Inventory and qualification
of bathymetric data in the NE Atlantic

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Introduction

Objectives

✓ Improve SHOM's knowledge :
- o on external sources of bathymetric data
- o in the area Bay of Biscay/ Gulf of Cadiz / Channel
(within15°W / 3°E / 32°N / 52°N)

✓ Get access (buy if needed) to selected data of interest

✓ Evaluate and Qualify some of these dataset

Context

✓ Compute a DTM with the most recent data in the area with the highest resolution available (i.e. 100m on the shelf, 250 on the slope and 750-900m

✓ Opportunistically exploit EMODNET - Hydrography
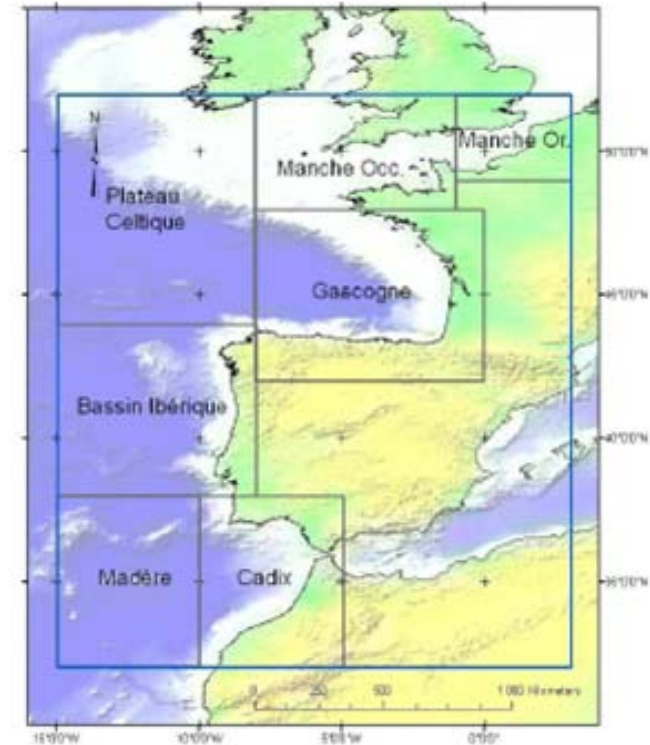
1/ Inventory of bathymetric data

✓ Request metadata (coverage and characteristics of the datasets)

✓ Build a GIS based database

✓ Set a hierarchy of bathymetric data to get hold

Requesting metadata

✓ 10329 metadata sets collected in the DB (inc. redundancy)

✓ 577 metadata sets not included in the DB (due to lack of localization)

✓ 33 sources of metadata information (out of which 29 were used)

Important metadata

✓Localization

✓Name and type (survey or transit)

✓Age of the dataset

✓Type of sensor (multibeam, singlebeam, lead line, Lidar, …)

✓Type of processing (raw, processed, DTM)

✓Data provider and distribution policies

✓Average completion of the important metadata = 80.9%

Metadata providers

Hydrographic offices

Data centers

Research institutes, Universities

Port Authorities

Private societies

Other Governmental bodies

2/ Bathymetric data qualification

✓ Get access to the bathymetric data of interest

✓ Develop a process of evaluation of the datasets

✓ Analyze and compare the dataset (in order to priories their introduction in a DTM)

Requesting bathymetric datasets

✓ 241 bathymetric datasets collected

✓ Volume > 845 Go

✓ 10 data holders
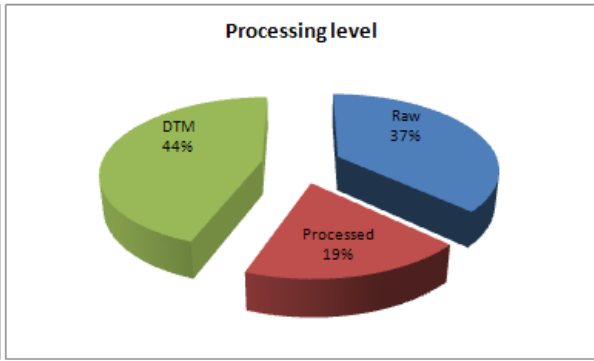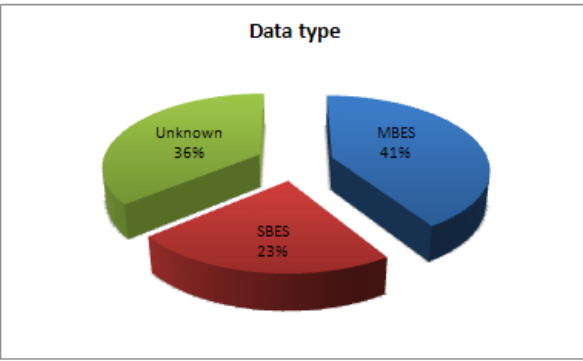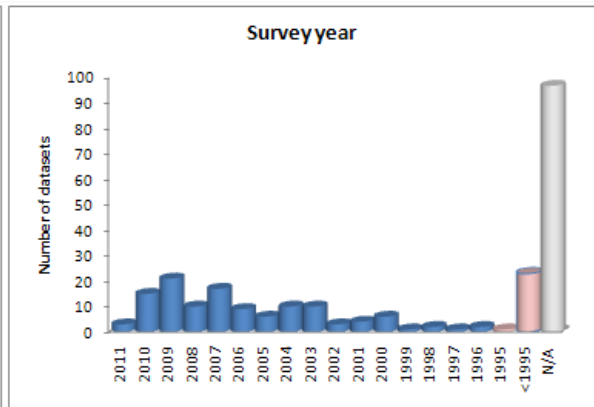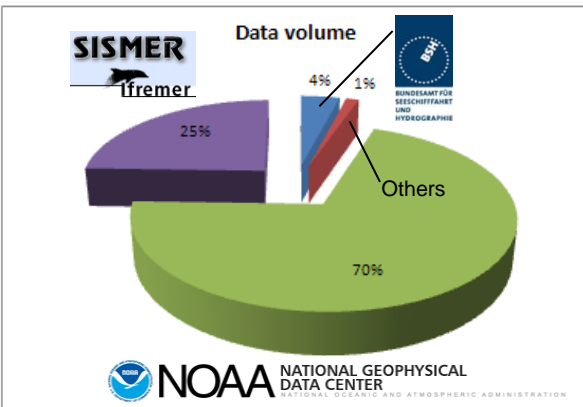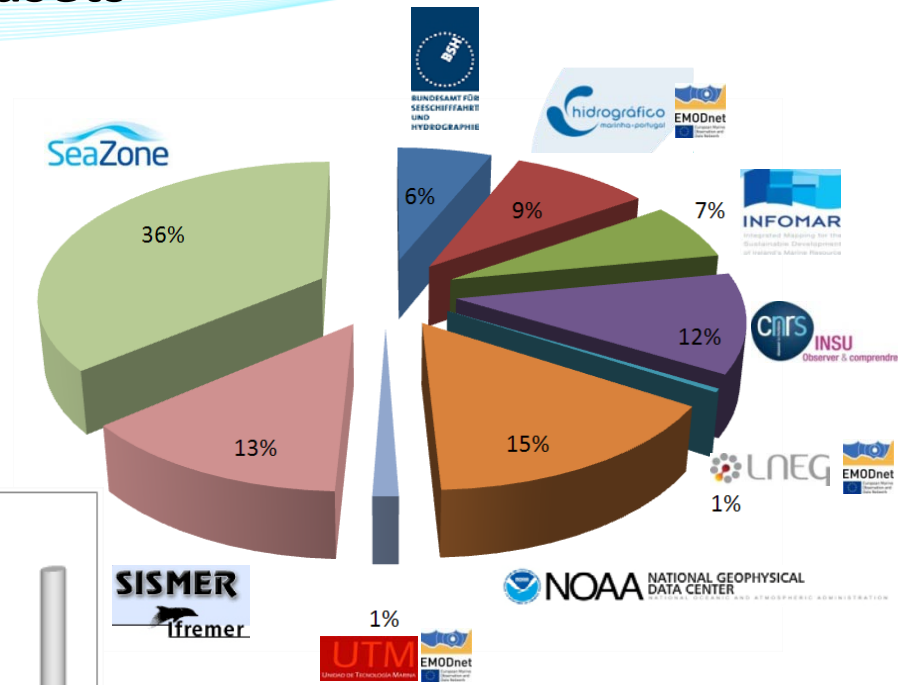
✓ NGDC, SISMER, BSH higher volume

