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Summary:	This document reports on an intercalibration meeting held in Brest under the aegis of the Mesh project. Three specific habitats were dealt with: Intertidal Zostera, subtidal macroalgae and sandy soft bottom in shallow water, all being investigating with several techniques. Two particular techniques were demonstrated, shallow water acoustics on board a light vessel and intertidal ground truthing.
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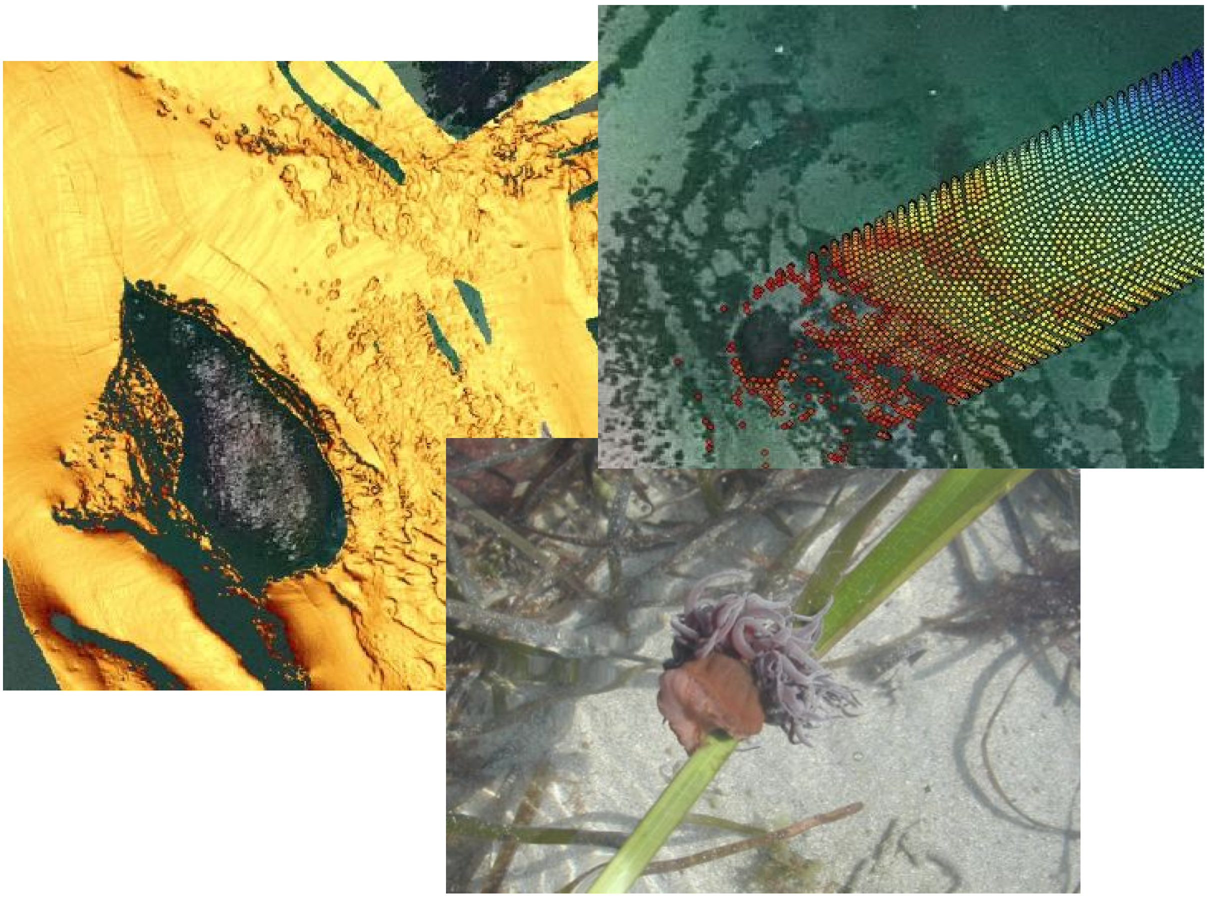
MESH Intercalibration workshop report

Brest, 20-23 Sept. 2005



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MESH MAPPING EUROPEAN SEABED HABITATS

CONTENT

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APPROVAL FOR ISSUE

Jacques POPULUS, IFREMER DYNECO/VIGIES, France

DATE

January 2006

Summary

1 Introduction

This intercalibration meeting, as defined in the Mesh workplan, was hosted by Ifremer during the first half of the project. Intercalibrating usually means measuring a given phenomenon using several tools operated by various people and comparing the results. Ideally, the output involves setting up corrective actions so that eventually several teams can proceed in the same way. The idea here was slightly different in that it was planned to look at a given habitat environment (that of Northern Brittany) with several different tools and as compare how adequately these tools were able to map these habitats. At a secondary level, data interpretation was also critically looked at by the various experts at the workshop, by working in sub-groups.

This kind of exercise is expected ultimately to bring partners together from across Europe to employ their surveying tools, interpret data and produce maps in similar ways. It also means providing input to the best practise guidelines, a key deliverable of Mesh action 2 on standards and protocols.

The choice of the target site was important and substantial work was carried out by the host team at Ifremer to provide as thorough a data set as possible. Of course it could not be overlooked that most Mesh teams deal with subtidal matters, and the number of "intertidal partners" is relatively small (actually only two or three partners deal with intertidal mapping on a permanent basis). Keeping this in mind, the challenge was to produce a stimulating agenda for all the partners by focusing the participants attention on a very specific zone, the shallow water area. It probably summoned the widest interest, as it lies at the interface where visible light and acoustic remote sensing are potentially combined to overcome severe surveying constraints.

To this end, data from various sources were gathered covering an area from 40 metres depth to the more inshore tidal reaches. These were outputs from conventional surveys and more recent experimental surveys alike (some of them conducted only a few weeks before the workshop). As such, this newly harvested material was ideal to test the reaction of the audience.

This report first addresses various strategic aspects, then focuses on the three intercalibration workshops and relates how transnationality was enhanced, and finally deals with specific questions of relevance to the Mesh partnership.

2 Agenda and participants

The agenda is shown in Annex 1, along with the list of participants in Annex 2. Eleven Mesh partners from outside France were present and two experts from the UK had been invited. The French participants were mostly from Ifremer, along with participants from various partners of the Brittany Rebent network (Ceva, IUEM, CNRS Dinard and Roscoff)
As shown in the agenda, the first day was devoted to an open presentation by six teams (some of them non-Mesh ones) of how they go about dealing with their habitat mapping approach. The output was about mapping strategy: which tools, which coverage, the broad processing methodologies and their limitations etc.

A field trip was organised on the second day, the participants were split into a subtidal and an intertidal group. The subtidal group was given the opportunity to embark on the “Survex”, a light boat equipped with shallow water Reson Multibeam. The intertidal group followed a demonstration of field data acquisition with dGPS rovers and could get to know the various habitats found there: sand and muddy sand, rocks and boulders, seagrass beds.
The third day was devoted to a hands-on tutorial session looking at three different types of seabed, where partners were shown a data interpretation procedure and could interact with it. A description of the sessions is given below.

Finally during the fourth day, after debriefing the working groups, some common Mesh matters were discussed.

3 Mapping strategies and procedures

3.1 Mapping strategies

Habitat maps : what do we want to map?

