Preparatory Action for development and assessment of a European broad-scale seabed habitat map

EUSeaMap

Maintenance Report

October 2012
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Note on figures: All maps are displayed in the ETRS89 LAEA projection, unless otherwise stated. Maps are orientated with north uppermost unless otherwise stated. Coastline used in data processing for maps: Global Self-consistent Hierarchical High-resolution Shorelines version 2.0 July 15, 2009, distributed under the Gnu Public License. Coastline used for presentation of maps: World Vector Shoreline © US Defence Mapping Agency. Not to be used for navigation purposes.
1. Introduction

The maintenance phase for the Preparatory Action for development and assessment of a European broad-scale seabed habitat map (EC Contract No. MARE/2008/07) has now been completed by the EUSeaMap project. EUSeaMap has been one of 6 themed components in the initial phase of the European Marine Observation Data Network (EMODnet), the other components being: Hydrography, Geology, Chemistry, Biology and Physical parameters. Each was tasked with collating and standardising otherwise fragmented or inaccessible marine data within the themes and providing public access to the data via a series of web portals.

Beginning in February 2009 with a two year development phase, EUSeaMap produced harmonised broad-scale seabed habitat maps for the Baltic, North, Celtic and western Mediterranean Seas. The maps were modelled using a number of abiotic variables following the EUNIS benthic habitat classification system¹. As such, EUSeaMap served not only as a component of EMODnet but also as a test-case user of some of the products provided by the other portals.

In the final year of operation, the EUSeaMap web portal (http://jncc.defra.gov.uk/page-5040) has continued to deliver broad-scale habitat maps, making them available for viewing, querying and download. Although not a requirement for the maintenance phase, the project has also taken steps to improve some of the habitat maps, and these improvements are outlined further in this report.

¹ European Nature Information System (http://eunis.eea.europa.eu/habitats.jsp)
2. Maintenance phase (months 23 – 36)

In the first two years of the EUSeaMap project, the consortium developed the necessary data layers and methods to produce harmonised habitat maps for the Baltic, North, Celtic and western Mediterranean Sea basins (Cameron and Askew, 2011). The EUSeaMap data portal was launched publicly in December 2010, allowing users to access, query and download the modelled maps and their input data layers. Since then the portal has been kept live. Although the main remit of the maintenance phase was to simply keep the portal operational, a number of further developments were taken on that were not possible within the development phase and these are outlined further below.

2.1. Input data layers

After the final model runs that were completed in the development phase, improvements to some of the input data layers became available for the North and Celtic seas. Among these were improvements to the most critical abiotic variables that contribute to the modelling of the habitat classes: substrate and bathymetry. As such JNCC decided that a re-run of the model for the North and Celtic Seas, incorporating the new data, would be completed as part of the Maintenance phase.

2.1.1. Substrate

A revised substrate layer was received from the EMODnet Geology lot in January 2012. The layer contained a number of improvements which were significant for the North and Celtic sea regions. Firstly, for UK waters, a major revision of the estimated areas of rock was incorporated. This new version of the EMODnet layer brought the product into line with the current DigSBS product (DigSBS v2) from British Geological Survey (BGS), and hence also the UKSeaMap 2010 (McBreen et al., 2010) broad-scale habitat map. Previously there had been an underestimation of areas of hard substrata, but by re-examining their database of seabed samples and in particular ‘no-sample’ returns, the layer has been updated, and the areas of hard substrata extended accordingly (Gafeira et al., 2010).

In the Celtic sea, progress has been made in refining Irish seabed substrate maps by Geological Survey Ireland (GSI) as part of their programme to utilise backscatter from surveys undertaken during Ireland’s national seabed mapping programme, INFOMAR. These data have been incorporated into the latest version of the EMODnet Geology’s seabed substrate layer. The updates account for an additional 23% of the seabed within the Irish EEZ and these areas can now be brought into the EUSeaMap habitat map (see Figure 1 and Figure 2).
Figure 1 Seabed substrate map of the EMODnet geology study area (August 2010 release).

