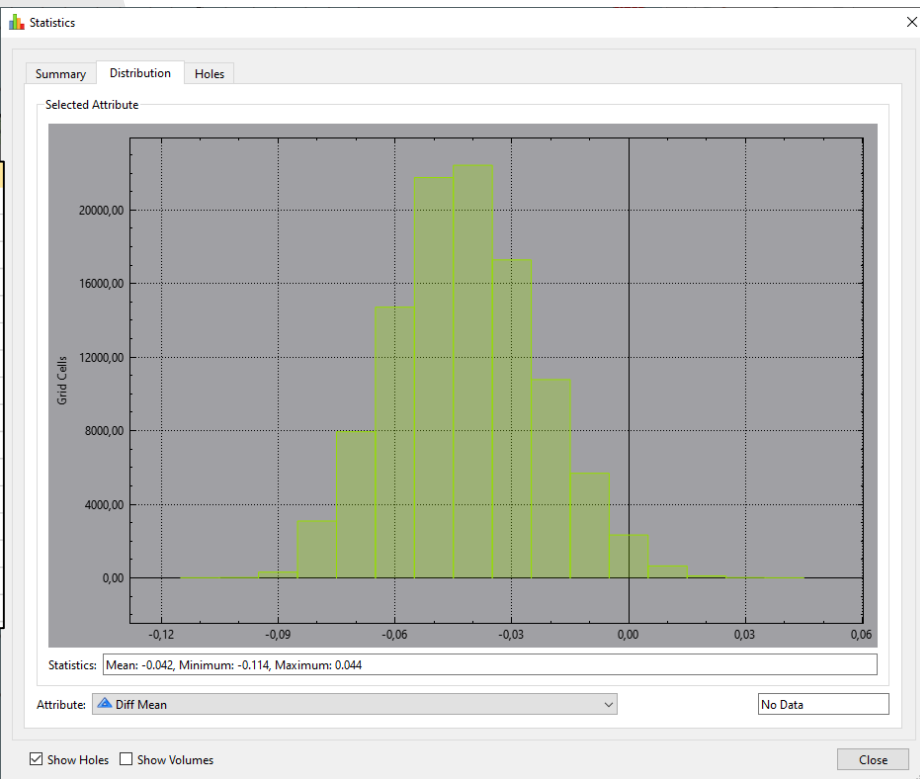
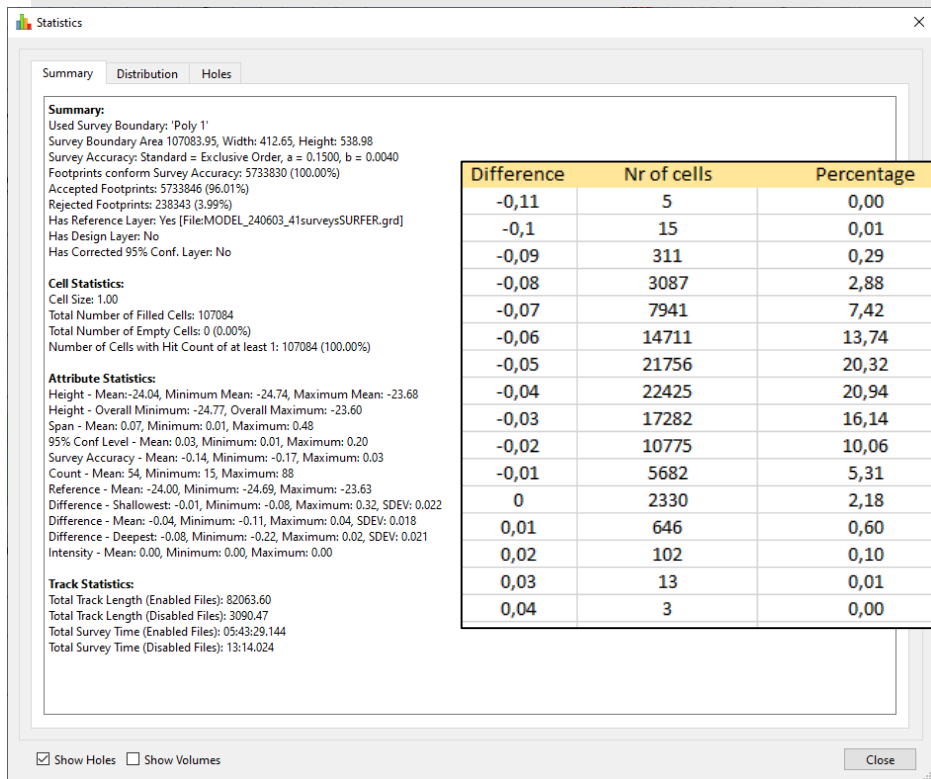


