

EM124 AND SBP29

INSTALLATION AND QUALIFICATION OF THE NEW DEEP-SEA SYSTEMS OF THE FRENCH HYDROGRAPHIC OFFICE

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Agenda

- Context/History
- Planning
- Dry-dock period
- Acceptance tests & IHO Qualification

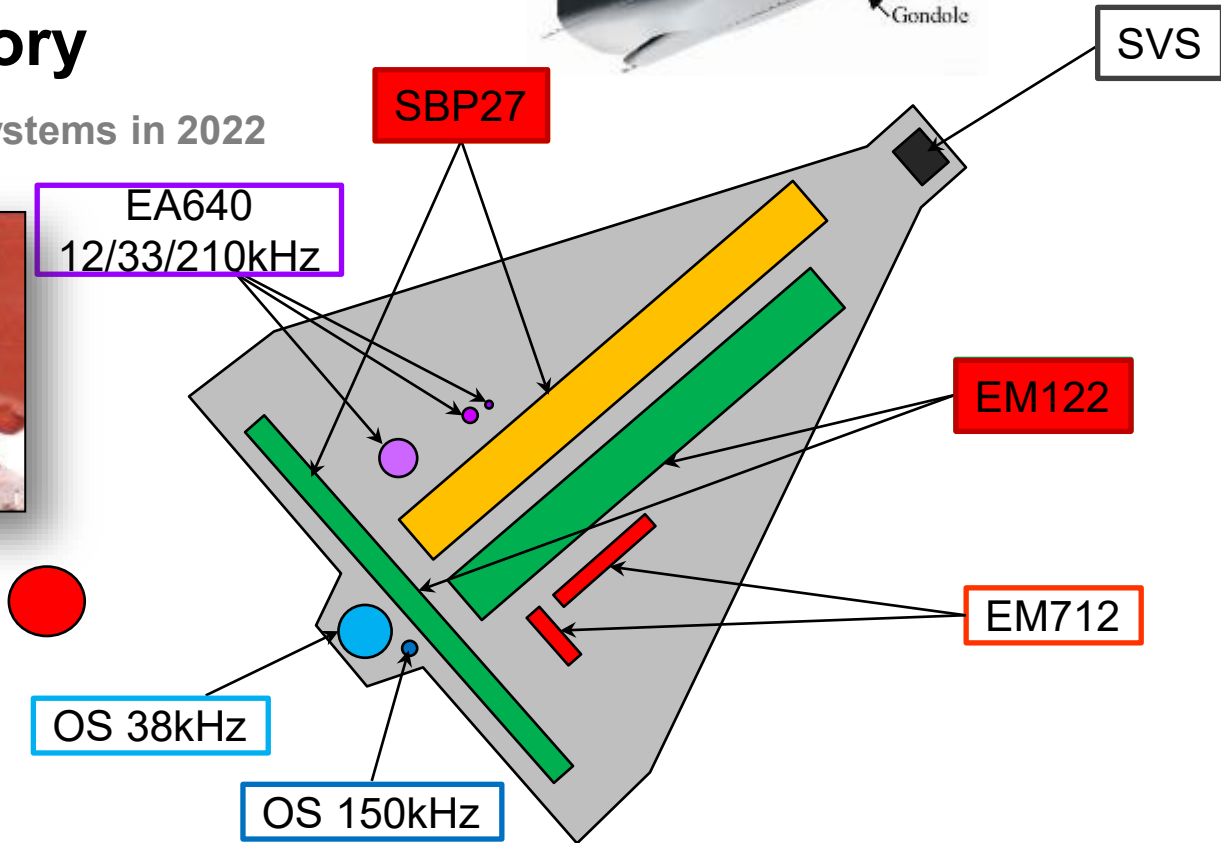


1. Context/History



Context/History

Onboard acoustics systems in 2022



Context/History

Gondola maintenance

- Major maintenance of the gondola planned in 2022
=> Blast, antifouling, paint, mechanics, ...
- First removal of all acoustic systems from the gondola (included frames) since the birth of the Beautemps-Beaupré (2003)



Good time to do a major systems upgrade !!

Hope no bad surprises !!

Context/History

The deep-water systems (before dry dock)

- Deep water MBES EM122 need to be change :
 - Tx antenna module => **14 Tx modules from 2003, 34 Tx modules replaced in 2010**
 - Rx antenna module => **16 Rx modules from 2010/2012 replaced in 2020** (with impedance on some modules)
 - Pre-amplifier unit from 2003
 - Other electronics from 2014.
- Sub bottom profiler SBP27:
 - All transducers and electronics changed in 2017 (mid-life upgrade of BHO)



2. Planning



Planning

1 year's preparation

- Internal meetings (Navy, Shom entities)
- External meetings (Kongsberg Discovery, Shipyard, Local industrial)

⇒ To list materials, potential incoming issues and to have spares available in case of...

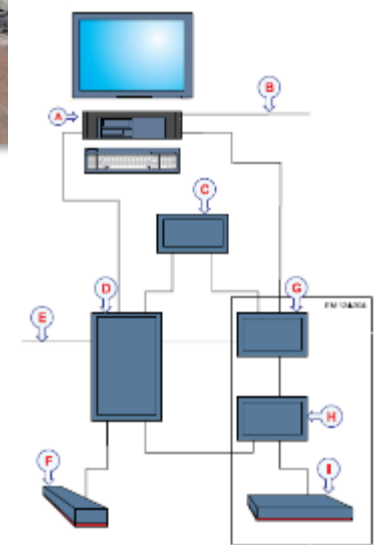
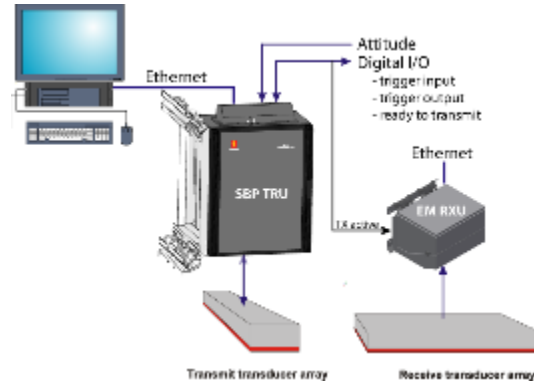
- Frames
- Transducers
- Electronics
- Screws/Bolts
- ...

Deep water upgrade

What will change ?

- Moving from EM122 to EM124
 - Tx antenna change
 - Add baffle plates to Rx frame (changed in 2020)
 - Change electronics in sonar room
 - Run all MBES with SIS V5

- Moving from SBP27 to SBP29
 - Based on existing electronics (recabling)
 - Software upgrade



Schedule

Dry dock tasks planification

⇒ FAT @Kongsberg Facilities done the 26th september 2022

⇒ Planned duration of the dry dock : 9 weeks (18 oct to 15 dec 2022)

Task number	Task	Under-task	Task allotment	KD support	Progression	Duration	Starting date	Ending date
0	Pré-AT					3 days	18-oct.-2022	21-oct.-2022
		Removal of EM122 electronics (Preamp Unit, Tx unit and junction box) + HWS	Shom			2 days	18-oct.-2022	19-oct.-2022
		Uncabling sonar room + Protection of transducers connectors	Shom			1 days	20-oct.-2022	20-oct.-2022
1	Dismounting/cleaning			y		10 days	24-oct.-2022	8-nov.-2022
		Cleaning active face of transducers	Shom			1 days	26-oct.-2022	26-oct.-2022
		Removal of gondola acces hatches	CNN-MCO			1 days	27-oct.-2022	27-oct.-2022
		Removal all transducers and cables	CNN-MCO			4 days	27-oct.-2022	3-nov.-2022
		frame dismounting	CNN-MCO			2 days	4-nov.-2022	7-nov.-2022
		cleaning frame	CNN-MCO			2 days	4-nov.-2022	7-nov.-2022
2	Sonar material storage	Transducers cleaning				6 days	27-oct.-2022	7-nov.-2022
						40 days	24-oct.-2022	21-déc.-2022
3	EM122/EM124 Rx frame modification					10 days	7-nov.-2022	21-nov.-2022
4	Sonar room modification					7 days	27-oct.-2022	8-nov.-2022
		Mecanical modification	CNN-MCO			5 days	27-oct.-2022	4-nov.-2022
		Electrical modification	CNN-MCO			2 days	4-nov.-2022	7-nov.-2022
5	Remounting frames			y		5 days	21-nov.-2022	25-nov.-2022
		Baffle plates mounting on EM124 Rx antenna	Shom					
		Remounting frames	CNN-MCO			2 days	21-nov.-2022	22-nov.-2022
6	Remounting transducers	Land survey (Quarta)	CNN-MCO			5 days	21-nov.-2022	25-nov.-2022
			CNN-MCO	y		10 days	28-nov.-2022	9-déc.-2022
7	Remounting sonar room		CNN-MCO	y		8 days	12-déc.-2022	21-déc.-2022
		Electronics installation	Shom			3 days	9-nov.-2022	14-nov.-2022
		Cabling	CNN-MCO			5 days	9-déc.-2022	15-déc.-2022
8	Acceptance tests			y		10 days		
		HAT	CNN-MCO			2 days	tbd	tbd
		SAT	CNN-MCO			8 days	tbd	tbd

Little time for all the work !