Figure 2 Seabed substrate map of the EMODnet geology study area (January 2011 release). Note the additional areas mapped in Irish EEZs and the greater extent of hard substrata in areas including the Orkneys and Shetland Isles, and the South-west approaches.
2.1.1. Bathymetry

In the previous iteration of EUSeaMap (v1, released February 2011), the SeaZone Hydrospatial Digital Elevation Model (DEM), a licenced data product, had been used for much of the UK shelf waters since the intended primary bathymetry datasource, EMODnet Hydrography, had at that time been unable to secure the use of UK Hydrographic Office (UKHO) data to incorporate into the EMODnet DEM. Although there are still ongoing issues with the incorporation of UKHO data into publicly available DEMs such as EMODnet, the EUSeaMap project was able to utilise an intra-governmental licenced DEM newly created from UKHO data holdings. The DEM is produced on two grids: 1 arcsecond (~20m resolution) and 6 arcsecond (~100m resolution). The availability of improved bathymetry data has knock-on consequences for other input layers to the model. Input layers used to define the biological zones, for example, percentage of light at the seabed and wavebase, both require depth values in order to be derived from light attenuation and wavelength statistics respectively.

Tests were made using the 1 arcsecond product to run the habitat model at the same resolution but over such a large area the model quickly reached its computational limit. However, since both DEMs are derived from the same data, it was possible for the 1 arcsecond DEM to be used with habitat survey records to ensure the most accurate threshold analysis possible (see Section 2.2), whilst the 6 arcsecond DEM was used to run the model itself. Since the EUSeaMap model extends into the Kattegat, the 6 arcsecond was joined to the both the EMODnet Hydrography DEM and the BALANCE (Al-Hamdani et al., 2007) project bathymetry to provide full coverage.

Light at the seabed

Ocean colour satellite imagery is an effective way of providing large coverage light attenuation data at relatively high spatial and temporal resolution. Several models are commonly used to derive $Kd_{\text{sun}}$ (diffuse attenuation coefficient of down-welling photosynthetically available radiation) maps from satellite imagery. For EUSeaMap v1, an improved $Kd_{\text{PAR}}$ layer was estimated from radiance measured by MERIS, the Medium Resolution Imaging Spectrometer Instrument aboard the European Envisat satellite (Saulquin et al., in prep.).

Depth zones can then be determined by intersecting the improved depth data layer with these light attenuation values and using a pre-defined threshold (see Section 2.2). The intensity of light ($I_h$) at the seabed (depth $h$ below surface) can be computed using the formula:

$$I_h = I_0 e^{-h.Kd_{\text{PAR}}}$$  \hspace{1cm} (1)
Where $I_0$ is the intensity of incoming radiation at the surface. If incident light $I_0$ data is not available then it may be assumed that $I_0$ is constant and the proportion of incoming radiation arriving at the seabed ($Fr$) can be calculated instead (equation 2):

$$\frac{I_h}{I_0} = Fr = e^{-h.Kd_{PAR}} \quad (2)$$

The limit of the infralittoral may then be defined as the threshold value of $Fr$ that will define the zone’s lower boundary (Section 2.2).

High resolution MERIS imagery (250m pixel size) was processed from 2003 to 2008 for the area shown in Figure 3, the resulting layers being intersected with the new bathymetry data layers.

Figure 3 Overview of $Kd_{PAR}$ as computed for the MERIS swath zone (limited by 13W, 18E, 36N, 60N). Red boxes show where high resolution (250m) was computed for the coastal areas within EUSeaMap. This data layer was intersected with the improved bathymetry dataset for the North and Celtic Seas.
2.2. Thresholds revision

In order to incorporate the improved bathymetry data into the North and Celtic seas an essential task for the re-run of the EUSeaMap model was re-examining the light attenuation data and the associated thresholds that determine the lower bound of the infralittoral zone. On Atlantic coasts the infralittoral zone is where favourable light conditions enable the development of kelp forests; this boundary hence varies in terms of depth according to water clarity and the effects of turbidity but can reach to beyond 45 metres in some areas of the Atlantic. In the analysis for the lower bound of the infralittoral that EUSeaMap presented in the development phase, point habitats records (in particular for rocky substrata with kelp presence/absence data) were selected from the UK Marine Recorder database\(^2\), and their spatial distribution in relation to the 1 km MERIS light data were analysed. In the Maintenance phase this analysis was revised. Firstly, only those samples that had been classified to the equivalent of level 4, 5 or 6 in the EUNIS habitats classification scheme were used in the analysis, as these level contain biological information, suggesting that the surveyor saw and identified kelp where the sample was taken. Marine Recorder allows users to specify whether a record is “whole” or “partial” and whether the classifier is “certain” or “uncertain”; only “whole” and “certain” records were used in this investigation. Secondly, the light values that were associated with the habitat samples were derived utilising the more accurate depth values available from the 1 arcsecond bathymetry dataset and the 250 m resolution MERIS light data. Furthermore, Generalised Additive Model statistical techniques were used to refine the threshold analysis methodology. This work is discussed in detail in the Light Technical Appendix.

