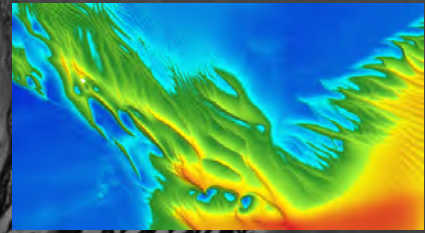


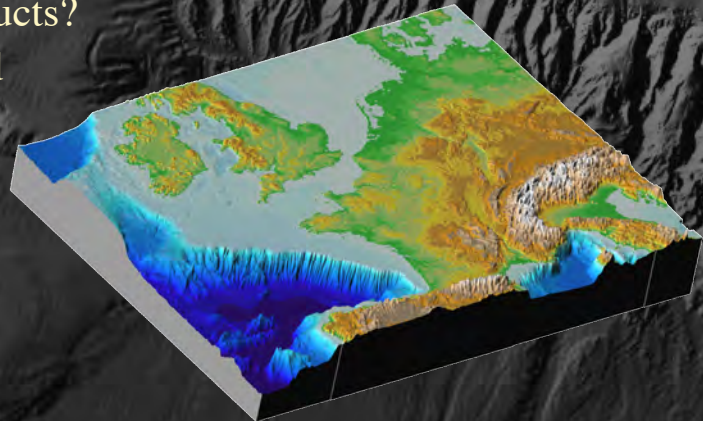
# Mapping of European sea-beds

## What for ? With what means ?

- Why is sea-bed mapping important?
  - Why do we need accurate maps ?
  - Where should the Directives be applied ?
  - For who ?
- What are the tools and products?
- Assessment of effort needed and where are the gaps ?
- A European project ?



R/V Atalante - EM710



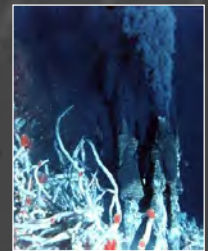
Jean-François Bourillet  
marine geologist

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1

## Why is sea-bed mapping important ?

- To improve the scientific knowledge
  - Records of past climate changes, sea-level rise, geohazard, ...
  - Natural resources : sand&gravel, minerals, oil, fisheries, ...
  - Basic data : habitat, biodiversity, renewable energy....
- To provide references to states for ocean management
  - Safety and Defense
  - Natural resources
  - Crisis prevention and management : tsunamis, landslides, oil spills ...
- To allow states to fulfill their international duties
  - Legal continental shelf extension (UNCLOS) **2009**
  - Marine Protected Area **2012** (Rio, OSPAR, Barcelona & Helscom)
  - European Directives : Bird & Fauna, WFD **2015**, European Maritime Strategy **2021**



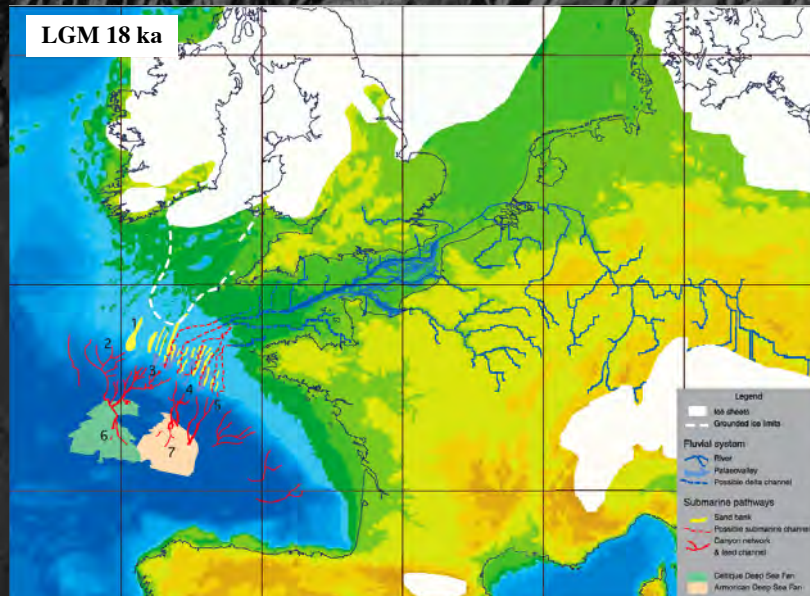
© Ifremer



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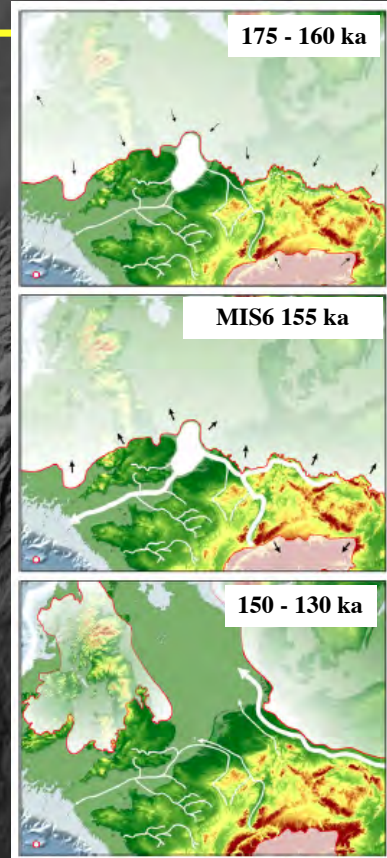
2

# Records of past sea level and palaeoenvironment



(Bourillet et al., 2003)

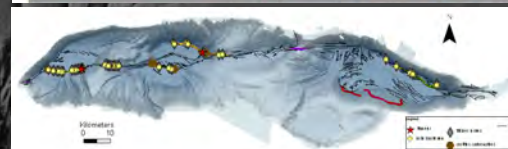
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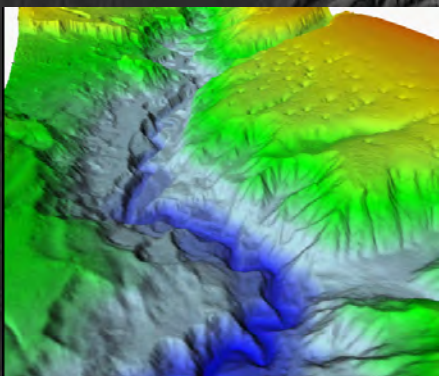
(Toucanne et al., 2009)

# Geohazards

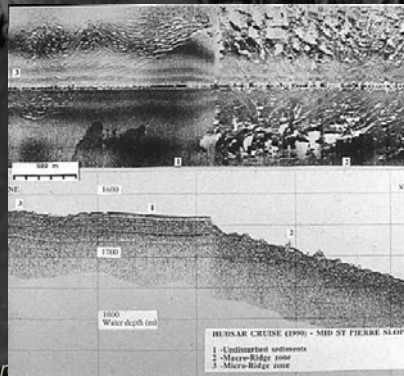
- Seismicity, tsunami, sub-marine landslide
  - Potential risk areas
  - Characterisation
  - Triggerring factors
  - Forecast



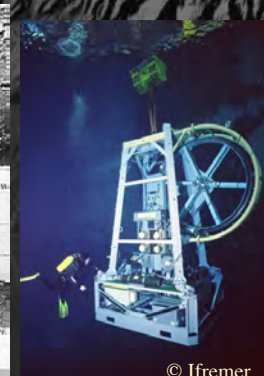
(Géli et al., 2002)



(Bourillet et al., 2007)