3. Dry-Dock period

Dry-Dock

Acoustic systems dismantling



Uncabling and protecting

Dry-Dock

Acoustic systems dismounting



Issue n°1: Tons of Mud inside the gondola !!

Dry-Dock

Acoustic systems dismantling



Issue n°1: Tons of Mud inside the gondola !!

Dry-Dock

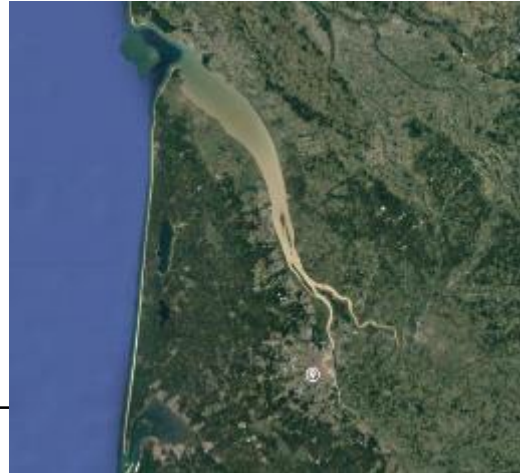
Acoustic systems dismantling

Why such mud inside the gondola ?



⇒ Combination of multiple factors :

- A stopover in the muddy Gironde River ? (July 2022, Bordeaux, France)
- All gondola holes blocked=> no drainage
- Bad maintenance by divers !
- An issue in ADCP acoustic foams installation



Dry-Dock

Acoustic systems dismantling

Remove transducers and
cleaning



Dry-Dock

Acoustic systems dismantling



Need to clean them perfectly...



Dry-Dock

Acoustic systems dismounting

...Before storage !



Dry-Dock

Removing all Frames



Dry-Dock

Removing all Frames and cleaning all parts



Dry-Dock

Removing all frames



Issue n°2 : SBP frame partially corroded !! (in good state in 2017)

Dry-Dock

Removing all frames



Less than 40% of the stand off in good shape
(141 over 384)

Issue n°2 : SBP frame and stand off (changed in 2017) partially corroded !!



Dry-Dock

Removing frame

Why the SBP frame is corroded?



⇒ No answers yet...

- Link to the mud in gondola ? (but why only this frame !)
- Anodes not working well ?
- A quality difference in the frame material during production ?
- Kind of chemical products or treatment, like a different type of paint or a kind of additive in the cooling water ?
- Active/electrical corrosion of the boat modified ?

➡ We need to investigate more !

Dry-Dock

Removing frame

KD sent a new SBP frame in 10 days !

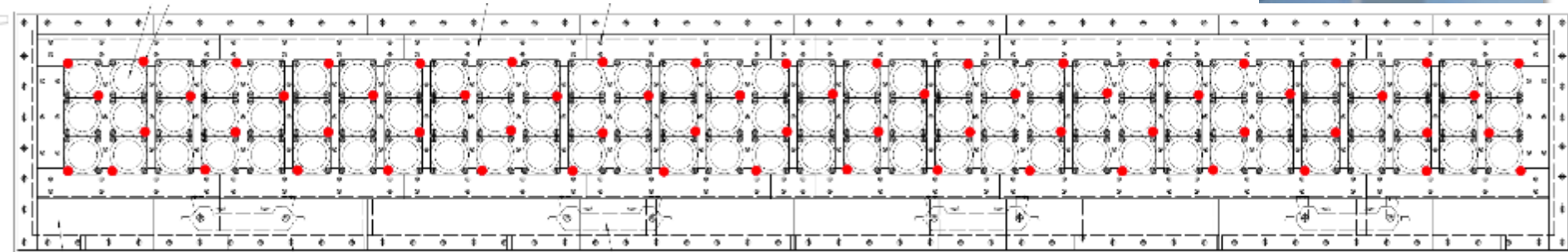
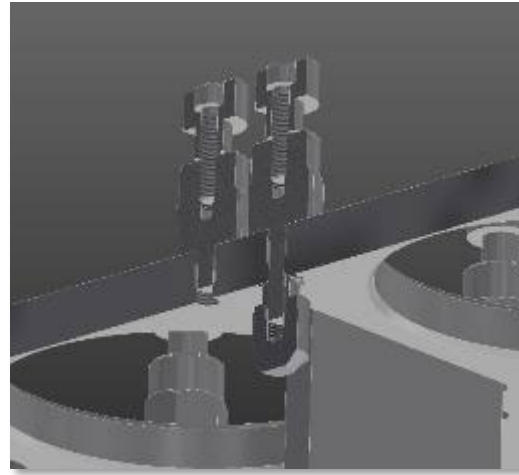


Dry-Dock

Removing frame

Added 66 anodes to avoid corrosion !

Next check in 2024



Dry-Dock

Mechanical changes on the EM122 Rx frame



Threaded Holes for baffle plates installation



Dry-Dock

New gondola !!



Before



After

Dry-Dock

Remounting frames and land survey

SBP Tx



With the old good anodes...



EM712 Rx



Dry-Dock

Remounting frames and land survey

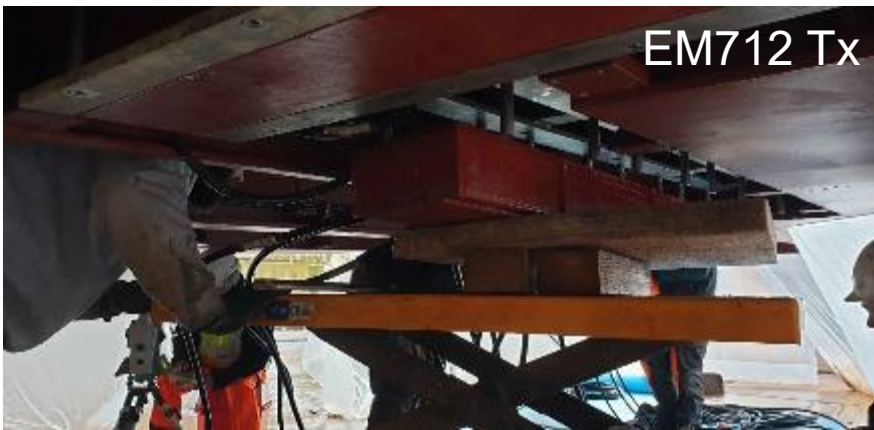


Flatness measurement and wedges installation



Dry-Dock

Mounting transducers



Dry-Dock

Mounting and cabling sonar room



Dry-Dock

Job Done !



Dry-Dock

Job Done !



A final land survey and Let's go at SEA !!

4. SAT and IHO qualification



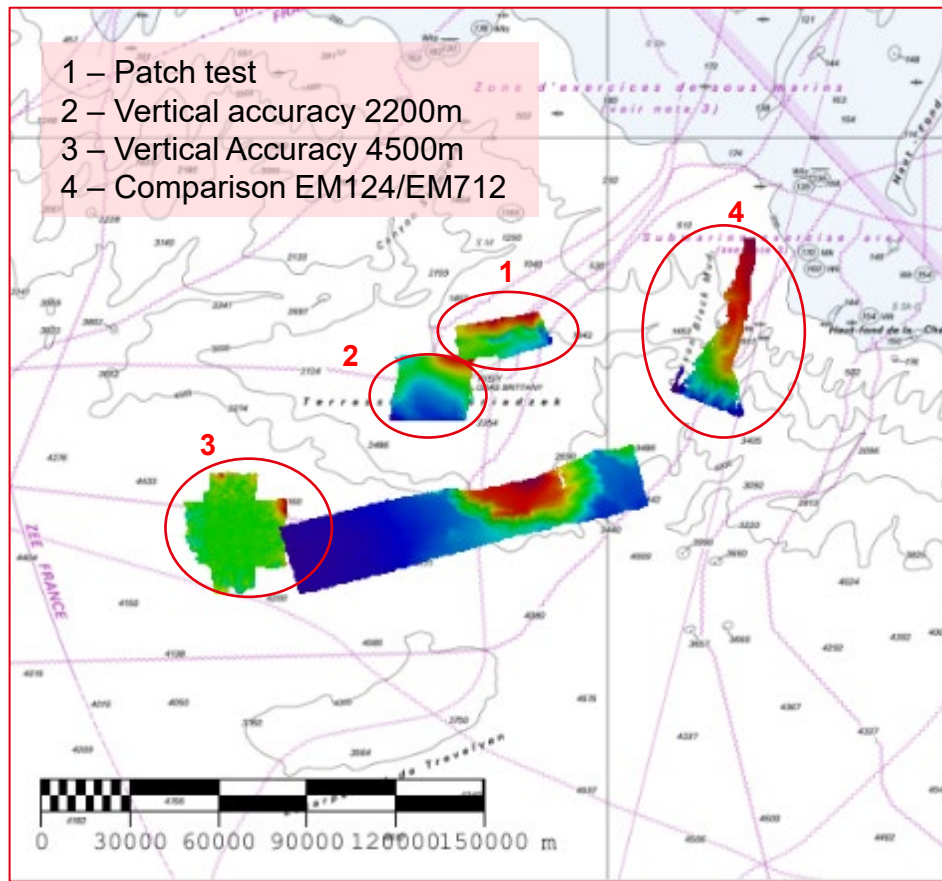
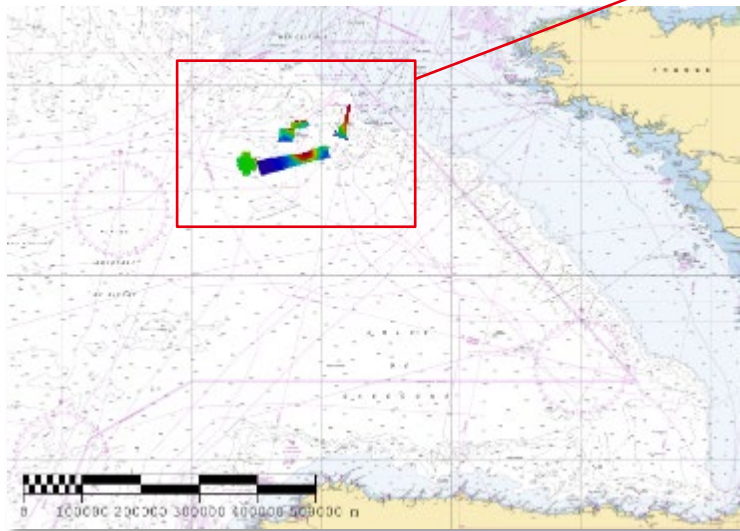
EM124/SBP29 SAT