The group could not afford a lengthy discussion on the concepts of habitat and the relation between environment and biology. The definition of habitats is a multiple question that arises constantly (ref. ICES Wgmhm 2005 meeting). This is all the more true with modified habitats (invasive species, impact of fisheries aquaculture) or for example habitats relating to birds (oyster catchers on mussel beds). The need for habitat maps may well tilt in favour of a holistic product but is also often dictated by specific needs on given habitats of local interest (maps but also estimates, statistics, etc.) to answer questions relating to fishing, aquaculture etc. Mesh being a mapping project, a habitat definition could be "a recognisable unit sheltering organisms or communities".

Most surveys are not directed towards making a habitat map. This seems to have been the case in the Netherlands where more recently habitat maps has been based on physical parameters. This leads to creating some landscapes, much in the same way as was performed in the UK. These must then incorporate the biology, which is quite often only recognisable in the field.

Fairly massive decisions are taken based on habitat mapping, even though the way data are presented to decision makers may be in an over-simplifed “binary” way. We must ensure that quality assessment is performed, and we must preserve the future. As currently generated data will be used in say 5-10 years, we should be prescriptive about accuracy and confidence.

Intertidal mapping strategies

The case of sea-shore, shallow water and intertidal surveys mapping strategies is somewhat more straightforward than that of the more offshore zone. Remote sensing from satellite or aircraft tends to provide 100% coverage immediately. It would not be recommended to achieve partial coverage for several reasons: a) most sensors are affected by side effects and postprocessing does make use of ample overlap (typically 30%) between flgthlines to reduce this effect, b) completeness is desirable where complex and patchy seabed units are encountered, which is usually the case in rocky sea shores.

The problem with remote sensing lies in the ability of the available tools to provide us with the right information. Basically remote sensing used so far is of three kinds: satellite imagery (or more widely digital imagery), aerial photography, Lidar. An explanation was given as to how the knowledge of the spectral signature of a facies (the way it interacts with light measured by a sensor) could help build the right algorithms to identify it. However this remains limited to airborne remote sensors capable of reproducing the signature, i.e. only a few costly devices available today.

Suggestions were made to look into radar, whose signature on e.g. oyster beds or even on sand with arenicoles is likely to be quite peculiar.

In general, the effectiveness of the single/combined use of the techniques mentioned above has been proved in mapping the vegetal facies of the tidal zone. However identifying sediment classes remains a difficult task where the results are way off the expectations. Some research directions could include looking at the topographic Lidar waveform on various sediment types.

Intertidal and transition zone mapping is currently fully conducted in a georeferenced context at all stages: survey preparation, operation, data processing, interpretation and warehousing. All surveyed data are stored in geodatabases and/or servers.

Subtidal mapping strategies

Review documents on many techniques are easily available today, the question being "where do we need which tool"? It is recognised that the best way of proceeding before surveying is firstly to step back and thoroughly define the survey objectives, by questioning the people who will use the maps in the end, then to decide which type of tool is the best for this purpose and how it should be used : survey settings, techniques, resolution, coverage, mapping units, confidence, overlap etc. In other words, what are the drivers and what are the alternatives to mapping : could any proxies do, to which extent?

It is vital to understand the resolution to be achieved, the absolute positioning accuracy (this is more of an issue in underwater mapping than in remote sensing, for example, video tows nowadays positioned thanks to acoustic beacons), and also the repeatability of a measurement.

It may happen that some people use whichever tools are available without deciding on the logistics (budget being critical at all times). Besides, one may not be aware of what will be found on the bottom, so it is not certain that the right tool will be used (also given cost and survey vessel constraints). Anticipating what lies there would be of great help to decide on the survey type. For example in the case of steep sloping rocky shores, it has been shown that a side scan sonar was not appropriate as the slopes were not identified.

The "nested approach" is recommended, firstly by doing broad scale maps for large areas (with e.g. sidescan sonar) and then surveying in much greater detail with appropriate tools. To this end, a rapid assessment of large survey areas is needed, possibly using reliable classification systems or expert systems that can inform about artefacts/noise.

The main subtidal tools are sidescan sonar, multibeam sounder, single beam sounder (AGDS). People tend to abandon single beam echosounders to day, as full coverage is sought. However multibeam systems providing both depth and bottom imagery are still expensive to deploy.

Sidescan sonar bathymetry is better for flat homogeneous bottoms, whereas a multibeam may be better for rapidly changing bathymetry. The quality of interferometric sonar is still questionable to some researchers.

Concerning the choice of frequencies, lower frequencies are better for multipurpose work, while high frequency is preferable for rugged biocenosis such as maërl, oysters and the like.

Some operating hints were mentioned such as the direction of the sidescan profile in relation to the expected bottom features, the importance of being able to follow the survey in real time. The reliability of tow fish positioning is also an issue, whereas hull secured systems give more accuracy.

Sampling problems were also raised concerning either the ground truthing or biological work. For example if an oyster bed covers 30% in density, then the grab is not good enough, as it may catch a vacant place. A dredge will then be better, integrating over a distance. However in many cases the dredge will provide a mixture of otherwise distinct sedimentary/faunal contents.

The survey reporting mode should also be closely examined, the use of GIS being prescriptive today.

3.2 Interpretation of acoustic data

There are many recent innovations in acoustic systems. They concern platform behaviour, navigation and positioning accuracy, but also beamwidth and the use of multiple frequencies. Beamwidth narrowing has increased the accuracy and resolution of systems but it has also entailed reduced coverage, while at the same time the amount of data collected has been multiplied by 2 or 3 orders of magnitude. To day, the use of multiple frequencies ensures that this coverage problem has been overcome.

State of the art procedures in acoustic post-processing includes: a) for bathymetric data in real time: navigation, quality checking, coverage checking, colour coding, contouring and DTM creation, b) for backscatter (either from multibeam or side scan): contrast enhancement, interpolations and production of mosaics. Moreover DTM and backscatter image can be combined in 3D vision.

Advanced methods deal with eliminating speckles from data (e.g. wavelet based methods removing noise without affecting data content), analysing angular backscatter intensity and classifying the data with image segmentation. Segmentation seems to give good results even in more complicated areas such as complex sand ripples.

Another common requirement is to normalise sonar images, removing the incidence and distance dependence of the backscatter as well as the bed slope influence. This ensures that the shape of some rocks, which was not possible previously.

Currently, texture analysis using sidescan sonar does identify subtle differences in sediment type between sand, silty sand, gravel/coarse sand and mixed sediment. Seaweed on rocky outcrops were also reported to be reasonably well mapped.

The issue concerning full coverage was also debated. Some authors performed surveys with swath spacing leaving gaps in coverage of up to 50%. The ability to interpolate between the swaths depends on bottom type, however it is believed that the increase in coverage does not always justify the additional cost of the survey.

3.3 Interpretation of visible remote sensing data

The interpretation of visible remote sensing data used to be performed on a pixel-based identification. Field work would identify a set of training areas, possibly "pure targets" of a certain size that had a meaning with regards to sensor resolution. Another set of these training areas would be kept for subsequent classification assessment. These methods were later judged to be of limited value as they did not encompass the local arrangement of pixels (referred to as texture, or "image granulometry") especially in patchy facies or habitat mosaics.