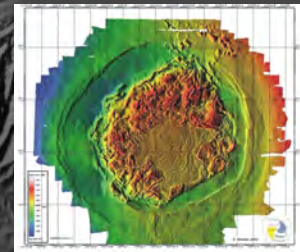
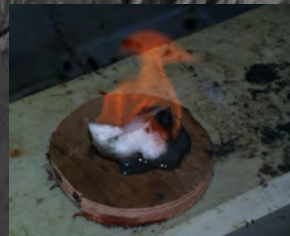
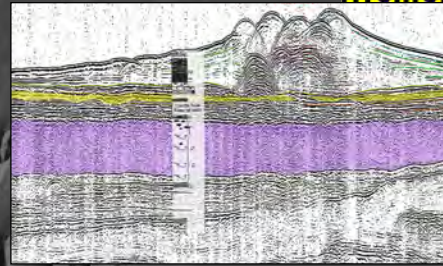


(Cochonat & Piper, 1995)



# Applications to resources of energy

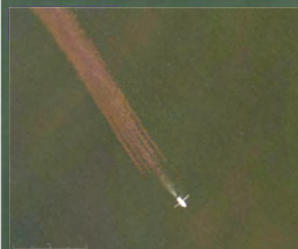
- Present analogues of deep oil traps (sand/mud ratio)
- Characterisation of fluid and hydrates
- Discovery of native H<sub>2</sub>
- Site survey for renewable energy (windfarm, thermal energy, ....)



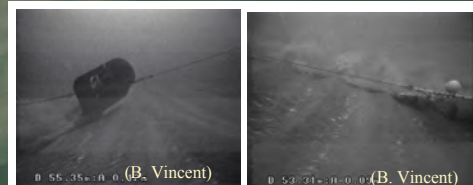
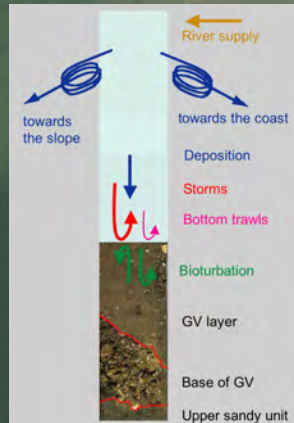
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## Why do we need accurate maps ? (1)

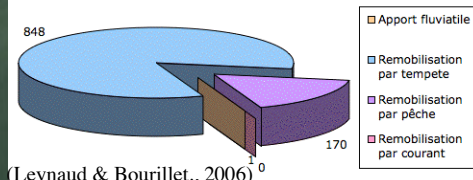
- The Nephrops of “la Grande Vasière”
  - Study of the sedimentary evolution over the past 30 years : the muddy fraction decreases
  - Storm effects : steady
  - Fishing effort : 1 million miles (2002)
  - Resuspension : anthropogenic action from 20% to 50% of natural factor



© Océanopolis



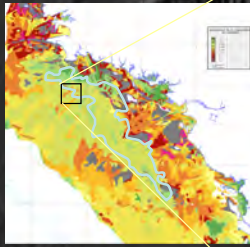
Fraction fine remobilisée (Mt/an)



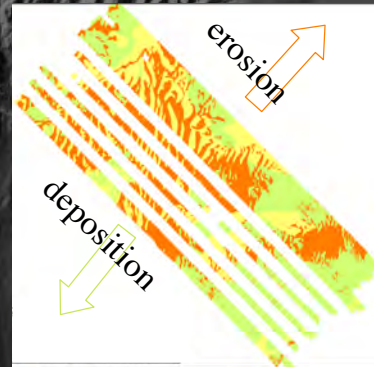
# Why do we need accurate maps ? (2)

Is the mud eroded and where does the mud go ?

- Mapping up to the 1990's: Interpolation from samples
- New mapping approach: from sectorial coverage to sea-bed nature



(Bouysse et al., 1986)



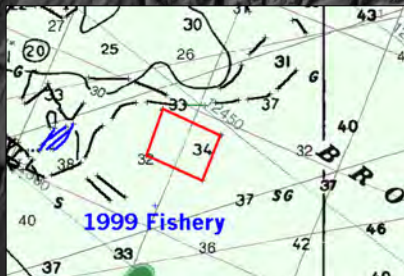
(Gautier et al., 2009)

- Understanding of the processes
- Fisheries management

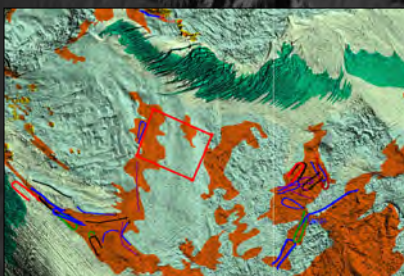
# Why do we need accurate maps ? (3)

## Benefits of Mapping: Scallop Fishery

1999:  
Without



2000:  
With



### IMPACTS

Economic efficiencies:  
30-40% gain

Environmental  
disturbances: 73%  
reduction by use of light  
equipment

## Marine spatial planning

Mariculture  
 Marine Recreation  
 Renewable Energy  
 Fishing  
 Submarine Cables  
 Dredging & Disposal  
 Conservation  
 Culture  
 Military Activities  
 Navigation & Ports  
 Coastal Defence  
 Oil & Gas



(Weaver, 2008)

### Mapping at a very fine scale

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## Lessons from Geohab Atlas

- Atlas of seafloor geomorphic features and benthic habitats
- 57 case studies and a questionnaire (end of 2011)

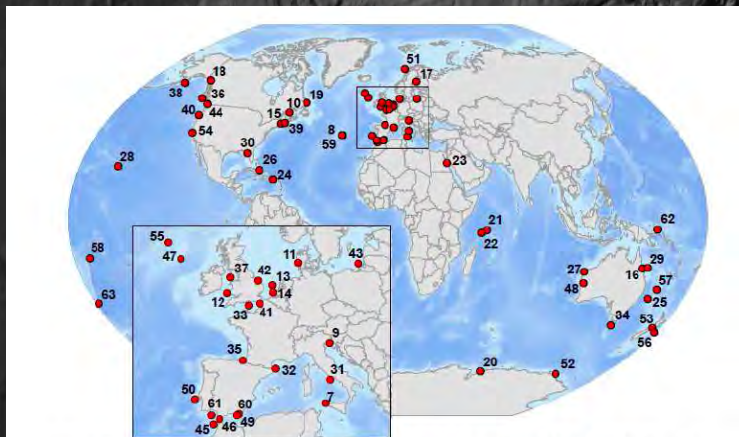


Figure 8. Map showing the distribution of case studies included in Part 2 of this book. The numbers refer to case study Chapters. About half of the case studies are from waters around western Europe, with the remainder scattered around North America and the Austral-Asian region; few are located in Africa and there are none in Asia or South America.

Harris, P.T., Baker, E.K., (in press). GeoHab Atlas of seafloor geomorphic features and benthic habitats - synthesis and lessons learned. In: Harris, P.T., Baker, E.K. (Eds.), Seafloor Geomorphology as Benthic Habitat: GeoHab Atlas of seafloor geomorphic features and benthic habitats. Elsevier, Amsterdam.

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# Lessons from Geohab Atlas : What for?