Bathymetry check (~TVU)

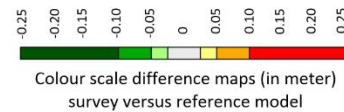
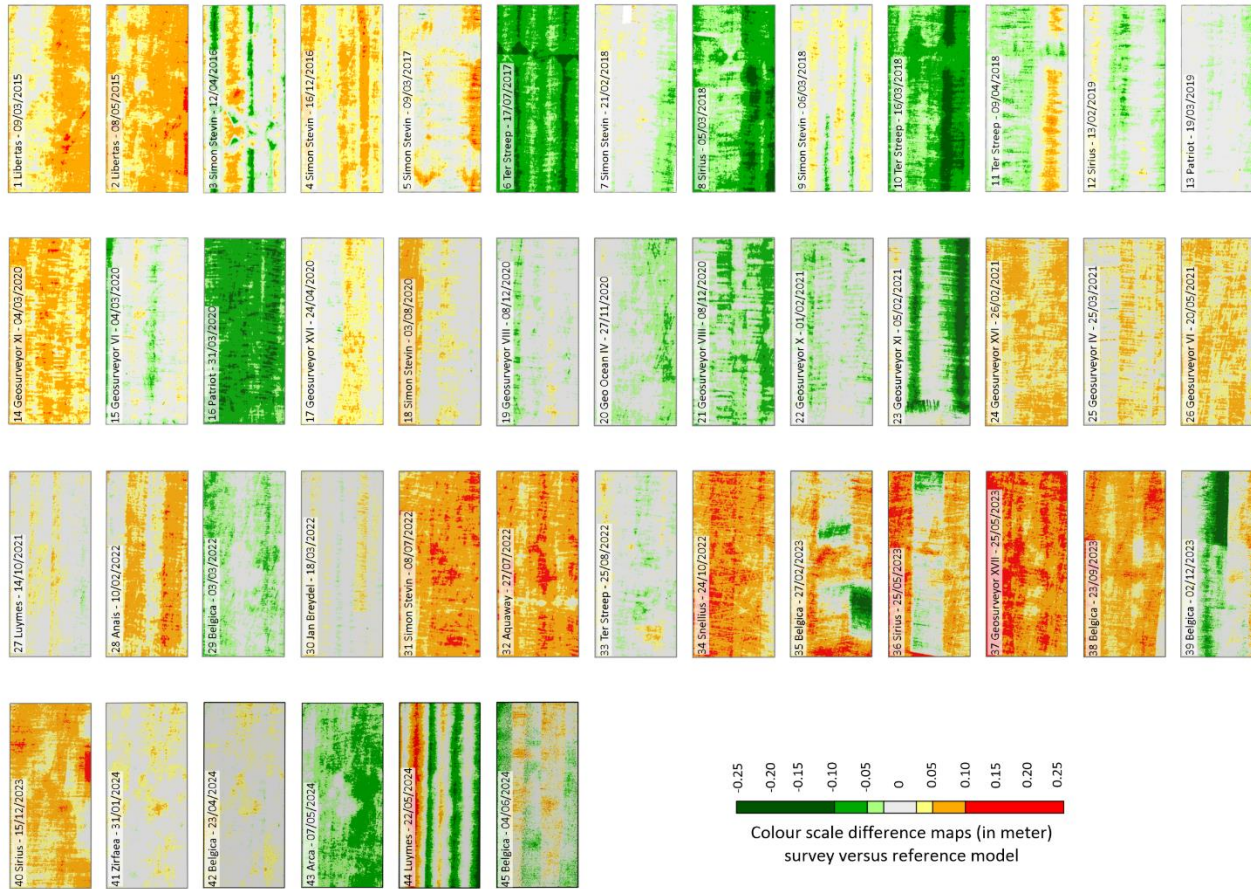