✓ 2/5 Multibeam

✓ 1/5 Singlebeam

✓ DTM products

✓ 1/5 processed

✓ Relatively recent

Requesting bathymetric datasets

✓Heterogenous coverage

🟢 Relatively good coverage for:

- The british Isles and Ireland (Seazone, NGDC, INFOMAR)

- Gulfe of Cadix (IHPT)

- French coasts (SISMER, INSU)

🟠 Limited coverage for :
- Celtic continental sea
- Spanish and Portuguese coasts
- Deep sea areas (>3000 m)

Legend:
- BSH
- INSU
- LNEG (EMODNET)
- NGDC
- SISMER
- UTM (EMODNET)
- IHPT (EMODNET)
- INFOMAR
- INSU
- SEAZONE
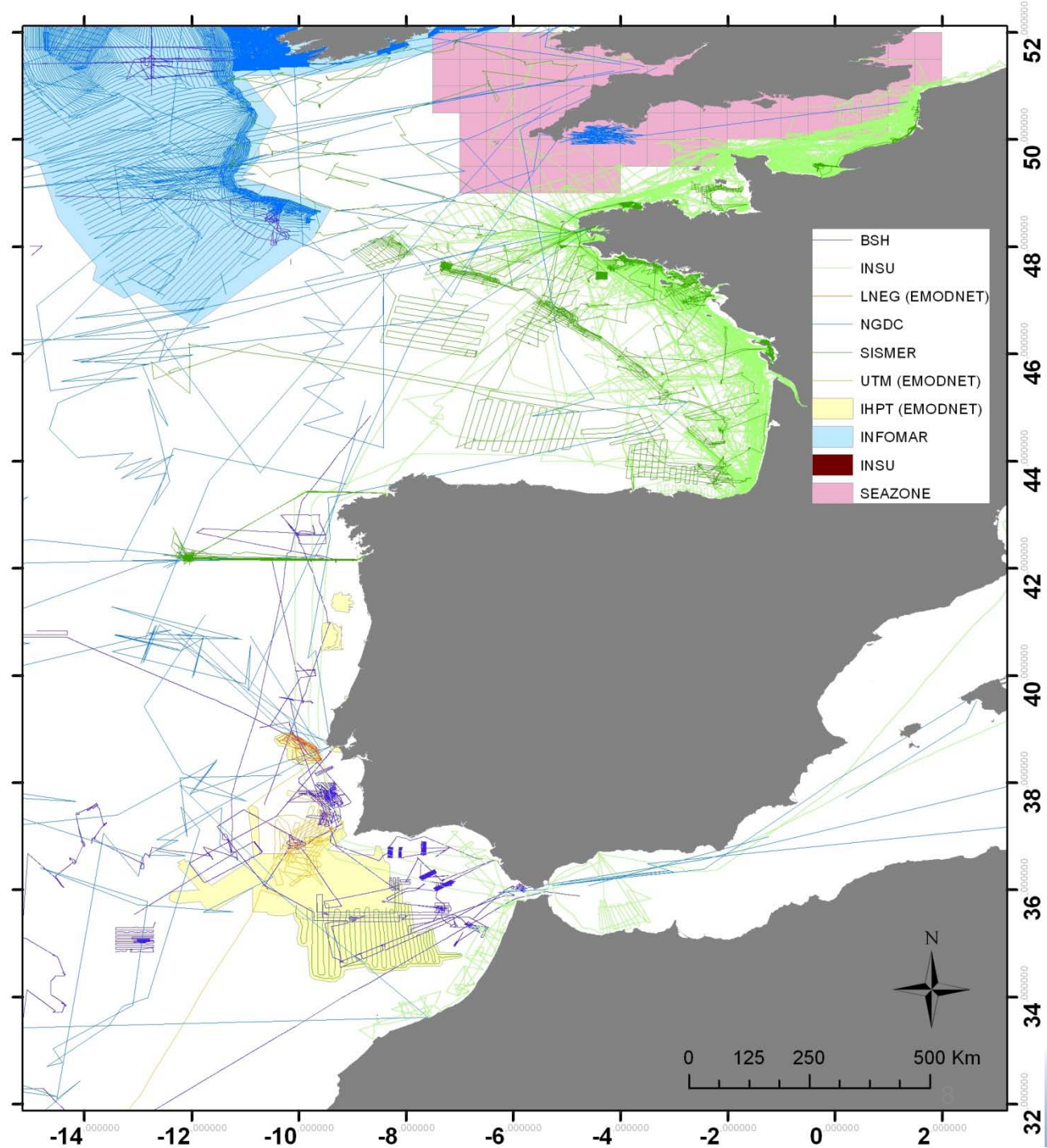
With respect of IHO S44 standards
(coverage, vertical uncertainty)

Internal qualification
(Intrinsic coherence)

Punctual errors (spikes)

Bias

Vertical precision

Other stats
(Min., Max. and average water depth, Standard deviation)
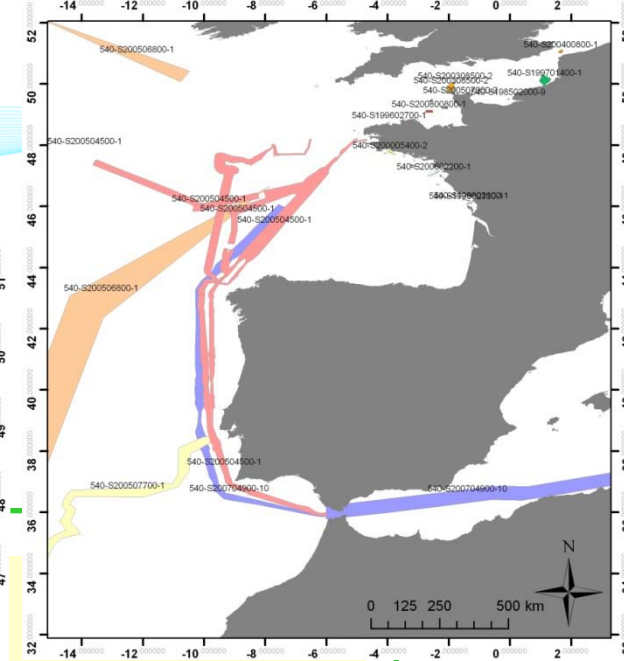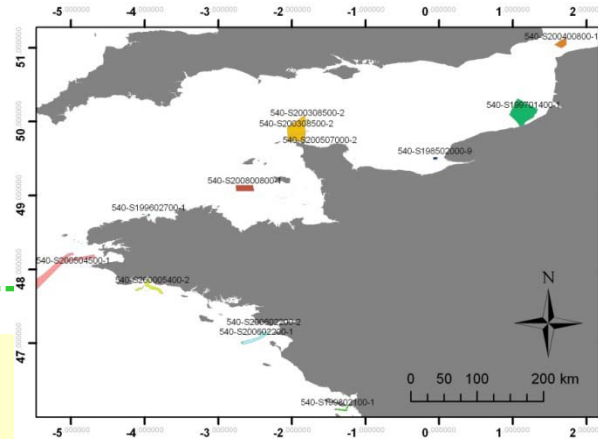
External qualification
(extrinsic coherence)

