EMODnet Thematic Lot n° 3 Seabed Habitats

EMODnet Phase 2 – Annual report

Reporting Period: Sept. 2014 to Aug. 2015

Date: 16/09/2015

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List of abbreviations and acronyms

CBD	Convention on Biological Diversity
DCE	Danish Centre For Environment And Energy
DTM	Digital Terrain Model
EBSA	Ecological and Biological Significant Marine Areas
ECMWF	European Centre for Medium-Range Weather Forecasts
EU	European Union
EUNIS	European Nature Information System. **eunis**.eea.europa.eu
EurOBIS	European Ocean Biogeographic Information System. www.eurobis.org
FP7	7th Framework Programme for Research and Technological Development
GEBCO	General Bathymetric Chart of the Oceans. www.gebco.net
GeoEcoMar	National Institute of Marine Geology and Geoecology of Romania. Project partner.
GIS	Geographic Information System
HCMR	Hellenic Centre for Marine Research. Greek Project partner.
HELCOM	Baltic Marine Environment Protection Commission - Helsinki Commission
IBCM	International Bathymetric Chart of the Mediterranean. www.ngdc.noaa.gov/mgg/ibcm/
ICES	International Council for the Exploration of the Sea
IEO	Spanish institute of oceanography. Project partner.
Ifremer	French Research Institute for Exploitation of the Sea. Project coordinator.
INSPIRE	Infrastructure for Spatial Information in the European Community (2007/2/EC)

INTERREG	From wikipedia: "*An initiative that aims to stimulate cooperation between regions in the European Union.*"
ISPRA	Italian Institute for Environmental Protection and Research. Project partner.
JNCC	Joint Nature Conservation Committee – UK project partner.
K_{DPAR}	Diffuse attenuation coefficient of the photosynthetically available radiation
Mc-WAF	Mediterranean-Coastal WAve Forecasting
METU	Middle East Technical University. Turkish project partner.
Mesh Atlantic	Interreg Atlantic Area project (2009-2013)
MODEG	Marine Observation and Data Expert Group of European Commission
MS	EU Member States
MSFD	Marine Strategy Framework Directive (2008/56/EC)
NETCDF	Format for description of scientific data, among which oceanographical variables such as wind, tidal current, temperature etc.
NIVA	Norwegian Institute for Water research. Project partner.
OSPAR	The Oslo-Paris Convention for the Atlantic
OWF	Offshore Wind Farms
QA/QC	Quality Assurance/Quality Control.
RAC/SPA	Regional Activity Centre for Specially Protected Areas
ROC	Receiver Operating Characteristics
UK	United Kingdom
WFD	Water Framework Directive
WGMHM	ICES Working Group on Marine Habitat Mapping
WP	Work Package

1. Introduction

Let us remind the reader of the principal objective of the EMODnet seabed habitat lot which is to create a homogeneous EUNIS (European Nature Information System) seabed habitat map covering all European sea basins. The main block of work is to thus extend the broad-scale seabed habitat map - referred to as the EUSeaMap - to cover all European basins, with enhanced validation and confidence assessment. A second objective is to complement the modelled broad-scale habitat map with the collation of survey habitat maps obtained from Member States repositories. The habitats portrayed in the maps are going to be translated into EUNIS codes, and maps are going to be stored in an attractive portal designed to suitably meet users' needs.

The developments achieved in the second year of the project were quite effective regarding the first objective and the consortium was able to provide a broad-scale map which meets the tender requirements. The broad-scale habitat map is comprehensive for all EU marine basins with the exception of the Madeira Island in the Atlantic where no data were found in spite of our best efforts. The delivered map also extends into areas that are beyond EU Member States jurisdiction, namely in the Levantine Sea, Black Sea and Barents Sea, on the basis of outputs received from the Emodnet Bathymetry and Geology lots. In areas where substrate data were missing but bathymetry was available, biological (depth) zones were computed and displayed. Although these areas are not reported according to EUNIS habitat codes, they provide information on the extension of the biological zone which may be useful to some users.

The second objective of collating survey maps from partners' countries has only been very partially fulfilled. The countries that had long been "in the loop" owing to previous habitat mapping projects (mostly UK and France) went on providing some newly-made maps from surveying programs but this is all too marginal. Other partner contributions are still pending because during year two most effort was placed on data collection and resolving threshold issues fundamental to the modelling process. Although no commitments for volumes have been made in the contract, the idea was to demonstrate feasibility and set the scene for a potential follow-on where the seabed habitats portal would become the central access for habitats maps in Europe. Emphasis is going to be given on this task right after the Ostende Jamboree.

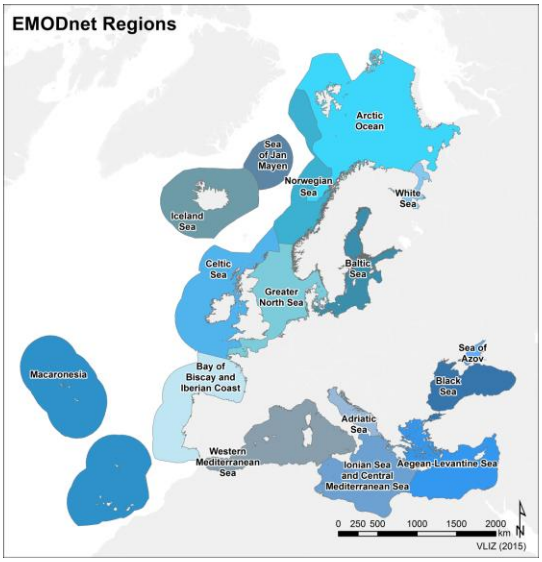
Improvements were implemented in the webGIS, i.e. harmonisation of layers and keys giving more visibility, more guidance for the user, more effective cross-linkages between pages. Consultation and downloads from the portal remained at high levels during this second year and it expected that new interest will arise from the incorporation of a number of new basins.

2. Highlights in this reporting period

- Creation of the broad-scale EUSeaMap for the entire EU marine area, implying the improvements of EUNIS habitat thresholds based on statistical analysis.
- Improvement of the definition of some EUNIS level 2 and 3 habitat categories in the Black Sea as feedback to EEA's EUNIS group.
- Broader collation of Posidonia maps from the Mediterranean for inclusion as a substrate type. As a result data owners and stakeholders are becoming much more aware of EMODnet in the Mediterranean.
- Tidying up of the webGIS, addition of new facilities and addition of new layers such as models of Mediterranean habitats and habitat maps from survey.

3. Summary of the work done

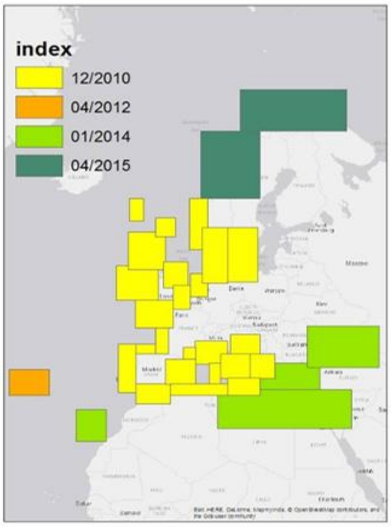
Work done



- First run ever of the comprehensive EUNIS habitat model for all EU marine basins, namely Baltic, Norwegian, North Sea, Celtic, Atlantic, Macaronesia, Western Med., Ionian and Central Med., Aegean and Levantine, Black Sea.
- Creation of two masks covering river plume areas (Po and Danube). This was made necessary by the high impact of turbidity and fine sediment apposition on habitat distribution which made light driven infralittoral/circalittoral thresholds used elsewhere irrelevant.
- Final choice of a list of broad-scale habitat types to be modelled for the Black Sea (BS), which at this stage may not (yet) be compliant with the BS habitat hierarchy

currently defined in EUNIS. This implied making sure our physical data sources would be suitable in terms of resolution (spatial and semantic) to render these habitats in the absence of an established classification. In turn this list will be helpful for the ETC/BD when revising the EUNIS Black Sea habitats.

- Lots of statistical work done on thresholds by using adapted models and data sets, both physical and biological. In the Atlantic most thresholds were based on UK MNCR habitat data base. Elsewhere local data sets (vegetation, endofauna) were used, which are described in WP3 below.
- Light data from the Meris satellite imagery were obtained in April 2015 for the Norwegian Sea up to the Russian border. A synopsis of the geographic area today covered in light data is shown in the figure.
- Collation of Posidonia data in the Mediterranean, both in the form of samples (aimed at thresholds validation) and in the form of polygons (to feed the "substrate" layer). Over ten institutions were contacted with overall good return.
- Improvements of the Seabed habitat portal, and specifically the webGIS, following a survey and resultant recommendations made by the Secretariat.



Synopsis of the geographic area covered in Meris satellite data in four deliveries from 2010 to 2014 during EMODnet phases 1 and 2.

Tasks that remain to be done

- A "maintenance" phase of the broad-scale map will run in third year using the latest outputs from both the Bathymetry and Geology lots to increase coverage and quality.
- Where available, improved physical data on seabed exposure will be used namely: i) for France results provided by ongoing hindcast runs of a French high resolution model (500m) will be incorporated. In addition to a slightly better resolution, those results will improve the habitat maps because they will provide values of kinetic energy at the seabed, while the model that was used for the present version provides values that are averaged over the full water column, ii) for Italy the expected outcomes are very high-resolution estimates of sea-bottom kinetic energy due to

wind-wave and currents in two selected coastal areas (the western area of Cyprus Island and the western area of Elba Island at 1/240 deg resolution at least). In addition, the estimates of peak kinetic energy at the bottom due to waves will be improved in all the Eastern Mediterranean (from 1/30 to 1/60 deg. resolution). We will make use of the new bathymetric products made available from EMODNET Bathymetry.

- The feasibility of running the EUSeaMap model on resolution 100m will be assessed. The issue is: how much of the EU marine area can still be reliably covered using this resolution and what is the scope for future improvements?
- Four pilot sites will undergo modelling at very high resolution (tentatively 50m or better) and biological data incorporated as a way to test this dual approach (physical modelling + biological samples) as an alternative to full surveys.
- Confidence will be assessed for seabed habitat maps. This work will be coordinated with lots Bathymetry and Geology which also have an obligation to QC their data sets. A timeline will be jointly adopted at the Jamboree in a special session.
- Special emphasis will be placed on each partner contributing survey habitat maps to the webGIS. Spain (IEO) have worked on processing 4 survey maps in Spanish waters, namely Seco de los Olivos, Banco de Galicia, Golfo de Cádiz and Cañón de Avilés. These will be delivered soon.
- A page on broad-scale maps confidence and limitations with examples of application of the modelled data with a link from the access data pages, will be designed. The creation of habitat maps, thoroughly described in the frame of the MESH project at (http://www.emodnet-seabedhabitats.eu/default.aspx?page=1485) will be expanded and moved to the main EMODnet Seabed Habitats website, with relevant links to external sites.
- Regarding thresholds, some improvements are still planned using biological from ROV survey. The identification of biological limits using multivariate analysis and habitats modelling techniques could be taken forward in some specific pilot areas of continental Spain and the Canaries.
- Expected publications:
  - Black Sea habitats, e.g. reflections on the specific approach and the linking of biology to physical parameters.
  - Synthesis of light thresholds across European basins
  - Map confidence (based of long experience accumulated over the last 5 years).
  - Uses of the broad-scale EUSeaMap

4. Challenges encountered during the reporting period

WP	Challenges encountered
WP2	We failed to get data on Madeira, in spite of attempts from our partner IEO to liaise with Portuguese colleagues. It was recently confirmed by the Portuguese representative to the Geology Lot that no substrate data were available for Madeira, which precludes us from making the full habitat map. What is feasible is the default solution of representing biological zones based on depth only (shown in grey tones in the symbology).
WP2	Regarding the delivery of Geology WP3, it was striking to see that regions actually covered by a marine sediment map compatible with the 1:250000 requested scale appeared void on the Geology Index map of the latest delivery (e.g. the French part of the Bay of Biscaye). This probably comes from some misunderstanding between Geology partners. Fortunately we had access ourselves to the proper data sets so we were able to remedy this problem and the habitat map will not suffer from it, however in future it is hoped data flows will be more properly established between Member States sources and EMODNet to avoid such issues. In the Adriatic sea, the Emodnet geology 1:250000 delivery map provided a substrate characterisation, for the area lying in the Italian midline sector of the Adriatic, that is believed to be unrealistic as far as the coastal belt is concerned (i.e. a sandy mud belt extends directly from the coast to offshore). Since the IBCM map portrays the presence of a more typical coastal granulometry pattern (narrow, strictly coastal, strip of sand followed by a deeper belt of muddy sand) it was decided to ignore the current 1:250000 delivery and use the IBCM substrate map integrated with the limited coastal Emodnet geology 1:50,000 maps.
WP2	Except for most of the Atlantic shores, the outputs from hydrodynamic models are still too coarse to be of real use for modelling seabed habitats. In the Mediterranean in particular, the extension of broad-scale habitat types influenced by hydrodynamics (i.e. maerl beds on coastal detritic bottoms) is such that hydrodynamic models capable of discerning energy levels at lower resolution are needed. This is all the more critical for steep shores (Mediterranean and Black Sea) where wave action does not go much deeper than 50m, making the need for high resolution wave data more acute. The project would like to make this recommendation to DG/MARE for

	transmission to Copernicus. The answer of the EMODnet Physics Lot is that they have some *in situ* wave data (discrete sources of wave data time series) while Copernicus are assimilating these information for models and forecasts, but this does not meet our requirements. Regarding model outputs, the Physics Lot, along with EuroGOOS and Copernicus *in situ* TAC have started working on wave data to have some products to be used by third part users but it will take a while. Therefore we are going to write some specifications for joint work by the end of the year with a 6 to 8 month deadline and will report on progress at next seabed Habitats meeting (April) and by all means in the third interim report.
WP3	Obtaining biological data still remains an issue sometimes because of bureaucratic slowness. This was the case for Posidonia shapefiles from Malta and for southern Mediterranean countries from RAC/SPA. The Maltese spatial data became available too late in the process for them to be included in the testing of the light threshold and integration in the substrate data for the present delivery. They will be used in subsequent map updates. Data on P. oceanica presence (i.e. Turkey) were only available as point data and therefore were not mapped as such. More generally benthos data are still very scarce, whether it be for a better understanding of the links between the physical and biological aspects of the seabed or for integration for better mapping and modelling. This issue is going to be raised at the Jamboree in view of the forthcoming phase and calls. More specifically, it has to be made clear that there is a gap between taxonomic lists resulting from a field observations and habitat classes. When survey maps are made, these lists are as best as possible translated into a level 5 or 6 Eunis habitat class (also called a bioconosis to use a more Mediterranean word), which is based on statistics and by all means remains an approximate process. First of all hardly any country except the UK keep a data base (MNCR) of habitat types, so where existing these are kept in scattered places and are not reachable unless in bits and pieces through “private networking”. Secondly the Biology Lot do not have a remit of collating biocenosis data. What they do is, they collect taxonomic lists, sort them out to make samples of presence, absence, at times abundance of unique species and may make maps of those depending upon spatial density. As it is very rare a unique species is representative of a biocenosis (which is a community of species) it remains difficult for us to use these data either for threshold calibration or better for integration into our abiotic maps. On a positive note, the two groups, after initial contacts in Ostende, will start work as early as end of Nov. in a telco to look at a joint way forward.