- | | |
|---------------------|---------------------|
| 1 Libertas | 26 Geosurveyor VI |
| 2 Libertas | 27 Zr. Ms. Luymes |
| 3 Simon Stevin | 28 Anais |
| 4 Simon Stevin | 29 Belgica |
| 5 Simon Stevin | 30 Jan Breydel |
| 6 Ter Streep | 31 Simon Stevin |
| 7 Simon Stevin | 32 Aquaway |
| 8 Sirius | 33 Ter Streep |
| 9 Simon Stevin | 34 Zr. Ms. Snellius |
| 10 Ter Streep | 35 Belgica |
| 11 Ter Streep | 36 Sirius |
| 12 Sirius | 37 Geosurveyor XVII |
| 13 Patriot | 38 Belgica |
| 14 Geosurveyor XI | 39 Belgica |
| 15 Geosurveyor VI | 40 Sirius |
| 16 Patriot | 41 Zirfaea |
| 17 Geosurveyor XVI | 42 Belgica |
| 18 Simon Stevin | 43 Arca |
| 19 Geosurveyor VIII | 44 Zr. Ms. Luymes |
| 20 Goocean IV | 45 Belgica |
| 21 Geosurveyor VIII | |
| 22 Geosurveyor X | |
| 23 Geosurveyor XI | |
| 24 Geosurveyor XVI | |
| 25 Geosurveyor IV | |