Summary

- 6 days at sea (19th to 25th April 2023)
- All acoustics systems tested and qualified
- 2 KD Engineers onboard

EM124 SAT

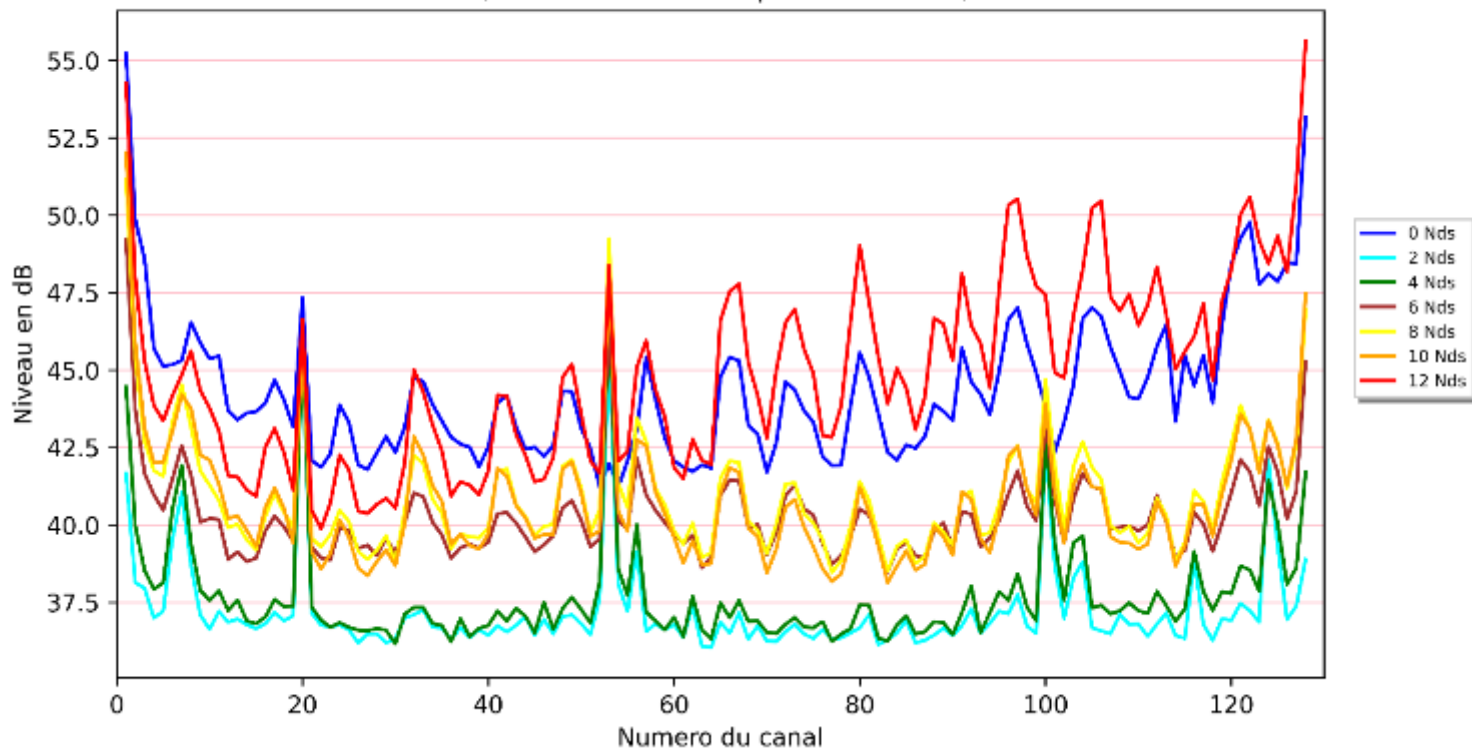
Areas overview



EM 124 SAT

Noise test

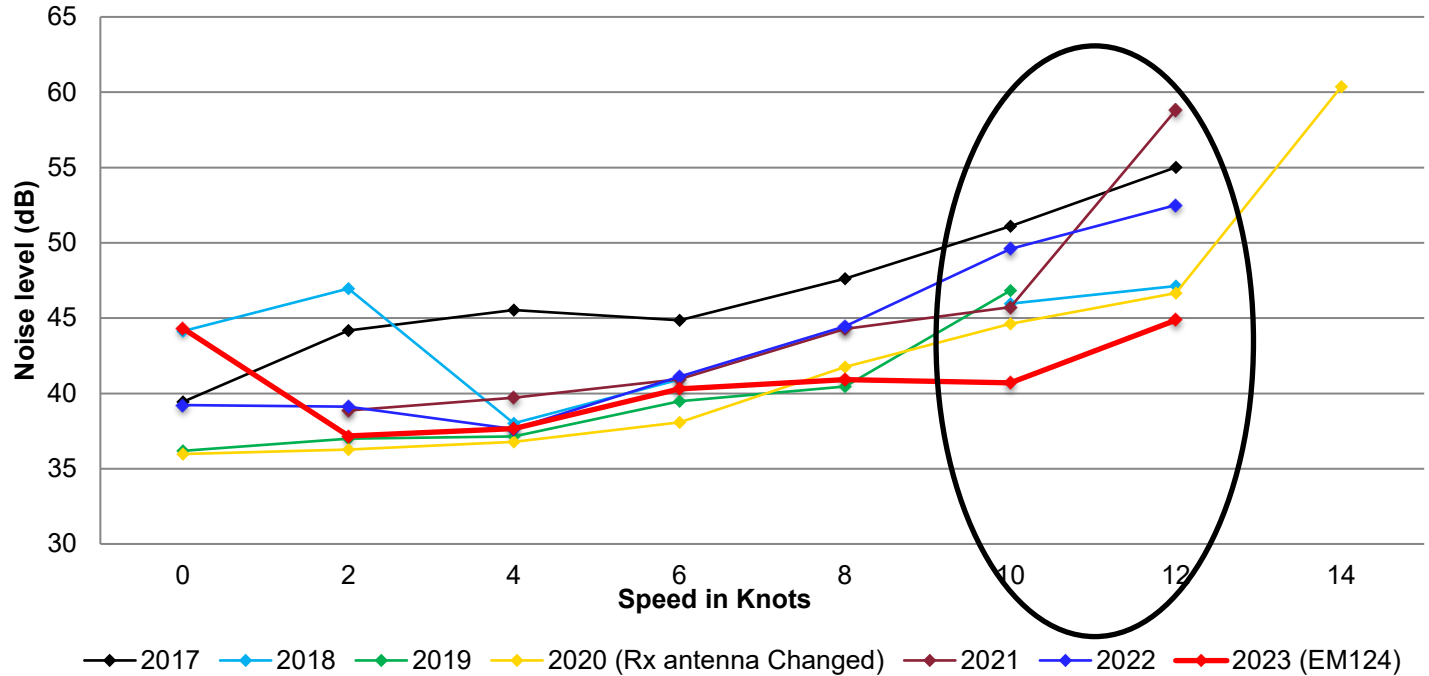
Mesure de bruit (dB) en fonction de la vitesse du navire (Nds)
(BBP - EM124 - Frequence 10 kHz)