Nowadays a new generation of imagery has been developed with full colour resolution of the order of 3 metres. This constitutes a progress as it means enhanced identification power and the availabilty of purer training sets. However this makes pixel-based classifications even more ill-adapted as the reject class (mixed pixels) tends to become much bigger. As the averaging effect of large pixels is reduced, texture has subsequently become much more crucial.

One way forward is to perform image segmentation, a process that takes into account the local variance by isolating clusters of pixels. In a second step, these clusters are classified using training areas.
More generally, as the remote sensing of sediments has given poor results, building a sediment map is still based on a blend of some remote interpretation coupled with grain size data collected in the field. The incorporation of qualitative biology is the final step, where sediment polygons are manually reshaped (to take it into account).

3.4 A helping tool for habitat identification: the catalogue of signatures

The catalogue of signatures is a task identified in Mesh action 2, as it concerns guide lining habitat interpretation. The idea is to build a web-based system to make information available to the wider community on habitats surveyed by the Mesh partners, by showing examples of different habitats using different sensing techniques. Although the provision of a paper output is agreed upon as a being traceable delivery (a downloadable PDF could be produced, which could be updated as required, as well as direct printout options), the flexibility of a web product is preferred.

It will be possible to access the catalogue by querying different habitat characteristics leading to a "quick look" page, where various occurrences of the habitat are shown. There will be no limit to these examples, provided they bring an original view. There could be brief information on how each image has been obtained (interpretation), as well as information on basic survey metadata (discovery).

When clicking on a particular habitat, the next page could be created on the fly from a data base sitting in the web site. Users could populate this data base with their own examples by using a capture template, to be submitted to the administrator. Discovery metadata were discussed at the Ices/Wgmhm group earlier in 2005 and a reduced list of core fields will be circulated for final agreement (describing survey and processing alike).

As far as possible, a EUNIS code will be allocated to each habitat and appropriate links established to the relevant websites of biotope classifications. If there are plans to map the occurence of habitat types, there should be links to the Mesh mapping website as well.
The conclusion is that a pragmatic tool should be designed that draws on the experience of the partners. A list of habitats will be drawn up as complete as possible (including habitats disturbed by human activities), circulated among the partners and signatures will subsequently be collected for database population.

3.5 Change detection

This is the area where confidence is mostly at stake, as without it no change can be assessed. This involves automating the mapping procedures, so that the human factor is reduced. This is perhaps clearer to understand with visible remote sensing, where spectral indices are built on spectral reflectance, i.e. a calibrated (and corrected for atmospheric influence) physical quantity intrinsic to ground units. If comparisons are needed over a time period, not only should resolutions be of the same order but also the reflectances at the two dates should be comparable. Likewise, acoustic processing should be capable of providing a calibrated backscatter coefficient independent of the surveying conditions.

When analysing change, it is recommended to use a proxy in order to have a warning (qualitative) about change, then to survey in an appropriate way in order to check the amount of change (quantitative).
Such remote sensing methods were applied in Brittany to study changes in vegetation cover over a ten year period. Although northern Brittany has seen little change, southern Brittany shows a decrease in vegetation cover while oyster beds have taken over from seaweed. Unfortunately, even though the vegetation recession is seen on imagery, oyster is not visible!

3.6 Bringing biology into habitat maps: issues regarding the EUNIS classification

EUNIS incorporates elements which are not "mappable". A number of problems arise from the discrepancy between viewing facies from a biological point of view and viewing them as recognisable ground units.

In some cases it seems difficult to implement EUNIS into practise. EUNIS is quite poor on intertidal sediment. In the Netherlands it is currently agreed to consider 4 levels in grain size, 3 levels in drying height and 3 to 4 levels in water dynamics. It is a level of description which is not at all provided for by EUNIS. Mapping problems according to EUNIS also concern rocky types where it is difficult to determine exposure classes. From a mapping point of view, should EUNIS thus incorporate more landscapes?

It is also mentioned that in complex biotopes (mosaics), the combination is more important than individual components, another aspect that should be catered for.

The use of EUNIS is still limited. In the Netherlands, some habitats are very dynamic, which unfortunately cannot be expressed in EUNIS terms. Several speakers refer to the EUNIS classification leaving out all aspects of human activities and their impact, a fact that cannot be overlooked as it deeply affects some seabed habitats. This is the case for e.g. large bouchots (mussel poles) areas or dredging zones. Not only the benthic aspects but also pelagic/birds descriptors are necessary to fully describe an area.

3.7 The biotope matching programme

The biotope matching programme is a statistical routine that compares a biological sample to standards. It is based on SACFOR, a semi-quantitative abundance scale used in marine surveys. It provides matching only to the infaunal community. The program should be available in prototype form quite soon. It will run on both physical and biological variables (together or separately). Gathered physical data and biotope standards are shown. This analysis is run and the program comes up with the best 10 matches within the standards set.

The question arises as to how to manage an epifauna/infauna link. Mesh has a work package under action 2 that must deal specifically with this issue.

4 Reports from working groups

4.1 Intertidal zostera mapping

Zostera mapping

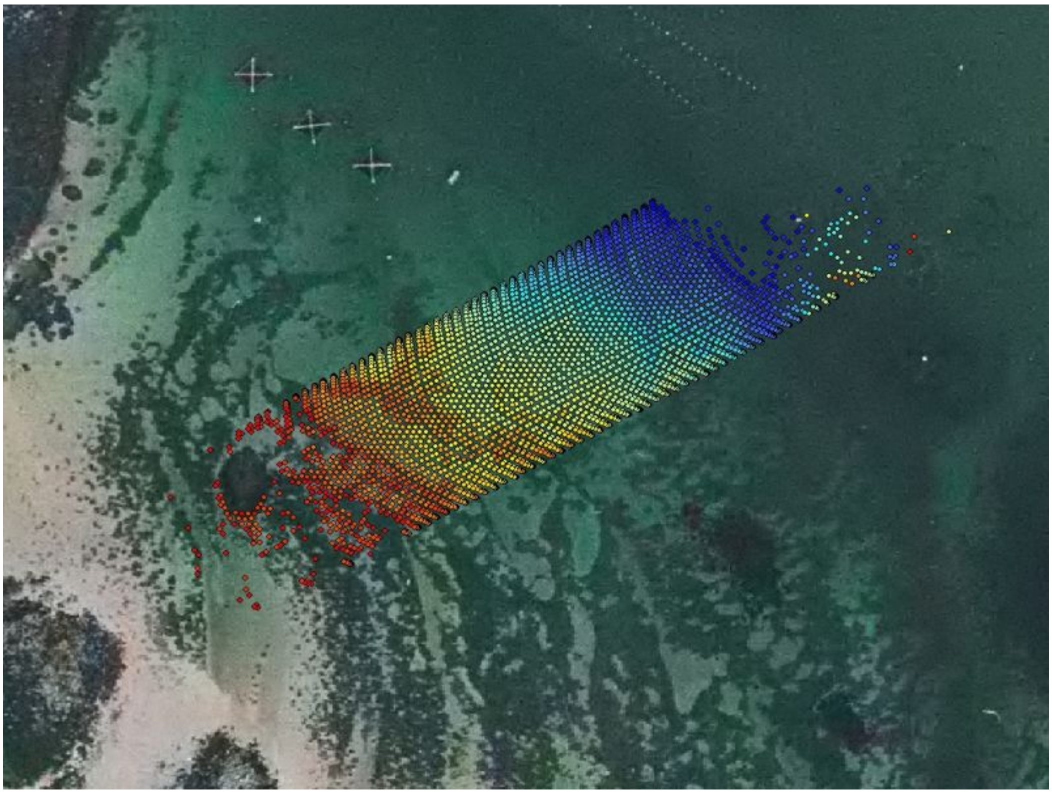
The group looked at multibeam data, aerial photos, Spot imagery (infrared) and bathymetric Lidar on the coastal site "les Abers", on the north coast of Brittany, France. Unfortunately no one in the group had data or experience in radar data.