WP4	For thresholds computation, there is still some difficulty in gathering proper sample data, all the more for deep sea ones, which are extrememy rare. Sometimes they are not made available by their owners (e.g. some Posidinia samples), but most of the time it is difficult to just know they exist at all. To put it in simple words, every time there is a habitat map, there are benthos samples translated into habitats associated with it. This is a mere problem of visibility that could gain from EMODnet in the future. As a matter of fact habitat samples data are not being catered for by the Biology Lot who do not go further than collating and processing benthos species and associated features. There is a general lack of translation from species to habitats, an operation specific to mapping that should be taken into account in the prospective and that is on the agenda of upcoming discussions between the two lots.
WP6	We have not managed to showcase the collation, translation to EUNIS and webGIS publication on the webGIS of one legacy habitat map per new basin, as was initially planned. We are going to take strong action for this to happen once people have cleared the task of producing the broad-scale map in early year 3. Ways to speed up this process will be looked at during the Oct. progress meeting in Ostende.
WP6	Mediseh coordinator clearly indicated in an email to Project coordinator (Ifremer) and that the geodatabase on Posidonia meadows and other biocenotic data could not be made available to the consortium. This entailed EUSeaMap human resource investment in taking a census Posidonia cartographies ex novo.

5. Allocation of project resources

Consumption of project's resources is at an estimated 68% by Aug. 2015, which is roughly proportional to time elapsed. However in contrast with the other lots the third year is not regarded as a maintenance phase, but rather as a full continuation of the project. Tasks remaining to be done are listed in Section 3 above and they fully justify the remaining resources.

The breakdown of resources into the main objectives has been made by rule of thumb as follows:

- Making data and metadata interoperable and available: 15%
- Preparing data products: 55%
- Preparing web-pages, viewing or search facilities: 15%
- Project management: 10%
- Interaction with users: 5%

6. Meetings held since last report

Date	Location	Topic	Short Description
30 Sept. - 1 Oct.	Malta	EMODNet Geology progress meeting	Topics of interest for us: • 2015 delivery of 1/1M sediment layer • provision of a layer with special features of the seabed • confidence as addressed by the Geology lot
6 Oct.	Rome	EMODNet special event organized by Secretariat	• Status report of each lot and checkpoints. • Contribution of EMODNet to MSFD reporting
20-24 Oct. 2014	Athens	Progress meeting #2	Year 1 work debriefing. Year 2 progress plan with geographical focus on Black Sea and Norwegian Sea.
12 Dec. 2014	Skype conf.	Thresholds meeting	Progress on Eunis thresholds involving Ifremer, JNCC, NIVA and ISPRA
9-10 Dec. 2015	Brussels	Steering Committee meeting	• Progress status • Portal issues • Back to back meetings
28 Jan. 2015	Brest	Emodnet	Emodnet Information Day organised on Ifremer premises
6 Feb. 2015	Skype conf.	Progress meeting	All partners
16 Feb. 2015	Skype conf.	Modelling	Partners involved in WP5: JNCC (leader), Ifremer, GEUS
2 Mar. 2015	Skype conf.	Map submission for WebGIS	Data submission guidance developed by JNCC.
18 March	Skype conf. (Ifremer/ISPRA)	Adriatic seabed sediments	Discussion on some aspects of the Adriatic sediment map delivered by Geology
21-24 Apr. 2015	Bucharest	Progress meeting #3	• Assessment of progress • Workplan and actions for next period • Preparation of Year 2 reporting and Emodnet Jamboree
23 Jun. 2015	Skype conf.	Thresholds	Final decision on thresholds values for: • Biozones • Energy at the seabed
25 Jun. 2015	Skype conf.	Model runs	Summer planning for model runs: • Atlantic • Med. + Black Sea • Baltic Sea

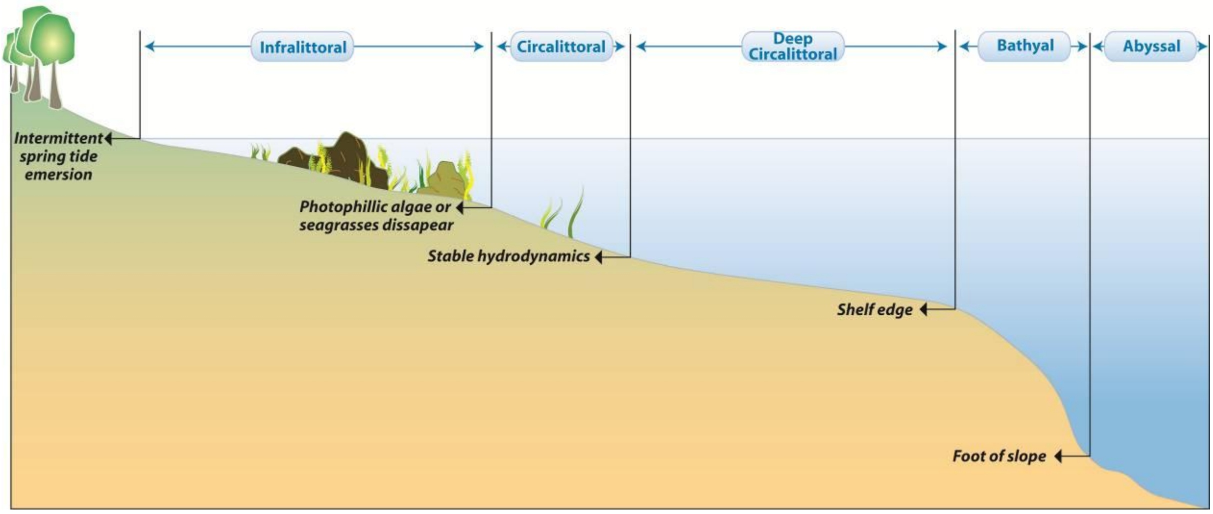
30 Jun. - 2 Jul. 2015	JRC Ispra	Inspire meeting and Steering Committee meeting	• Inspire meeting (EMODNet compliance) • Steering Committee in the presence of JRC staff
2 Jul. 2015	Skype conf.	JNCC and Geus	Thresholds in the Baltic Sea.
13 Aug. 2015	Skype conf.	Modelling subgroup	Coordination of modelling work and reporting
7 Sep. 2015	Skype conf.	All Forthcoming events	• Assessing model runs before delivery • Finalising year 2 report • Preparation of Ostende Jamboree

7. Work package updates

WP1 – Classification review

1.1 Biological zones definition

There is, typically, a marked zonation of communities from the top of the shore to the bottom of the deep sea. However, this zonation is not directly related to depth but to a range of linked factor such as: the drying of the intertidal zone caused by low tides is greater at the top of the shore than the bottom; the amount of wave energy experienced at the seabed dissipates with depth; the degree of thermal stability increases with depth; the proportion of surface light reaching the sea floor decrease with depth.



Where the factors determining zonation are well understood, it may be possible to use bathymetry as a surrogate for the factor causing the zonation, although with increasing distance away from the 'tested' area, this relationship may become increasingly unreliable. A factor which works well to define zones in one region (e.g. light) may not be appropriate in another region (e.g. where wave energy might be more important). There are particular differences between zonation in the Celtic and North Sea regions to the Mediterranean whilst there is not common agreement on zonation in the Baltic.

Biozones (short for biological zones), alongside seabed substrate, are a key feature of habitat classification schemes and an essential component of EUNIS. EUNIS biological zones terminology aims to be univocal across marine regions but the environmental parameters and the degree to which they are responsible for the zonation of the assemblages within the biological zone can vary from one region to another due to biogeographical differences. This entails defining a) the principal environmental parameter which is most responsible for biological zone b²oundary definition in each biological zone and then b) quantifying the physical amount of the environmental variable influencing the biological zoning (threshold value representing the cut off point between the part of seabed that is influenced by the variable defiing the biological zone and the adjacent biological zone). In year two we spent a long time discussing how to model biological zone boundaries, not so much in marine areas for which knowledge on abiotic variables driving zonation have long been established, but for two specific cases a) areas that need to be masked from the wider geographic biological zone modelling approach because biological zonation patterns are influenced by large riverine sediment inputs (areas of the infralittoral and circalittoral influenced by river plumes) b) the deep sea where things are still under development in the scientific community. Examples of the applied considerations are given in Appendix 4, where thresholds defining EUNIS biozones are recapped for each basin.

For example, in the western area of the Adriatic Sea influenced by the Po river plume, light energy reaching the seabed was not considered the driving variable that could be utilised to define the boundary between infralittoral and circalittoral zones. In this area, fine sediment deposit driven by riverine inputs is the predominant factor believed to determine the shallow shelf benthic zoning, whereby the development of infralittoral soft bottoms communities is driven by the presence of fine superficial sands and partially muddy sand, whereas the circalittoral communities develop on sandy mud and mud substrates. A mask was therefore constructed to delimit the external boundaries where sediment typologies were to be applied in determining the infralittoral/circalittoral boundaries. Since the mask area refers to the marine sectors influenced by the river input, the mask boundaries were defined by considering the average surface salinity values observed in the northern part of the basin (37.93 PSU), since this variable is strongly correlated to freshwater input. Wave energy at the seabed (468 N/m2 average energy value observed in correspondence to the maximum depth known to be affected by energy) was also used to define the mask boundary since fine sediments lying in shallow water are also influenced by kinetic energy. Within the mask the infralittoral/circalittoral boundary was based on the intersection of kinetic energy at the seabed and geographic position associated to known infralittoral and circalittoral sediment types.

In the Atlantic at large (consisting in 3 basins plus the Norway area), the deep sea is being split in several biozones according to Bett's late works, which identifies zones based on multiple variables; however for simplicity in this project, the thresholds applied are mostly depth contours.

In NW Mediterranean, the delineation of the bathyal/abyssal boundary was initially made with the help of shelf geomorphology, itself a composite of slope, depth and local ruggedness. In other parts of the Mediterranean where tectonic activity is strong, this is no more viable. When going down from the circalittoral to the abyssal zones, the depth profile can very a lot, from regular in more ancient geology to quite complex in more recent formations where a number of local shelves and depressions, plains or seamounts are found. This implies no single definition of the bathyal zone and the need to rely on experts' say and local knowledge to manually draw the boundary. Examples are given in the figure below.

Bathyal/abyssal boundary in Eastern Mediterranean

1.2 Habitats to be modelled

The habitats to be modelled in the Mediterranean Sea are similar throughout the basin. They were reported in the previous report and have not undergone any modification since then. The process for the Black Sea is described below.

Black Sea

The project produced a tentative broad-scale habitat list for the Black Sea, which could contain the known benthic assemblages occurring throughout the basin and the abiotic variables known to influence them. It is to be noted that at a basin wide level there is no concerted agreement over a univocal list of known benthic assemblages nor of the hierarchical classification scheme according to which these assemblages are sorted out. In the Black Sea this work remained to be undertaken because there has never been a task force capable of exhaustively tackling this issue, and some current Black Sea habitats listed in EUNIS are mostly adaptations of Mediterranean types using modifiers. Effort was therefore put into first agreeing on a pan Black Sea list of assemblages that could be portrayed at broad- scale resolution and harmonising the information available concerning the environmental variables that are likely to influence the distribution of each habitat type (i.e. sediment size, light, temperature, salinity, oxygen saturation etc.)

The Black Sea habitat list was fine-tuned through the revision and modification of the environmental variable ranges necessary for modelling some of the circalittoral deep habitats. This involved checking literature and ground truth data for temperature and salinity values associated to the deep circalittoral muds. Modifications were also proposed for additional substrate categories to model the circalittoral habitats. This involved adding the substrate category "coarse and mixed sediment" to two habitats occurring on sand and mud respectively in the upper and lower circalittoral zones. The addition of coarse and mixed sediments as a determining modelling variable is justified on the basis that these assemblages occur on sand and muddy bottoms characterized by a high proportion of shelly debris. Since no additional layers will be provided by EMODNET geology regarding the presence of bioclastic/biogenic material the only way to model the above-mentioned habitat types is to add the category “coarse and mixed” to the substrate type of these habitats. On soft bottoms, there is a need to split between shallow and deep circa based on seabed temperature regime and in the deep circalittoral oxygen saturation also comes into play to model periazoïc and anoxic habitats.

At this stage the Black Sea broad-scale map will not be a map portraying currently existing Black Sea EUNIS codes, but rather based on a list of specific physical habitat classes agreed on within the project that best describe the seabed. It is hoped that in the near future, following the re-visitation of the EUNIS classification (a task currently led by the EEA and its European Topic Center on Biodiversity), the EMODnet seabed habitats output for the Black Sea will allow for a more straightforward and comprehensive integration into the EUNIS classification scheme. This time-consuming work is drawing to an end in this second year with the delivery of a final table of Black Sea habitats shown in Appendix 1, although several unexpected habitat types emerged from the modelling process with respect to the initial habitat list. These unexpected habitats are most likely to be attributed to substrate typologies which were not expected in the initial list and work will be done to correct and amend the table accordingly in the third year.