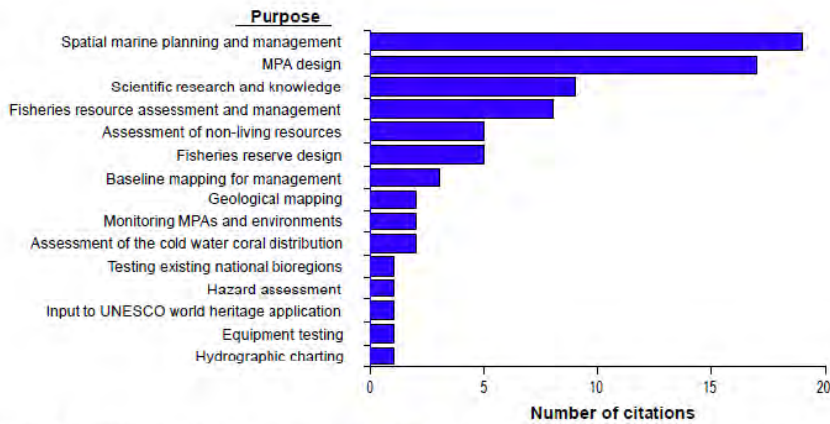


Figure 5. Purposes of habitat mapping specified by case study authors and the number of times they were cited.

(Harris & Baker, in press)

# Lessons from Geohab Atlas : which kind of parameters ?

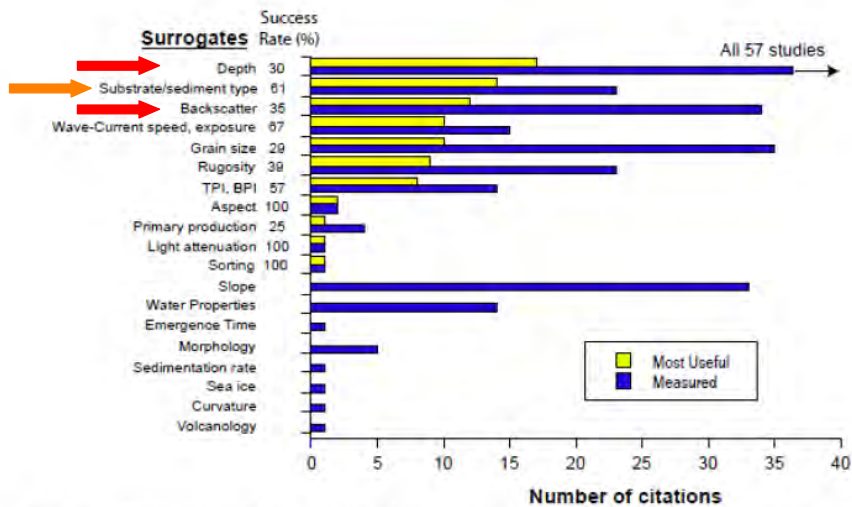


Figure 3. Comparison of the number of times variables were measured (blue) versus variables found to be the most useful surrogates for the occurrence of biota (yellow). Water depth was measured in all case 57 studies.

(Harris & Baker, in press)

# Lessons from Geohab Atlas : anthropogenic pressure

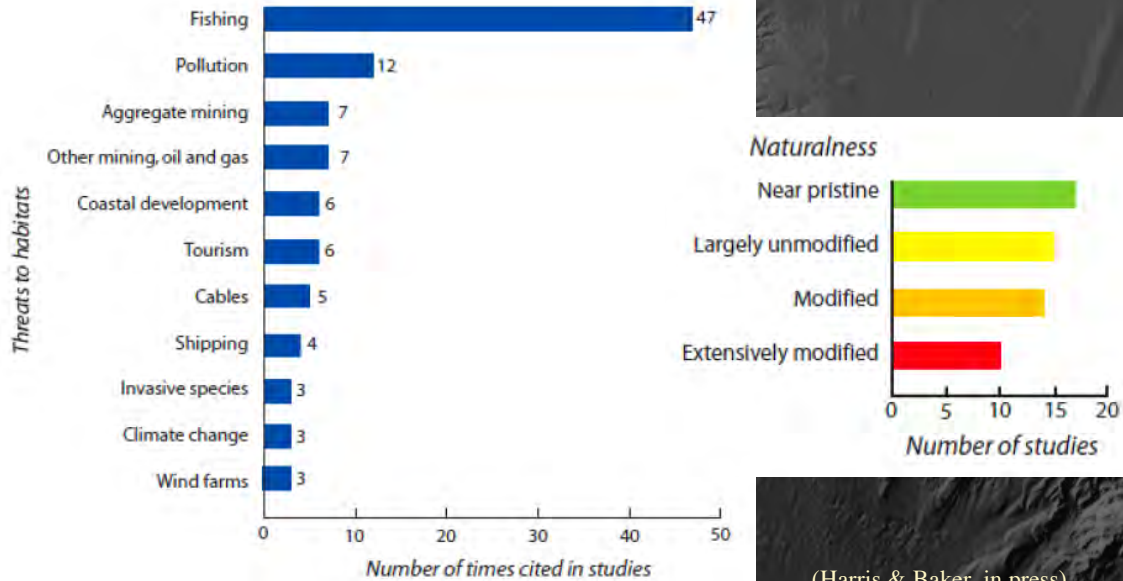


Figure 2. Graph showing the anthropogenic pressures cited in the case studies.

(Harris & Baker, in press)

# Lessons from Geohab Atlas : for who ?

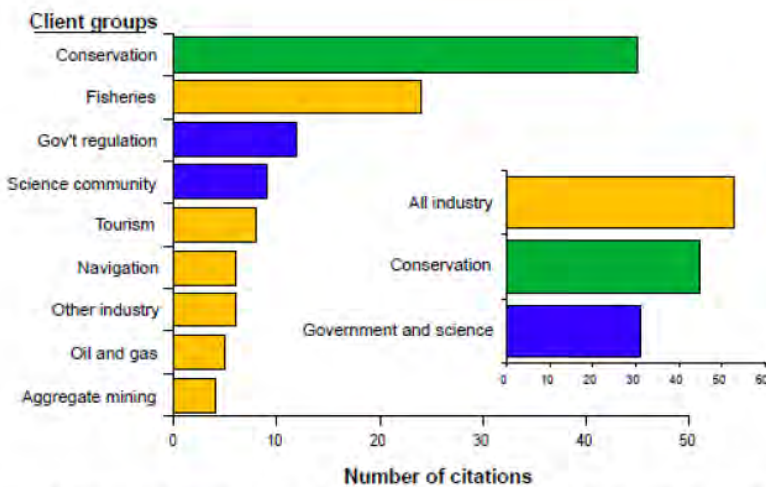


Figure 6. Users and clients of habitat mapping specified by case study authors and the number of times they were cited. Inset shows the industry-related users grouped together actually forms the largest single group.