The use of ortho-photography as a base layer was deemed a good one in intertidal mapping. However not all facies are easily recognizable and confusion often arises (this is due to the natural limitations of natural color air photos as well as to variable mosaic quality).

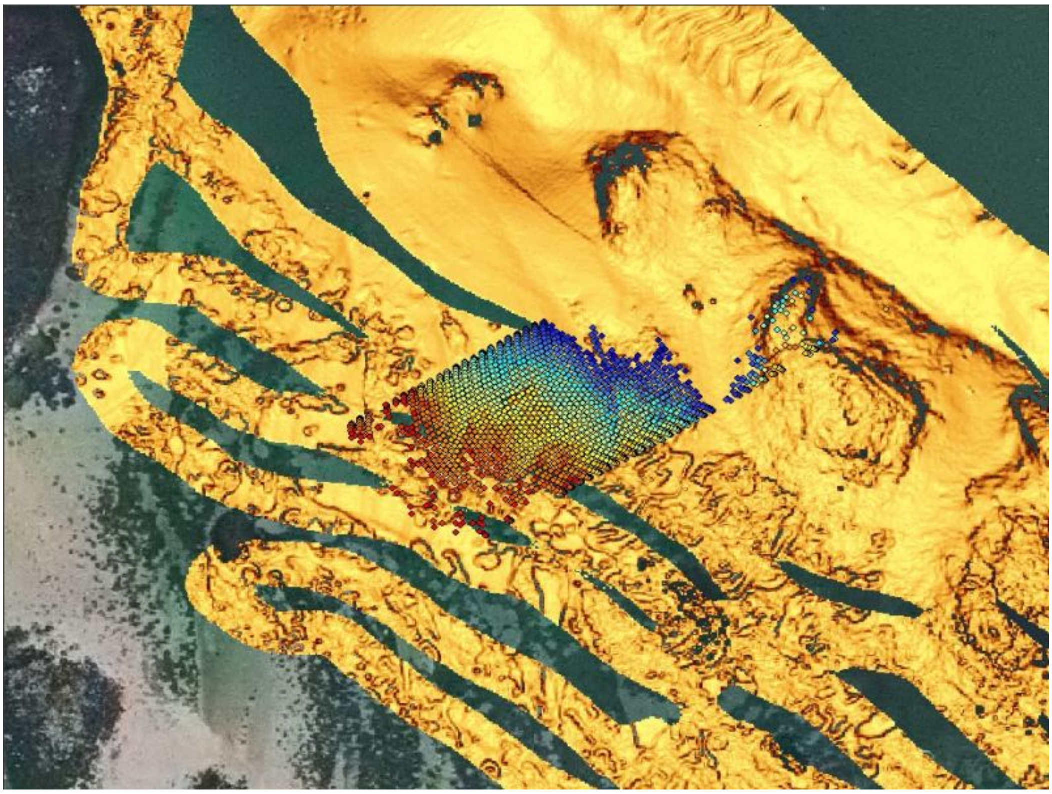
Concerning Zostera sp in particular, as they are a very dynamic habitat, and thus the surveying season is crucial. The best time seems to be end of May, particularly for *Zostera noltii* which have a very straight seasonal variability and grow most of the time on macroalgal bloom areas.

The use of the map also needs to be defined: inventory or monitoring? Concerning monitoring surveys, standardized approaches have to be well defined and automatic classification software seems to be a very efficient way of evaluating bed cover.

Seagrass signatures can also be detected thanks to bathymetric data (bathymetric Lidar and Multibeam echosounder as featured by Survex). It is believed that the air content of the leave is a driver in the surprisingly high acoustic response. These methods ensure that variations between the top of the canopy and areas of sediments without Zostera shoots can be finely distinguished.



Zostera marina beds are visible on bathymetric Lidar (raw data as colored dots); background : ortho-photography on Les Abers, France



In yellow patterns, slope values from Survex Multibeam EchoSounder ensure that all "Zostera marina" shoots can be finely distinguished (Les Abers, France).

In terms of interpretation, the notion of bed density is quite important, as for example beds in the Netherlands are much sparser than in France (generally, less than 25% coverage is discarded in France). If presence/absence is the sole request, then oblique aerial photography may be sufficient.

Saltmarsh mapping

Saltmarshes were also quickly discussed. EUNIS defines 5 kinds of saltmarshes (at EUNIS 200410 level 4, from A2.51 up to A2.55), according to their drying height. However there are differences in immersion tolerance between schorres in north and south Netherlands for instance. In France, it was reported that the 10% immersion time level corresponded very closely to the boundaries between pioneering saltmarshes with *Spartina marina* (A2.5543) and low-mid saltmarshes with *Halimonie portulacoides* (A2.545). This must still be validated and verified in other schorres areas with other tide conditions in various biogeographic areas.

The 10% immersion time level (in red) is between pioneer and low-mid saltmarshes (Le Croisic REBENT area, France)

4.2 Subtidal macroalgae mapping

The group looked at diver survey data, single beam sounder data, high resolution Reson multibeam data, on the same “les Abers” site.

The first phase of the work is a diving survey to delineate the kelp lower limit (*Laminaria sp*.). The three types currently found are *Laminaria digitata*, *Laminaria hyperborea* and *L. cystoseira*. Divers are towed by boat and the boat position is GPS/GIS recorded. The diving survey lasts 2 weeks over three test site subareas. The first discussion concerned "lower limit/boundary"; how do we define it? For example on Dutch mussel beds, as soon as there is a 25 metre gap between two patches, then another patch is retained. The second question is whether the lower limit actually follows a depth contour. This will be examined with the high resolution multibeam (data herebelow).

The second data set is 120 kHz single beam echosounder with dGPS (Pulse duration: 64 µs - Transmit power: 500 watt). The same surface as above is covered in two days (Total track length : 27 km ~= 14,5 miles - Number of samples: 365 100 pings). One hundred sounder pings are echo-integrated corresponding from 10 to 15 meters in distance (distance between each ping varying between 5 to 10 centimeters). Accuracy along the vertical axis is about 5 centimeters.

The analysis of the echo sounder return was split into three layers (layer 1: 20-70 cm; layer 2: 70-110 cm; layer 3:110 – 200 cm). The software used for the post-processing of the raw acoustic data was Movies+ developed by a research team at Ifremer. In addition, a specific algorithm which is still in progress has been set up for the discrimination species. Each layer reveals a certain amount of backscatter and this information has been used for the detection and discrimination of underwater vegetation. Zostera is mainly observed in the first layer with very high reflectivity (the highest among all species detected during the survey) although kelp is usually observed in the first two or the three layers with lower backscatter values.