WP2 – Collation and preparation of physical data

WP2 includes collation of primary data and preparation of the data layers as inputs to the model. Basically we use three main types of data: bathymetry, geology (substrate) and oceanography, plus marginally some chemical data (Black Sea). The former two are received at every update from the other EMODnet lots, therefore their secondary elaboration is rather limited with the exception of the Black Sea.

Oceanographic data (light, energy, salinity) need more preparation because they are used as climates and as such undergo statistical computations leading to secondary layers that can go into the model.

2.1. Bathymetry

The complete 250m DTM was provided by the Bathymetry lot. Additionally some depth data were provided by the Romanian, Bulgarian and Turkish partners to complete the Black Sea bathymetry that until now is essentially based on GEBCO. The Black Sea DTM, although marginally improved for EU waters is still basically at a resolution of 1 km.

Name	Origin	Area
Depth contours	GeoEcomar	Black Sea Romania
Depth contours	IOBAS	Black Sea Bulgaria
Depth contours	METU	Black Sea Turkey

2.2 Substrate

1: 1M Substrate map

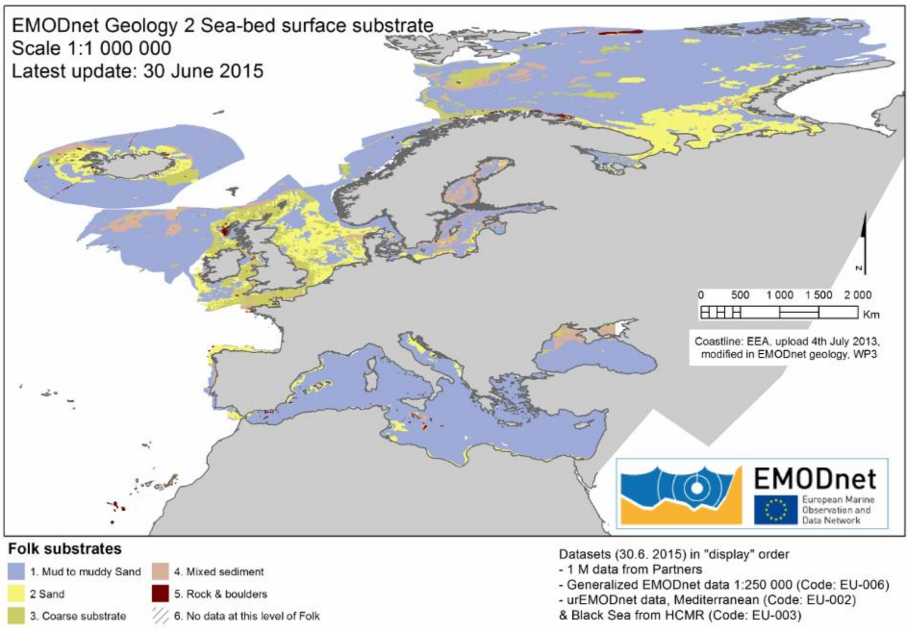
Substrate data were received from the Geology lot in June 2015 as a coverage of Europe at scale 1:1M, compatible with our model at around 250m resolution. Data were combined from the following datasets:

- Broad scale (scale not better than 1:250000) data received from the partners (by 17th June)

- 1:250 000 data that were generalized into 1:1M

- UrEMODnet data (1:1M)

- Unconsolidated Bottom Surface Sediments of the Mediterranean and Black Seas (IBCM-Sed) (Emelyanov, E.M., Shimkus, K.M, Kuprin, P.N., 1996. Intergovernmental Oceanographic Commission (UNESCO).



EMODnet_Geo_WP3_Substrate_1M_30June2015_5Classes

Substrate classes

Geology delivered three files with 15, 7 or 5 Folk classes. In the 5 class layer the split between the muddy class and the sandy class is at the 9:1 mud to sand ratio. Therefore on the Folk five class triangle the left hand side category goes from pure mud to sand with only 10% mud, incorporating Folk mud, sandy mud and muddy sand into one single class.

This split is different to the 5 class map product produced in urEMODnet (which splits the transition from sandy habitat to muddy habitat at 8:2) and has caused problems for consistency.

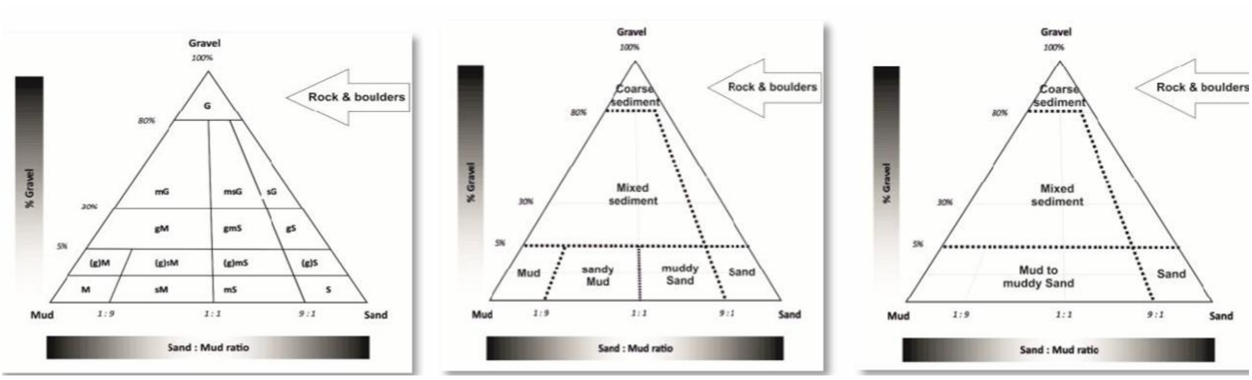


Figure showing the 3 different Folk triangle divisions in which seabed sediments were classified

The substrate layer at scale 1:250000 will be delivered in Oct. 2015. It will only cover 20% of the EU marine area, the remaining part being bridged with 1:1M data. It will enable to test the feasibility of a future 100m resolution map and to process a few coastal pilot sites at 50m resolution across the partnership.

2.3. Oceanographic data

Mediterranean and Black Sea

The objective of the activities in the second year of the project was to consolidate the preliminary Mediterranean scale oceanographic results obtained during the first year, refine the analyses at the regional scale in terms of increased resolution where possible, and prepare the necessary framework for the coastal scale analysis which will be carried out in the third year. The expected results are:

- the re-evaluation of the 90th percentile seabed peak kinetic energy (KE) due to wind-waves and currents in the Mediterranean Sea; the analysis of salinity, temperature and currents in the Adriatic Sea using high resolution data, and salinity, temperature and currents in the Black Sea;
- the evaluation of bottom peak KE (90th percentile) at high resolution in the Adriatic Sea for both the contributions of currents and wind-waves;
- the evaluation of wind-waves sea-bottom peak KE at very high resolution in the Northern Adriatic Sea.

The seabed peak KE has been re-evaluated for the wind-waves component improving: a) the bathymetry in coastal areas, b) the parametrisation of the wave-bottom interactions and c) extending the temporal period previously considered. Waves (Appendix 2, section 1) are based on the Mc-WAF and the Kassandra project data at resolutions of resp. 1/30° and 1/60° on a finite element triangular mesh at variable resolution. Finally, at 1/120 deg. res. has been studied as a test for the very high-resolution analysis. The same analysis will be extended to the areas near Elba Island and Cyprus in the next stage of the project. Based on the experience gained during the first year of the project, special care was taken to improve the bathymetric data used for Mediterranean, regional and coastal-scale simulations, in particular for the range of very shallow waters. All models were used with the capability of simulating the main interactions with the sea bottom, i.e. wave refraction and breaking. A set of boundary conditions was added to the system in order to improve the results in the central Tyrrhenian Sea and to introduce regional, high-resolution scale areas in the Aegean and Levantine Sea. The new conditions are necessary for the implementation of the high-resolution coastal areas near the Elba Island and Cyprus which will be the objective of the final stage of the project. All simulations have been run again from the start in order to provide a consistent set of results. New regional scale products at high resolution have been also made available for the Adriatic Sea and the Black Sea. While in the previous preliminary analysis the peak statistics were based on the maximum value in the period, all the new peak seabed kinetic energy estimates have been re-evaluated in terms of 90th percentile.

Temperature, salinity and current statistics, already preliminarily estimated during the first year, have been improved in the Adriatic Sea using high-resolution data (1/45°) from the Tessa project. The Black Sea has been included in the analysis using the MyOcean and Kassandra project data. The following highly resolved statistics have been added for Adriatic Sea and black Sea:

- the average salinity at the bottom and at the surface;
- the average of annual maxima of salinity at the bottom and at the surface;
- the average of annual minima of salinity at the bottom and at the surface;
- the average velocity modulus ($\overline{v}$) at the bottom and at the surface;
- the average of annual maxima velocity (indicated as VAAM) at the bottom and at the surface;
- the average temperature at the bottom;
- the average of annual maxima of temperature at the bottom;
- the average of annual minima of temperature at the bottom.
- The 90th percentile of seabed kinetic energy (wave and currents contributions)

All data used to refine and extend the present analysis were extracted from the archives of the MYOCEAN project, the Tessa project, the Kassandra project and from the ISPRA Mediterranean-Coastal_WAve Forecasting system. Details on the sources are given in Appendix 2 section 1. The numerical methods are described in Appendix 2 section 2. Due to the wide extent of the subject, results are outlined and briefly discussed in Appendix 3 section 3. Data files are produced as shapefiles and NETCDF geo-referenced files as detailed in Appendix 2 section 4.

Norway

For the whole of the Norwegian coastal zone, wave exposure (5 year average) has been developed with a 25 m resolution. This is the same model as has been developed for Sweden, Finland, the Danish region of the Skagerrak coast and the Russian, Latvian, Estonian, Lithuanian and German areas of the Baltic Sea. The wave energy is at its maximum close to the sea surface, declining towards the seabed. A wave exposure model at the seabed was therefore also run for the whole Norwegian coast. Wave base was detemined by comparing the modelled wave exposure at the seabed with the wave base contour that was applied in the North Sea during EMODnet phase I.

Current speed (90th percentile) was modelled for the whole entire Norwegian coast and parts of the adjacent seas (Albretsen et al. 2011) at a spatial resolution of 800 m using the Regional Ocean Modeling System (ROMS, www.myroms.org, Haidvogel et al, 2008, Shchepetkin and McWilliams 2005, 2009). The current speed model has been transformed into current kinetic energy.

A Light model (PAR and KdPAR) was modeled for the whole Norwegian coast, funded by Ifremer and NIVA. Kelp data (both presence/absence data and real lower growth limit) have been submitted in order to combine this with light in the estimation of the light-related thresholds.

In summary, below is the table recapping physical as well as oceanographic data obtained from various sources as inputs to the EUSeaMap model:

Name	Origin	Area	Spatial resolution	Time
Depth DTM (Whole EU)	Bathymetry lot	Whole Europe	250m	V1 Feb. 15
Depth DTM (Black Sea)	Bathymetry lot + depth lines from IO-BAS, GeoEcoMar and METU	Black sea	1 km	May 2015
Seabed sediments	Geology Lot	Whole Europe	1 km	Jun. 2015
Seabed sediment	Geology Lot	Whole Europe (only 20% cov.)	250m	Feb. 2015
Periazoic zone polygon	METU	Whole Black Sea	–	–
Waves	ISPRA	Adriatic	1.2 km	Ready
Currents	ISPRA	Adriatic	2 km	Ready
Waves	ISPRA	All Med	4 km	Ready
Currents	ISPRA	All Med	4 km	Ready
Waves	ISPRA (Kassandra)	Black Sea	Variable	Ready
Currents	ISPRA	Black Sea	5 km	Ready
Wave-induced seabed energy	French Previmer archives	French coasts	250m	2000 to 2004
Monthly, inter-annual and climatological means of Kd(PAR) (attenuation coefficient of photosynthetically available radiation)	MERIS FR orbits archives	Norway	250m	2005 to 2009
Monthly, inter-annual and climatological means of atmospheric PAR (photosynthetically available radiation)	MERIS RR orbits archives	Whole Europe	4 km	2005 to 2009
Secchi disk measurements	METU	Black Sea	–	Point

WP3 - Biological data collation

The objective of this second year was to collect as much as possible biological information (phyto and zoobenthic communities) in the form of polygons and sampling points, to be used as ground truth data for setting up the physical thresholds of habitats within the Mediterranean basin (Central Mediterranean Sea, Ionian Sea, Aegean Sea, Levantine Sea, Adriatic Sea), North Sea, North Atlantic, Celtic and Black Sea.