EM 124 SAT

Noise test

Rx Noise level test - BHO - EM122/EM124 - 10 kHz



EM 124 SAT

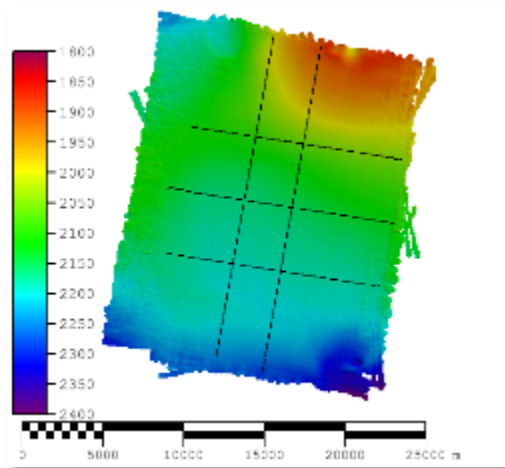
IHO Qualification : S-44

$$TVU_{max}(d) = \sqrt{a^2 + (b \times d)^2}$$

Reference	Criteria	Order 2	Order 1b	Order 1a	Special Order	Exclusive Order
Chapter 1	Area description (Generally)	Areas where a general description of the sea floor is considered adequate.	Areas where underkeel clearance is not considered to be an issue for the type of surface shipping expected to transit the area.	Areas where underkeel clearance is considered not to be critical but features of concern to surface shipping may exist.	Areas where underkeel clearance is critical	Areas where there is strict minimum underkeel clearance and manoeuvrability criteria
Section 2.6	Depth THU [m] + [% of Depth]	20 m + 10% of depth *Ba5, Bb2	5 m + 5% of depth *Ba8, Bb3	5 m + 5% of depth *Ba8, Bb3	2 m *Ba9	1 m *Ba10
Section 2.6 Section 3.2 Section 3.2.3	Depth TVU (a) [m] and (b)	a = 1.0 m b = 0.023 *Bc7, Bd4	a = 0.5 m b = 0.013 *Bc8, Bd6	a = 0.5 m b = 0.013 *Bc8, Bd6	a = 0.25 m b = 0.0075 *Bc10, Bd8	a = 0.15 m b = 0.0075 *Bc12, Bd8
Section 3.3	Feature Detection [m] or [% of Depth]	Not Specified	Not Specified	Cubic features > 2 m, in depths down to 40 m; 10% of depth beyond 40 m *Be5, Bf3 beyond 40m	Cubic features > 1 m *Be6	Cubic features > 0.5 m *Be9
Section 3.4	Feature Search [%]	Recommended but Not Required	Recommended but Not Required	100% *Bg9	100% *Bg9	200% *Bg12
Section 3.5	Bathymetric Coverage [%]	5% *Bh3	5% *Bh3	≤ 100% *≤ Bh9	100% *Bh9	200% *Bh12

EM 124 SAT

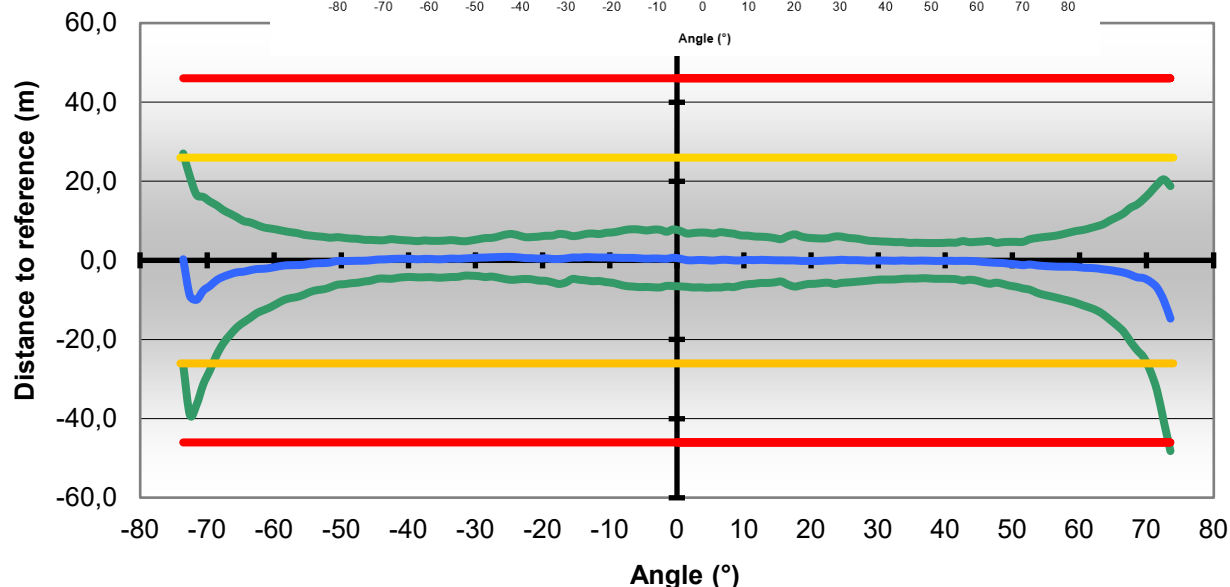
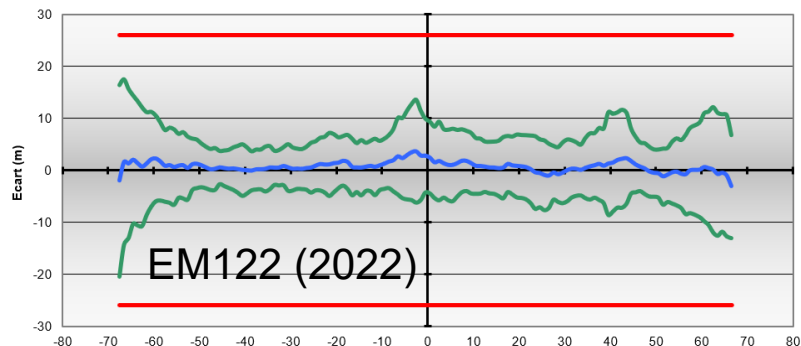
IHO Qualification : Vertical accuracy 2200n



Mean vertical offset : 0.85 m

Order 2 : Full swath

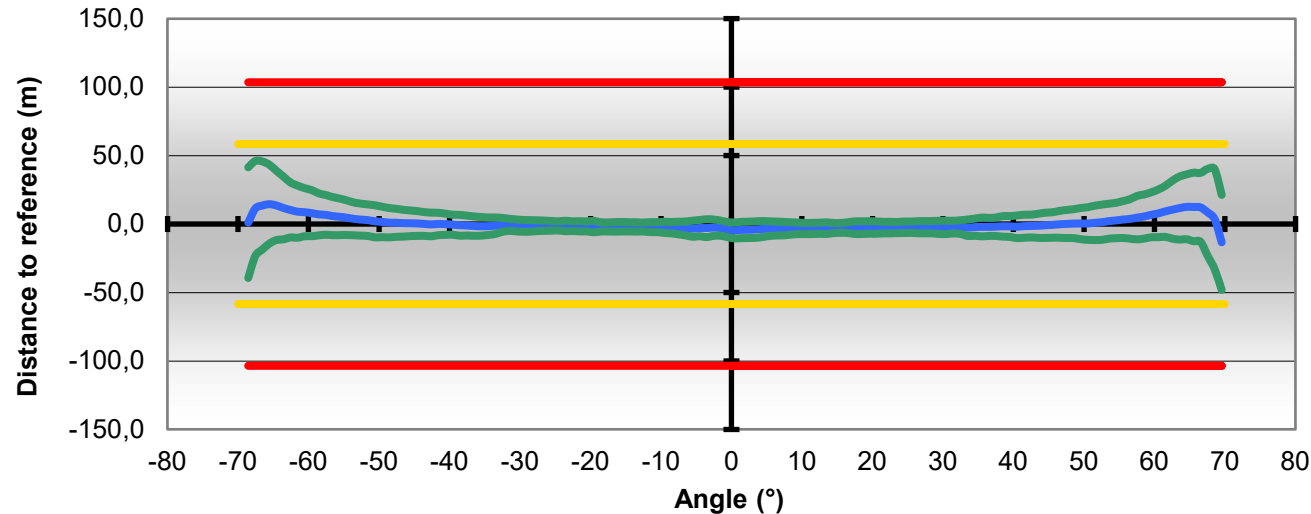
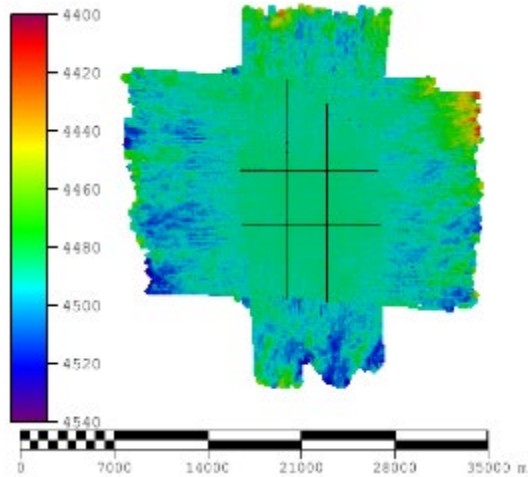
Order 1 : +/- 69°