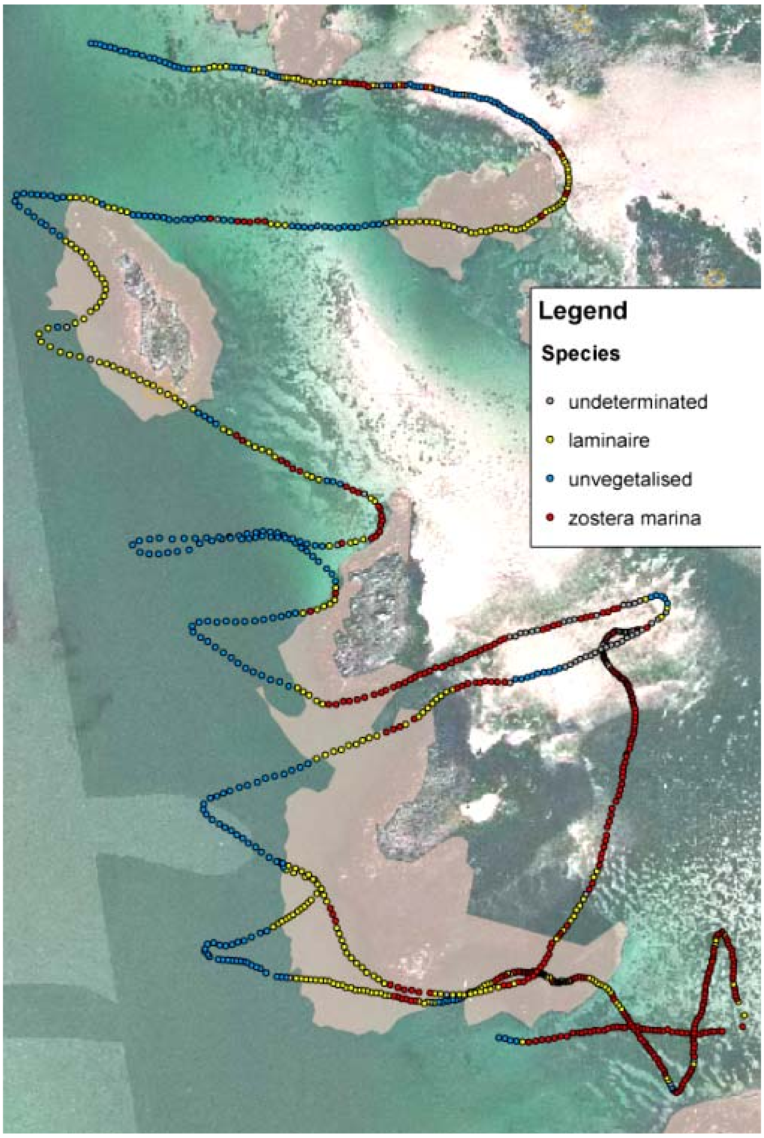
Single measurements were interpolated into a raster density map and binned into five classes (bare rock and four kelp density classes). Interpolation was only performed on one subarea where sufficient samples were available.

The three main types of kelp mentioned above seem to have distinct signatures. Extra penetration is noticeable on softer bottoms as is the case with seagrass but the nature of the underlying substratrum is not detected (e.g. rock slabs or boulders).

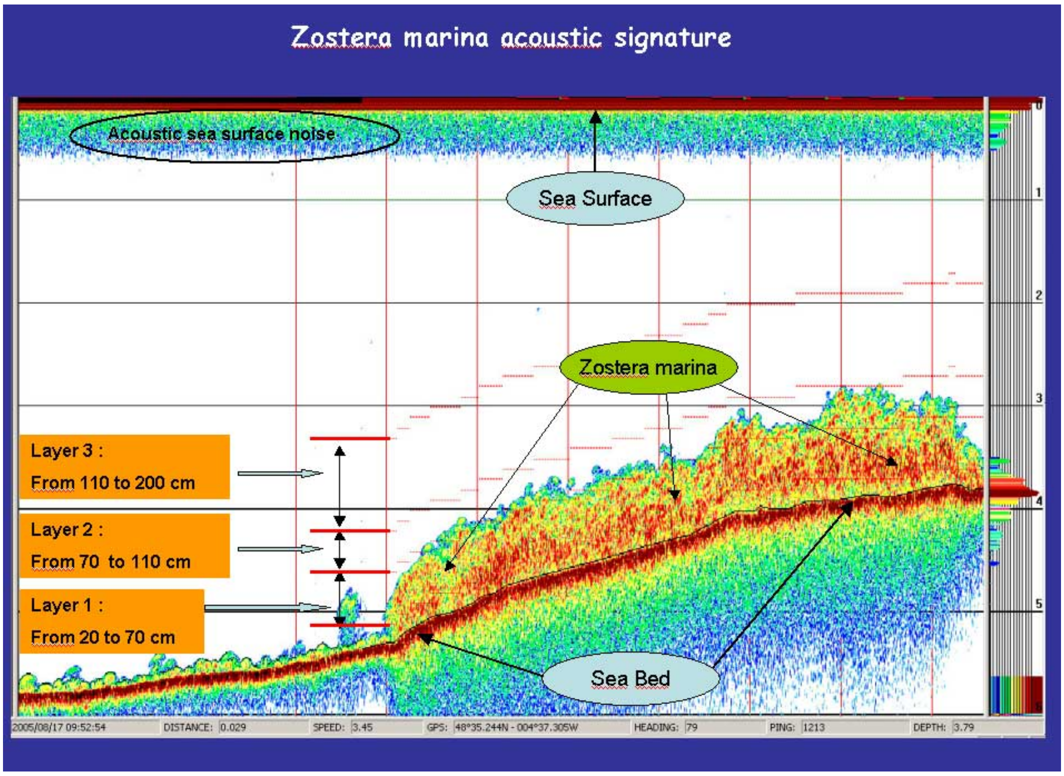
High resolution Survex multibeam data are then overlaid and depth and slopes computed from them. There appears to be a good agreement between slope and presence/absence of kelp. Looking at depth according to seabed type, suggests that Zostera, *Laminaria sp* and no vegetation show different mean depths (19 metres for *Laminaria sp*. while deeper areas are mostly unvegetated). There also seems to be more density within the 10-20 metre range for kelp. Seagrass is mainly localized between 0 and -1.5 m (below LAT level). The areas of unvegetated rocky substratum are clearly identified, which should help us understand how kelp thrives.

The group also discussed about factors influencing the lower limit of macroalgae, i.e. substratum, light, shear stress, etc.