Sources of funds:

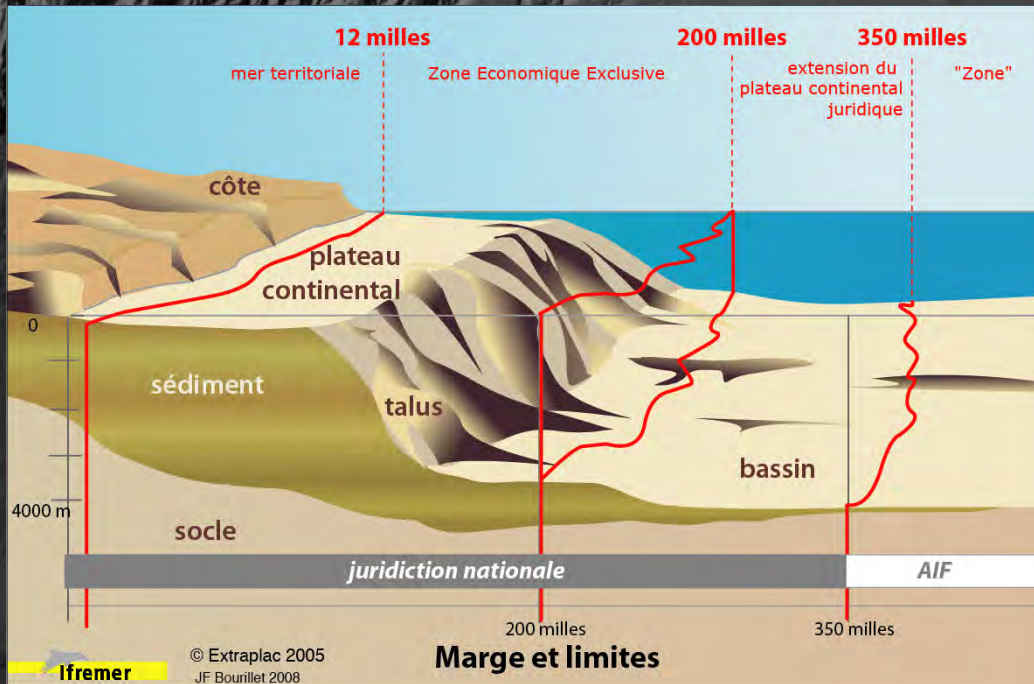
governments 84%  
(or government funded agencies)

Industry 11%

non-governmental organisations 6%

(Harris & Baker, in press)

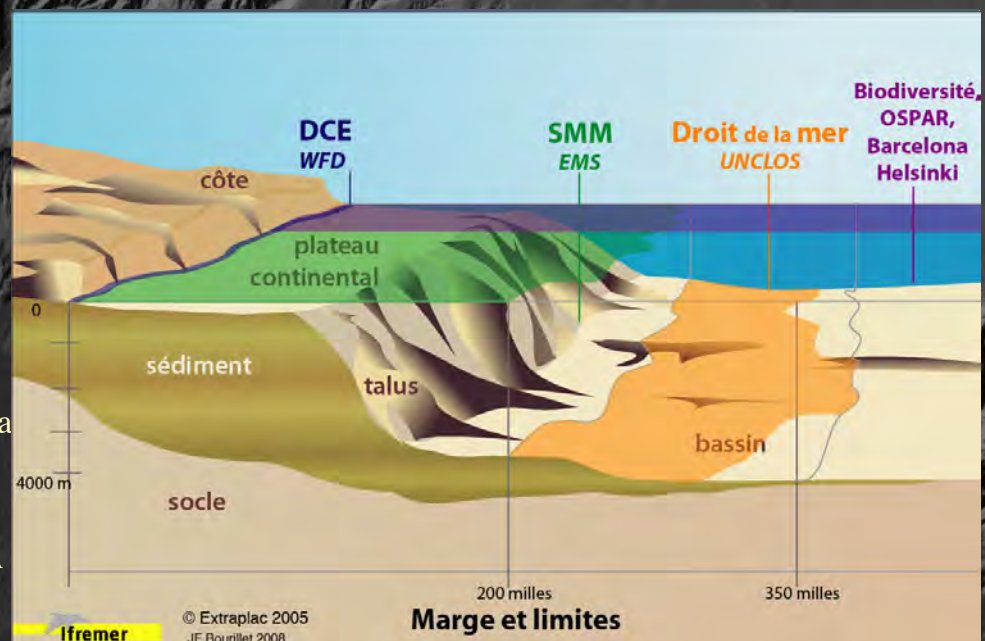
# Where should the Directives be applied ? (1)



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# Where should the Directives be applied ? (2)

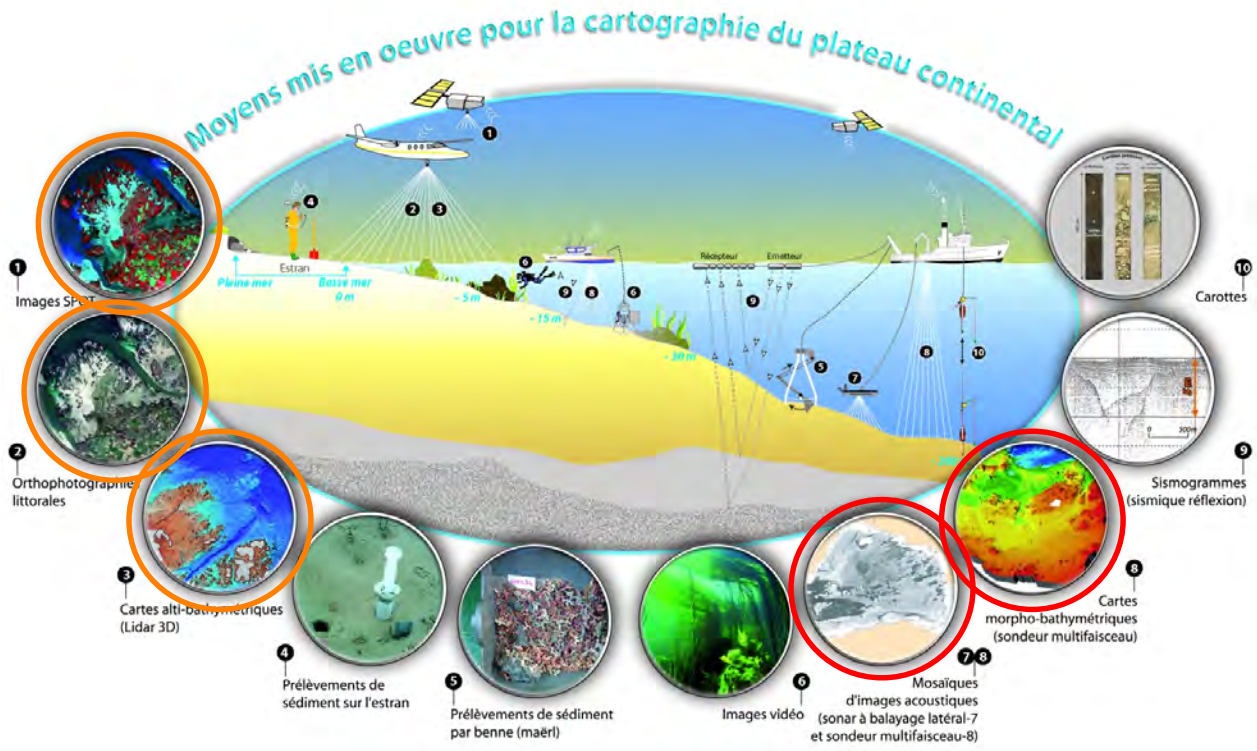
- **WFD-2015**  
Water Framework
- **EMS - 2021**  
Eu Maritime Strat.
- **UNCLOS - 2009**  
UN Con. Law Sea
- **BDC - 2012**  
10 to 30 % of MPA  
and Ospar,  
Barcelona,  
Helscom