- Moyenne
- Moy + 1.96.Ecart Type (SMF)
- Limite Min Ordre 2
- Limite Sup ordre 1
- Moy - 1.96.Ecart Type (SMF)
- Limite Sup Ordre 2

EM 124 SAT

IHO Qualification : Vertical accuracy 4500 m depth



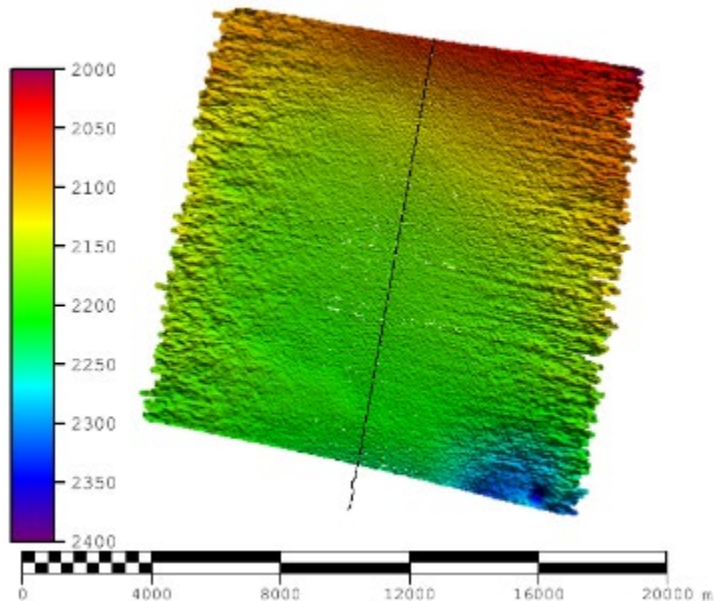
Mean vertical offset : 0.5 m
Order 2 & 1 : Full swath

- Moyenne
- Limite Sup Ordre 2
- Limite Sup ordre 1
- Moy - 1.96.Ecart Type (SMF)
- Limite Min Ordre 2
- Limite Min ordre 1
- Moy + 1.96.Ecart Type (SMF)