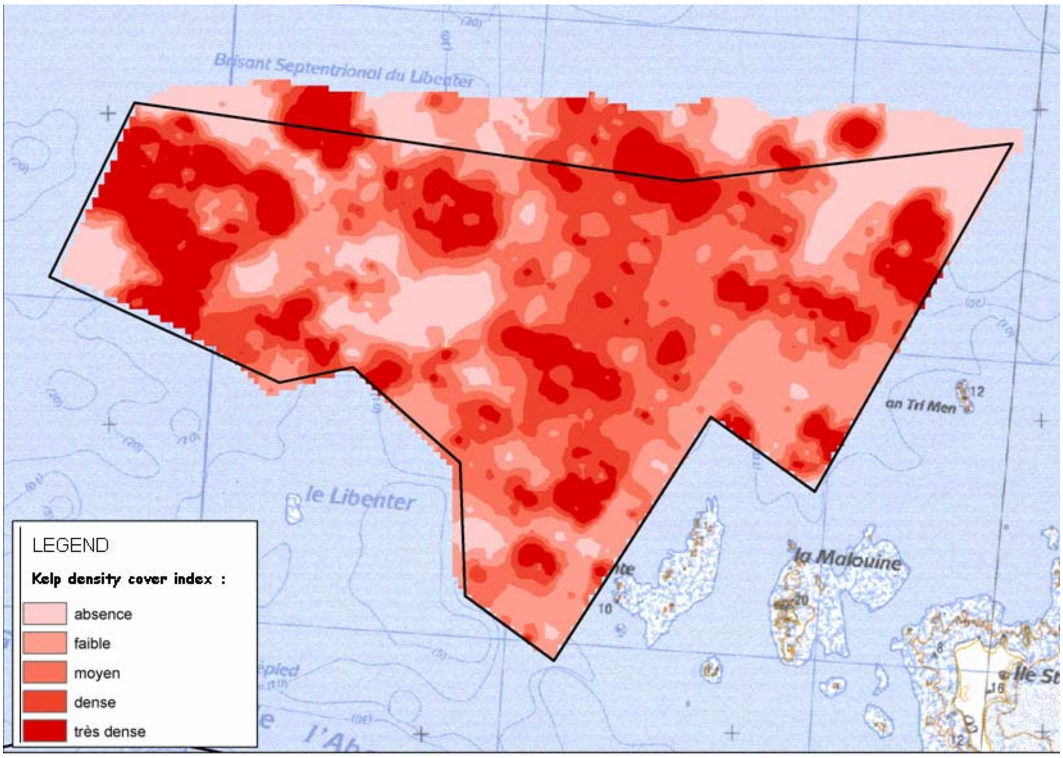
The conclusions drawn on the first acoustic experiments involving subtidal macroalgae mapping on the site "Les Abers" are the following:
- Single beam echosounder detects underwater vegetation with good accuracy
- Discrimination between eelgrass and kelp works thanks to the echo integration technique (yet one has to be careful with seabed contribution when the seabed is not well detected)
- Echo sounder systems offer a real cost effective alternative to scuba diving especially in "deep" water with strong tidal currents,
- Ground truth is still necessary to identify species and validate echo integration results,
- There is a need to collect more data on the signatures of subtidal species.



Single profiler transects with colour code according to bottom type



Acoustic signature on *Zostera marina*



Index of kelp density cover on subarea 3, interpolated from transect measurements

4.3 Subtidal soft bottom

Example in Belgium

Data from the Sierra Ventana region (dumping site) were shown, with multibeam bathymetry and classification of Triton (classes correlated with different backscatter values).
On the side scan sonar, biological communities of the tube worm *"Lanice conchilega"* are recognisable as patches on the image. This pattern is currently encountered on the Belgian shelf and particularly at the bottom of the slopes (combined with multibeam). It is assumed to be caused by high currents at the bottom of the slopes, where fine muddy material is suspended in the water column, acting as a food source for filter feeding animals.

There is high multibeam backscatter inside the current dumping site, which is not caused by coarse sand but by very compact muddy sand. It is not only the sediment type (grain size) which defines the backscatter strength, but also the compactness.

In Oostende two different surveys (carried out at different times) gave conflicting information about the sediment type present at one survey site; one survey suggested sand whilst the other suggested mud. This was caused by a very fine sand layer on top of the mud, through which the multibeam signal from one survey could not penetrate (box cores showed this very fine sand layer on top of the mud). This incident reinforces the importance of groundtruthing using samples and/or video.

Example in Brittany

Sidescan data of the sites of Concarneau Bay and Les Abers were shown. It is easy to identify rocky outcrops, Zostera beds (with the help of ortho-photographs and side scan sonar draped on multibeam, but to that degree of detail do they have to be mapped?), pockmarks, different grain sizes of the sediment. It is difficult to recognise macroalgae (kelp). It is also difficult to compare different resolutions of 0,3 m and 1 m in the same area (in overlapping zones of Reson and Edgetech data). Combining different techniques and software is very interesting; e.g. side scan sonar draped on multibeam, 3D visualization in Fledermaus…

No real standard classification system exists yet, thus a standardized signatures atlas of acoustic imagery could be very interesting in order to achieve more standardized interpretation. Until now only manual classifications have been performed, no automated classifications are used.
It is interesting to use the side scan sonar for planning sub-tidal macroalgae sampling campaigns to test if certain interpretations of the imagery are indeed correct.

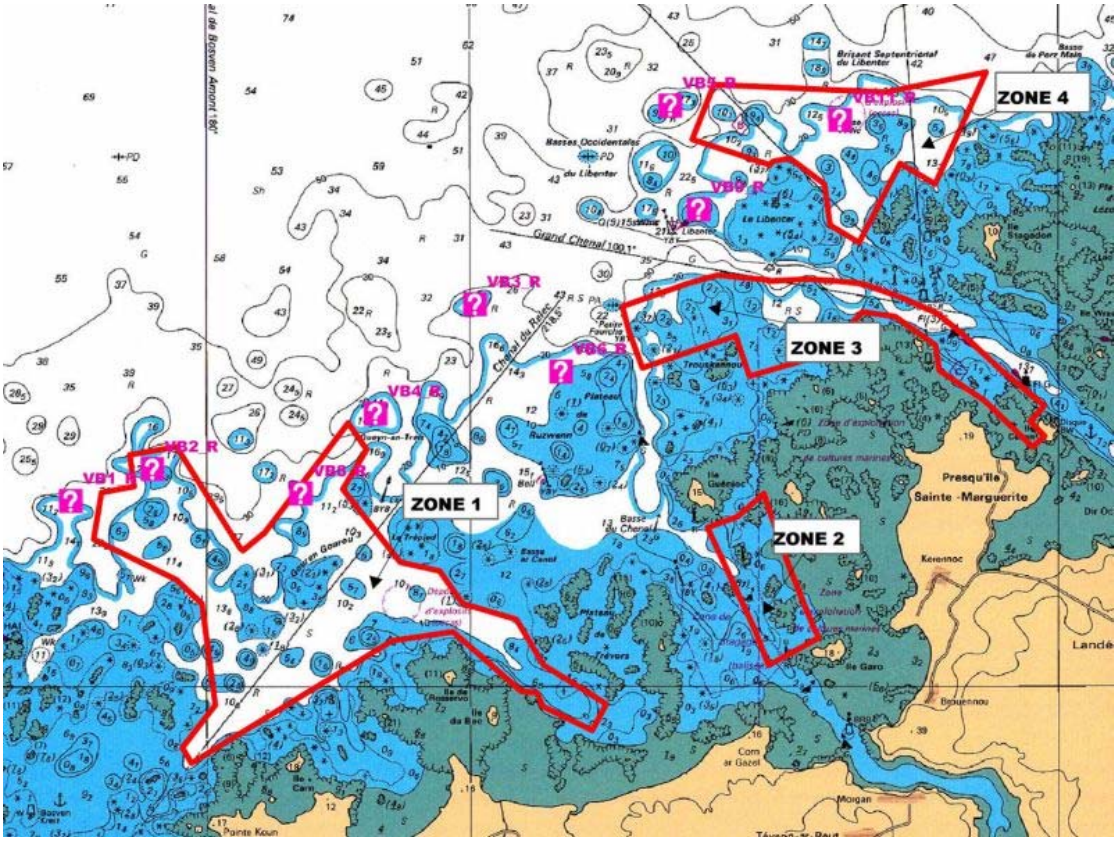
MESH surveys strategy on Les Abers (Finistère, France)