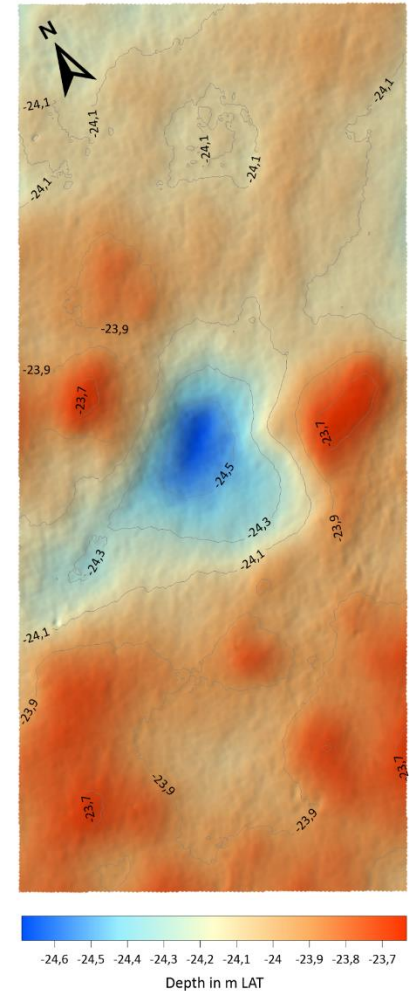
Statistics



Difference maps

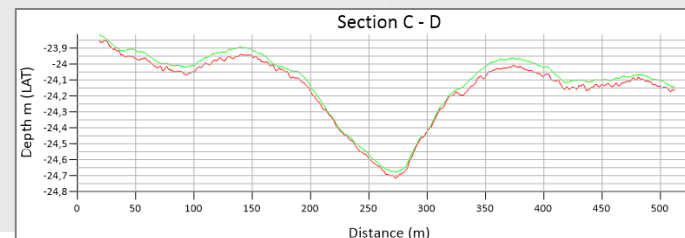
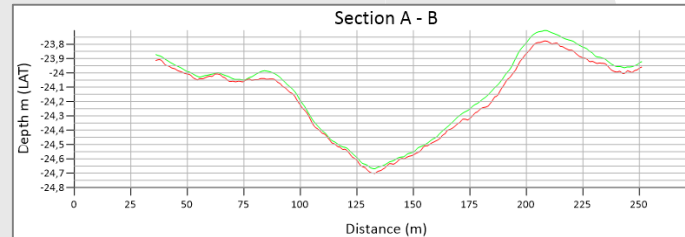
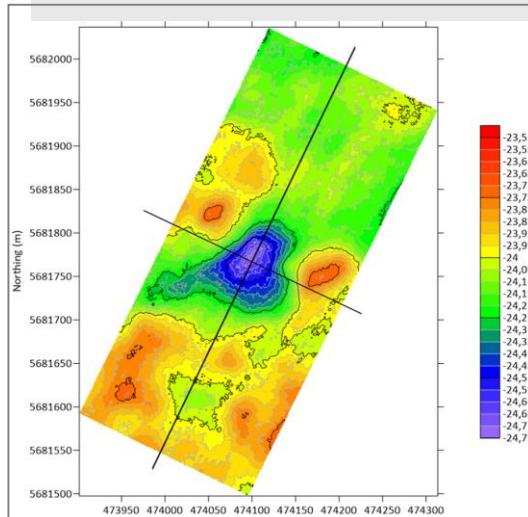


Model of the control area based on 45 surveys



Report

- Bathymetry and backscatter (see presentation Marc) are analysed
- Survey settings and statistics
- Results and comparison with model




AGENCY
MARITIME and
COASTAL SERVICES

economie

REPORT HYDROGRAPHIC SURVEY
KWINTE ZONE

Institute	Hydrographic Service, Royal Netherlands Navy
Vessel	Zr. Ms. Luymes
Survey date	22/05/2024
Sequence number	43
Acquired data	multibeam bathymetry, multibeam backscatter

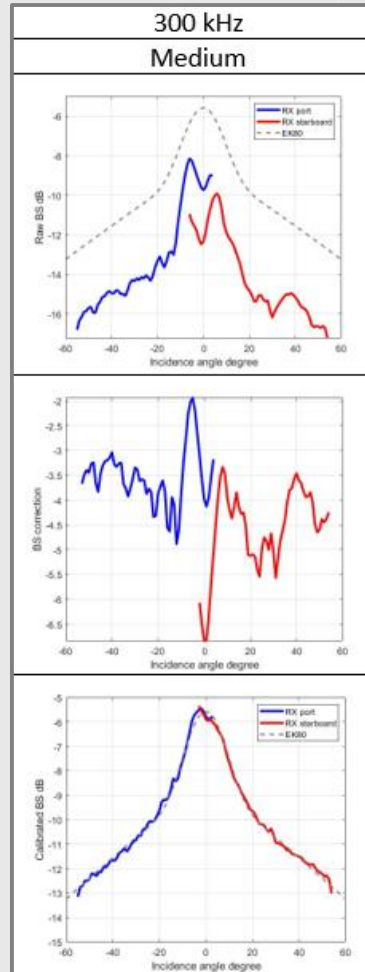
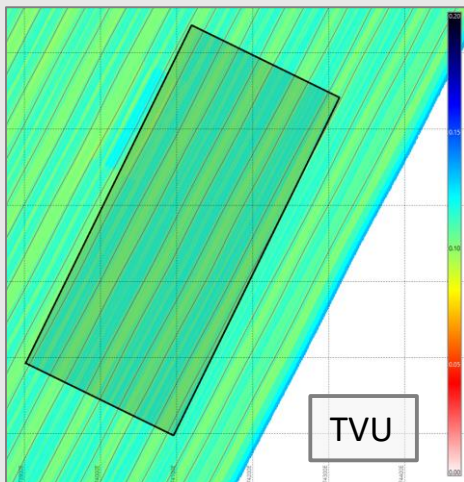
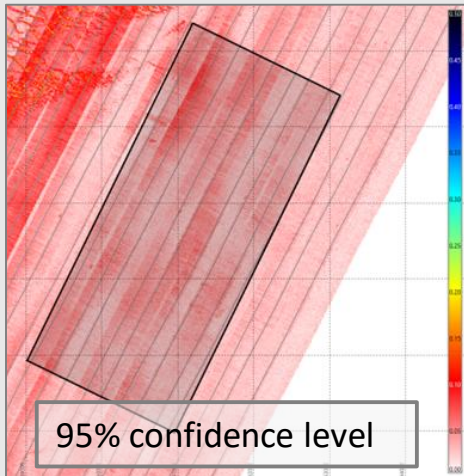