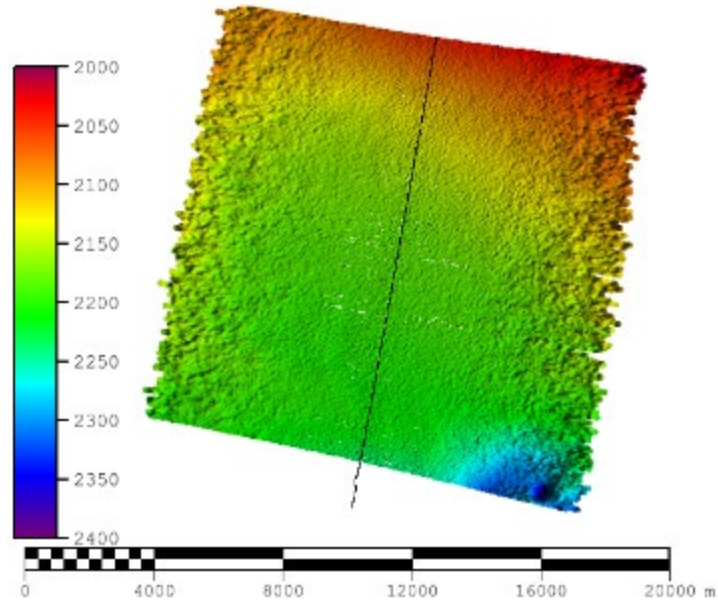
EM 124 SAT

Line analysis

Raw data, vertical exaggeration X10,
lightning perpendicular to ship road



Raw data, vertical exaggeration X10,
lightning parrallel to ship road



No issues in attitude, beamforming : **Very good data quality**

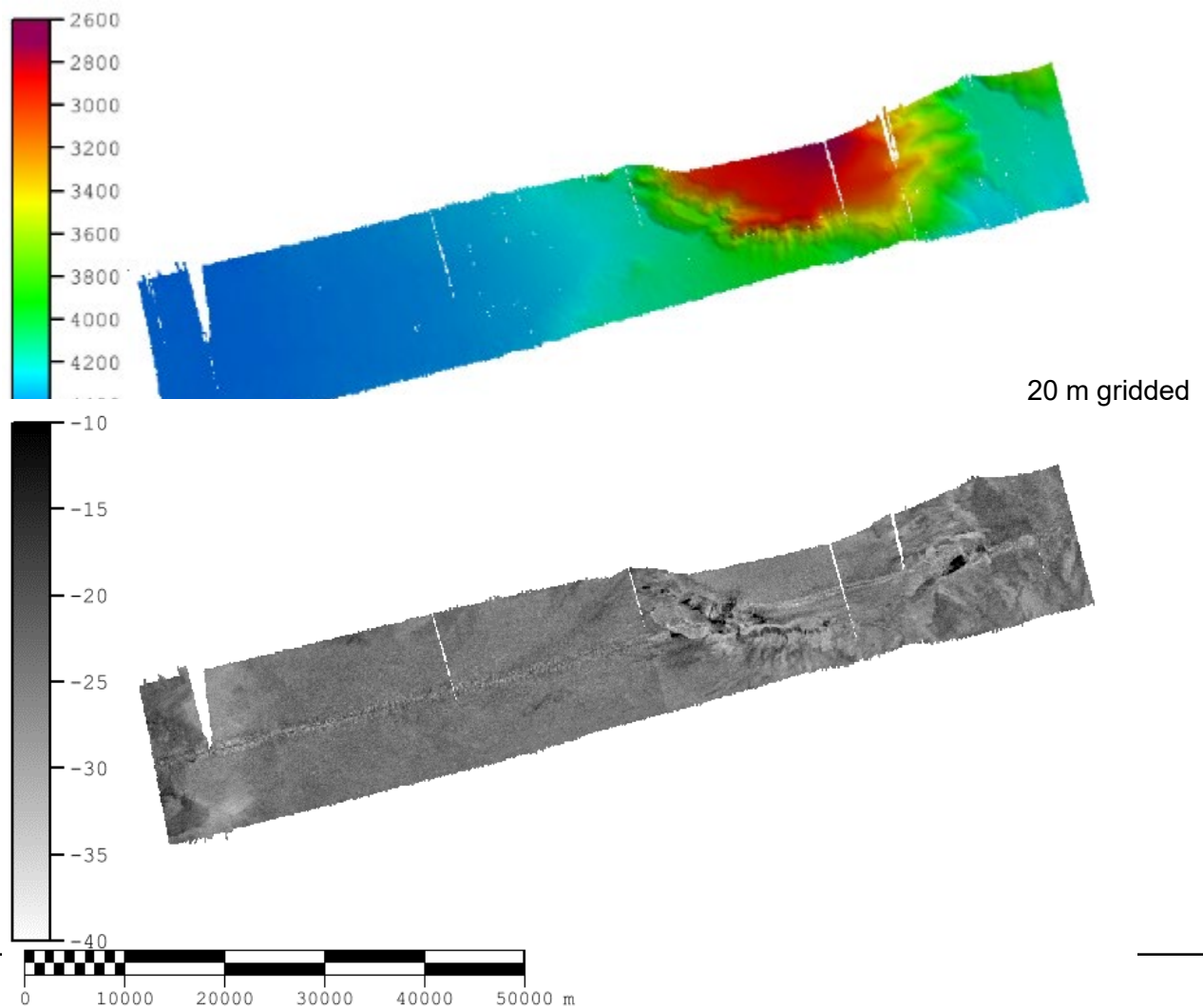
EM 124 SAT

Backscatter



EM 124 SAT

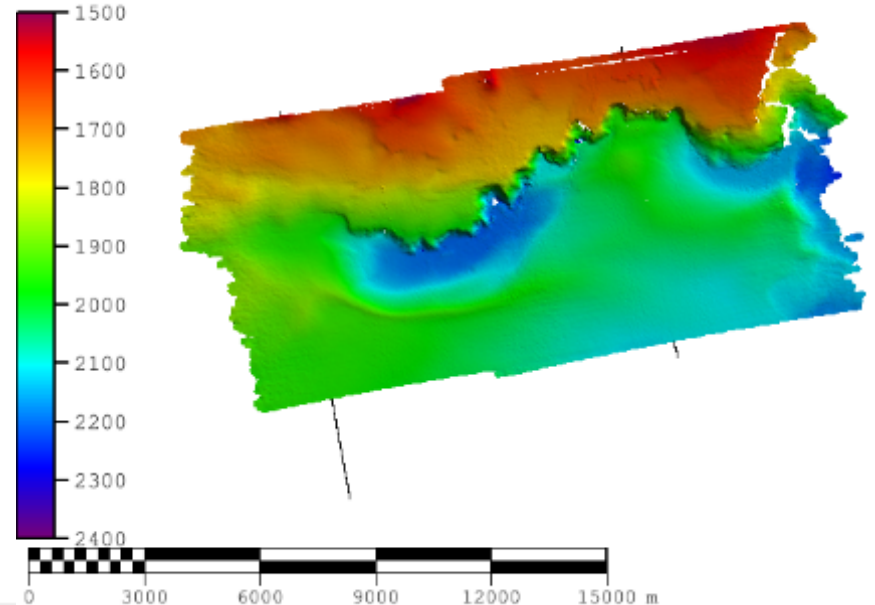
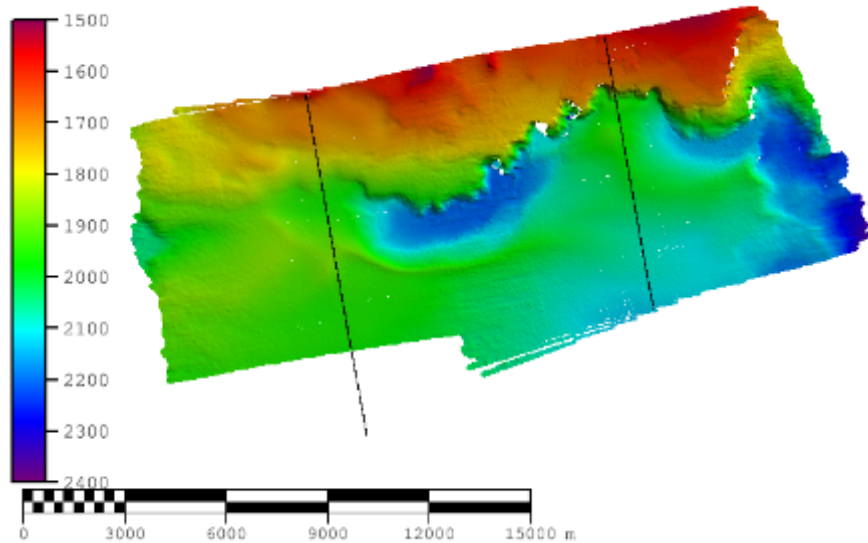
Backscatter



EM 124 SAT

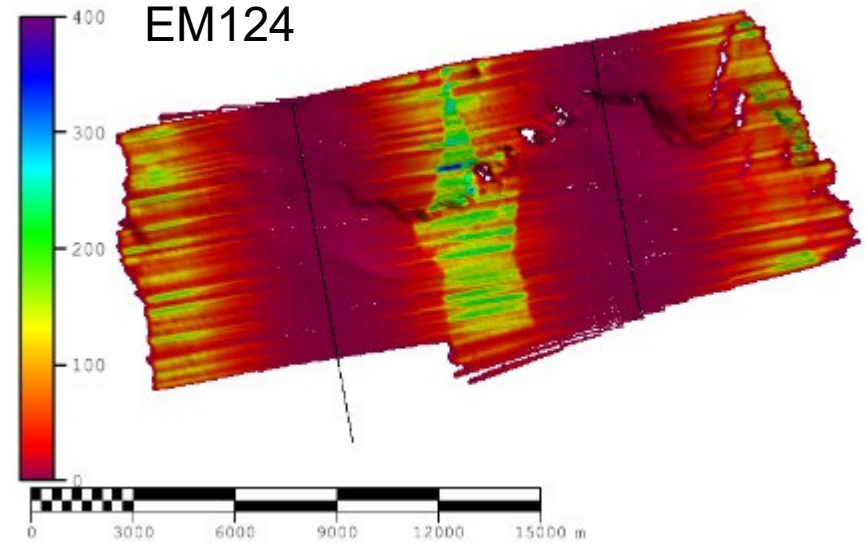
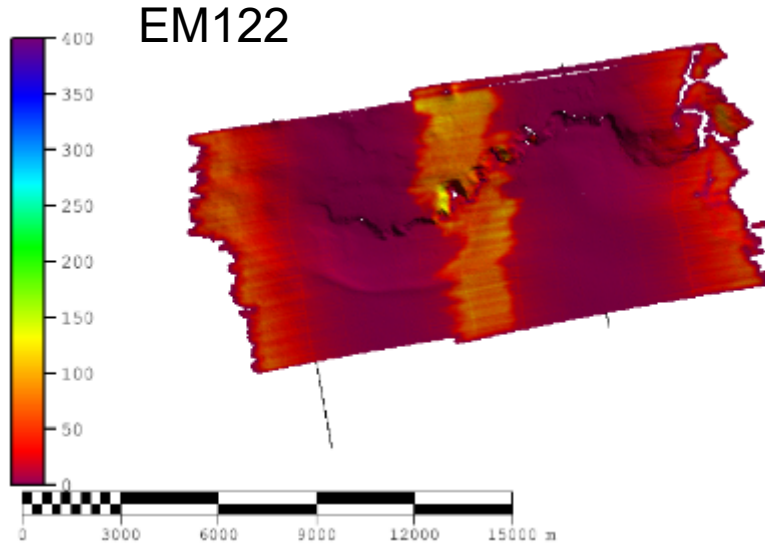
EM124 vs EM122

Increased coverage ($\pm 70^\circ$)



EM 124 SAT

EM124 vs EM122



Sounding density doubled => Higher DEM resolution possible

EM 124 SAT

Feedback on SIS V5/EM124

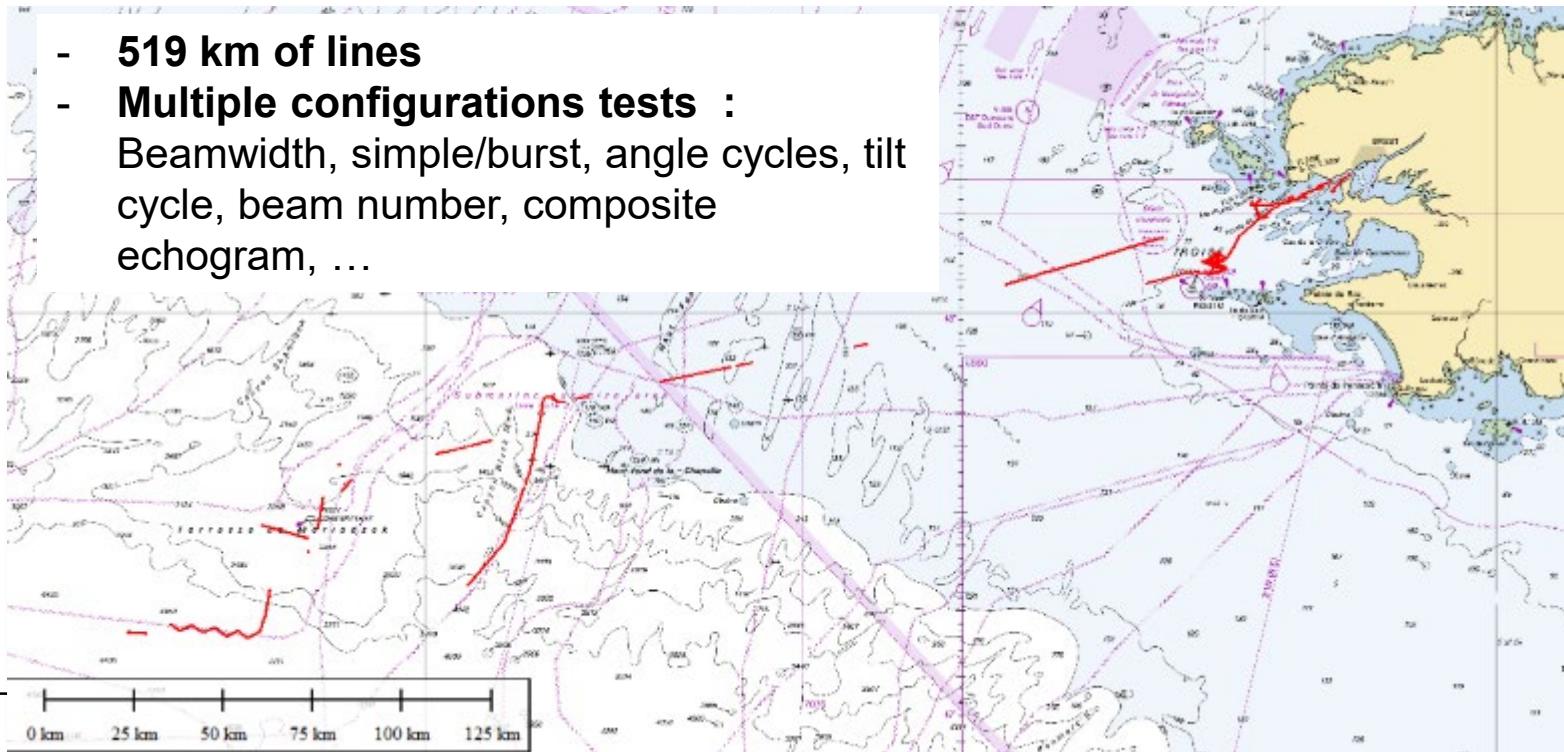
Benefits	Possible improvement
<ul style="list-style-type: none">- SIS very user friendly and stable- Planning module optimized- K-controller and SIS no need to restart all- Better transverse sounding resolution- Higher coverage	<ul style="list-style-type: none">- Must be for shallow water mode during up power reduce to 105V- Some old features missed :<ul style="list-style-type: none">⇒ Stored coverage, etc⇒ Grid size- Crosstrack DBT not working- Vertical exaggeration of the grid

HYDROGRAPHERS HAPPY!