Dataset comparison

Well known datasets
(i.e. SHOM datasets)

Global datasets
- GEBCO08 @ 30''
- Smith&Sandwell's altimetry @ 1' (1997, v13.1)

9

Bathymetric data qualification

Spike detection

✓ Detection is a function of the distance of the soundings to the interpolated surface for a vertical threshold related to an appropriate IHO S44 order

✓ Detected values are flagged

✓ Multiple resolution for the interpolated surface

✓ Provide statistics of dubious soundings

DTM @ 25 m
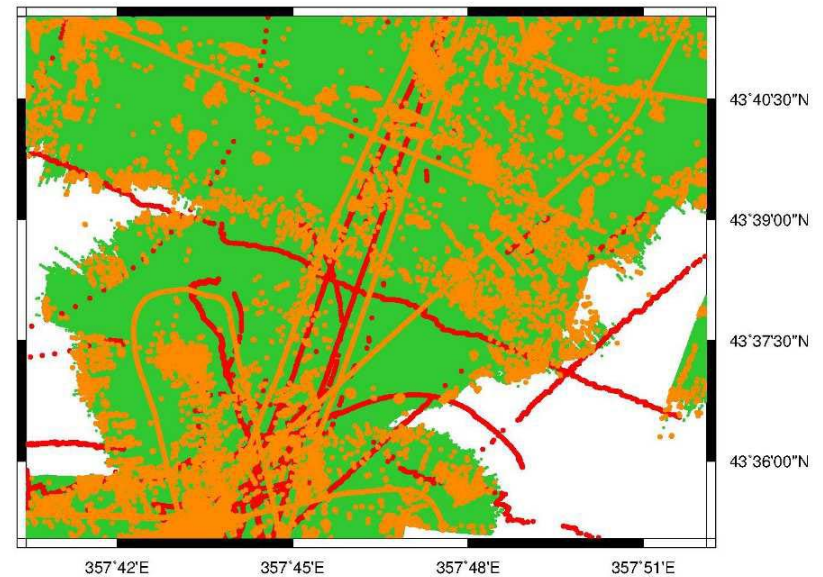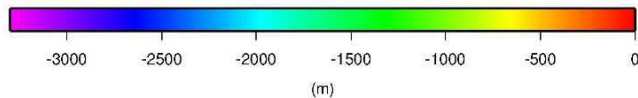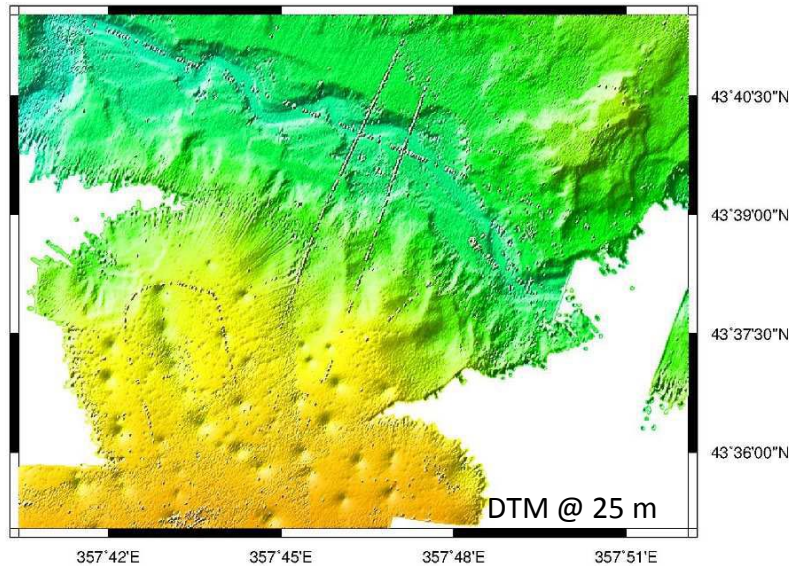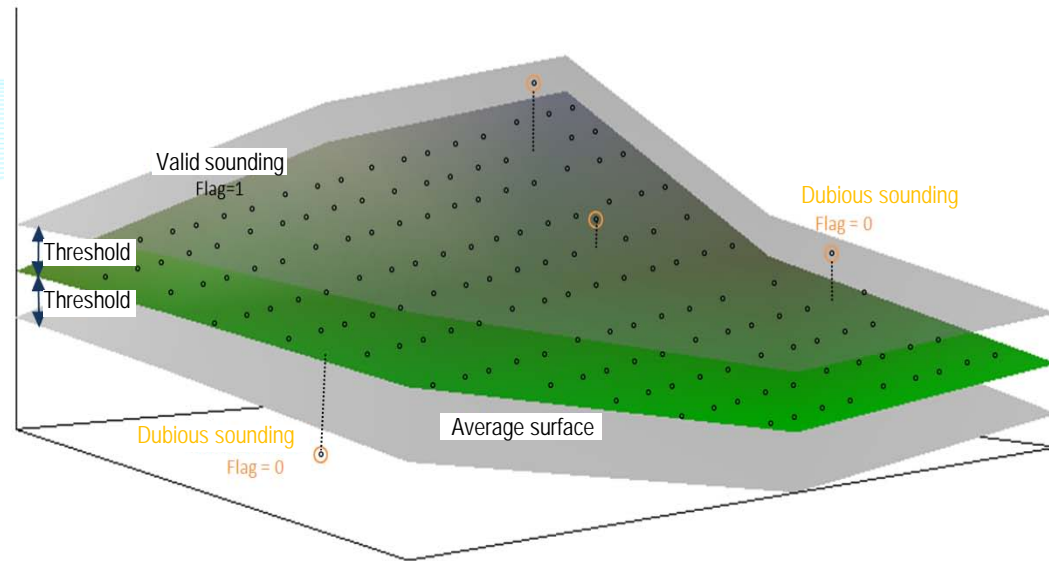
CAM_CRNO_10030080_SMF_7150
(SARGASS, SISMER)

Total nb of soundings :_____31148007
Nb of valid soundings :_____8633453
Nb of dubious soundings :_____17888250
Nb of invalid soundings :_____4626304

Percentage of valid soundings:_____27.72 %
Percentage of dubious soundigns:__57.43 %
Percentage of invalid soundings:___14.85 %

Bathymetric data qualification

Estimation of the vertical precision of a survey

✓ difference between :
  - one (or several) regular profile(s)
  - crossing profile for the nadir beams (DTM)

✓ Statistics can be provided with respect to beam number

✓ Vertical uncertainties are displayed with respect to the adapted IHO S44 standards