Zr. Ms. Luymes

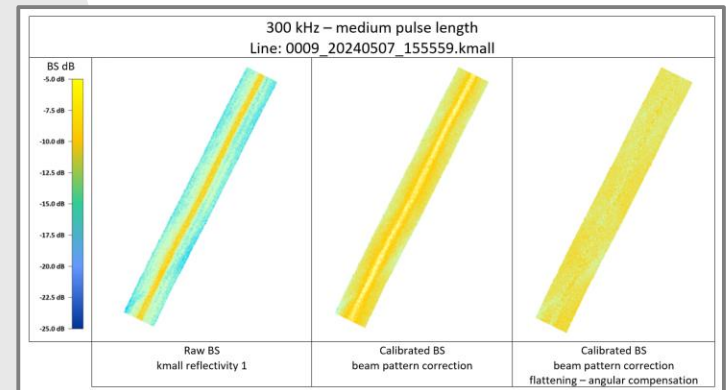
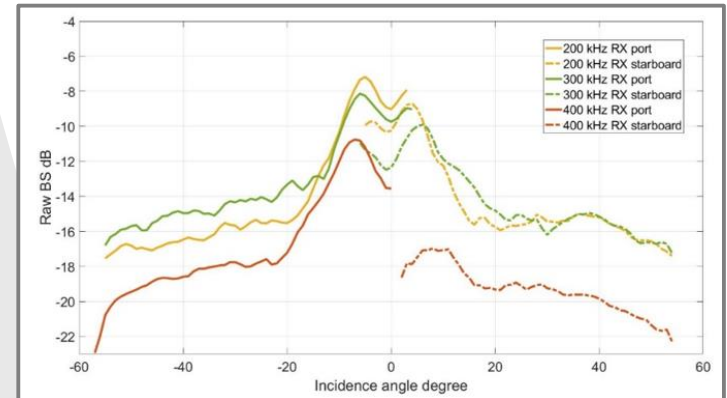
Checked by:
Flemish Hydrography (VH)
Continental Shelf Service (COPCO)

1

Examples from the report

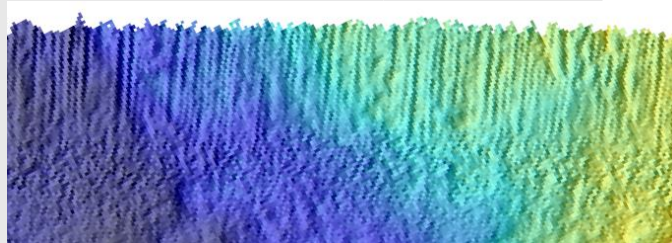


	200 kHz		300 kHz		400 kHz	
	RX port	RX starboard	RX port	RX starboard	RX port	RX starboard
Very shallow	-3.5	-2.6	-1.7	-5.7	-5.6	-10.5
Medium	-3.9	-3.1	-3.4	-4.2	-7.5	-9.0
Deeper	-2.8	-2.6	-2.0	-2.2	-6.1	-7.4