Refining the thresholds across the entire basin can have a significant effect in improving the output maps. Table 1 summarises the changes in area of the infralittoral and deeper zones. The percentage share by area of the infralittoral zone is decreased by \(~3.5\%\) when the new threshold is applied.

<table>
<thead>
<tr>
<th>Biological zone</th>
<th>Original Light threshold Area, km(^2)</th>
<th>% total area</th>
<th>Revised Light threshold Area, km(^2)</th>
<th>% total area</th>
</tr>
</thead>
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<tr>
<td>Infracalittoral</td>
<td>176,945</td>
<td>5.0</td>
<td>52,645</td>
<td>1.5</td>
</tr>
<tr>
<td>Circalittoral and deeper</td>
<td>3,352,713</td>
<td>95.0</td>
<td>3,471,748</td>
<td>98.5</td>
</tr>
<tr>
<td>All zones</td>
<td>3,529,657</td>
<td></td>
<td>3,524,393</td>
<td></td>
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</tbody>
</table>

\(^2\) The Marine Recorder package was developed by JNCC as a collect and collate piece of software designed to hold and manage marine survey data including from Marine Nature Conservation Review surveys. The JNCC database holds benthic sample data from a variety of organisations including the JNCC, the UK Statutory Nature Conservation Bodies (SNCBs), Marine Environmental Data and Information Network (MEDIN), Seasearch and Local Record Centres. A snapshot of the database has also been incorporated into the EuroOBIs database by EMODnet Biology.
The layer was assessed using expert judgement to check the refined extent of the infralittoral (see Figure 4). Depth statistics for the infralittoral zone derived using the new and old thresholds were also examined, with a reduction seen in the mean depth, standard deviation and the range. Initially some extreme values appear (up to 783m) but these originate almost exclusively from the deep Nordic fjords, where the spatial resolution of neither the light or bathymetry data is sufficient to cater for the specific environmental factors that would be present in such areas; in particular the steep sided slopes. Since the habitat map was not intended to cover such areas, these points were removed from the analysis. Once removed the summary statistics for the depths found within the infralittoral zone appear much more reasonable (see Table 2). The high values seen for the maximum depth all arise from areas of overlap between the high resolution depth layer and the $K_{\text{PAR}}$ light layer in deep sea lochs, where mismatch between the resolutions of the two datalayers can result in extremely high values that cannot reflect the dramatic topography of the feature. Again, as these areas fall beyond the intended scope of these maps (and in areas that the key datalayer, substrate, does not generally cover), these extreme values can be disregarded.

Table 2 Comparison of depth statistics (metres) for the revised infralittoral zone.

<table>
<thead>
<tr>
<th></th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>Std. Dev*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original threshold</td>
<td>0.0</td>
<td>205.9</td>
<td>19.2</td>
<td>11.7</td>
</tr>
<tr>
<td>Revised threshold</td>
<td>0.0</td>
<td>187.0</td>
<td>7.4</td>
<td>5.8</td>
</tr>
</tbody>
</table>

Figure 4 The revised extent of the infralittoral zone in (left) the eastern Irish Sea and (right) Roaringwater Bay, West cork, Ireland. The transitional area of blue to green represents the change from infralittoral to circalittoral zone arising from the fuzzy modelling process, whilst the maximal extent of the infralittoral in the previous version of EUSeaMap is also shown here for comparison.
2.3. Revised model – Celtic and North Seas

The model was re-run for the North and Celtic Sea areas using the improved data layers described above and summarised in Table 3, and incorporating new thresholds to delineate the lower bounds of the infralittoral and circalittoral biological zones (based on percentage light at the seabed and wavebase respectively). The resulting map is shown in Figure 5.

Table 3 Physical data layers used in the construction of the revised EUSeaMap predictive seabed habitat model for the North Sea and Celtic Seas.