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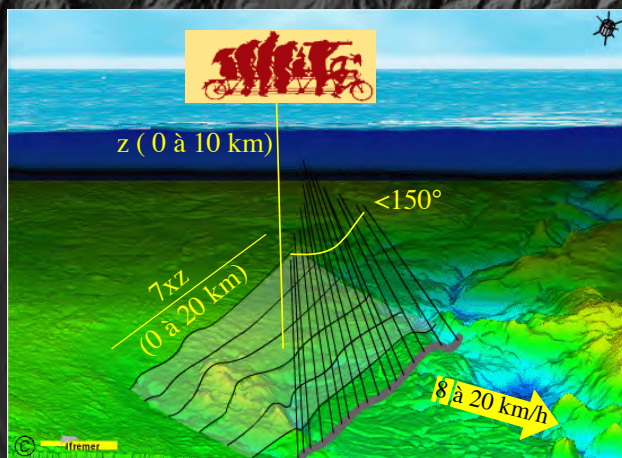
# The tools



(Rollet et al., 2009)

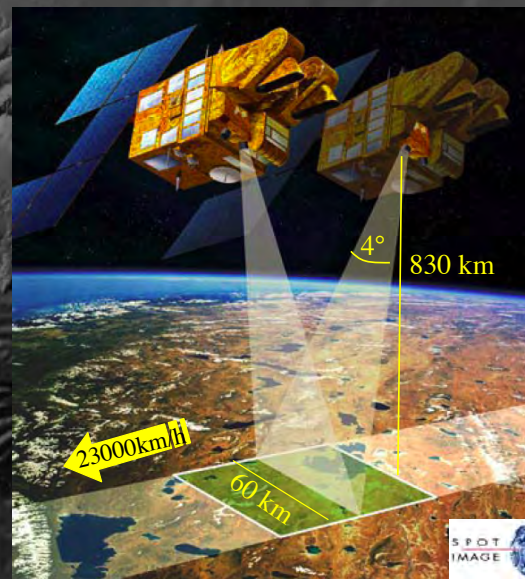
## MultiBeam EchoSounder (MBES)

Same principle than Spot satellite but some differences



Variable width and accuracy according to water depth  
Pixel size: 1 m to 100 m

Full coverage of all oceanic seafloor: 4 to 5 centuries



Pixel size: 2.5 m to 5 m  
No direct measurement of bathymetry

Full coverage of Earth floor: 15 days

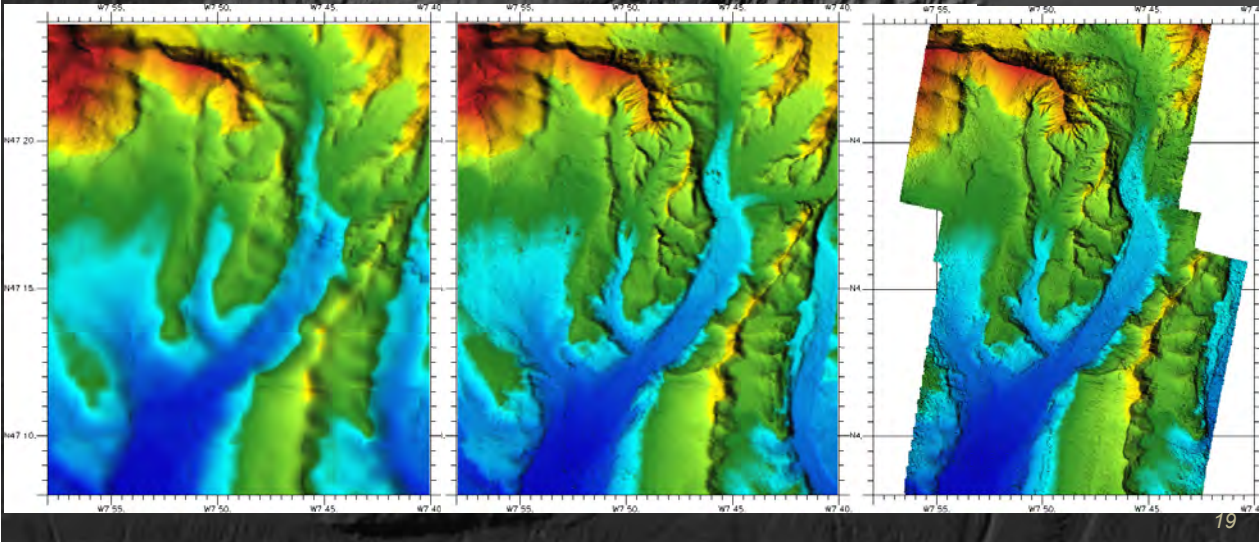
# Evolution of MBES

Seabeam R/V Jean Charcot  
1977 - 12 kHz  
12 beams ;  $s = 0.6 Z$

EM12D L'Atalante  
1992 - 12 kHz  
120 beams ;  $S = 5 \times Z$  & BS  
grid cell : 125 m ;  $z=4000$  m

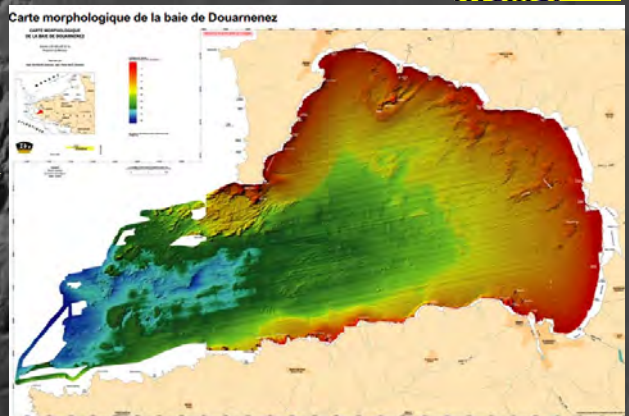
7150 12 kHz Pourquoi pas?  
2007-12 kHz  
400 beams ; Z & BS  
grid cell : 75 m

7150 24 kHz Pourquoi pas?  
2007- 24 kHz  
800 beams ; Z & BS  
grid cell : 50 m

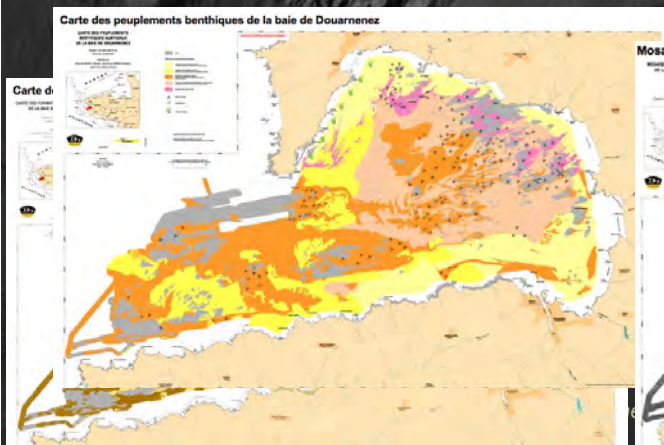


# The products

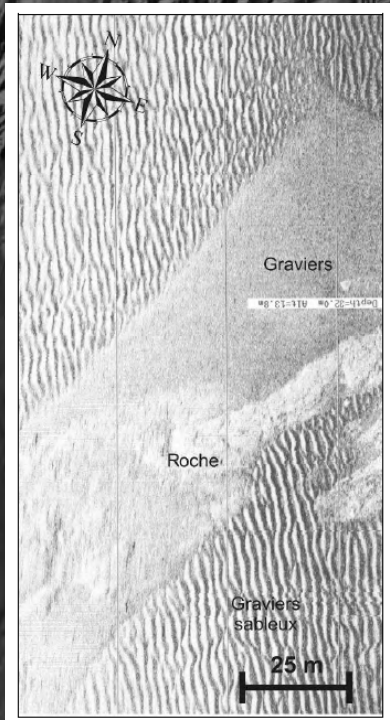
- Basic maps
  - Bathymetry: twoway travel time of signal
  - Backscatter: intensity of reflected signal
- Derived maps
  - Surficial sediments
  - Benthic population
  - ...