3.1 Data collated

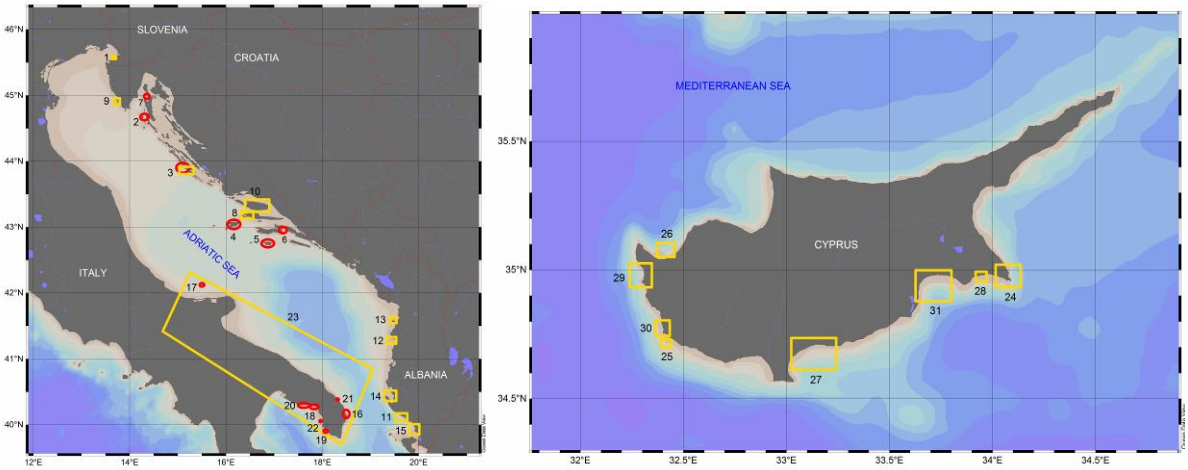
Mediterranean, Adriatic, Aegean, Levantine and Ionian Seas

In order to build the integrative substrate layer made of *Posidonia oceanica* meadows and to determine the infralittoral lower limit based on the estimated light value associated to the deepest point where Posidonia could be found (proxy for light penetration at the seabed), ISPRA and HCMR collected data from almost all countries around the Mediterranean Sea. The data included both sampling points and polygons. All data were passed through a complex selection and validation process involving the selection of Posidonia meadows whose lower limit extension was estimated to be influenced by decreasing light and not by other anthropogenic or environmental factors. This involved selecting cartographic data characterised by meadows that had specific lower limit morphologies, depth ranges, shoot density and surface area cover. The data collection process for the selection of *Poceanica* for validation of light threshold was conducted in parallel with the collection of *P. oceanica* and *Cymodocea nodosa* maps to be used as additional substrate layer. Maps of seagrass meadows and information on the above mentioned criteria regarding Posidonia meadow lower limits were identified and collated as follows:

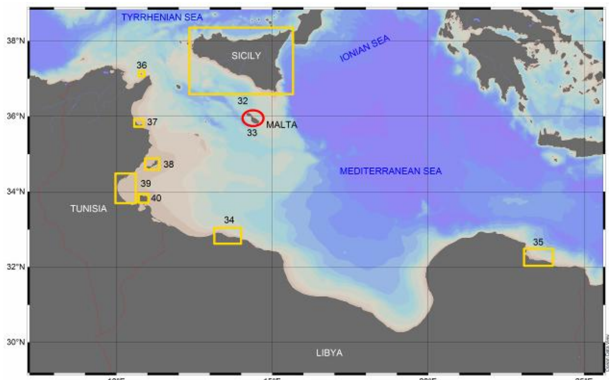
- Project partners searched in house and through national research networks for available *P. oceanica* and *C. nodosa* cartographic data;
- All Barcelona Convention National Focal Points for the SPA/BIO protocol were contacted to make a census of the available mapping data and national contacts known to have been involved in monitoring Posidonia lower limits for the WFD.
- A literature review of UNEP-RAC/SPA technical documents and proceedings of the five Mediterranean Workshops on Marine Vegetation was conducted so as to identify potential scientific data owners with cartographic data and information on Posidonia meadows that met the selection criteria described above.
- Requests were sent to all identified data owners so as to collect cartographies and georeferenced information on *P. oceanica* lower limit characteristics. Advice was sought directly with national experts and data owners so as to discuss

appropriateness of data collected with respect to the above mentioned selection procedure.

- A challenging task was to obtain Posidonia data from North Africa where Posidonia maps and studies on the meadow lower limit are not abundant. In spite of difficulties, ISPRA managed to obtain mapping information from Tunisia and Lybia through the UNEP/MAP RAC/SPA secretariat of the Barcelona Convention.



Locations of sampling points (red dots) and polygons (yellow rectangles) in Adriatic Sea and Cyprus Details of numbers are given in Appendix 3



Locations of sampling polygons in Sicily (whole coast coverage), Tunisia, Lybia and Malta. Details of numbers are given in Appendix 3

Atlantic Sea

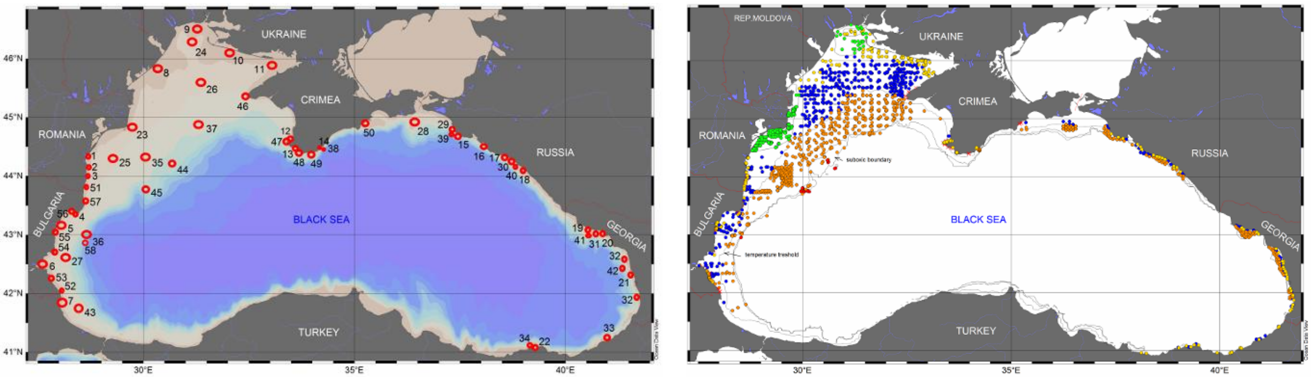
In Norway data on kelp distribution (presence/absence data) in infralittoral of the Norwegian coast were collected by NIVA. There were recorded more than 3000 presence points and almost 400 absence points. The data were compiled from NIVA's projects, but mainly from the National program for Mapping for Diversity – Coast. These have been collected in order to model the kelp forest distribution in relation to wave energy index and light threshold for infralittoral delineation.

In UK and Ireland a large amount of presence/absence point data covering practically almost whole UK and Ireland coasts (Appendix 3) has been gathered by JNCC. This data is referring to biological information related to biotopes/communities on infra and circalittoral rock. The kelp (presence) and many other communities (absence) have been used for light thresholds analysis, while low/high/energy communities on rock for the energy thresholds. The data comes from many renowned organizations with attributions in the field of data collection and nature protection and conservation from UK and Ireland.

Black Sea

In case of the Black Sea, GeoEcoMar has collected more than 3000 sampling points (see Figures below) that came from GeoEcoMar, IO – BAS, IBER and EurOBIS databases. The data are referring to zoobenthic communities (abundances and presence/absence data) and photophyllic algae (presence/absence data), which form specific assemblages associated to the modelled Black Sea broad-scale habitats. Both GeoEcoMar and IO-BAS zoobenthos point samples are based on data obtained during different national monitoring programs and national and international projects (e.g., Nucleu Programs, UNDP/GEF BSERP, 7 FP EC Project CoCoNet, MISIS, WAPCOAST, etc.).

In order to increase their reliability and confidence these data were filtered prior to be used. Hence, georeferenced datapoints referring to species abundance data (i.e. number of individuals, biomass etc.) that were representative of given assemblages were considered.



Black Sea: Locations of sampling points (top), locations of sampling points within habitats (bottom). (Legend: yellow dots – infralittoral soft bottom; red cross – infralittoral hard bottom with photophilic algae; green dots – Danube and Dnieper mask area; blue dots – shallow circalittoral soft bottoms; orange dots – deep circalittoral soft bottoms; red dots – suboxic deep circalittoral). Details of numbers are given in Appendix 3

3.2 Gaps

Mediterranean, Adriatic and Ionian Seas

Although they are the most complete and up-to-date dataset for *Posidonia* distribution in Greece, the obtained polygons are all part of the NATURA 2000 habitat mapping project (implemented back in 2001), and are estimated to represent less than 20% of the total area covered by this habitat type in Greek seas.

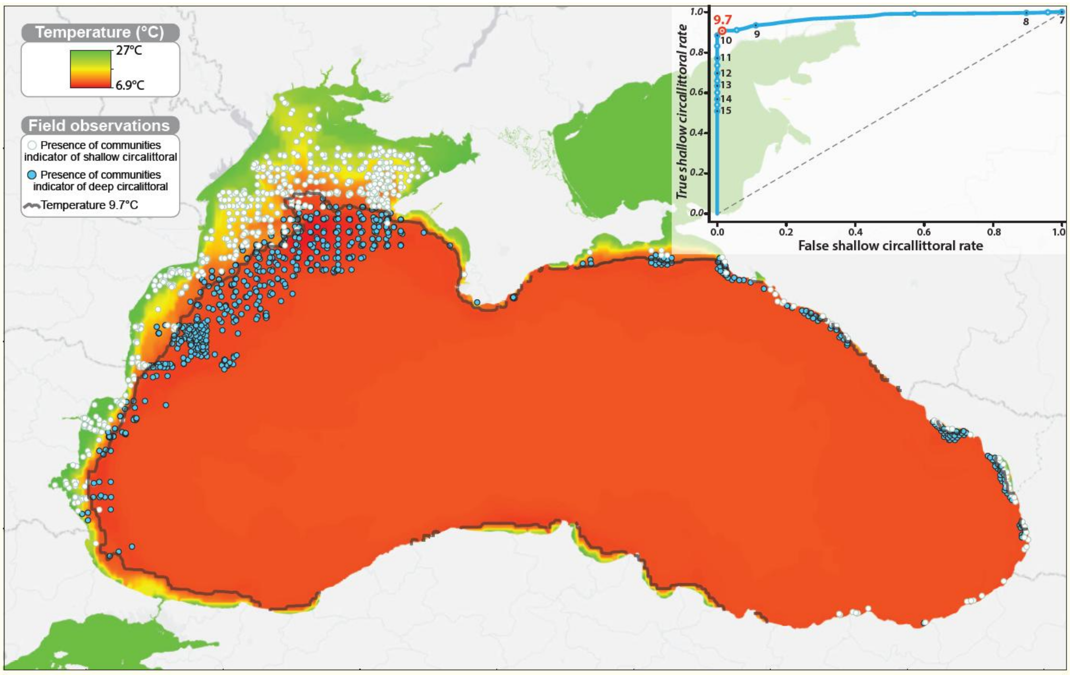
Black Sea

Due to difficulty in obtaining data points from western (Ukraine), northern (Russia, Georgia) and southern (Turkey) parts of the Black Sea, most data was obtained from the EurOBIS database. The Turkish coast was the area least covered by samples, either as point data or polygons. Therefore, thresholds generated for some Black Sea habitats are likely biased by an inadequate geographic coverage of the pertinent assemblages or by the insufficient spatial resolution available for some of the considered datasets (i.e. Cystoseira point datasets were too scarce to define an infralittoral lower boundary).

WP4 - Establishing EUNIS thresholds

Before the creation of the broad-scale maps in a GIS software, it is necessary to define thresholds for likely changes in habitats: in each input layer these are used to define the boundaries between classes, where the change in the physical conditions reaches a critical point that defines an expected change in habitat type (at the map-scale adopted in EUSeaMap, 250mx250m blocks). For example in the Black Sea the boundary between the shallow circalittoral and the deep circalittoral biological zones is where the change in temperature condition reaches such a point that associations of mud with *Melinna palmata* are no longer able to prosper and give way to associations of mud with *Modiolula phaseolina*. The expected threshold value corresponds to that critical value of temperature.

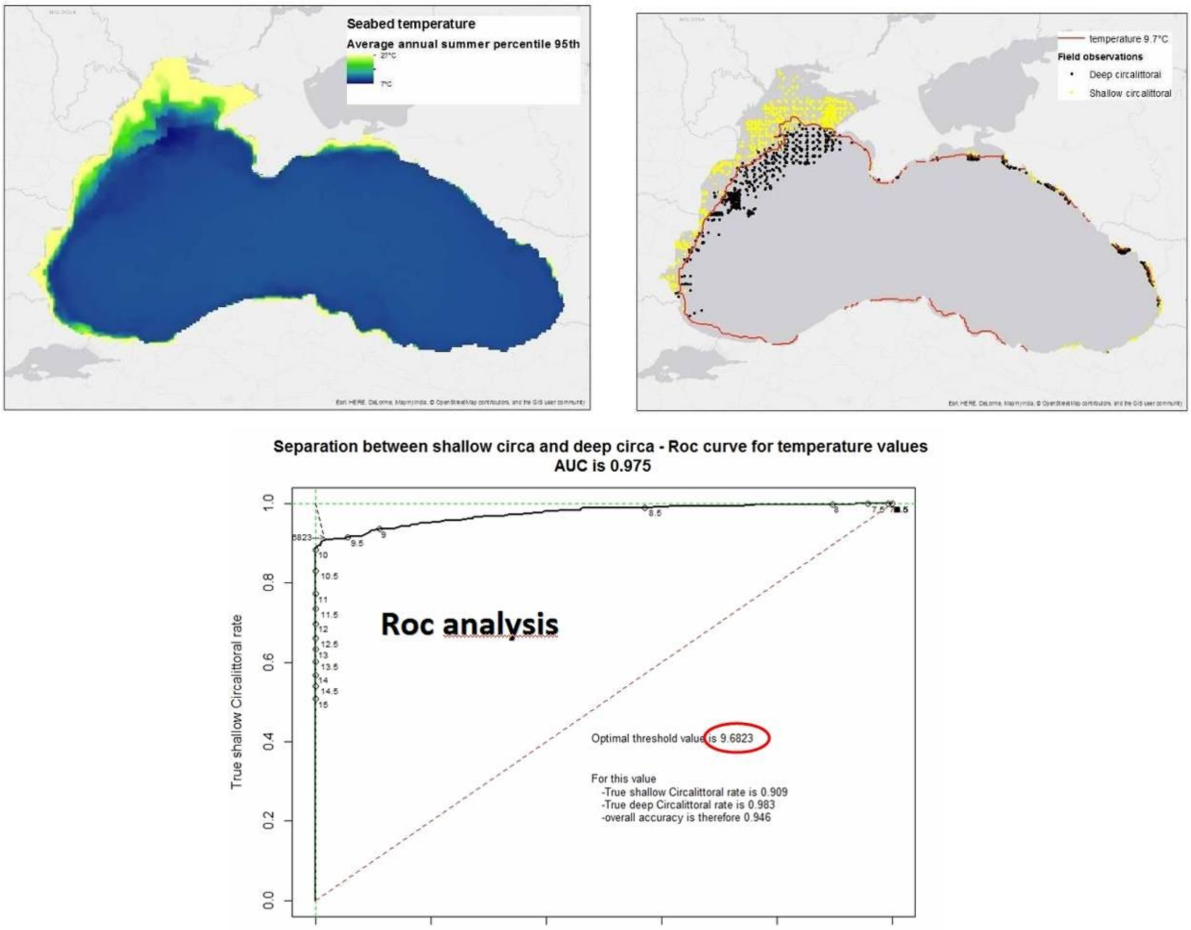
In order to get threshold values that best fit observations in the field, the thresholds are derived from statistical analyses of field-observation sample points. In the optimal situation, where samples on both side of a given boundary (in the aforementioned example observations of *Melinna palmata* of *Modiolula phaseolina*) are available, the receiver operating characteristic (ROC) curve is used. This tool is commonly used for the determination of the optimal threshold value for any variable having a high discriminatory capacity to differentiate one category from another.