Cork_harbour, NGDC
SIMRAD EM1002, 111 beams
2 regular, 1 crossing

Average depth: ~18 m
Crossing profile DTM @ 2m
2x20 nadir beams
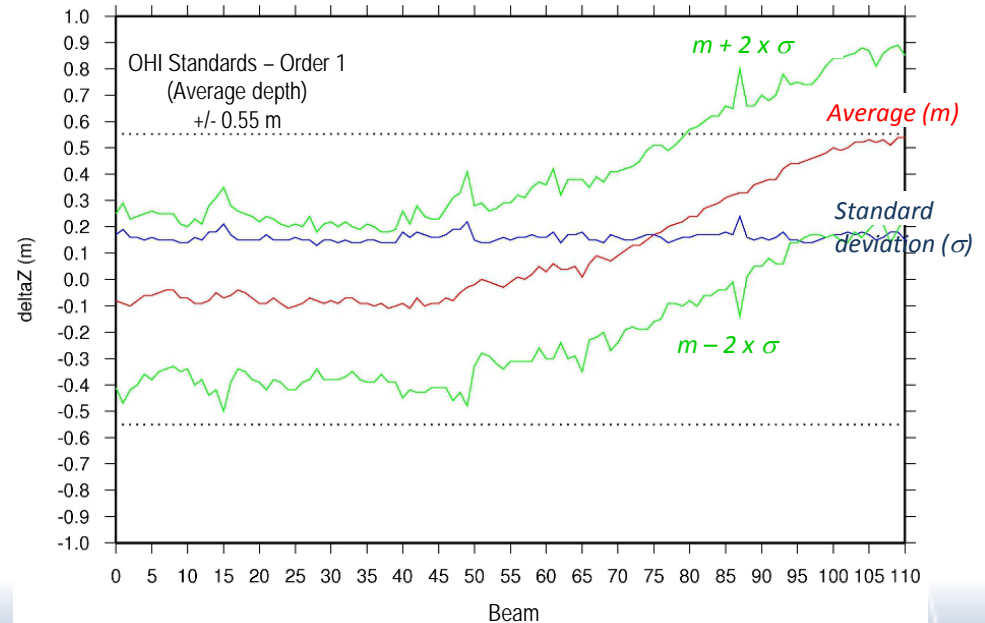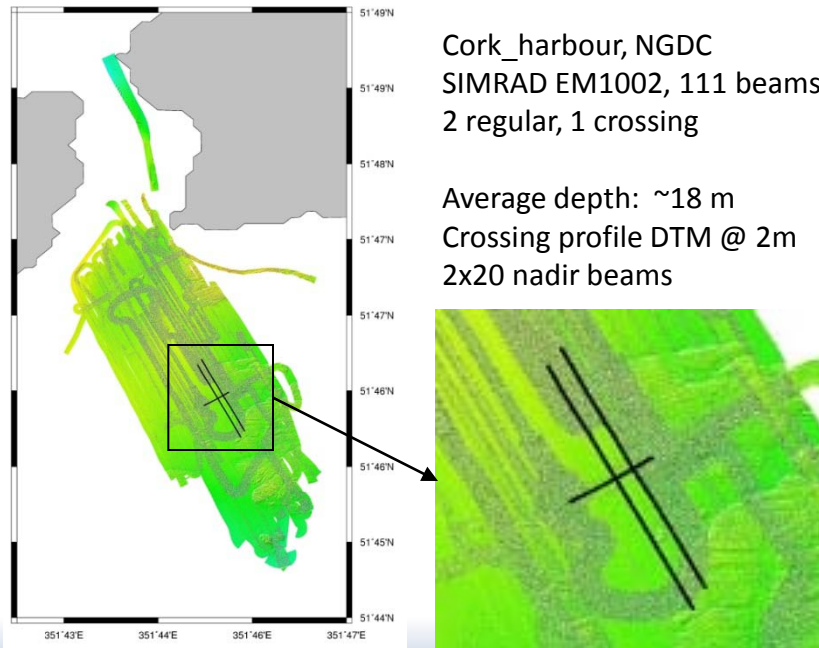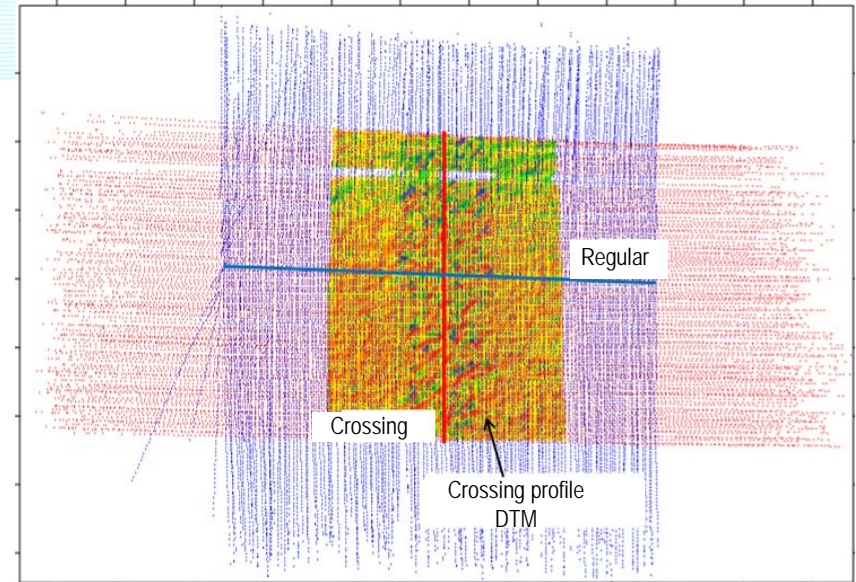
Qualified datasets

✓ 91/241 qualified (time constraints)

✓ Selection based on (extent, type of sounders, data holder)