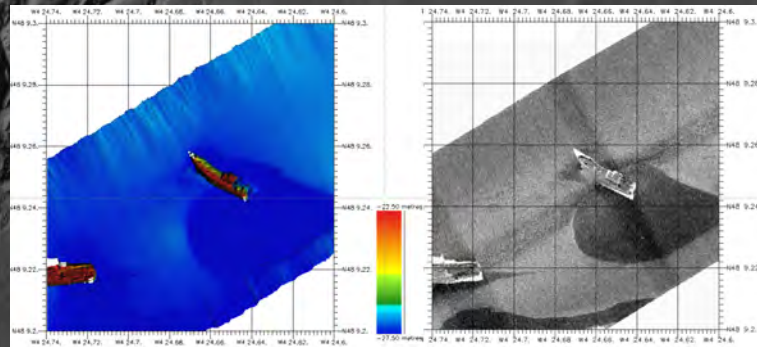
(Augris et al., 2005)



# Details of MBES

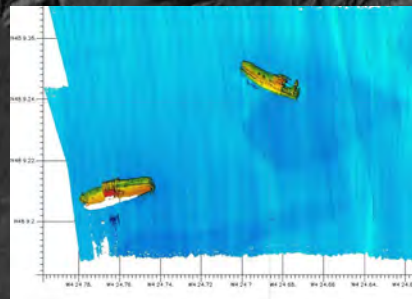


(Ehrhold et al., 2006)



R/V L'Atalante MBES: EM710

(Biscay et al., 2010)

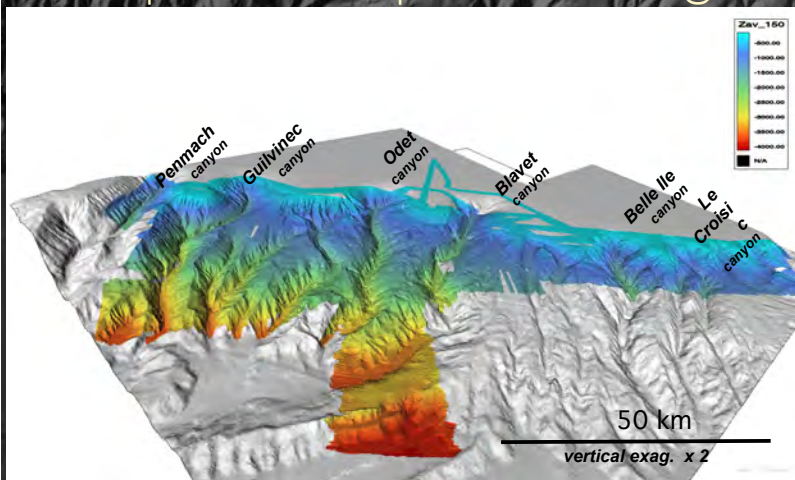


ROV Victor  
MBES: Reson 8125



# Geomorphological classification from MBES (1)

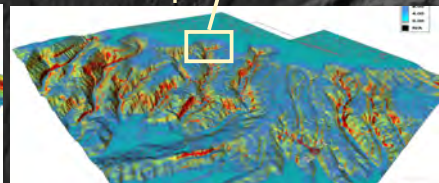
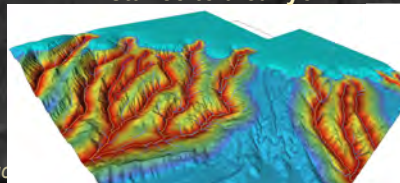
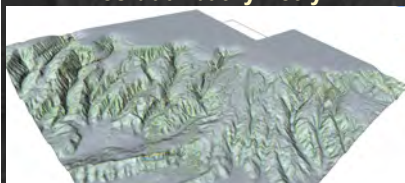
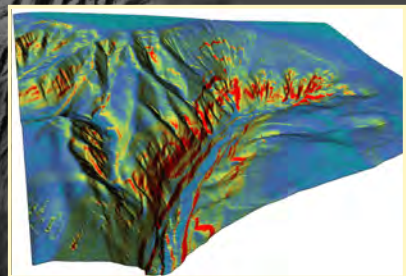
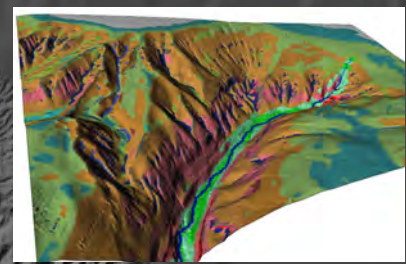
DTM @25m from MBES data (R/V Pourquoi pas ?)  
Complemented with interpolation a former DTM @125 m