SBP29 SAT

Shallow, medium and deep water Trials

- **519 km of lines**
- **Multiple configurations tests :**
Beamwidth, simple/burst, angle cycles, tilt cycle, beam number, composite echogram, ...



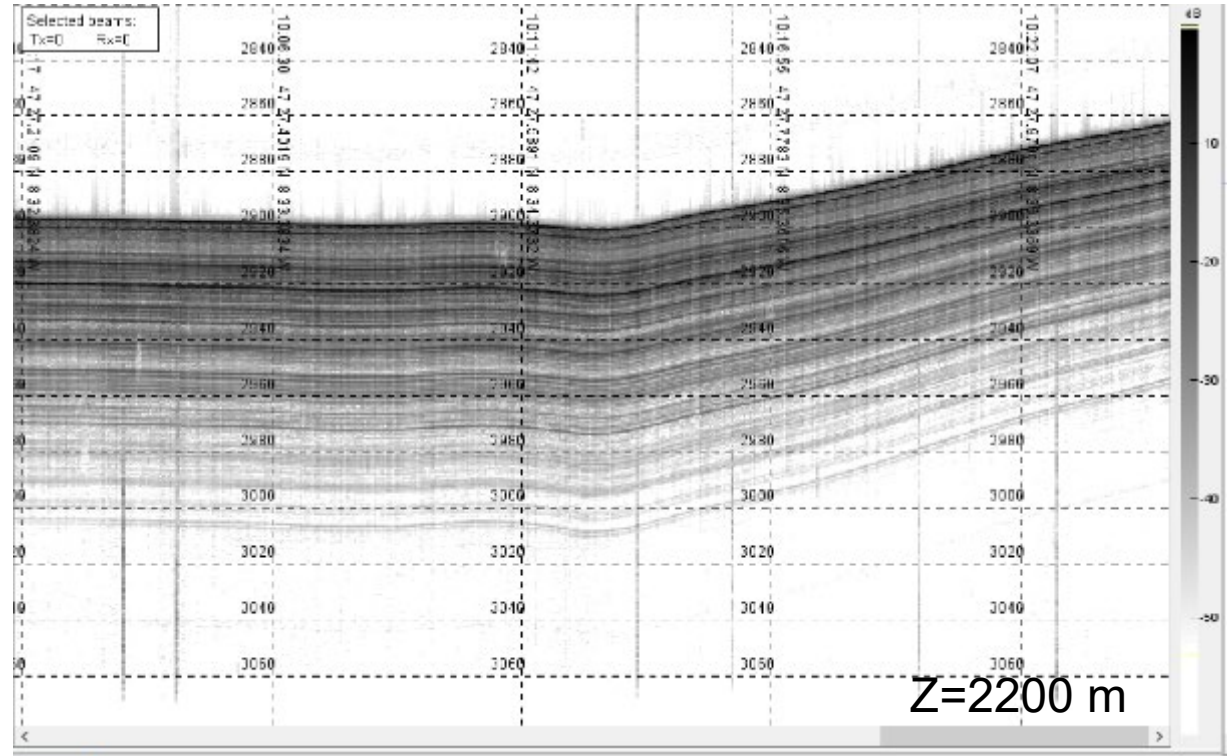
SBP29 SAT

Deep water trials

Beamwidth : 3°

No tilt cycle

1 Rx beam

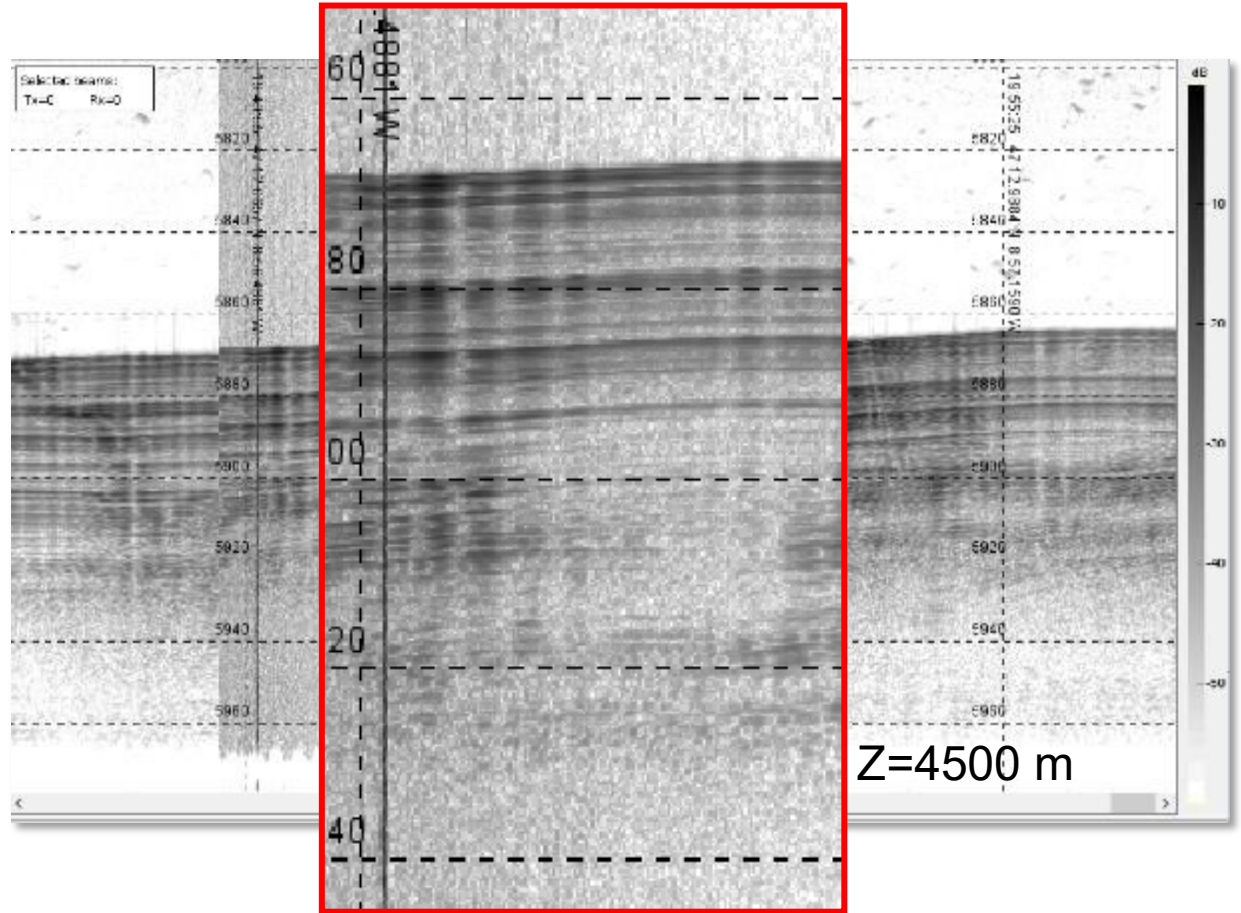


SBP29 SAT

Deep water trials

⇒ Error of 2° pitch value...more than 24 hours to find why these lower intensity bands

⇒ Be careful to angular offset values entered !!!