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Source(s)</th>
<th>Resolution</th>
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<tbody>
<tr>
<td>Bathymetry</td>
<td>Defra/Astrium</td>
<td>Coastal Digital Elevation Model</td>
</tr>
<tr>
<td></td>
<td>Intergovernmental Oceanographic Commission (IOC) (of UNESCO) &amp; International Hydrographic Organization (IHO).</td>
<td>GEBCO³ 30 arcsecond</td>
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<tr>
<td></td>
<td>EMODnet Hydrography project partners</td>
<td>EMODnet hydrography DEM 15 arcsecond</td>
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<td></td>
<td>BALANCE project partners</td>
<td>BALANCE bathymetry 1:250,000 - 1:1,000,000</td>
</tr>
<tr>
<td>Light</td>
<td>ESA</td>
<td>MERIS on ENVISAT platform 250m coastal 1km offshore</td>
</tr>
<tr>
<td>Substrate</td>
<td>EMODnet Geology partners</td>
<td>EMODnet Geology substrate map (v 20120105) 1:1,000,000</td>
</tr>
<tr>
<td>Waves</td>
<td>NOC</td>
<td>ProWAM 12.5km</td>
</tr>
<tr>
<td></td>
<td>DHI</td>
<td>MIKE21 Spectral wave model (from the coast out to 6km from the coast) ~100m</td>
</tr>
<tr>
<td>Currents</td>
<td>NOC</td>
<td>POLCOMS CS20⁴ 1.8km (2007 version)</td>
</tr>
</tbody>
</table>

³ General Bathymetric Chart of the Oceans: [www.gebco.net](http://www.gebco.net)

⁴ Run 11 was used.
Figure 5 Full detail modelled seabed habitats for the North and Celtic seas. In areas without substrata data available from the final (August 2012 version) EMODnet Geology data layer, biological zone and energy information from the model are still shown, but under a different colour scheme.
Figure 6 Legend for the full detail modelled seabed habitats for the North and Celtic regions. Areas without substrata data were modelled according to biological zone and energy class; since they cannot be fitted to the EUNIS classification without substrata data these have been labelled simply as seabed. In addition, the more detailed classification for the Atlantic deep sea as proposed by Howell (2010) has been shown here, rather than the broader EUNIS A6 classes.


2.4. webGIS Portal

The portal has continued to be maintained since its launch. No significant upgrades have been made to the functionality of the portal itself, although some minor improvements have been made. For example, the Web Mapping Service has been improved, which provides all data layers as images to users across the world wide web to use within desktop or other web-based GIS systems. These improvements have included:

1. making layer names more user-friendly and descriptive,
2. providing abstract summaries for the most important layers, and
3. providing bounding box information for raster data to improve performance.

In order to facilitate ease of use for visitors wishing to use the maps for their own analytical needs, a ‘download all layers’ option has also been added to the portal. Users may still download individual layers via the layers menu should they wish to access only some of the datasets on their own machines. Some further optimisation has also been carried out for some layers to make the browsing experience smoother for end-users.

2.4.1. Monitoring: Visits and downloads

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<td>102</td>
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<tr>
<td>Totals</td>
<td>3018</td>
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</table>

In addition to 192 unique user downloads of data in the period February 2011-2012, the project has received a number of queries and requests. Some of these have given an insight into the many potential different uses of the EUseaMap products. For example, the HARMONY project (Stock et al., in prep) used a generalized version of the EUseaMap data (based on substrate and biological zones) as "ecosystem component layers", i.e. presence/absence of coarsely defined benthic habitats. These were then combined with data on potentially damaging human activities and pollution (e.g. bottom trawling) using
expert judgement to determine which habitats are sensitive to which types of human disturbance. Other uses include:

- MSFD Initial Assessments
- Sustainable mariculture in North Sea
- International Marine Protected areas assessment
- Analysis with fishing Vesse Monitoring System (VMS) data

3. Post-maintenance phase

EUSeaMap continues to be promoted throughout the marine habitat mapping community in Europe (see Appendix II). In April 2012 the project was presented at the conference ‘Using EUNIS habitat classification for benthic mapping in European seas’ hosted by the MESH Atlantic project in San Sebastian where leaders in seabed habitat classification gathered to discuss the potential improvements to the classification scheme upon which EUSeaMap is based. References were made in several presentations to the developments made in EUSeaMap indicating the worth of the project (Galparsoro, 2012).