Example of threshold identification: the temperature threshold used to separate between the shallow circalittoral and the deep circalittoral in the Black Sea. Map: full-coverage temperature layer and sample points used to construct the ROC analysis; top-right: ROC curve (along which temperature values are displayed), which led to a decision threshold value of 9.7°C. The 9.7°C isoline is also shown on the map. See how well it separates between the shallow circalittoral (white dots) and the deep circalittoral (blue dots).

There have been a lot of computations on threshold values, i.e. the values that allow for the classification of environmental variables (e.g. seabed temperature, seabed light energy) into the EUNIS upper level habitat categories (e.g. 'circalittoral', 'high energy'). Where feasible, i.e. where existing sample data were available, the threshold values were fitted via statistical analyses of these points. The sample point data were occurrences of species (or associations of species, or biotopes) that are indicator of a biological zone limit or modelled broad-scale habitat type.

For example in the Black Sea where the boundary between shallow and deep circalittoral habitats was investigated, the threshold value was computed by taking into account 750 samples points describing associations of mud with *Abra prismatica - Pitar rudis - Spisula subtruncata, Acanthocardia paucicostata* and *Nephtys hombergii*, mud with *Melinna palmata* or Mytilus beds and 710 points associated to deep circalittoral assemblages such as the shelly mud and mud with *Modiolula phaseolina, Terebellides stroemii, Pachycerianthus solitarius, Amphiura stepanovi*. The driving parameter that was analysed was temperature, retrieved from MyOcean and expressed as the 95 percentile of averaged annual summer values.



Top left: Black Sea Seabed temperature, top right: Overlay of samples locations and shallow to deep cicalittoral boundary, bottom: ROC statistical analysis.

The findings of the analyses are reported basin per basin in the tables of Appendix 4. Most thresholds are now stable and have been used to deliver this report alongside with the maps. For a limited number of thresholds provisional values quite close to the final ones will be adopted for this preliminary version of the comprehensive broad-scale map, however they are still prone to some adjustments upon our seeking additional sample data in the third year (i.e. additional maps of *Posidonia oceanica* meadows). Subsequently a final run will be produced by project end.

4.1 Black Sea

For the Black Sea, all threshold values were worked out. They were fine-tuned via statistical analyses of sample point data provided by GeoEcomar and IOBAS. The shelf edge, which is the slope change that was chosen as the boundary between the deep circalittoral and the bathyal, was manually drawn by HCMR.

4.2 Eastern Mediterranean, Aegean, Ionian and Adriatic Seas

The threshold development is complete, as well as the manual delineation of the shelf edge for the circalittoral/bathyal boundary and the foot of slope (for the bathyal/abyssal boundary).

At basin level, threshold development for infralittoral lower limit was obtained by running statistics from Posidonia polygons selected according to the criteria described in WP3. Light threshold differences were computed at regional level to take into account eventual oreographic and hydrologic differences between basins. To this effect it is to be noted that different observed light threshold values identified in the Adriatic sea with respect to the more southern regions could be attributed to numerous factors such as: steeper rocky continental shelves where the light extrapolation on seabottom is biased by the bottom slope and lower bathymetric limit resulting in higher estimated light values, higher light penetration to equivalent depths, etc.

4.3 Celtic Seas and Greater North Sea

It was decided to review all the thresholds that were defined in the framework of phase 1. The infralittoral/circalittoral boundary threshold was defined via statistical analysis of sample point data provided by the UK Marine Recorder and sample point data of lower growth limit of kelp for Norway. A new statistical analysis of the Marine Recorder samples was also carried out for the high / moderate / low wave energy EUNIS categories. Analysis is in progress for the shallow/deep circalittoral and the deep sea boundaries.

4.4 Bay of Biscay, Iberian Peninsula, Azores, Canary Islands

The classification into EUNIS categories will largely build upon the thresholds that were previously developed within the framework of the MeshAtlantic project. However for the infralittoral/circalittoral boundary the new threshold value given by the analysis of the UK Marine Recorder and Norwegian samples will be used (see above, Celtic Seas and Greater North Sea). Since there have been new fine-scale inputs for wave- and current-induced energy for the bay of Biscay, all the thresholds for that area are also being redefined for the classification into high / moderate / low energy EUNIS categories and for the shallow circalittoral / deep circalittoral.

4.5 Baltic Sea

Thresholds that were developed in the first phase will be re-used. For the fully marine Skagerrak area adjacent to the North Sea, the thresholds developed for the Celtic Seas and Greater North Sea were adopted.

4.6 Norway

The wave energy variable used in Norway for the classification into the high / moderate / low energy levels or shallow /deep circalittoral is a fetch-dependent wave exposure index, while it is kinetic energy at the seabed in other regions. The threshold values will be calibrated so that the resulting mapped boundaries match the boundaries defined for the Celtic Seas and Greater North Sea where the exposure index and the kinetic energy layers overlap. For other boundaries the thresholds developed for the Celtic and Greater North Sea are used.

WP5 – Modelling and Confidence

The purpose of this work package is i) to produce a comprehensive broad-scale EUSeaMap by integrating the physical layers and processing them in GIS and ii) develop confidence layers for the broad-scale habitat map and input physical layers. This section reports on the way the models were organised, on the quality of the outputs and future improvements needed during the maintenance phase. The sea areas have been divided into three blocks for creating and running the GIS workflows to produce the habitat maps: (1) Atlantic (Norway to Macaronesia) assigned to JNCC, (2) Mediterranean and Black Sea to Ifremer and (3) Baltic Sea to NIVA-DK.

5.1 Overview of the approach used to produce the maps

The general approach used to produced the maps is the same in all areas, and it is based on principles described in Cameron and Askew, 2012. Data processing and modelling was carried out in ArcGIS Model Builder™ by creating a toolset that is divided into 3 main modules: The Combined Energy, the Biological zone and the Habitat mapping tools. The Biological zone tool is used to combine GIS raster layers (such as light at the seabed, wavebase, salinity etc) and map biological zones. The tool applies ecologically-relevant thresholds between classes obtained as described in WP4 and reclassifies the datasets into a biological zone code. Similarly, the Combined Energy tool combines wave and current energy information (where available) into High, Moderate, Low energy classes. The Habitat Map tool combines the outputs of the Biozone and Combined Energy tools with the Substrate layer (See WP2) to obtain a model code per habitat type. Model codes are joined to a EUNIS habitat codes table. Tables of EUNIS Habitat types that can be identified in each basin from the input data layers are shown in Appendix 4.

All raster layers are in WGS84 coordinates, have a resolution of 0.0021 degrees and share the same grid obtained from the EMODnet Bathymetry Mosaic layer (Version February 2015).

5.2 Descriptive summary of maps in new regions.

Norway

During phase 2 we have extended the mapping of Norway's seabed habitats to include most of Norway's exclusive economic zone (EEZ), where data are available. Several challenges were encountered in the creation of this map. To begin with, EUNIS is not usually used in Norway and was not developed with Norway in mind. This meant that we needed to put much thought into the biological relevance and definitions of the habitat classes that we assigned to Norwegian seabed. Data availability was a limitation as surface PAR (I0) layers did not cover the full Norwegian EEZ area and substrate data are more or less absent outside of the Mareano areas. The wave exposure model for Norway was also an index, making the inter-calibration with the wave exposure models of the other countries a bit challenging. Due to the steep slope of the seabed in coastal areas, the resolution of the input data layers was not always high enough. Another challenge was producing a seamless map at the join between this and the Greater North Sea map as sometimes it was necessary to use different rules or thresholds due to the sometimes different input parameters and/or data layers.

We will continue to improve the map in year 3, with specifically further refinement of the thresholds for energy and deep sea biological zones.

Black Sea

The main challenge was to deal with several unexpected habitats on top of those primarily identified in the Black Sea habitats list of Appendix 1. A more detailed explanation of this situation can be found in Appendix 4 in the note below Table A4.4).

Concerning the habitats within the mask area of Danube, the presence of all types of substrate in the mask area might have created a confusion in the distribution of these habitats in different biological zones. It was proposed that in the future a new approach based on bathymetry to be tested in order to delineate the mask contour.

Modelling of the Marmara and Azov Seas using the Black Sea approach should be reconsidered since the former is mainly under Mediterranean influence, while the latter is hardly connected to the Black Sea, with characteristics quite different of it (very low salinity, very shallow, high riverine inputs).

Finally, a significant part of the Black Sea, namely the south-eastern part, needs to be considered next year in order to increase the efforts towards getting new biological data about the habitats and species there. If possible, a common methodological approach on data collection should be trialled (e.g., increasing the polygon data collection) and much attention paid on improving the knowledge on communities prone to form specific habitats strongly dependent of certain environmental parameters.

Adriatic, Central Mediterranean and Ionian, Aegean and Levantine seas

Appendix 1 contains the list of broad-scale habitat types that were modelled in the Mediterranean sea basins during this phase. The habitat modelling matrix is the same as that used to model the Western Mediterranean habitats in the first phase, which relies mostly on the intersection of substrate classes and biological zones. Within the Adriatic mask the infralittoral/circalittoral boundary was defined through a GAM model which takes into account seabottom wave energy and geographic position. The substrate layer was integrated with additional substrate categories for *Posidonia oceanica* and *Cymodocea nodosa* meadows.

The modelled map resulted in the presence of unexpected infralittoral habitats classified as infralittoral sandy mud and mud obtained through the intersection of the substrate layer with the biological zone. In most cases these unexpected habitats are considered doubtful because infralittoral sandy muds and muds are present in very shallow superficial waters, well protected from wave exposure and they have limited surface area extensions. Most of the unexpected polygons of this nature instead are large and it is likely that they can be attributed to coarse / poor quality substrate input layers. These doubtful habitats could also be due to poor bathymetric data which would interfere with an erroneous estimation of light at the seabed used to define the infralittoral/circalittoral boundary. These habitat polygons are flagged on the modelled map as “uncertain”. The only exception to these doubtful records could be where they occur in very sheltered bays or in proximity to large ports with high siltation due to coastal degradation, or in proximity to river mouths. In the western portion of the Adriatic sea where soft bottoms prevail, although habitat modelling output does not seem to show unexpectedly large polygons, the coast-to-offshore sequence of modelled habitat types does not appear to have a smooth continuum as would be expected. In particular, the succession of sand to muddy sand to sandy mud and mud does not occur along belts running in a continuous mode alongside the coast, due to the presence of limited 1:50000 sediment maps surrounded by 1:1000000 sediment maps.

The planned improvements for year 3 concern:

- The collation of missing P. oceanica and C. nodosa meadows for integration into the substrate layer. Point datasets indicating P. oceanica presence will be integrated into the map as an additional layer indicating presence/absence
- The rerun of light threshold value including Maltese meadows
- An attempt could be made to generate a mask surrounding the major rivers that are not masked in the present map in order to take into account shallow areas with circalittoral substrate types (mud and sandy mud) and better model the infralittoral / circalittoral limit.

Greater North Sea and Celtic Sea

A broad-scale physical habitat map was first created for this region during EMODnet phase I, with the most recent version created in 2012. During phase II we input some more up-to-date physical data and reviewed some of the thresholds for classifying the input data layers. An overview of the parameters and input data layers used in the creation of the habitat map can be found in Appendix 4, Table A4.11.

Compared with the more recent version, as a result of the revised thresholds and changes to some of the input layers for biological zones, the new map generally has a larger infralittoral zone, a smaller shallow circalittoral zone and a larger deep circalittoral zone. The naming of and boundaries between deep sea biological zones have changed to follow the most recent research, as summarised in Parry et al (2015). The exclusion of the 10 % most extreme energy values has resulted in an increase in lower current energy classes, while the reassessment of the wave energy thresholds has resulted in an increase in the extent of moderate energy classes. Finally, due to EMODnet Geology changing their definition of some of the broad sediment types in their substrate map, the amount of muddy habitat has increased and the amount of sandy habitat has decreased.

Because a map already existed for this region, we had to be careful to make sure any changes we made were justifiable. This is because the existing map is already being used for planning and decision-making in several Member States. This region has a relatively good amount of biological reference data for the assessment of thresholds. However, there were challenges in finding the most suitable reference species or biotopes for the assessment of energy classes and the boundary between shallow circalittoral and deep circalittoral. Other challenges included producing a seamless map around the intersections with maps from other regions - Arctic (Norway), Baltic and Biscay - as sometimes it was necessary to use different rules or thresholds due to the sometimes different input parameters and/or data layers.

We will continue to improve the map in year 3; as well as the general improvements provided by enhanced input data layers this will include further refinement of the thresholds for energy and deep sea biological zones.

Baltic Sea

A broad scale habitat map was produced in the first EUSeaMap project in 2012. All relevant and available datasets were used for the final production. Since then some data layers were improved noticeably such as the sediment layer and the bathymetry. These two new layers were used in the production of the 2015 habitat map for the Baltic Sea waters. An overview of the parameters and input data layers used in the creation of the habitat map can be found in Appendix 4, Tables 4.13 and 4.14.

Not so many changes were made as compared with the previous EUSeaMap habitat map except for the seabed sediment map which was produced with higher resolution after new sediment data was attributed to the existing map and the new bathymetry map with about 0.02 degree cell size. The major changes can be identified in areas where sediment data has been improved.