Benefits of the reference area

- Contractors have to pass the test => more certainty for the client but also for the contractor
- Research Institutes and Governmental Institutes can get certainty about their multibeam setup
- The more accepted surveys, the more robust the model
- It is a **natural** reference area => reflecting real surveys in the field



- ⇒ overall: all participants reflect on their setup and will understand all what can affect the data quality
- ⇒ Errors (random or systematic) will come out: MRU artefacts, GNSS problems, spikes, shifts in z, wrong vessel setup, ...

b) Multibeam controlezone KWINTE

Indien de test over de sluisdremmel in Zeebrugge succesvol werd afgerond dient een referentiezone "KWINTE" ingemeten te worden die wordt begrensd door volgende ETRS89, UTM31N coördinaten. De zone dient met multibeam opgemeten te worden.

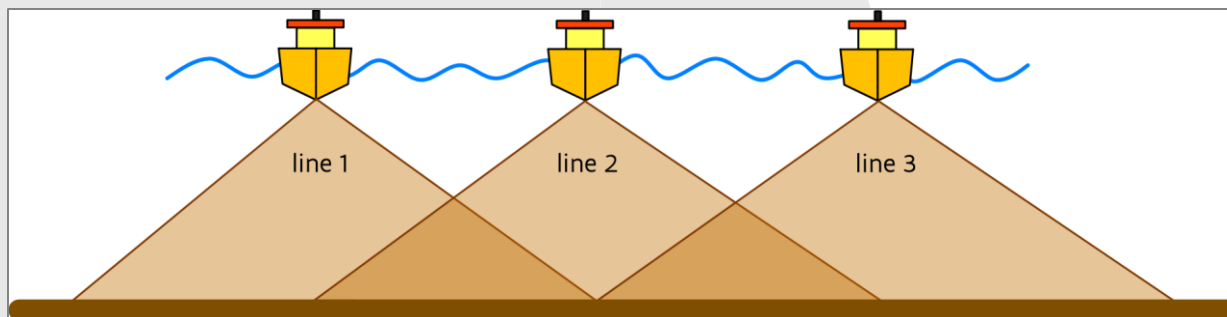
Bestek 16EH/24/01

Dossiernummer 224.000

*Example: short extract of Acceptation Tests description
in Tender*

How to participate (1)

- Sail your lines in NNE-SSW orientation (typically 4 to 6 hours of work)
- Try to achieve a hit count of 5 points/m²
- After processing, a grid of 1x1m should be filled
- Determine your line spacing so an overlap of 50% is achieved => 200% coverage
- Refer towards LAT (see next slide) and survey with RTK (preferably) or PPP



How to participate (2)

Please provide us with:

- Your dataset as a Qimera or Autoclean project
- Raw and if possible processed data in one of the following formats: *.db, *.bwxraw, *.s7k, *.kmal/all, *.gsf
- Metadata: date, database setup, dimensional survey, used equipment (multibeam, MRU/INS, GNSS, SVP), weather info
- Used multibeam settings (frequency, power, gain, mode, ...) => see also presentation Marc
- Used RTK methodology to have your results in LAT. We can help you with this by providing our LAT model for Qinsy or Navaq

Please email all of this to: samuel.deleu@mow.vlaanderen.be and marc.roche@economie.fgov.be