The MESH Atlantic project is currently using the methods and model developed by EUSeaMap to extend the broad-scale habitat model to the Atlantic waters of Europe. This project is independent of EUSeaMap; however, some partners have been involved in both projects. The resources available for the broad-scale modelling section of the MESH Atlantic project are much smaller than EUSeaMap’s. However EUSeaMap’s production and documentation of repeatable methods and models allow the relatively easy application to a new area of ocean. Although not a MESH Atlantic partner, JNCC have continued to have involvement with this aspect of the project in a small advisory role, ensuring that the new Atlantic product is as continuous and comparable as possible across boundaries with EUSeaMap regions.

4. Conclusions

The EUSeaMap portal has continued to be maintained online. In the maintenance phase some modifications have been made to the webGIS service itself (download options, metadata, optimisation), whilst improvements have now also been made to the maps and methods behind them for the North and Celtic Sea areas.

In the North and Celtic Seas, improvements to bathymetry data have allowed revised versions of the input layers for light percentage at the seabed and wavebase to be used in a re-run of the seabed habitat model. Corresponding threshold analysis has been conducted to review the boundaries applied to delimit the infralittoral and circalittoral zones, and these new methods could form the basis for future thresholds work. The thresholds analysis is critical to the creation of these types of habitat maps as it is the part of the process that
integrates biological data with the physical parameters that are used to construct the final habitat maps. They also have a bearing on the confidence layers that accompany the maps. The quality of broad-scale habitat maps such as these that combine abiotic variables following the EUNIS system are heavily reliant on the interpretation of the thresholds between classes in the classification system, and whenever improvements become available in either the input data layers or available habitat validation data, it is highly recommended that the relevant thresholds are re-analysed.

An improved substrata layer produced by the EMODnet Geology group was also incorporated. Future developments in sediment mapping that allow for dynamic classification (allowing users to specify sediment profiles according to different classifications such as Folk and Wentworth) could open up possibilities to test the thresholds for sediment classes as they relate to EUNIS habitats using similar methods to those used for the other input abiotic variables.

**Challenges faced**

Biotope tagged (or simply classified habitat) samples are still relatively scarce in offshore waters across European waters as a whole, meaning there is a limited ability to undertake stastically robust threshold analysis for deeper waters. Within UK waters the situation is, by comparison, very good, with a large database (in the form of Marine Recorder) to draw on as a resource for threshold analysis, and there are further fine-scale seabed habitat maps that have been drawn together under the MESH project previously for North Atlantic waters. However, even in this case, there is still a bias towards near-shore areas, and a lack of consistency amongst classifying habitats based on the abiotic variables recorded (if any).

As an example, when testing wavebase, the number of available samples for habitats within the circalittoral and deep circalittoral zone (that wavebase is used to define the boundary between) is only 165 when only sediment biotopes classified to EUNIS level 5 and 6 are used, i.e. with biological data also recorded, were available from Marine Recorder. Even when looking at samples that include level 3 and 4 classified habitats (i.e. using physical habitat data as well as biological), the sample size is only taken up to ~1000.

To improve the circalittoral/deep circalittoral boundary in future iterations of the broad-scale habitat map, many more samples would be needed, ideally to the biotope level (EUNIS level 5 and 6). Ideally there would be some measurements of energy conditions taken with habitat samples as well to gain more *in-situ* measurements with which to calibrate the data layers, and improve threshold analysis. Further analysis would also be useful to look at seasonal variation, i.e. to further examine whether in the case of defining the circalittoral/deep circalittoral boundary it is extreme or average conditions that are the guiding constraint.

One of the intentions at the start of the maintenance phase was to join the Baltic and North/Celtic Seas models, as there would be advantages to dealing with as few boundary issues as possible. However, computational limitations were soon reached by the higher
resolution datasets that were available over such large basin areas. Other software might be feasible but the model wouldn’t be as accessible as it currently is.

Outer (seaward) extents are generally constrained only by the limit of our focus, whereas inner (shoreline) extent is much more limited by the technical capability in terms of modelling/mapping our input layers. For most data, the inner coastal areas, the ‘white ribbon’ of missing data, is an ongoing limitation for mapping, especially when generating full coverage broad-scale layers.