DATE	AREA	START	END	KM	OBJECTIVES
10/06/2005	3, 4	9h06	19h00	73	1, 2, 3
11/06/2005	2, 3, 4	8h05	17h10	66	1, 2, 3
12/06/2005	1, 2, 3, 4	9h02	18h30	84	1, 2, 3
13/06/2005	1, 2	9h25	18h30	83	1, 2, 3
30/06/2005	1, 2	8h15	15h00	56	1, 2, 3
01/07/2005	1, 2	9h10	17h30	78	1, 2, 3
02/07/2005	1	8h10	16h30	68	1, 3

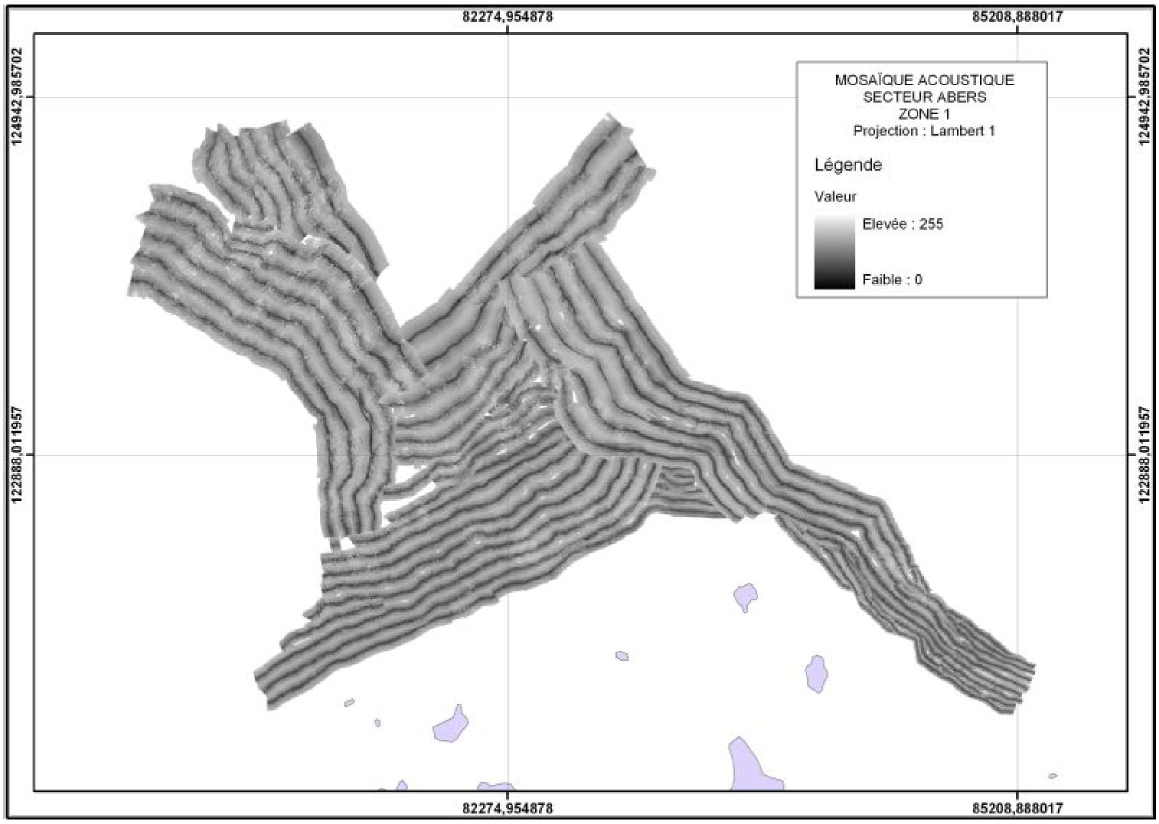
1: adds in shallow waters with DF1000

2: low limits detection of Zostera marina beds

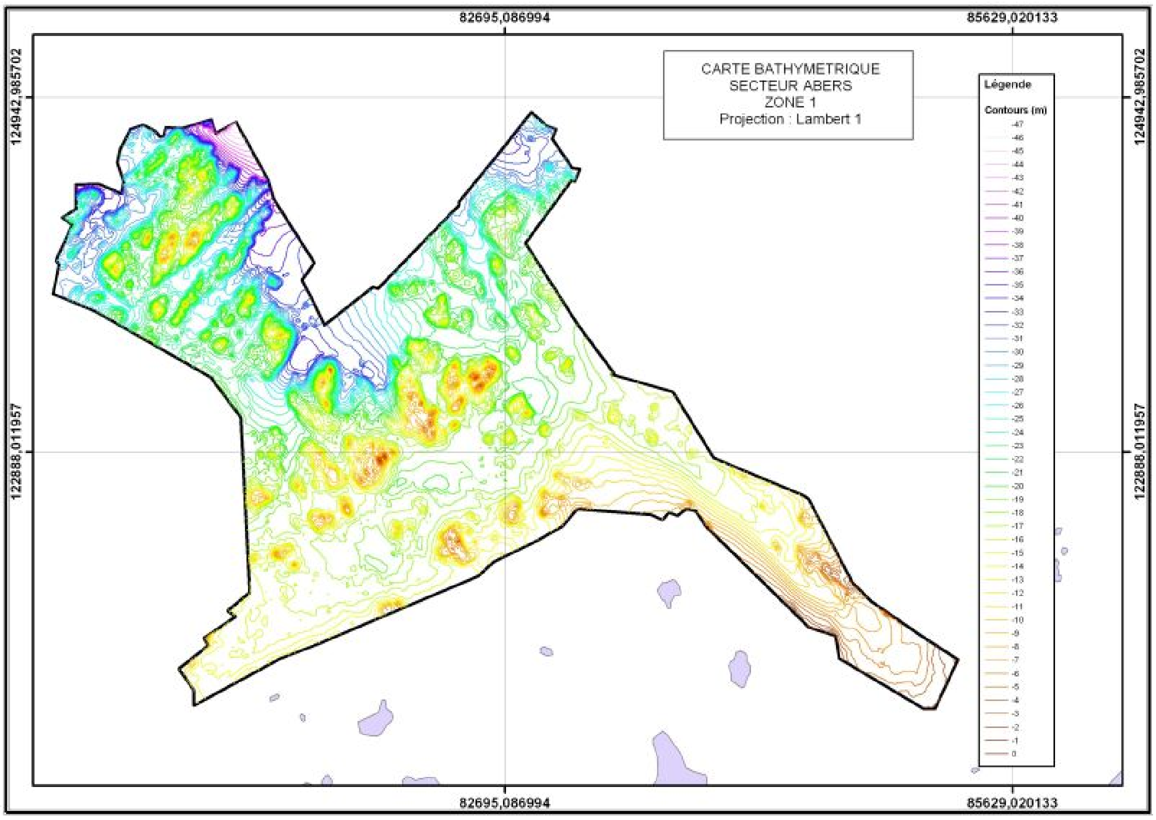
3: Intercalibration with bathymetric lidar data



Four shallow water areas selecteddefined on Les Abers (Finistère, France)



Sidescan sonar imagery of Les Abers, area 1



Bathymetric values of Les Abers, area 1

5 - Conclusion : enhanced synergy and transnationality?