The main challenge is for areas where there are no equivalent EUNIS classification. These were not given any codes and left for future discussion. Also efforts have started for finding a higher resolution light penetration dataset (Secchi disk depth) as it could strongly effect the biological zones spatial distribution. So these efforts will continue in the next step, as well as on searching for improvements in the biozone thresholds.

Western Mediterranean

This map has not been updated in this phase. However it could be improved by adding masks (for Rhône, Ebre and Arno deltas for example). Polygons from maps of North African P. oceanica and C. nodosa also need to be added to the substrate layer.

Macaronesia (Canaries)

The map for the Canaries was described in the previous interim report and it has not been updated since then. IEO plans to get involved in the process of inferring hard seabed substrate from littoral relief ruggedness by applying bathymetric data and geologic elements analysis to assess the coastal rocky bottoms around the Canary Islands. This will be done in collaboration with HCMR.

5.3 Boundaries of the models

For the Baltic-Greater North Sea boundary it was decided to use the OSPAR/ICES ecoregion boundary to divide the Baltic Sea (model run by GEUS under NIVA-DK's supervision) from the Greater North Sea (JNCC's responsibility). For the Western Mediterranean-Iberia boundary we keep the limit that was used in phase 1 to divide the Western Mediterranean (Ifremer's responsibility in Mediterranean) from Iberia (JNCC's responsibility in Atlantic)

Where there is no substrate information (e.g. parts of Norway, Biscay, etc.), the map will just show biological zones, as was done in the first phase.

5.4 Look-up tables

In phase 1, the same ModelCode to EUNIS look-up table was used for the Celtic Seas, Greater North Sea and Baltic Sea, with a different table being used for the Western Mediterranean. This cannot be avoided, however we decided to try to follow a similar table format.

5.5 Confidence assessment

We reported the confidence assessment methodology in the first interim report as follows: "In summary we will continue to assess source layers using a qualitative scoring approach, the details will depend on the assessment of quality on the primary layers (provided by the other lots). The quantitative approach requires a large amount of in-situ physical data, it cannot be applied in every regional sea and it also requires that all contractors that are (or have been) involved in the derivation of physical layers also provide uncertainty information. Efforts will be concentrated on improving biological relevant fuzzy thresholds in the next year of the project."

Confidence in input layers

Confidence in primary input layers is to be provided by the other lots, basically Bathymetry and Geology. The latter did announce the delivery of a confidence layer in third year. The position of the former is still unclear for us so we suggested to take advantage of the Ostende Jamboree to convene a specific workshop between the 3 lots towards a common position. At best confidence scores would be provided for each CDI polygon, and the next step would be for us is to make a simple mean of the two scores of each single intersected polygon.

Fuzzy boundaries

There has been little progress on fuzzy boundaries at this stage because a lot of time was spent working on the statistical computation of thresholds. Basically there are two cases:

i) Where statistical methods were used, the probability of a zone being true can be directly used as a fuzzy value. This is the case for the infra/shallow circa and shallow circa/deep circa boundaries that are obtained using physical light and wave base data. For combined boundaries (e.g. infra/circa and wave exposure) there will be a need to run statistics with two variables.

ii) Where boundaries were obtained either from manually drawn geomorphological interpretation or a simple depth threshold (e.g. shelf edge or bathyal / abyssal), no fuzzy boundary can be obtained.

More efforts will be allocated to confidence in the third year, after more specifications have been jointly produced at the joint workshop in Ostende.

WP6 – Web portal

6.1 Introduction

Work was undertaken to address several suggestions made by an EMODnet Secretariat review review of the web portal organised in early 2015. The overall feedback was positive with regards to the objective of providing a gateway to European marine seabed habitats data & data products. Nevertheless, the users in the test group identified a number of issues for improvement to make the EMODnet Seabed Habitats portal more user-friendly and fit for purpose:

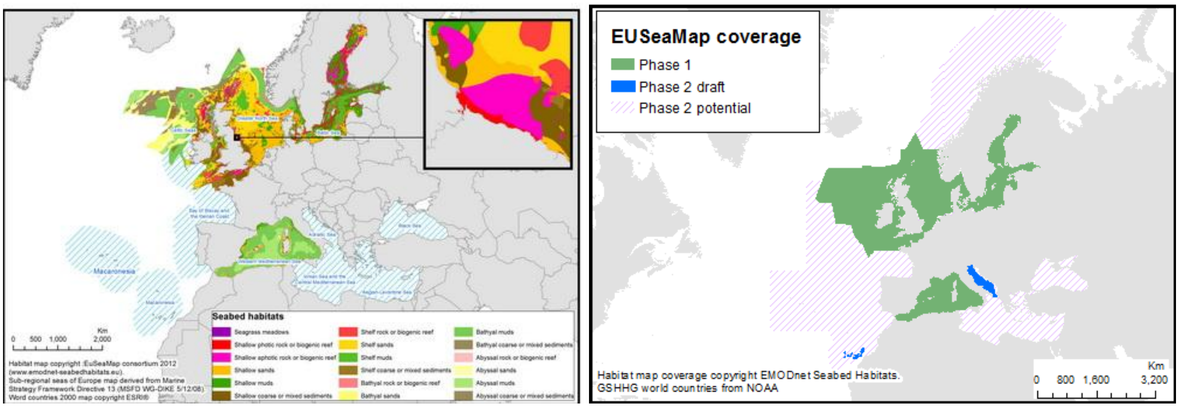
- To improve user experience and avoid confusion, the portal/website should use clear and consistent terminology and branding of the EMODnet Seabed Habitats portal and website.
- In particular it should be better explained how EMODnet Seabed Habitats and its deliverables relate to contributing habitat mapping projects (and their deliverables) mentioned on the portal (in particular EMODnet seabed habitats phases 1 & 2 and MeshAtlantic). Several users highlighted the need to have wider access to seabed habitat maps from surveys which are very fragmented, often exist across many different (in)formal repositories and not always available (yet) through the EMODnet Seabed Habitats portal.

6.2 Terminology and synopsis

The glossary page containing information on the various terms used across the site (http://www.emodnet-seabedhabitats.eu/glossary) has been updated and moved on to the top level of the EMODnet Seabed Habitats website structure to provide the user with a quick resource for unknown words.

Terminology used to refer to the various interlinked projects as well as their outputs has been made more consistent. Particular attention has been made to addressing the previous confusing between the terms "EMODnet Seabed Habitats" and "EUSeaMap" on the website. It has now been made clear that the former refers to the project and website, whilst the latter refers to the broad-scale habitat mapping products produced under the project.

Map layers have been sorted out and grouped according to their nature, for example broad-scale maps, marine landscapes, modelled maps of single habitats.



Previous overview of EUSeaMap coverage (left) and newer simplified version (right) from webpage http://www.emodnet-seabedhabitats.eu/default.aspx?page=2025.

In the 'About' section the map provided to indicate phase 2 deliverables in its current format (above at http://www.emodnet-seabedhabitats.eu/default.aspx?page=2025) was updated and its legend and caption made more descriptive and visible.

A statement has been added to the top of pages within the archived MESH website (http://www.emodnet-seabedhabitats.eu/default.aspx?page=2003), to make it clear to the users about the archived nature of the webpages.

6.3 Contributing data

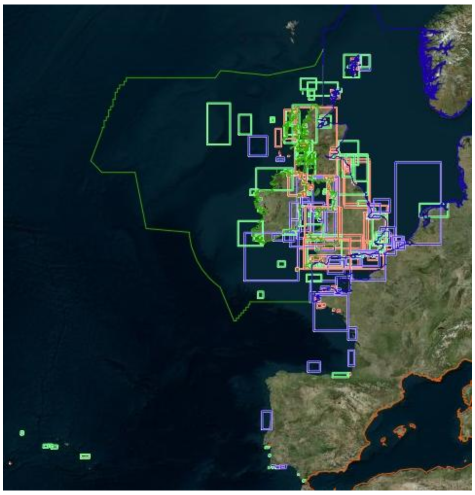
Guiding contributors

The way survey habitat maps can be added/submitted is currently covered by the "Contributing data" section. Users are now guided as how can contribute to the project by submitting data (products). Options for contributors are provided via our "Contributing Data" group of pages, see: http://www.emodnet-seabedhabitats.eu/contributedata.

Each representative of the partners signed up to be the point of contact for this task and committed to provide a copyright-free habitat map from their countries for testing the sequence of operations according to the technical guidance. New habitat maps from project partners are currently being ingested ready to be published on the portal during the next update.

Effective uploads

Sixty two new datasets have been added to the "EUNIS habitat maps from survey" dataset group, a large majority of which emanate from the UK. Building on the previous collections from the MESH and MeshAtlantic projects this results today in a total of 325 EUNIS maps held by EMODnet Seabed Habitats and 349 maps in total (including non-EUNIS datasets). Further habitat maps are expected to be added in the coming months as data preparation steps are completed by the data providers. The new overview of bounding boxes can be seen in the figure below and at:



Overview of "study areas", i.e. bounding boxes of all maps stored in EMODnet Seabed Habitats webGIS. See: http://www.emodnet-seabedhabitats.eu/default.aspx?page=1974&LAYERS=EUNISMappingAreas,Region&zoom=3&Y=53.67619250972515&X=9.916484373932684

6.4 Review of core information services of the thematic portal: Search & visualization functionality

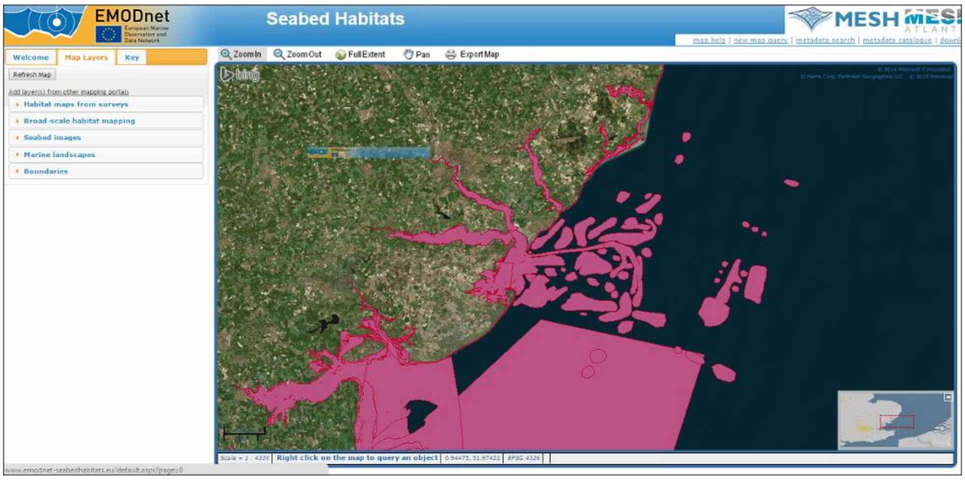
A large scale overhaul of the website has been conducted, focused on the webGIS services and including:

- Improved 'clean' layout for low-resolution screens, providing a larger "map view".
- Improved map layer groupings on the table of contents guided by user expectations.
- Improved system of viewing "habitat maps from survey" based on rough scales.
- Addition of 62 new "EUNIS habitat maps from survey" datasets.
- Addition of MEDISEH modelled Posidonia data.

The steering committee review stated that the cross-hyperlinking between the different services offered was considered smooth with one minor exception related to the map query: it is not possible to return to the main website via the banner or link on top right hand menu. This has since been addressed and the map query page has additionally been improved to provide further functionality and ease of use.

The "map search" page (http://www.emodnet-seabedhabitats.eu/search) has been improved, with the "view on map" link now directing the user to the map itself, zoomed in to the map's extent and with the relevant habitat map layer showing. The layer is also filtered to **only** show the selected dataset.

The "access data" page (http://www.emodnet-seabedhabitats.eu/webgis) has been improved to aid navigation by the user and to increase the visibility of the WMS service.



Map layers view, addition of seabed habitat via metadata search (‘Outer Thames Estuary Sandbank Study’)

When ‘Map layers’ tab is selected, the data layer added is not visible. With reference to the Metadata when the added Map layer is queried (right hand click) it currently only shows an ID code rather than the name of the added layer.

6.5 Data Download

The data download page (http://www.emodnet-seabedhabitats.eu/download) has been modified to place the "select layers" box at the top to aid user navigation. The new EUNIS habitat maps from survey have been added to the selection, replacing the previous older MESH dataset.

The additional functionality of download "preselection" when the user enters the download page from the interactive map is currently being investigated.

WP7 – Use of Maps

The key output from WP7 is the analysis and synthesis on the use of broad-scale seafloor maps in ecosystem-based management, especially under the EU Marine Strategy Framework Directive (MSFD). The deliverable will be a review targeted for a peer reviewed scientific journal - so far, the following steps have been taken:

- A working title has been agreed: ”On the use of broad-scale benthic habitat maps in the context of ecosystem-based management”.
- Potential contributors within the partnership framework have been identified – in addition an external contributor has been contacted and confirmed his willingness to contribute. For the time being, the total number of contributors is eight.
- A target journal has been identified, i.e. Marine Policy.
- Further, it has been agreed, as a first step and pending case study and data availability, to focus on European marine waters.
- Within the group of contributors, we have discussed and selected key references (peer reviewed publication, technical reports, MSFD reporting, etc.; n = 47), which all have to be addressed in the review. From screening the key references, it is envisaged that the review paper will both focus on (1) theme specific case studies (e.g. MPAs, OWFs, single stressors such as hypoxia) and (2) references in relation to mapping of the effects of multiple human stressors on key ecosystem components (including important seabed habitats) carried out with as part of Member States Initial Assessments under the MSFD. Currently, we have identified some best-practices in the northern regional seas (HELCOM and OSPAR), but would also like to include good case studies from the southern regional seas (Black Sea and Mediterranean Sea).
- In addition to the above, we have carried out an on-line literature survey and identified peer reviewed publications based on broad-scale seabed habitat maps (n > 20). Not surprisingly, the majority of the broad-scale seabed habitat maps have been developed by the MESH, UKSeaMap, BALANCE and EUSeaMap projects or are based on analogous methodology. Currently, we are in the process of reading, digesting and synthesising the literature.