Ultimately, the overall objective of the EMODnet is to assemble fragmented and inaccessible marine data into interoperable, contiguous and publicly available data streams for complete maritime basins. The maps produced by the EUSeaMap project represent a realisation of this objective. Improvements to the input data not only improve the resolution of the habitat models, but also offer the opportunity to refine the thresholds that relate these data to habitats. With increased amounts of in-situ habitat data and improvements to full coverage data layers there will be a steady narrowing of the gap between broad-scale and fine-scale maps.

5. References


Appendix I.  Version Control

Build status:

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<th>Reason/Comments</th>
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<td>10 Oct 2012</td>
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<td>Updated and finalised</td>
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Amendments in this release:

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<td>All</td>
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Distribution:

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Appendix II. Publicity log

The EUSeaMap project, for large scale cartography of European seabeds Definition of the process to model habitat distribution in the western Mediterranean - Presentation (Leonardo Tunesi) at Progetto CARG, Rome, Italy, 29-30 September 2009.

EUSeaMap: Towards common spatial seabed data - Presentation at the Maritime and coastal information systems (JNCC), Europe - EEA/EIONET workshop, Trieste, Italy, 18-19 November 2009

EUSeaMap: modelling European seabed habitats - Information paper and presentation at OSPAR Working Group on Marine Protected Areas, Species and Habitats (MASH) in Vilm, Germany, 24-26 November 2009.

EUSeaMap project: Modelling European seabed habitats - Information poster presented at GeoHab 2010, Wellington, New Zealand, 4-7 May 2010. Ifremer/Jean-François Bourillet.


EUSeaMap: Modelling European seabed habitats - Presentation (IFREMER) at Mesh-Atlantique kick-off meeting, Lisbon, Portugal, 31 May 2010.


EUSeaMap: Modelling European seabed habitats – Presentation (IFREMER) made at Pegaso meeting “Cases Bouches du Rhône” and Work Package 3 meeting, Marseille, France, 14 September 2010.
Modélisation spatiale des habitats benthiques à l’échelle continentale – Presentation (IFREMER) at ESRI France user conference, Versailles, France, 28-29 September 2010.

Development of EUNIS habitat classes for the Baltic Sea - Paper to the Workshop for the Biotope Experts of the Project for Completing the HELCOM Red List of Species and Habitats/Biotopes, Second Meeting, Stockholm, Sweden, 4-5 October 2010. HELCOM.

Prospects for a seabed and habitat map of Europe – Presentation (JNCC) at the EurOcean 2010 conference, Ostend, Belgium, 12-13 October 2010.

EEA/EIONET activities related to the work area Maritime – roadmaps, assessments, indicators - Presentation at the EIONET workshop (EEA), Copenhagen, Denmark, 25th -26th October 2010

Advances in broad-scale marine habitat mapping for the UK and Europe – Presentation (JNCC) at the GeoHab conference, Helsinki, Finland, 2nd-6th May 2011

Modelled seabed habitat maps for integrated management in European waters – Presentation (JNCC) at the Spatial Ecology and Conservation conference, Birmingham, United Kingdom, 4th – 9th Sept 2011

Modelled seabed habitat maps for integrated management in European waters – Presentation (IFREMER) at ICES Annual Science conference, Gdansk, Poland 21st Sept 2011

MPA distribution in the EC Western Mediterranean: an analysis conducted through a modeled broad-scale habitat map – Presentation (ISPRA) at World Marine Biodiversity conference, Aberdeen, United Kingdom, 31st September 2011

EUSeaMap - challenges in producing a seabed habitat map for 2,000,000 km² of European seas – Presentation (JNCC) at MAREMAP meeting, Southampton, United Kingdom, 4th November 2011

EUSeaMap - an example of the need for ocean monitoring data for seabed habitat mapping - Presentation (JNCC) at GMES (Global Monitoring for Environment and Security) User Forum Preparatory Workshop on Marine Monitoring, Brussels, Belgium, 25th January 2012

EUSeaMap - using EUNIS to predict broad-scale habitats for 2,000,000 km² of European seabed - Presentation (JNCC) at MESH Atlantic EUNIS classification workshop, San Sebastian, Spain, 23rd April 2012