This meeting had a very broad thematic coverage, both in terms of the habitats looked at and the tools employed to survey them. It would probably be more efficient to plan more focused meetings (e.g. tool-based, or single facies based), as is usually the case, however this could be at the expense of synergy.

It has been decided in this case to bring people together to examine a particular type of environment using all possible techniques. Specific emphasis was directed on shallow waters, a place of convergence for both visible and acoustic remote sensing where synergy is likely to be at its strongest. The number of data types considered during these four days was about twelve, including some “fresh” experimental ones (Lidar, shallow multibeam, integrated sounding profiles), which proves how active the seabed mapping community is at exploring new ways of investigation.

The question to be raised is : what should come out of this meeting ? new actions, new topics/meetings, specific surveys, more joint processing? No definite answer was given to that question. Some key recommendations were made following the presentations and discussions:

a) It was recognised that before embarking on a survey a clear idea of what the map will be used for is required. This will in turn help choose survey settings: tools, coverage, minimum mapping unit etc.

b) It was recognised by the audience that generally good guidelines (including the Mesh “Review on mapping standards and protocols”) already exist for most tools but they are produced on a per technique basis. There is still a lack of guidelines showing how various tools can be combined where appropriate. This topic should be enhanced in the Mesh “Standards of interpretation” action.

c) It was suggested to deal with survey strategies, specifically in the case of vessel-borne acoustic tools. Questions such as full versus partial coverage, the assessment of confidence in the data should be closely looked at, as they condition the final product.

d) The importance of having all data under GIS form should be stressed. During this event this was the only way to allow instant calculations such as summarising raster in polygons for example. This also ensures transnationality, as data can quite easily be stitched together when an exchange format has been defined.

e) Data warehousing issues were also raised: in view of the difficulty of assessing, let alone re-playing historic data sets, proper data capturing and tracing are crucial. This refers not only to final maps but also to raw data or key intermediate steps which are worth keeping track of.

Annex 1 : Workshop agenda

MESH Intercalibration workshop (20-23 Sept. 2005)

Tuesday, September 20 : Strategies

- **Survey strategies, procedures and techniques used in intertidal zone** (all types of habitats) Chair J. Populus, Secretary : E. Karpouzli
    - **Ifremer intertidal mapping** - Claire Rollet (Ifremer)
    - **Intertidal habitat mapping in the Netherlands** - Norbert Dankers (Alterra)
    - **Remote sensing of Scottish estuaries** - Evanthia Karpouzli (Scottish executive)
- **Survey strategies, procedures and techniques in subtidal zone** (synergy acoustics and optical tools in shallow waters) - Chair R. Coggan, Secretary N. Golding
    - **Subtidal mapping strategies for Rebent** - Axel Ehrhold (Ifremer)
    - **Use of Acoustic Techniques in Shallow Survey** - Richard Bates (St Andrews University)
    - **Seabed mapping with aid of swath bathymetry and acoustic ground Discrimination** (AGDS) – Peter Fox (Hydrosystems).
- **Discussion**: these talks are quite informal, open to discussion and may address all aspects of habitat mapping, namely: preparing, surveying, interpreting, organising and storing data, drafting maps.

Wednesday, September 21 : field trip

- **Intertidal group** - Lead C. Rollet, secretary N. Coltman
    - **Presentation of the study site** (salon de l'Océan)
    - **Field trip to "Les Abers" area** (Northern Finistère, near Brest) at low water spring tide.
- **Subtidal group** - Lead A. Ehrhold, secretary K. Vanstaen
    - **Sortie on Survex** shallow water vessel
    - **Presentations of acoustic processing methods and software** :
        - Seafloor mapping sonars: recent innovations in commercial sytems (X. Lurton),
        - Ifremer R&D results in sonar reflectivity processing" (J.M. Augustin),
        - Caraïbes software (C. Edy)

Evening : workshop dinner

Thursday, September 22: working groups

Morning : working groups

- **Zostera beds** (acoustic and optical methods, video) : Lead B. Guillaumont, secretary N. Dankers
- **Subtidal macroalgae** (Bathymetric Lidar, Sidescan Sonar, single beam, video…): Lead T. Perrot, secretary J. Strong
- **Subtidal soft bottom** (sidescan sonar, multibeam, video): Lead A. Ehrhold, secretary R. Bates
- **Intertidal group** : mapping data of Les Abers field trip. Lead C. Rollet, secretary N. Coltman.

Afternoon

- **working groups** (continued)
- **15.30 plenary** – Chair R. Cogan, secretary J. White
    - **Shallow water bathymetry** (Lidar and acoustics): S. Piel
    - **Presentation of Adelie software for video processing** : F. Lecornu
    - **Discussion on catalogues of intertidal/subtidal habitats signatures** : R. Loarer

Friday, September 23 : Reporting

- **Reporting on assessment of survey strategies**: common denominators, good practise etc. Mesh workplan for further developing strategy in shallow water zone.
- **Reporting of working groups**. Workplan of potential areas for further testing.
- **How do habitat types encountered fit with EUNIS typology?**
- **Workshop report drafting**.

End : 4 pm

Annex 2 : List of participants

Organism	Country	Name	Surname
CEFAS	UK	COGGAN	Roger
CEFAS	UK	VANSTAEN	Koen
Hydrosurveys	UK	FOX	Peter
JNCC	UK	COLTMAN	Natalie
JNCC	UK	DAVIES	Jon
JNCC	UK	GOLDING	Neil
Marine Institute	Ireland	WHITE	Jonathan
Queen's University of Belfast	Northern Ireland - UK	STRONG	James
Scottish Executive	UK	KARPOUZLI	Evanthia
University of Gent	Belgium	DU FOUR	Isabelle
University of Gent	Belgium	VERFAILLIE	Els
University of St Andrews	Scotland - UK	BATES	Richard
Alterra	Netherlands	DANKERS	Norbert
IFREMER Brest	France	ALLONCLE	Neil
IFREMER Brest	France	EHRHOLD	Axel
IFREMER Brest	France	GUILLAUMONT	Brigitte
IFREMER Brest	France	HAMDI	Anouar
IFREMER Brest	France	HAMON	Dominique
IFREMER Brest	France	LE GAC - ABERNOT	Chantal
IFREMER Brest	France	LOARER	Ronan
IFREMER Brest	France	PIEL	Steven
IFREMER Brest	France	POPULUS	Jacques
IFREMER Brest	France	ROLLET	Claire
CEVA Pleubian	France	PERROT	Thierry
CNRS Dinard	France	BONNOT-COURTOIS	Chantal
IUEM Brest	France	GRALL	Jacques
IUEM Brest	France	HILY	Christian
Station Biologique de Roscoff	France	GENTIL	Franck

Annex 3 : Pictures from field trip, les Abers, Brittany, Sept. 21st 2005



Change history		
Version:	**Date:**	**Change:**
1	19/01/07	