According to draft work plan, the analysis and planned synthesis work will be discussed at the upcoming Seabed Habitats progress meeting in conjunction to the EMODnet Jamboree taking place in Ostende, Belgium in October. A draft manuscript ready for internal discussions and fine-tuning is expected by the end of this year.

WP8 - Management

8.1 Payment

Upon acceptance of our first interim report and following receipt of payment from DG/MARE, Ifremer expedited payments to the partners according to the budget breakdown so that the money could be transferred to their bank accounts before Dec. 2014. Likewise Ifremer paid the second term of payment to their sub-contractor METU (15000€) after receiving in due time (17 Dec.) their report n°5 summarising 2014 activity.

8.2 Reporting

Bi-monthly reporting was carried out in a timely way. This present second interim report was submitted on 16 Sep. 2015. The one week delay was due to the coordinator being invited to the Checkpoints joint kick-off from 2-4 Sep.

8.3 Meetings

Out of sixteen meetings we were concerned with, nine were skype meetings usually involving a large number of partners to deal with technical issues. The group met twice for technical progress meetings. The coordinator took part in two Steering committee meetings (Brussels and JRC), one special EMODNet event in Rome. Ifremer convened an Emodnet day in Brest in Jan. 2015 which several DG/MARE staff attended.

8.4 Preparing the EMODnet Jamboree

- A skype meeting was held on 7 Sep. to organise the seabed habitats group participation to the Jamboree and finalise the report.
- The program was advertised among the group and people were requested to register at: http://www.emodnet.eu/jamboree-info
- The group's progress meeting will last 3 days between Monday 21 Oct. afternoon and Friday 25 noon. The partners will take part in the EMODNet Public day (22nd). Besides the group expressed their interest to the Secretariat to possibly have three joint sessions during the remaining day: i) with Biology on sample data, ii) with Geology about sediment types, iii) with both Bathymetry and Geology about confidence.
- Several posters are to be produced by the partners on: i) EUSeaMap modellling methodology and ii) output maps for all basins.
- Suggestions for future work to be taken forward at the Jamboree are:
    - How to foster development of high resolution physical models
    - An EMODNet benthos sampling program

- Coastal and intertidal habitat mapping
- Classifications (EUNIS revision and adaptation to all EU basins)

8.5 Publications

Partners were prompted to think about publications, a way to give EMODNet more visibility. On top of the current outputs, there is some material from phase 1 that would lend itself to publication. Tentative ideas of scientific papers are as follows:

- Black Sea habitats, e.g. reflections on the specific approach and the linking of biology to physical parameters.
- Light thresholds
- Map confidence (based of long experience accumulated over the last 5 years).
- Uses of the broad-scale EUSeaMap

Strong emphasis will therefore be placed on publications in the third year.

8. User Feedback

Little user feedback is available other than the quantitative one reflected by map downloads from the web and also the webGIS assessment made by the Secretariat. The topics that could be raised at the Ostende Jamboree are: i) How are we going to make a broader community of EMODnet users and ii) how could we get them to sign up to some sort of systematic feedback and quick assessment. If this could be implemented, it would also be of great help to the Checkpoints by emphasising data gaps and shortcomings.

9. Outreach and communication activities

- The EMODnet Day organised by Ifremer on 28 Jan. 2015 in its Brest premises gathered about 45 people. It was an opportunity to advertise EMODnet and its achievements within Ifremer and to a few external attendees. We enjoyed the presence Iain Shepherd and Silvo Zlebir from the Commission, Jan-Bart Calewaert from the Secretariat attending the meeting. SHOM was very well represented with seven staff present. All lots were represented except human activities, and a representative of the Mediterranean checkpoint also gave a talk. The variety of EU mechanisms dealing with oceanographic data (EMODnet, Seadatanet, Copernicus) was thoroughly described for the audience to better understand how these programs articulate and how their data are catered for. The DCF (Fisheries data) talk mentioned a difficulty of sharing data at MS level. The perspectives included the next 2015 calls, the Galway Statement for North Atlantic seabed mapping, the potential issue for the Commission to fund some multibeam surveys and the need to have SMEs engage more actively in EMODnet alongside research institutes.

- THE HCMR team presented two papers under the EMODnet seabed habitats at the national conference "Hellenic Symposium on Oceanography & Fisheries" held in Lesbos: i) "Bathymetric data and geologic elements analysis towards the assessment of coastal rocky bottoms" and ii) "A methodological approach for mapping soft bottom benthic biotopes of the Greek Seas".
- JNCC are keeping other UK government organisations informed of the project's progress through a national co-ordination group called the Seabed Mapping Working Group - last meeting was held on 30/04/15, where Graeme Duncan told the group about what EMODnet seabed habitats is doing and also made a request for new habitat maps from survey.
- The JNCC and Ifremer are jointly presenting a paper at the ICES Science Conference, Habitats Session "The EMODnet Seabed Habitats initiative and examples of applications of the EUSeaMap broad-scale seabed habitat maps" (Ref: ICES CM 2015/N:08, Copenhagen, Sep. 2015).

10. Updates on Progress Indicators

Indicator 1 - Volume of data made available through the portal

The following list comprises the "GUIs" (globally unique identifiers) of the newly submitted maps. These can be searched for in the "Metadata search" page on EMODnet Seabed Habitats.

- 67 new maps supplied by JNCC, UK, from their data holdings (various originators):
  GB001113, GB001110, GB001117, GB001115, GB100211, GB100210, GB100213, GB001072, GB100093, GB001248, GB001132, GB001245, GB000267, GB001058, GB001226, GB001308, GB001094, GB001092, GB001091, GB100053, GB000215, GB001242, GB001134, GB003010, GB001070, GB001142, GB000655, GB001084, GB000472, GB001104, GB001106, GB100088, GB001103, GB001102, GB100215, GB100267, GB003012, GB001251, GB001144, GB000377, GB200015, GB100206, GB100207, GB100204, GB100205, GB100202, GB100203, GB100200, GB100201, GB200057, GB200054, GB001133, GB001068, GB001069, GB100208, GB000943,GB100214, GB001082, GB001071, GB000864, GB003002, GB003003, GB003001,GB003006, GB003008, GB100209, GB001214
- 2 New maps supplied by IEO, Spain: ES001021, ES001023

- 1 New map supplied by Ifremer, France: FR000060

Indicator 2 - Organisations supplying each type of data based on (formal) sharing agreements and broken down into country and organisation type (e.g. government, industry, science).

- JNCC (government, UK), Ifremer (government, France), NIVA (government, Norway): point records of kelp presence and absence to allow analysis of thresholds to contribute to the development of the broad-scale maps.
- IOBAS (government, Bulgaria) and GeoEcoMar (government, Romania): points records of several species to allow analysis of thresholds to contribute to the development of the broad-scale maps.
- Institute of the Republic of Slovenia for Nature Conservation, Slovenia (government), International Marine Centre in Oristano (science), University of Zagreb, Faculty of Science, Division of Biology, Croatia (science), Institute for oceanography and fisheries, Split, Croatia (government), State Institute for Nature Protection, Croatia, (government), International School for Scientific Diving, Lucca Italy (NGO), Agenzia Regionale per la Prevenzione e la Protezione dell'Ambiente, Puglia, Italy (government), Agenzia Regionale per la Prevenzione e la Protezione dell'Ambiente, Puglia, Italy (government), HCMR (government), Department of Fisheries and Marine Research, Cyprus (government), UNEP/MAP-RAC/SPA, Tunis, Tunisia (Regional convention), Malta Environment and Planning Authority, Malta (government), Andromède Océanologie, France (SME): polygon and point records of *Posidonia oceanica* meadows and characteristics and geographic positions of selected meadow lower limits .
- Point data of species abundance which could be considered characteristic of benthic assemblages were obtained from the EurOBIS with help from the EMODnet Biology Lot. The data provided has covered many spatial gaps that we had for the Russia, Ukraine, Georgia, and Turkey part of the Black Sea.
- All Barcelona Convention National Focal Points for the SPA/BIO protocol were contacted for a census of their available cartographic data as well as all national contacts known to have been involved in the Water Framework Directive monitoring of Posidonia lower limits

Indicator 3 - Organisations that have been approached to supply data with no result, including type of data sought and reason why it has not been supplied.

The Mediseh coordinator clearly indicated in an email to Project coordinator and also ISPRA that the geodatabase on samples for Posidonia meadows and other biocenotic data could not be made available to the consortium. This entailed more EUSEAMAP2 human resources investment in making a census of Posidonia cartographies ex novo.

Indicator 4 -Volume of each type of data and of each data product downloaded from the portal

Layer	06/08/14 to 06/09/15
Predicted habitats - North Sea and Celtic Sea	262
Predicted habitats - Baltic Sea	77
Predicted habitats - western Mediterranean Sea	90
Energy - North Sea and Celtic Sea	91
Energy/Wave Exposure - Baltic Sea	33
Seabed Substrata - western Mediterranean Sea	53
Halocline - Baltic Sea	32
Salinity - Baltic Sea	39
Fraction of light at the seabed - North Sea and Celtic Sea	77
EUNIS habitat maps from surveys	267
Confidence and study areas for EUNIS habitat maps	90
OSPAR threatened and/or declining habitats (2013/2014)	187
Predicted broad-scale EUNIS habitats - Atlantic area (2013)	169
Biological Zones – Atlantic Area	108
National Marine Landscape Maps	150

Please note that due to intermittent faults (~40days) in the website's download log, both sets of values below will be underestimated.

Indicator 5 -Organisations that have downloaded each data type

06/08/14 to 06/09/15		
40 south energy	Hartley Anderson	Sea Fisheries Protection Authority
Aarhus University	Hebrew University of Jerusalem	Sea Mammal Research Unit
Aberystwyth university	Heriot-Watt University	Service hydrographique et océanographique de la marine
ABPmer	HKSTP	Severn Estuary Partnership
AECOM	HR wallingford	SINTEF
AFBI	HRI	SSE
Agence des aires marines protégées	IEO	St Andrews University
Aix Marseille Université	Ifremer	Staatsbosbeheer
Amec Foster Wheeler	IH Cantabria	Stockholm Resilience Centre
APEM	IMARES Wageningen UR	Sustainable Inshore Fisheries Trust
AquaBiota Water Research	INPEX Corporation	Swansea University
Aquafact Ltd	Institut océanographique Paul Ricard	TEO
Aquatera Ltd	Institute of Hydrobiology	The Crown Estate
Architectural Association	Institute of Marine Research	The National academy of sciences of Belarus
Ardboe Coldstore	Institute of Marine Sciences	Thomson ecology
Associação para as Ciências do Mar	Instituto da Conservação da Natureza e das Florestas, IP	Thünen Institute for Sea Fisheries
Atkins Global	Instituto Español de Oceanografía	Tidal lagoon power
AZTI-Tecnalia	Instituto Geologico y Minero (IGME)	TI-SF
Baltic University Programme	Intertek	Trinity College Dublin
Basque Centre for Climate Change	IPMA	TU Berlin
BfN	ISPRA	U.S. Geological Survey
BMT Cordah Ltd	Italian Navy	UALG
Bonn Agreement	IUCN	UCC
Bournemouth University	IUEM	UDC
BP	JNCC	ULg
British Geological Survey	Joint Research Centre -	UM5

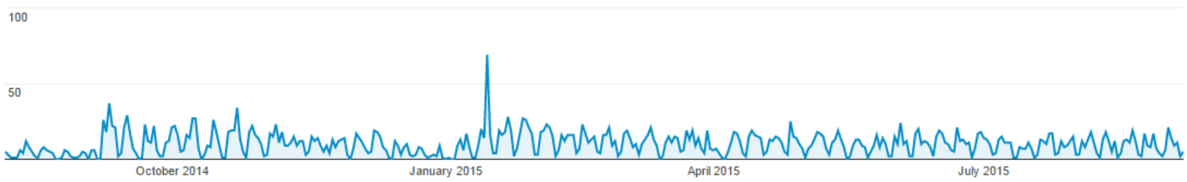
	European Commission	
Ca' Foscari University of Venice	Khulani GeoEnviro Consultants	Unigis
Cadcorp	Kretslopppsbolaget	Univerity of Colorado
Cagliari University	KU-MARSTEC	Universidad Autónoma de Madrid
Cardno	Leibniz Institute for Baltic Sea Research Warnemuende	Universidad de Cantabria
CCMAR	Les éoliennes en mer	Universidad de Extremadura
ccmar university of algarve	Lisbon University	Universidade de Aveiro
Cedre	Loughborough University	Universidade de Coimbra
Cefas	LPDB	Universidade dos Açores
CH2M HILL	LR Senergy	Universite de la Reunion
CIIMAR	LUC Environmental Planning Design & Management	Université d'Orsay
CMACS Ltd	Marine Biological Association	Université Libre de Bruxelles
CNR-IAMC Mazara del Vallo	Marine Ecological Surveys Limited	University Antwerp - Ecosystem Management Research Group
CNRS/UBO	Marine Institute	University College Cork
comata	Marine Laboratory	University of Aberdeen
Cooke Aquaculture Ltd	Marine Management Organisation	University of Aveiro
Cornwall Council	Marine Mapping	University of Birmingham
COWI A/S	Marine Scotland	University of Bristol
CREOCEAN	Mediterranean Institute for Advanced Studies	University of Caen Normandy
CRRU	MedPAN organisation	university of Cagliari
csln	Michigan State University	University of Cantabria
Danish National Institute for Aquatic Resources	MMT	University of Coimbra
Deltares	MNHN	University of Copenhagen
Devon and Severn IFCA	MRAG	University of Exeter
DGRM	MSG Sustainable Strategies	University of Gothenburg
dmi	National Biodiversity Data Centre	University of Greenwich
DNV GL	National Museum of Natural History (France)	University of Groningen
DTU Aqua	National Oceanography Centre	University of Hamburg
Earth Analytic, Inc	National Parks and Wildlife Service	University of Helsinki
EEA	Natural England	University of Hull
ENVIRON UK Ltd	Natural Resources Wales	University of Kansas
ENVIRONCORP	navama - technology for nature	University of Leicester
Environment Agency	Navionics	University of Leiden
Environment Systems	Navionics	University of Liverpool