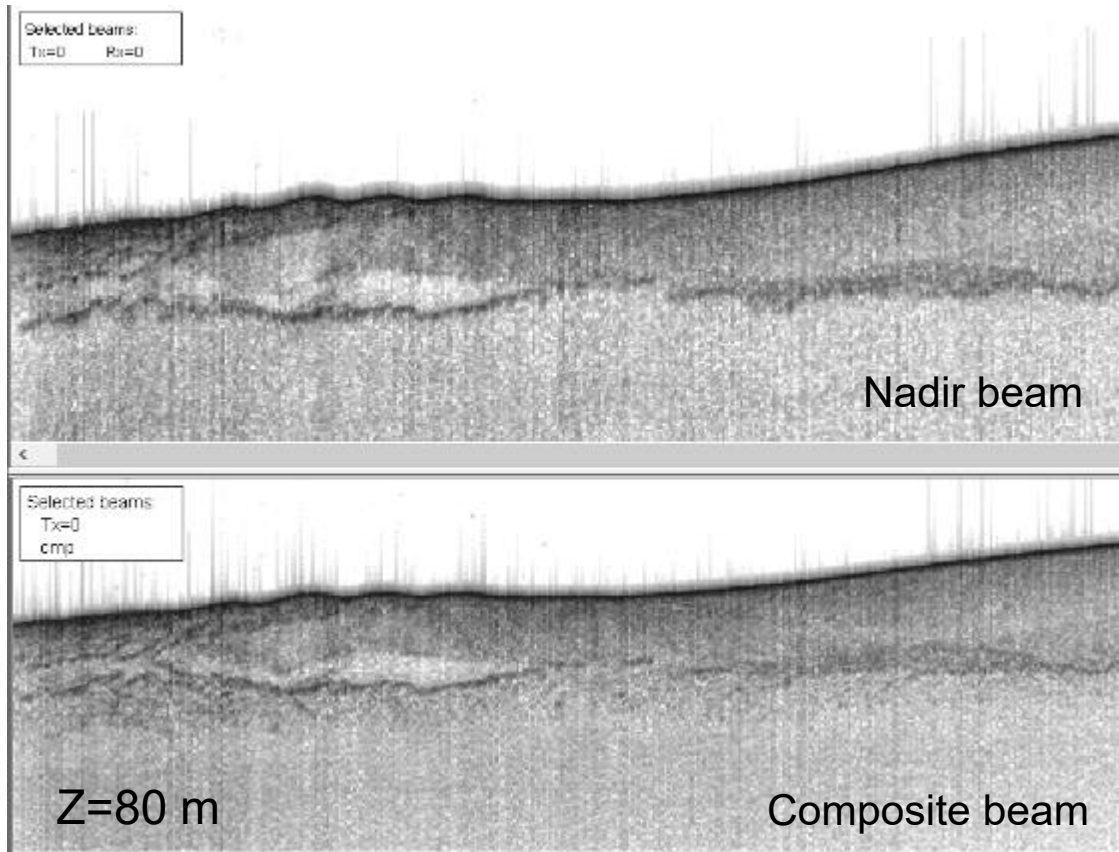
SBP29 SAT

Composite beam contribution

Beamwidth : 6°

No tilt cycle

21 Rx beams



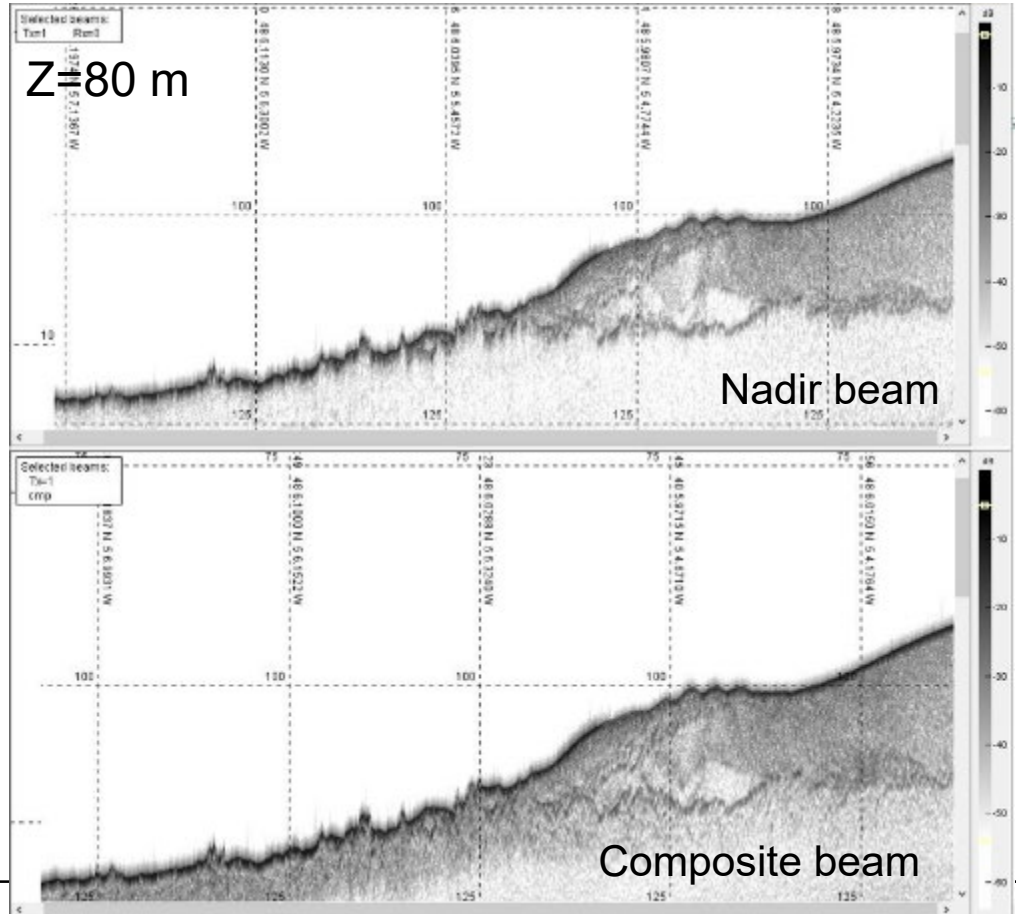
SBP29 SAT

Composite beam contribution

Beamwidth cycle : $3^{\circ}/6^{\circ}/9^{\circ}$

No tilt cycle

21 Rx beams



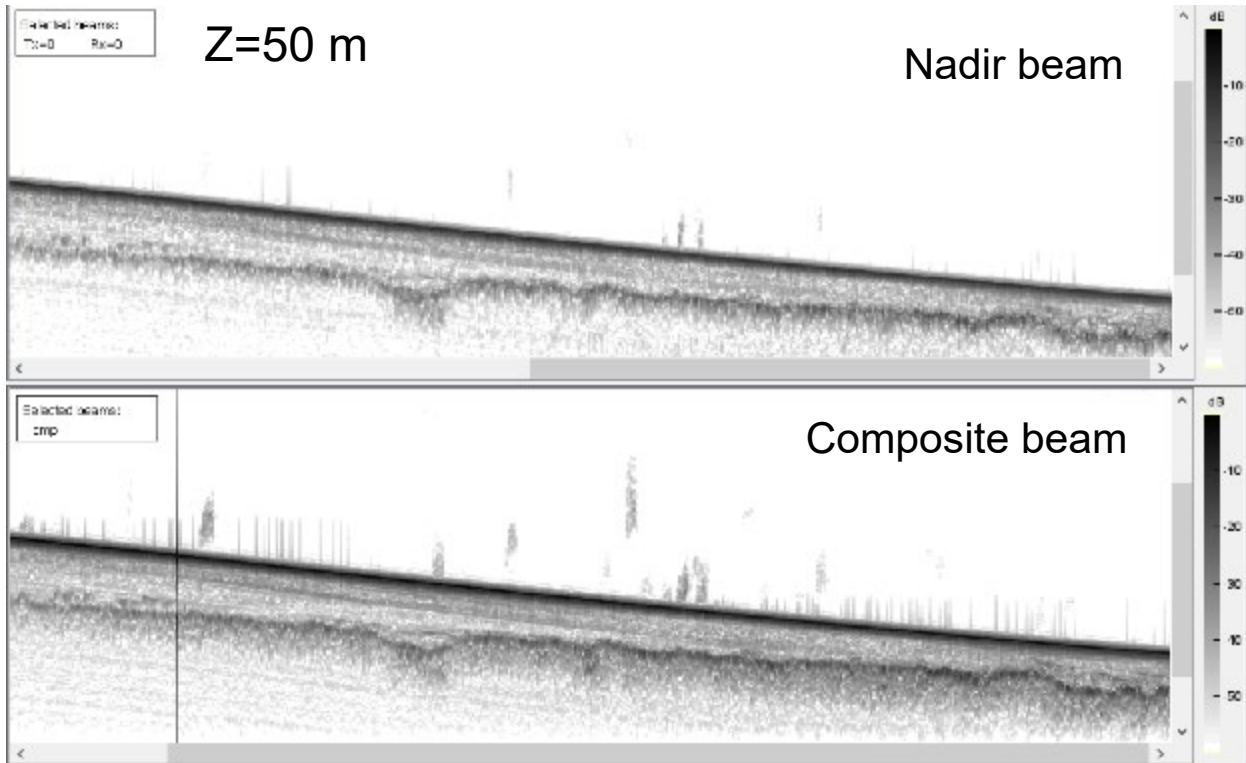
SBP29 SAT

Composite beam contribution

Beamwidth : 6°

Tilt cycle : $-6^\circ/-3^\circ/0^\circ/3^\circ/6^\circ$

21 Rx beams



SBP29 SAT

Composite beam contribution

- A benefit in discretisation of inclined sedimentary layers with tilt cycling and cyclical beamwidth activated
- A real-time help for Hydrographer and sedimentologist on board
- need more surveys to evaluate

SBP29 SAT

Feedback on SBP29

Benefits	Possible improvement
<ul style="list-style-type: none">- Composite beam in one .raw file- New friendly SBP beamformer software- Better quality data with EM124 upgrade	<ul style="list-style-type: none">- ON/OFF remote board issues (in investigation @KD)



Merci !