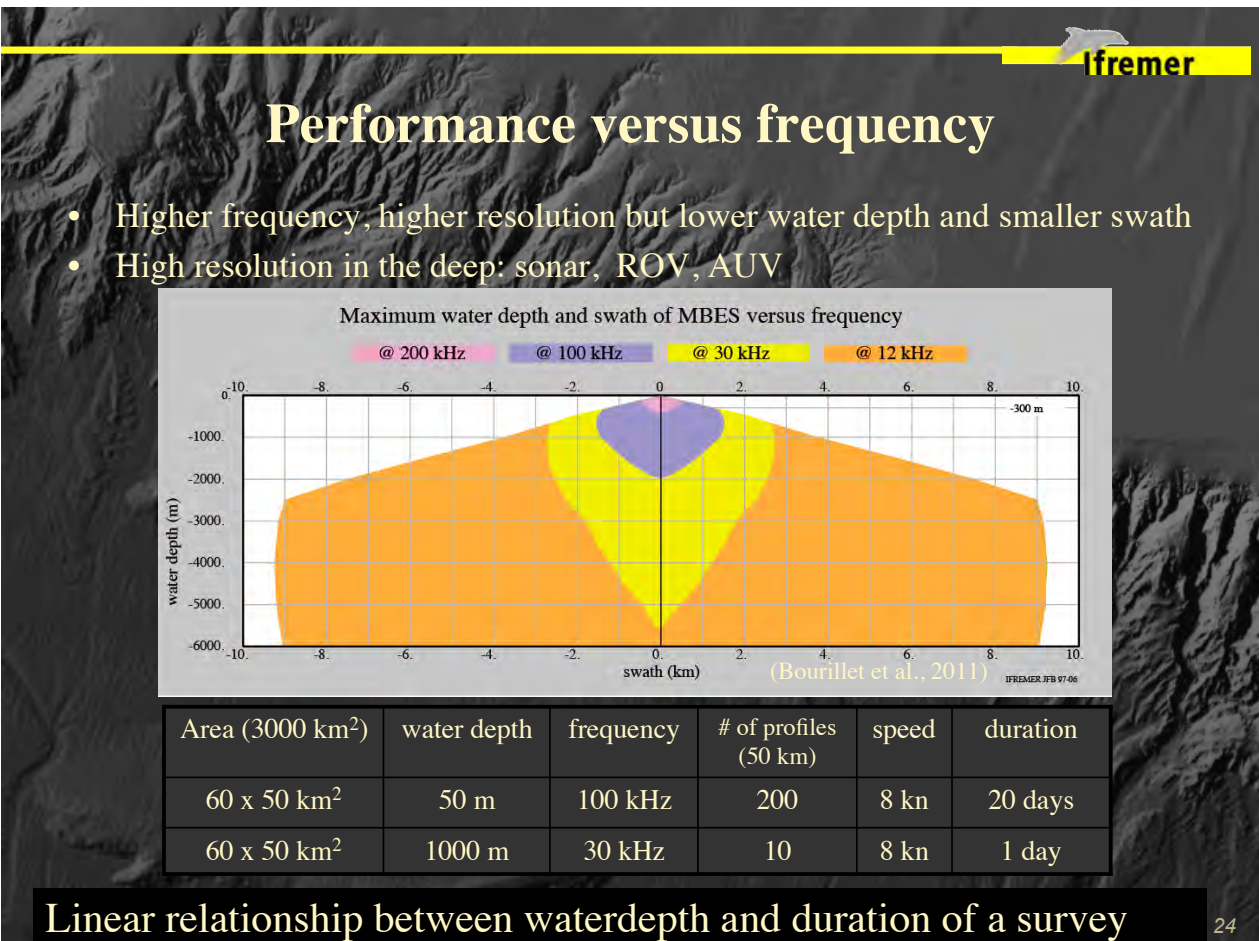
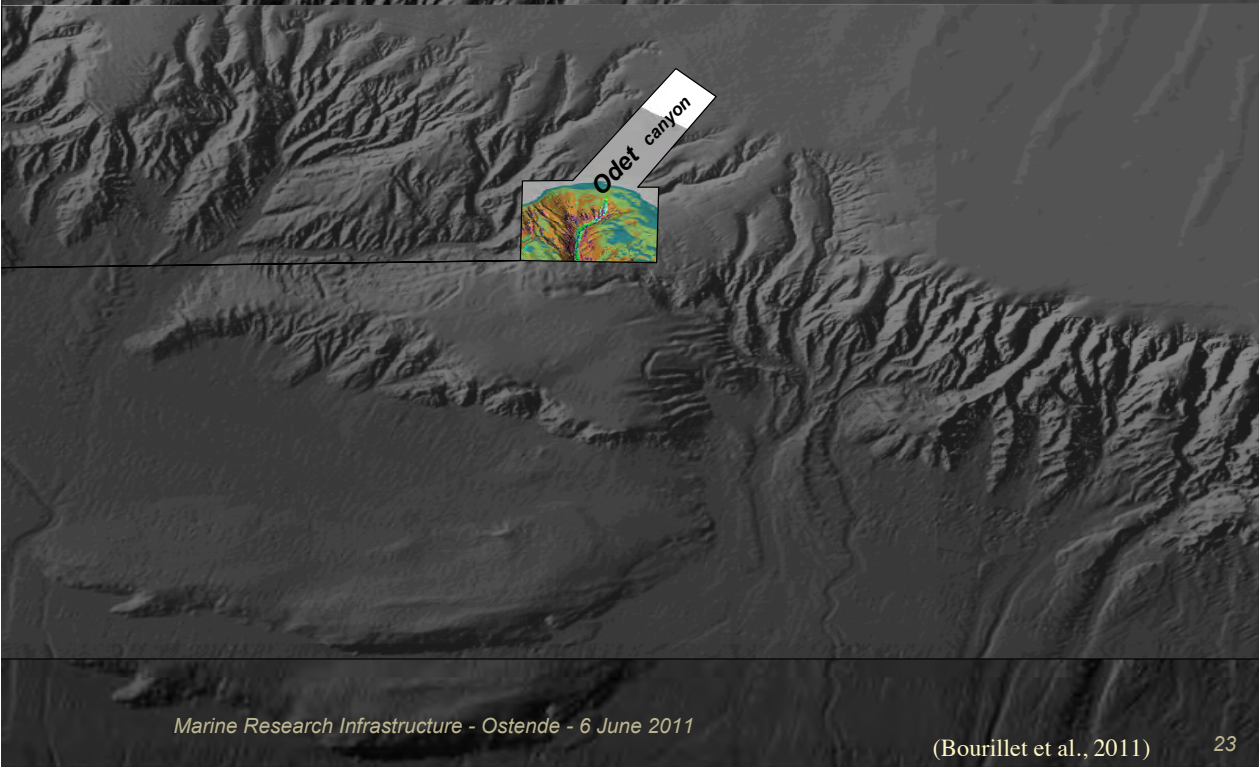
Residual bathymetry

Distance to a canyon

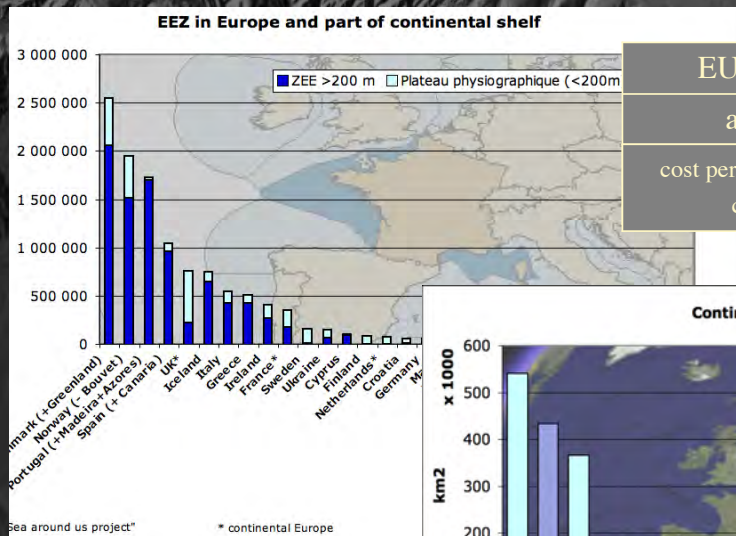
Instant slope



## Geomorphological classification from MBES (2)

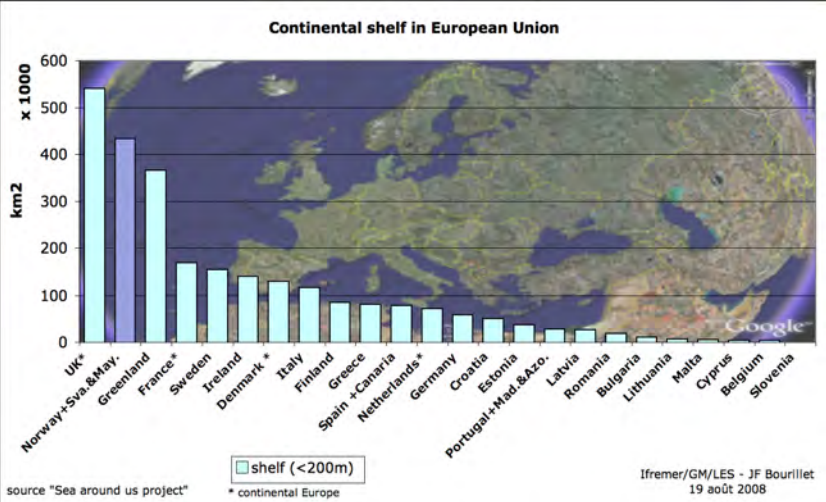


# Assessment of effort needed



EU EEZ	Deep > 200 m	Shelf < 200 m
area	6.4 M km <sup>2</sup>	2.2 M km <sup>2</sup>
cost per 1,000 km <sup>2</sup>	20 k€	400 k€
cost	130 M€	900 M€