✓ 2/3 Multibeam

✓ 2/5 processed; nearly ½ raw

✓ Mostly recent

Data holders

- SEAZONE 6%
- BSH 12%
- IHPT 18%
- INFOMAR 5%
- INSU 4%
- LNEG 1%
- NGDC 37%
- UTM 3%
- SISMER 14%

Survey year

Data type

- Unknown 6%
- SBES 27%
- MBES 67%

Processing level

- DTM 14%
- Raw 46%
- Processed 40%

Available, qualified
Available, not qualified
Available, qualified
Available, not qualified
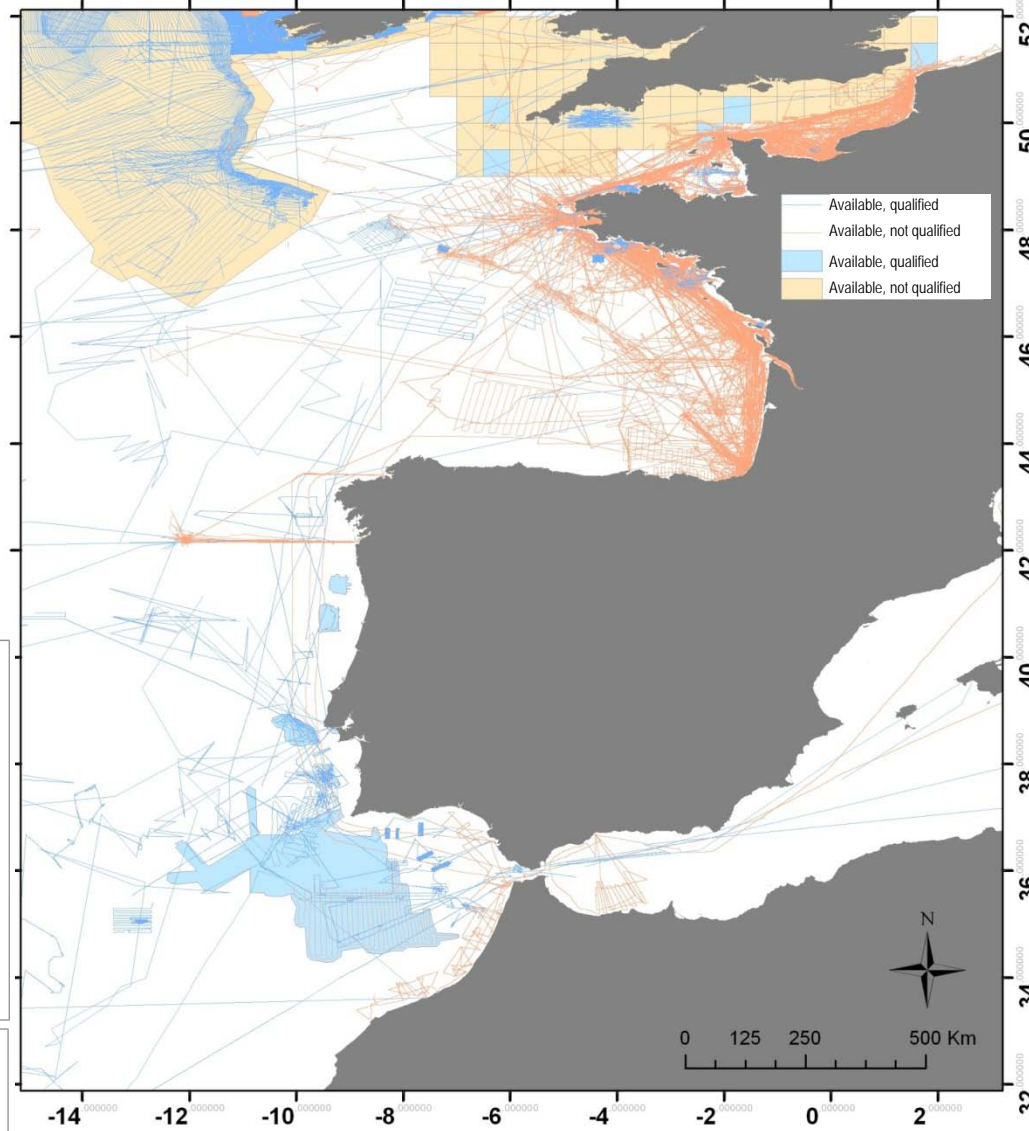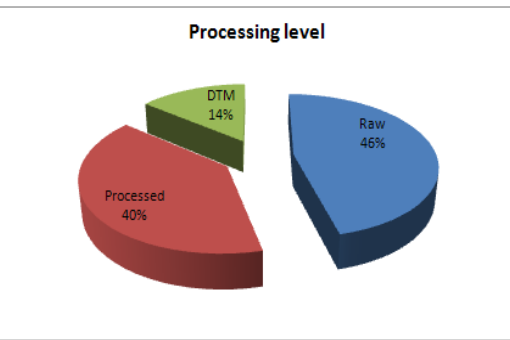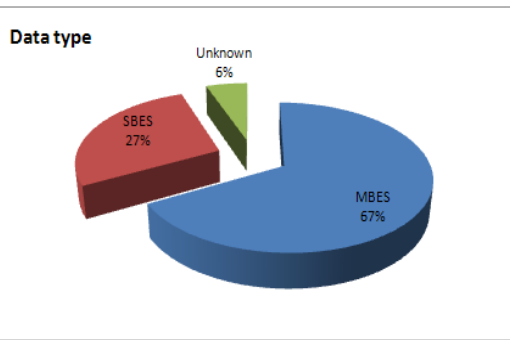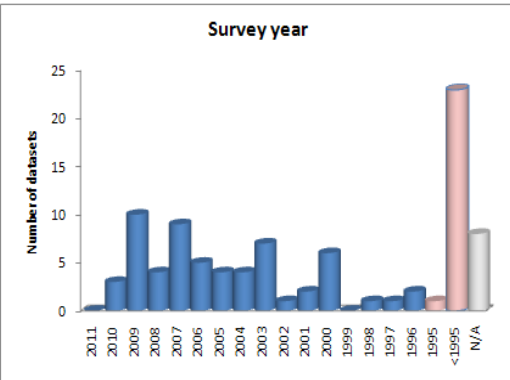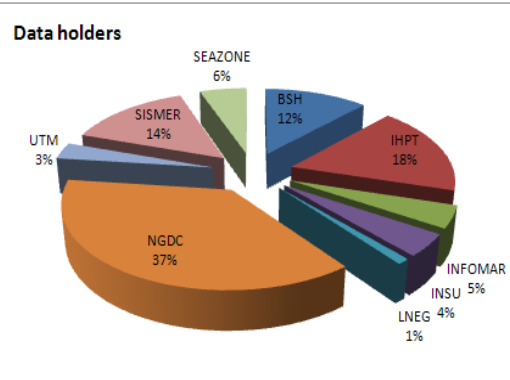
3/ Discussion

✓ Evaluate if and how the collected data can be used (set hierarchical rules)

✓ Anticipate the DTM production

Definition of 3 indexes:

✓ **Internal quality:**

→ Knowledge of the dataset (metadata) + intrinsinc coherence + evaluation of vertical uncertainties

✓ **External quality:**

→ External coherence

✓ **Confidance index:**

→ Confidance related to the parametrisation and related to the results of the internal/external qualification

Internal quality index :	7,9	/	10
Knowledge of the dataset	1,0	/	1
IQ1 - Main metadata filling rate (percentage of filling)		/	1
IQ2 - Positioning system		/	1
1 GPS (GPS, D-GPS, Kinematic GPS…)			
0,5 other			
0 unknown			
IQ3 - Auxiliary data (navigation, tide, celerity)		/	1
1 yes			
0 no or unknown			
IQ4 - Type of survey	1	/	1
1 survey	1		
0,5 transit			
0 unknown			
Intrinsinc coherence	2,5	/	4
IQ5 - Sounding density	1	/	1
1 good	1		
0,5 median			
0 insufficient			
IQ6 - Percentage of invalid soundings	0	/	1
1 less or equal to 5%			
0 more than 5%	1		
IQ7 - Percentage of dubious soundings	0,5	/	1
1 less than 1%			
0,5 between 1% and 5%	1		
0 more than 5%			
IQ8 - Bias seen on DTM	1	/	1
1 none	1		
0,5 deteriorated but not sizeable bias			
0 deteriorated and sizeable bias			
Respect of some OHI Standards criteria	2	/	2
IQ9 - Vertical uncertainty	1	/	1
1 yes, everywhere and on all beams	1		
0,5 partially			
0 no			
IQ10 - Coverage	1	/	1
1 full	1		
0 partial			
Global mark	5,5	/	7

External quality index:	2,0	/	10
Extrinsinc coherence	2	/	10
ICE1 - Coherence with other external datasets	2	/	2
2 yes, everywhere	1		
1 partial			
0 no or difficult to assess			
ICE2 - Nature of the external dataset	1	/	5
5 qualified SHOM datasets			
2 others			
1 global datasets (GEBCO and altimetry)	1		
Global mark	2	/	10