Participants





Vlaanderen
is maritiem

Vaartuig	MBES systeem	Uitvoerder	Datum
Libertas	Reson Seabat 8125	Eurosense	9/ 03/ 2015
Libertas	R2Sonic 2024	Eurosense	8/ 05/ 2015
Simon Stevin	Kongsberg EM2040	COPOO	12/ 04/ 2016
Simon Stevin	Kongsberg EM2040	COPOO	6/ 12/ 2016
Simon Stevin	Kongsberg EM2040D	COPOO	9/ 03/ 2017
Ter Streep	Kongsberg EM2040cDS	VH	17/ 07/ 2017
Simon Stevin	Kongsberg EM2040D	COPOO	21/ 02/ 2018
Srius	Kongsberg EM2040D	VH	5/ 03/ 2018
Simon Stevin	Kongsberg EM2040D	COPOO	6/ 03/ 2018
Ter Streep	Kongsberg EM2040cDS	VH	16/ 03/ 2018
Ter Streep	Kongsberg EM2040cDS	VH	9/ 04/ 2018
Srius	Kongsberg EM2040D	VH	13/ 02/ 2019
Patriot	Reson T50R	Enviros	19/ 03/ 2019
Geosurveyor XI	Kongsberg EM2040cD	GEOxyz	4/ 03/ 2020
Geosurveyor VI	R2Sonic 2024	GEOxyz	4/ 03/ 2020
Patriot	Reson T50R	Enviros	31/ 03/ 2020
Geosurveyor XVI	Kongsberg EM2040cD	GEOxyz	24/ 04/ 2020
Simon Stevin	Kongsberg EM2040D	VLIZ	3/ 08/ 2020
Geosurveyor VIII	R2Sonic 2024	GEOxyz	19/ 08/ 2020
GeoceanIV	Kongsberg EM2040D	GEOxyz	27/ 11/ 2020
Geosurveyor VIII	R2Sonic 2024	GEOxyz	8/ 12/ 2020
Geosurveyor X	R2Sonic 2024	GEOxyz	1/ 02/ 2021
Geosurveyor XI	Kongsberg EM2040cD	GEOxyz	5/ 02/ 2021
Geosurveyor XVI	Kongsberg EM2040cD	GEOxyz	26/ 02/ 2021
Geosurveyor IV	Norbit WBMS	GEOxyz	25/ 03/ 2021
Geosurveyor VI	R2Sonic 2024	GEOxyz	20/ 05/ 2021
Luymes	Kongsberg EM2040D-04	Dienst der Hydrografie	14/ 10/ 2021
Anais	Norbit WBMS	Enviros	10/ 02/ 2022
Belgica	KongsbergEM2040D-04	COPOO	3/ 03/ 2022
Jan Breydel	Kongsberg EM2040C	VH	19/ 03/ 2022
Simon Stevin	Kongsberg EM2040D-04	VLIZ	8/ 07/ 2022
Aquaway	Norbit WBMS	Enviros	27/ 07/ 2022
Ter Streep	Kongsberg EM2040cDS	VH	25/ 08/ 2022
Shellius	Kongsberg EM2040D-04	Dienst der Hydrografie	24/ 10/ 2022
Belgica	Kongsberg EM2040D-04	COPOO	27/ 02/ 2023
Srius	Kongsberg EM2040D-04	VH	25/ 05/ 2023
GeosurveyorXVII	R2Sonic 2024	GEOxyz	25/ 05/ 2023
Belgica	Kongsberg EM2040D-04	COPOO	23/ 09/ 2023
Belgica	Kongsberg EM2040D-04	COPOO	2/ 12/ 2023
Srius	Kongsberg EM2040D-04	VH	15/ 12/ 2023
Zirfaea	Kongsberg EM2040cD	RWS	31/ 01/ 2024
Belgica	Kongsberg EM2040D-04	COPOO	23/ 04/ 2024
Arca	Kongsberg EM2040cD	RWS	7/ 05/ 2024
Luymes	Kongsberg EM2040D-04	Dienst der Hydrografie	22/ 05/ 2024
Belgica	Kongsberg EM2040D-04	COPOO	4/ 06/ 2024



KONGSBERG

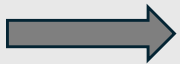


To conclude

An invitation to institutes/companies to be part of the project by carrying out a survey in the Kwinte zone. The data will be carefully analyzed and you will receive a report that gives you certainty about the multibeam setup used

It will give the participant a good reference of data quality and can be used as a testimonial of the proven setup in other projects

Many thanks to the participating institutes/companies!



And now over to Marc Roche and Part B on the Backscatter