(Bourillet, 2008)



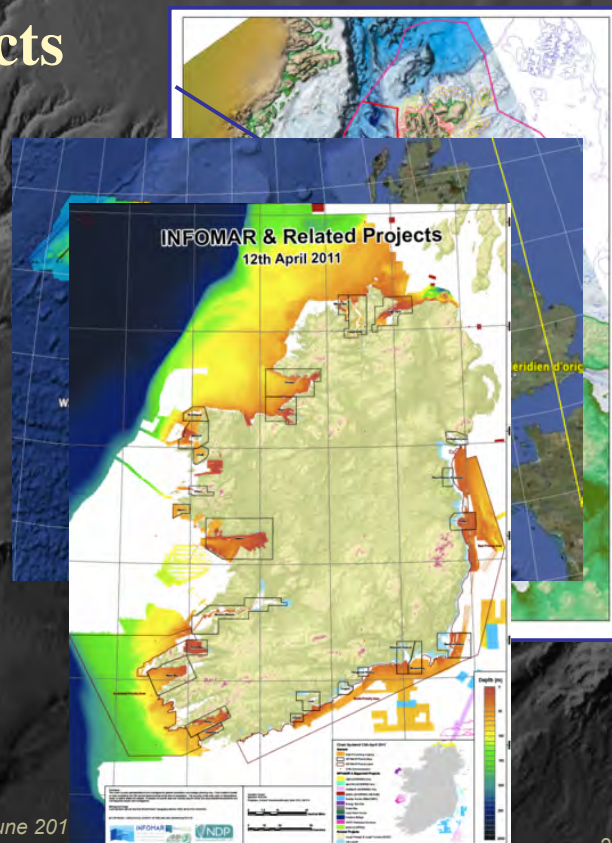
- EEZ of M states  
8.6 M km<sup>2</sup>  
= 2 x on shore EU

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Ifremer/GM/LES - JF Bourillet  
19 août 2008

# National projects

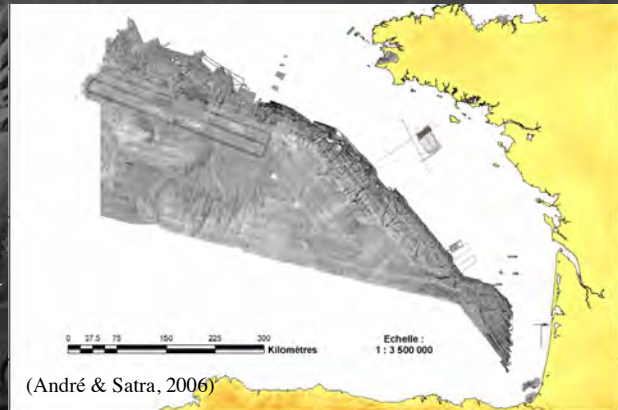
- Norway (NGU)  
*Mareano* (>2005)  
140.000 km<sup>2</sup> 26 M€
- Irlande (GSI - MI)  
*INSS* (1999-2005)  
7ans ; 32 M€  
*INFOMAR* (2006-)  
2x10 ans ; 4 M€/an
- Italy : *Magic*
- UK (NERC - BGS - NOC)  
*MAREMAP* (>2011)
- France (Ifremer - SHOM)  
*ZEPLA* (?)



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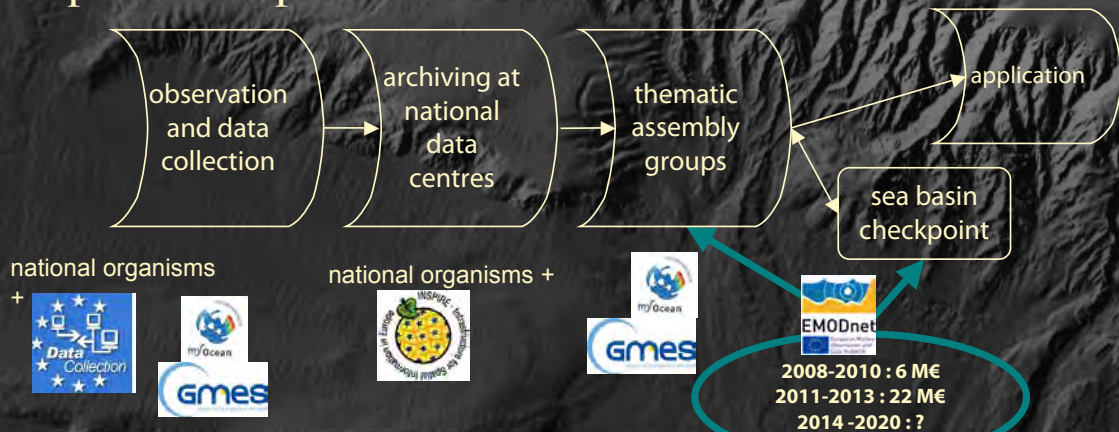
## Where are the gaps ?

- Variable coverage: in progress for the deep ; scarce for the shelf
- No catalogue for multibeam data
- Emodnet-hydrography Task 2.4 Complete Coverage for each sea basin:
  - the total area, the total area of deep water, the area within the EEZs or continental shelves of EU Member States,
  - the area already covered by surveys,
  - the total effort (in time and money) required to map the deep and shallow water at high resolution.



## European initiatives

- Emodnet : European Maritime Observatory Data NETwork
- Prototype 2008-2013: ur-emodnet
  - 6 preparatory actions (data assembly, portals, ...)
  - needs for end-users (... , bathymetry, sea floor nature), gaps (parameters, areas, ...)
- Operational phase from 2014



## Mapping of sea-beds: an European project ?

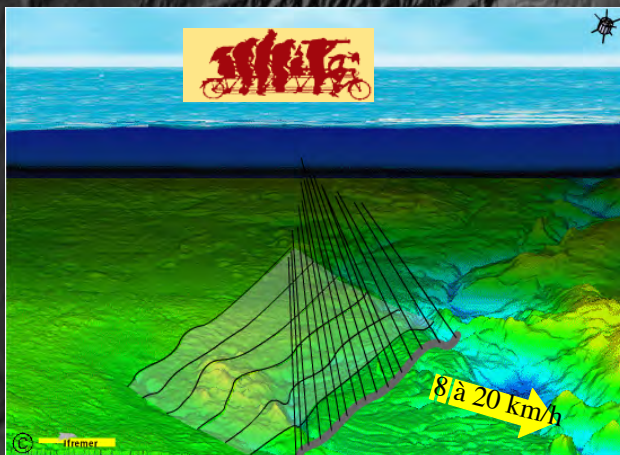
Questions and suggestions to initiate discussion

- Does the project be focused only on at sea data collection, validation and archiving ? Links with the National institutes ad NODC ?
- How could we stimulate sea surveys ?
  - enlarging the “Data Collection Framework” scope for sea-floor data ?
  - Example of R/V *Thalassa*
- Could we encourage common surveys based on ecoregions ?
  - Increasing the budget of EuroFleet on this specific topic
  - Proposing this topic for Interreg projects, MyOcean, ... or other short terms research projects?
  - Encouraging new projects (FP8, ...?) to contribute to the sea-bed mapping with a specific WP or specific standards ?
- .....

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**Many reasons for sea-bed mapping**  
**Deadlines are close and the gap is on continental shelf**  
**Sea data acquisition is a very slow process**



**Ocean sea-bed : 500 years**



**Earth surface : 15 days**

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