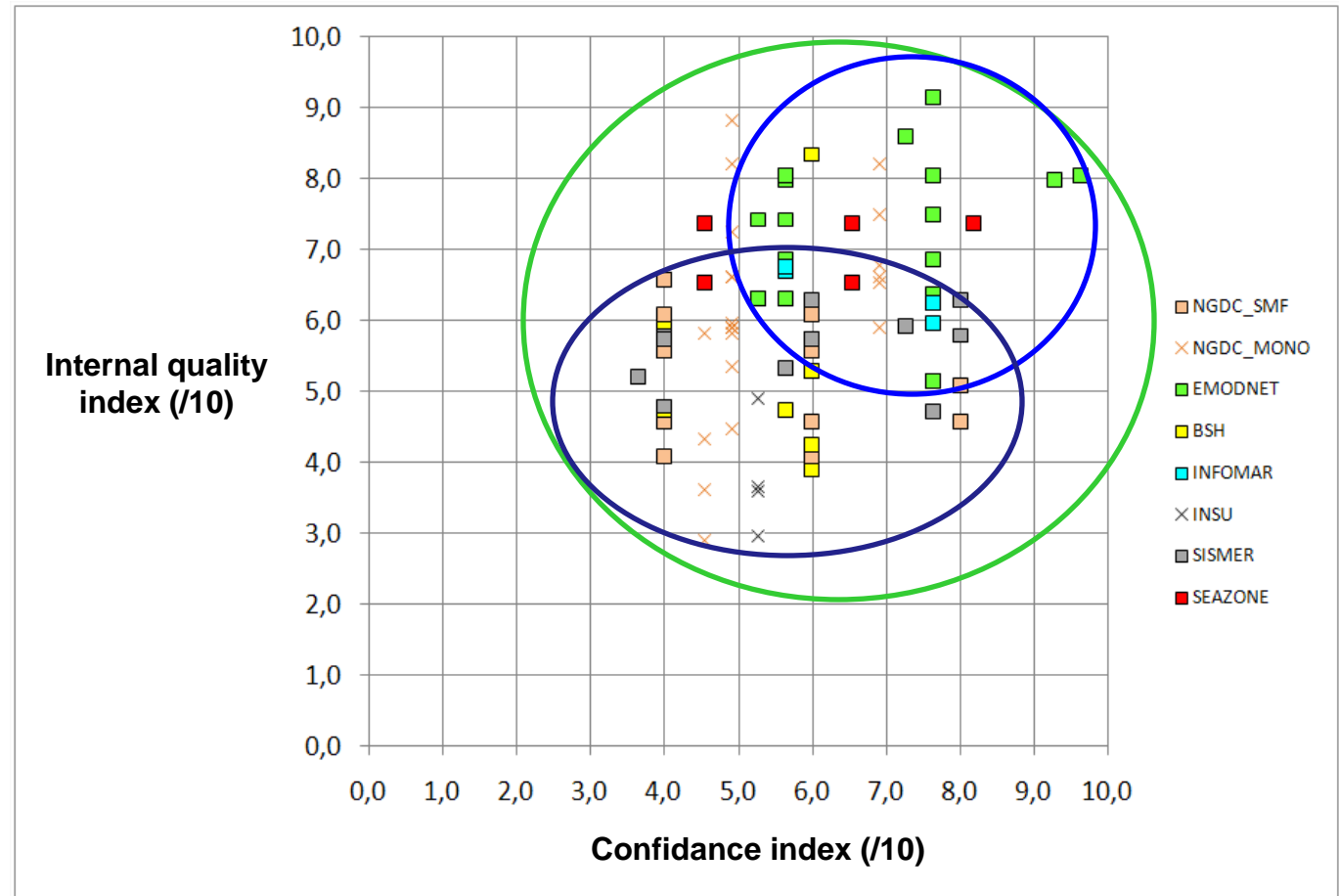| Confidence index :	8,9	/	10
Confidence in the qualification process	4,5	/	5
IC1 - Homogeneity of the dataset	1	/	1
1 yes	1		
0 no			
IC2 - Proportion of qualified data	1	/	1
1 all the dataset			
0 local subset			
IC3 - Artefact detection threshold	1	/	1
1 conform to OHI Standards	1		
0 not conform with OHI Standards			
IC4 - Number of assessed quality criteria	1,5	/	2
Knowledge of the dataset: IQ1+IQ2+IQ3+IQ4	1	/	4
Intrinsinc coherence: IQ5+IQ6+IQ7+IQ8	4	/	4
Respect of OHI Standards: IQ9+IQ10	2	/	2
Extrinsinc coherence: ICE1+ICE2	1	/	1
TOTAL:	8	/	11
Global mark	4,5	/	5

Synthesis of the results

✓ All the values are in the upper right corner
→We are dealing wiht a selection of data wiht a relatively high level of quality

✓ Processed data and DTM (EMODNET and INFOMAR):
→ Better Internal quality
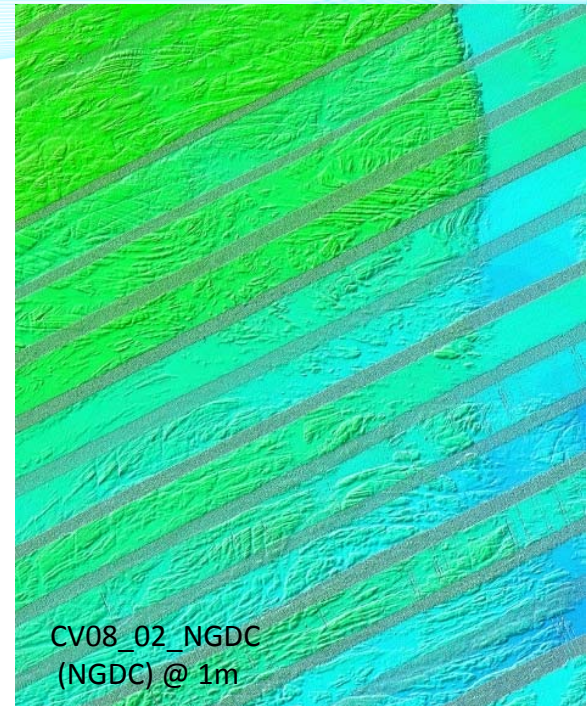→ Higher level of confidance

✓ Raw data (NGDC, SISMER, BSH):
→ Closer to the center of the diagram

Internal quality index (/10) vs **Confidance index (/10)**

Legend:
- NGDC_SMF
- NGDC_MONO
- EMODNET
- BSH
- INFOMAR
- INSU
- SISMER
- SEAZONE

Use of the data

Raw soundings
from:

🟠 Artefacts
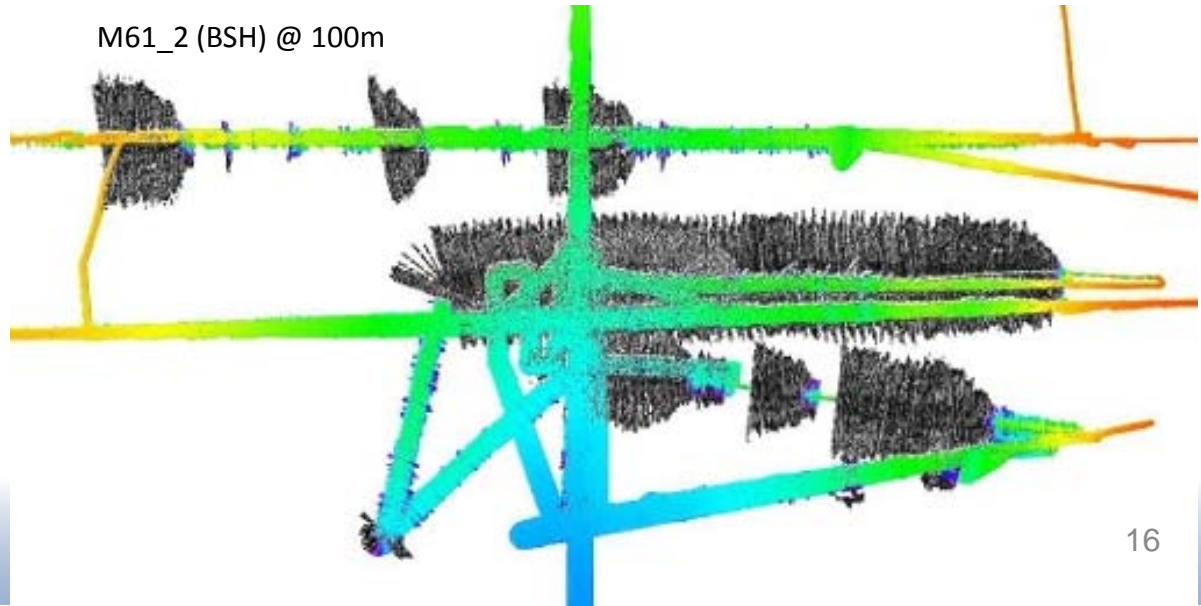
✓ SISMER, NGDC: Possible tidal issues for shallow areas

✓ BSH: Spikes

🟢 Coverage and density

➡️ **Further processing might be needed**
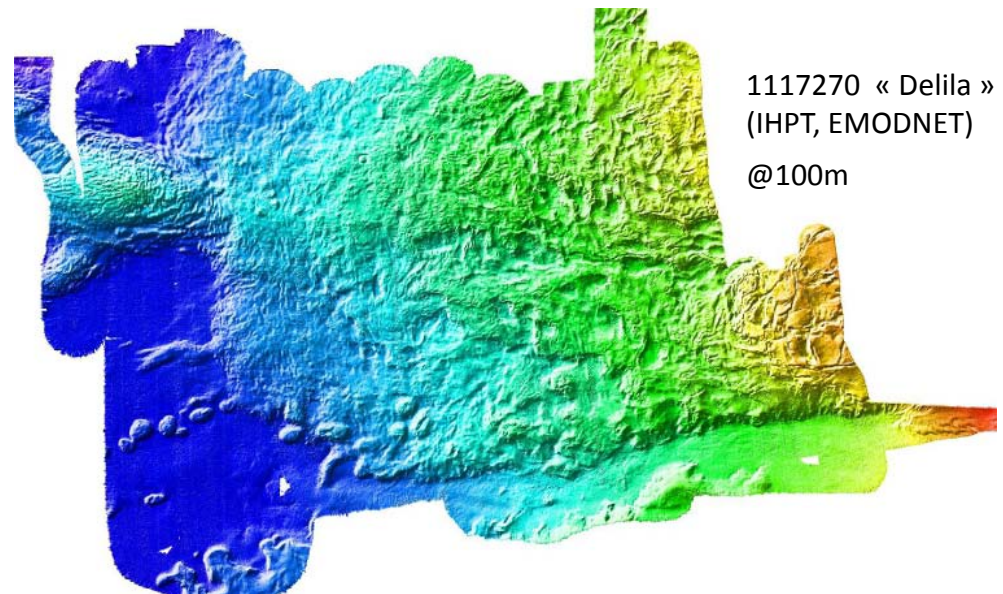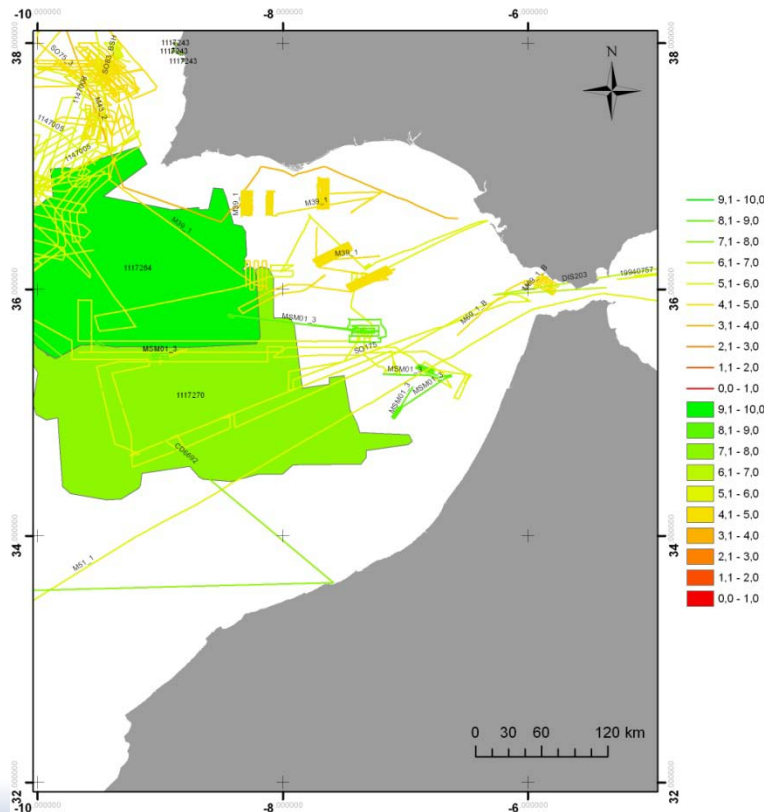

CV08_02_NGDC (NGDC) @ 1m

M61_2 (BSH) @ 100m

Use of the data

Processed datasets
from:

- High intrinsinc and confidence indexes

- Documented processing

- High density/coverage/quality for 1117264 (Matespro) and 1117270 (Delila)
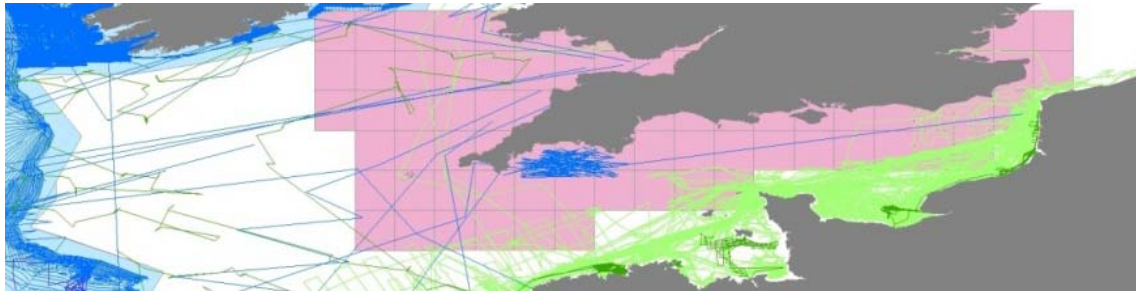

1117270 « Delila »
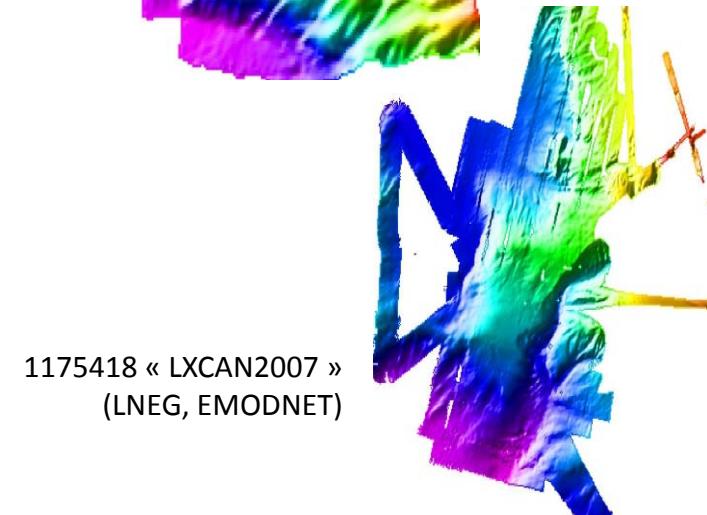(IHPT, EMODNET)

@100m

This dataset should be used without reserves

Use of the data

DTM from: **SeaZone**
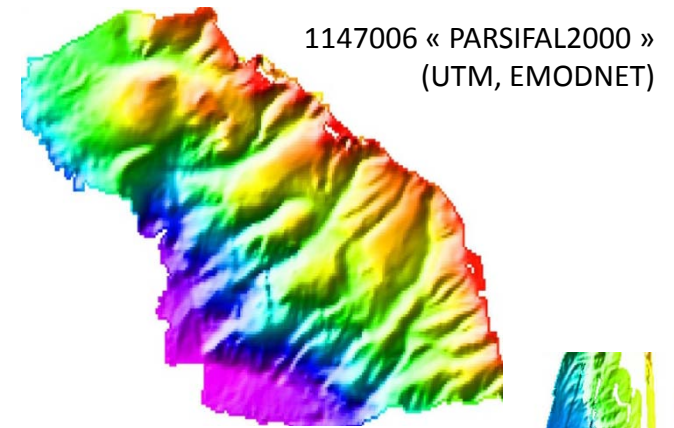
- Tiled DTM with a large extent (@1'' ~ 30 m)

- Bathymetric data are blended (including digitalization of isobaths)

- Interpolation Triangular Irregular Network (TIN) resampled in a grid → coarse artifacts

- Sources: Maritime and Coastguard Agency (MCA), United Kingdom Hydrographic Office (UKHO) and Port Authorities
→ IHO standards are generally respected

NE55100015
@ 30 m

- Low resolution (@ 464 m)

1147006 « PARSIFAL2000 »
(UTM, EMODNET)

1175418 « LXCAN2007 »
(LNEG, EMODNET)
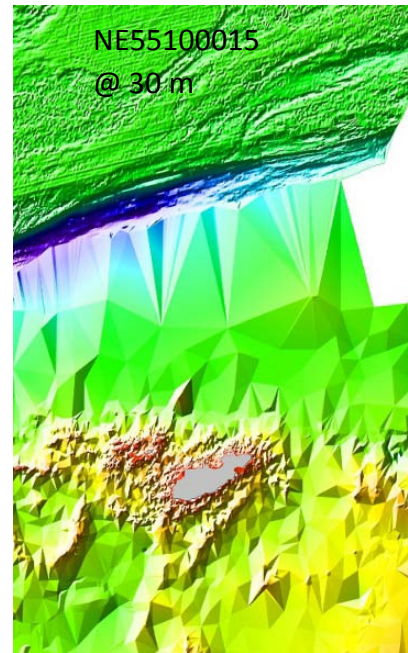
→ **This data should be used if there are no other datasets for the area**

Conclusions

✓ Inventory:

- Over 150 potential holder identified, 20% answered

- Over 10000 metadata sets (inc redundancy) included in a GIS DB
- This inventory process should continue and be extended to other area of interest (Mediterannean sea)

✓ Requesting data :

- 241 collected datasets, 91 qualified (from 10 sources)
-Diffusion policies are diverse and poorly described

✓ Qualification :

- Processing methodology (provide some sort of comparison between the datasets)
- Data are clearly acquired and archived to satisfy different objectives

✓ Future :

- Elaborate a BathyDM methodology that will include the various levels of quality and produce it
- Share some methodology and qualification with GEBCO (cookbook & GEBCO data store) ?
- Pursue this effort and update (attract the industry)
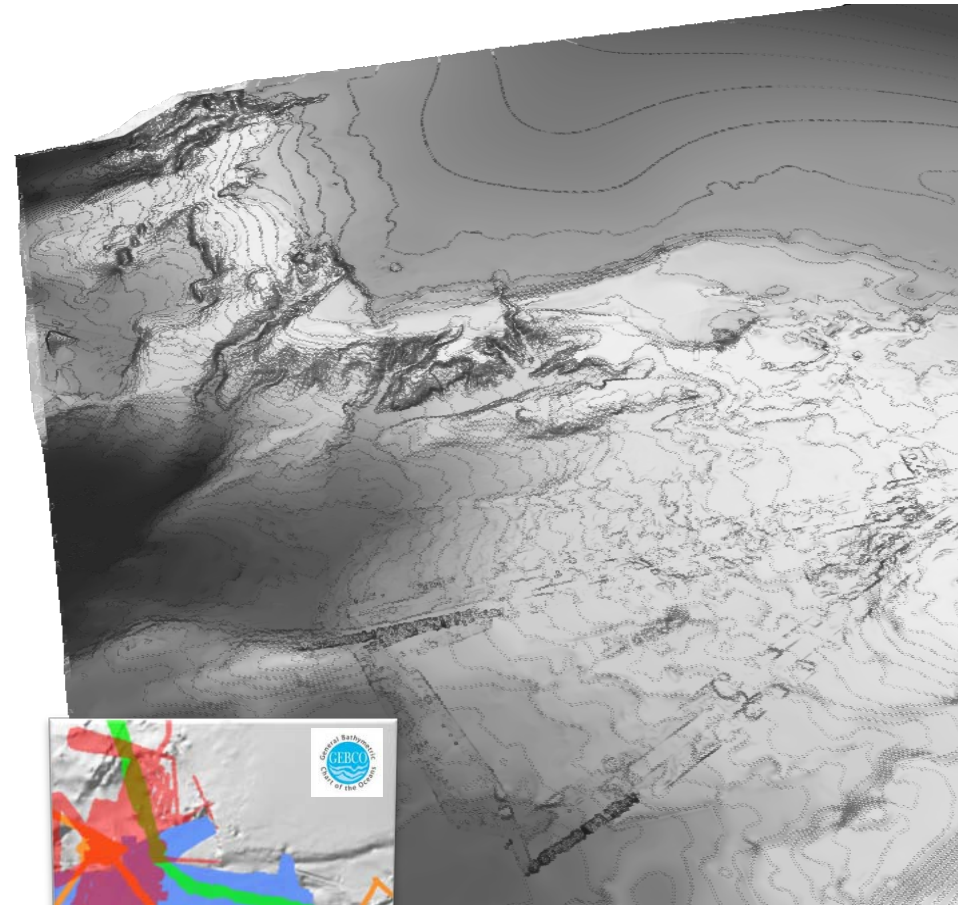
3D BathyDM of of the iberic margin

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