Environmental Administration of Finland	Newcastle University	University of Malaga
Environmental Research Institute, University of the Highlands and Islands	NINA	University of Pennsylvania
Environmental Resources Management Ltd.	NLWKN-Forschungsstelle Küste	University of Sheffield
Envision Mapping Ltd	NOAA, Southwest Fisheries Science Center	University of South Wales
ERM	NUI Galway	University of Southampton
European Commission, Joint Research Centre	Ocean Ecology	University of Stockholm
Faculdade de Ciências	oDTM	University of the Azores
Fauna & Flora International	Orbis Energy Ltd	University of Vigo
FCUL	OSPAR Commission	University of Winchester
Federal Maritime and Hydrographic Agency of Germany	Personal use	University of York
Fishing	Plymouth University	University Pierre et Marie Curie
FLPS	PML	upm
Flyby S.r.l. Livorno Italy	Politecnico di Milano	UPTC
France Energies Marines	Queen's University Belfast	URS
FugroEMU Ltd	Ramboll Environ	van Hall Larenstein instituut
Gardline Environmental Limited	RES Offshore	Vilniaus Universitetas
Genesis Oil and Gas Ltd	Royal Netherlands Institute for Sea Research	vodafone
GeoInterest	RPS group	Vrije Universiteit Amsterdam
Geological Survey of Spain IGME	RSK	Wildfowl and Wetlands Trust
GEOMAR	RSPB	Woodside Energy
Geo-Marine Technology	School of fisiography	WWF
GoBe	Scottish Association for Marine Science	Xodus Group Ltd
GRID-Arendal	Scottish Natural heritage	Yildiz Technical University

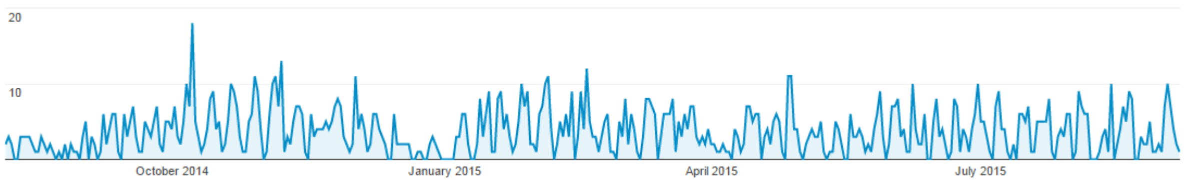
Indicator 6 - Using user statistics to determine the main pages utilised and to identify preferred user navigations routes

User statistics for mapper and download pages of EMODnet Seabed Habitat portal. Statistics are given for the bi-monthly and annual reporting period (this information is gathered by Google Analytics).

page description	page address	Number of unique visitors		How many users end their visit on this page		Average residence time (mm:ss)	
		29/06/15 to 06/09/15	06/08/14 to 06/09/15	29/06/15 to 06/09/15	06/08/14 to 06/09/15	29/06/15 to 06/09/15	06/08/14 to 06/09/15
Homepage	http://www.emodnet-seabedhabitats.eu	35	255	9	108	00:00:32	00:00:51
Interactive map	http://www.emodnet-seabedhabitats.eu/map	526	3370	464	3153	00:03:13	00:03:36
Downloads	http://www.emodnet-seabedhabitats.eu/download	215	1094	191	1102	00:02:11	00:02:03
Build custom map	http://www.emodnet-seabedhabitats.eu/custommap	70	508	22	330	00:01:09	00:01:11
Search	http://www.emodnet-seabedhabitats.eu/search	29	280	15	190	00:00:53	00:00:55



Visitors to EMODnet Seabed Habitats interactive map page from 06/08/2014 to 06/09/2015



Visitors to EMODnet Seabed Habitats downloads page from 06/08/2014 to 06/09/2015

Indicator 7 -List of what the downloaded data has been used for (divided into categories e.g. Government planning, pollution assessment and (commercial) environmental assessment, etc.)

This information is collected from the form that users fill out when downloading data from the download page (www.emodnet-seabedhabitats.eu/download). The upper table shows broad types of users (2014-2015). We acan see from it that commercial users are still a small fraction, while personal use (?) represents a very proportion of users.

We reproduce below the detailed reasons for downloads from last year (2013-2014), as these statistically would not be so different from this years's. Towards the end of the project it would be interesting to delve into these data to get a more detailed view of users' motivations.

Downloads per type of broad users

Reason	Proportion of total 06/08/14 to 06/09/15
Commercial/industry	11%
Education	15%
Exploration/Exploitation surveys	1%
Fisheries	2%
Government	13%
Personal use	48%
Research	7%
Other	4%

Reasons for downloads

Academic research Analysis for optimal location of aquaculture sites analysis in Scotland Analysis of environmental sensitivities offshore north sea. Application for the 28th Licence Round - Environmental impact	Habitat analysis Habitat assessments in Polessie protected areas/IBAs Habitat Mapping Habitat Modelling - PhD Research Habitats Directive assessment compilation of data on the	Research ecological status surrounding oil platforms. Research for job application. Research into climatic change effects on marine habitats and species Research into marine spatial planning

assessment part for DECC Alice Gadney - Cartographer -OMV UK 02073331985 Assessment of an invertebrate fishery and supporting ecosystem in the West coast of Ireland Assessment of MPA network and Marine Habitat Mapping Assist with research survey design and to contribute to ICES/OSPAR assessment Atlantic Sea in Azores Investigation background research for offshore route Bay of Biscay marine habitat mapping and management Bonn Agreement BE-AWARE project Building GIS map of habitats in Severn estuary Cable feasibility study Case study cartography to create a MPAs layout. Characterization of an area. Scientific research of the habitats in northern Spain Combining with VME Comparison with SNH survey deliverables to resolve apparent discrepancies Compilation of marine datasets for a strategic Environmental Assessment Creating marine habitat maps for a 'internal' research project for the UK Royal Society of Wildlife Trusts. Data Analysis Desk based feasibility study Desk based survey for Natural England ecosystem service assesmsent	marine environment I am a PhD student looking into over-wintering wading birds on estuaries and being able to see some biotopes for the mudflat they forage upon would be very useful. Species distribution modelling I am doing a GIS project on wind farm location to puffin populations Research project looking at spatial displacement of cetaceans for an MSc course. Mapping marine communities of Canary Islands TO create and manipulate maps for awareness-raising and advocacy for the Scottish MPA network and the National Marine Plan. ICES working group Inform benthic habitat assessment of tidal project in Northern Ireland Interreg Valmer. North Devon case study Kent and Essex IFCA habitat survey Knowledge of possible impacts of trawling in the area. Learn about the ecosystems that surround drilling platforms through spatial analysis. LIFE+ Project on MPA in Portugal local old version corrupted MAIA project Mapping in PO Mapping of marine ecosystem services Mapping survey results of the distribution of an invasive sea-squirt Didemnum vexillum in	Research into Nature Value and Nature Valuation Research project Research purpose Scientific purposes Scientific research Scientific use to model cetacean and seabird distributions along Portuguese mainland coast See possible impacts of trawl fishing in the area Sensitivity map for oil spill response planning Severn Estuary Mapping project Shoreline sensitivity mapping Statistical analysis study see beds in Azores STUDY-WORK Subsea cable feasibility study To assist authority to comply with the Biodiversity Duty and other regulations and guidance on environmental protection. To assist compliance with Biodiversity Duty To be able to describe the dataset as part of a marine data gap analysis for the EC funded EU BON project. to check habitat locations To check overlap to check overlap of habitats and activities To check overlap with habitats To compare my data with sediment characterization to compare with other

severn esyarry and bristol channel Ecosystem Service Mapping ecosystem service mapping severn estuary Educational use Environmental assessment Environmental Constraint Mapping Environmental Consultancy Environmental Desktop Study Environmental Mapping Environmental studies - EIA, ES etc. Establishing where Eunis habitats are in West of Shetlands Evaluation environnementale document de planification activit├®s en mer Figure creation for Department of Environment Northern Ireland by ABPmer. fisheries For a sensitivity mapping project within the NE of Scotland For connectivity assessment of macroalgae For environmental information on or near project sites and subsea cable routes. For inclusion in an EIA For potential usage in European project Turnkey (Atlantic Areas project) For reference in environmental planning. for scientific research of the Western Iberian margin For the web MPA OSPAR (GIS tool) For use in an ES For use in GIS projects along	Clew Bay, Co. Mayo, Ireland. Marine assessment Marine Mapping Project Marine protected area proposal and for sampling preparation and planning for PhD. MIS RAZONES Model of effects fishing in the Celtic Sea Model of the effects of fishing on several species in the Celtic Sea Modelling MPA OSPAR study MPA OSPAR website MSc assignment MSFD analysis MSFD use. My PhD aims to model the habitat preference and spatial usage of seals' colonies. For this modelling work, I need environmental variables as sediment and seabed habitat. Needed to create maps for Celtic Sea Trout Project. The project is part funded by the European Regional Development Fund through the Ireland Wales Programme (INTERREG 4A). Offshore renewable SEA Offshore wind farm planning and EIA OSPAR habitat mapping program OSPAR use PhD examining vulnerability of Modiolus habitats across OSPAR areas PhD project is investigating climate change impacts to Modiolus beds	habitat assessments in the same area To evaluate whether it can inform assessments of risk to marine ecosystems To incorporate data in habitat suitability modelling. To produce overlay with fishing effort map. To review content To update our records for NI Marine Conservation Zone designation process To update our records for the Northern Irelands Marine Conservation Designation Process. To use the data in future research To view results of habitat surveys carried out in Northern Irelands inshore and offshore waters. UK fisheries and environmental management Understanding the marine habitats around Guernsey Use in a postgraduate project Use in Ospar Cobam work Use in report for First Flight Wind use in research work and informative using data to examine vulnerability of Modiolus habitats Valmer Interreg We are computing a broad ecosystem map for the sea regions of Europe following EUNIS habitats classification at level 2. We are currently doing

with our own fisheries and scientific data. For use in subsea cable scoping study. For use on a sensitivity mapping project along the NE coast of Scotland For use within GIS for offshore windfarm EIA work Gaining insight in spatial distribution of marine habitat types. General interest General planning benthic survey. geoscience research regarding sound propagation through sediments GIS work about Marine Protected Areas Greater understanding for Environment Agency to use in WFD fish classification analysis for estuaries Mapping survey results of the distribution of an invasive sea-squirt Didemnum vexillum in Clew Bay, Co. Mayo, Ireland. To produce overlay with fishing effort map.	PhD research PhD Study: using mapping to scope best areas to protect Irish Sea ray species. Preparing a tender response and demo for OSPAR Project Consulting Project for a GIS class at Scripps Institute of Oceanography. Project for Northern Ireland Marine Task Force project on the impact of off shore windfarm on the biodiversity Quality check Reference Research Working on a project related to the impact of windfarm on the biodiversity Working on strategic plan for aquaculture in Ireland Creating marine habitat maps for a 'internal' Mapping marine communities of Canary Islands Interreg project	research on ecosystem services delivered by the Belgium North Sea. To calculate biodiversity values we need to have habitat data for specific species and there sensitivity. We are currently planning to conduct a coral habitat mapping in the eastern Mediterranean and want to compare our future data with these data. We are recompiling GIS information related to the Azores Islands (Portugal) for scientific use. Work on the problem of coastal erosion Working on a project on support structure of offshore wind turbines Creating marine habitat maps for a 'internal' research project for the UK Royal Society of Wildlife Trusts. Fisheries

Indicator 8 - List of web services made available and user organisations connected through these web services

A standard WMS service (supplied by MapServer) of all map layers viewable on the interactive map is provided to clients through our Access Data page.

Appendix 1: Mediterranean and Black Sea habitat list

Mediterranean

EUNIS Habitat code	EUNIS Lev.	Eunis habitat name	Barcelona Convention habitat code	Regional habitat name (or Convention name)	Biological Zone	Light	Bathimetry / slope	Substrate
A3	2	Infralittoral rock and other hard substrata	III.6.	HARD BEDS AND ROCKS (intended as biocenosis of infralittoral algae)	INFRA	>1% surface light - *in situ* data	1-45 max	bedrock, boulders and cobbles / ROCK
A5.23	4	Infralittoral fine sands	III.2.	FINE SANDS WITH MORE OR LESS MUD	INFRA	>1% surface light - *in situ* data	0-45	fine homogenous granulometry and well sorted fine sands / SAND / MUDDY SAND
A5.13	4	Infralittoral coarse sediments	III.3	COARSE SANDS WITH MORE OR LESS MUD	INFRA	>1% surface light - in situ data	0-45	COARSE & MIXED SEDIMENT
A5.23	4	Infralittoral fine sands	III.2	FINE SANDS WITH MORE OR LESS MUD	INFRA (mask)			SAND / MUDDY SAND

A5.36		Circalittoral fine mud	IV.1.1.	MUD	CIRCA (mask)			MUD
A5.35	4	Circalittoral sandy mud	IV.1.1.	Mud	CIRCA (mask)			SANDY MUD
		Circalittoral sand	IV.2.	Sand	CIRCA (mask)			SAND
A5.26	4	Circalittoral muddy sand	IV.2.	Sand	CIRCA (mask)			MUDDY SAND
A5.14	4	Circalittoral coarse sediment	IV.2.	Sand	CIRCA (mask)			COARSE & MIXED SEDIMENT
A4	2	Circalittoral rock and other hard substrata	IV.3	Hard bottoms and rock	CIRCA (mask)			ROCK
A4.26 &A4.32	4	Mediterranean coralligenous assemblages moderately exposed to hydrodynamic action (we intend Coralligenous beds)	IV.3.1	Coralligenous biocenosis	CIRCA	<1% surface light >0.01% - in situ data	25-100	ROCK
A5.46	4	Mediterranean biocoenosis of coastal detritic bottoms	IV.2.2.	Biocenosis of the coastal detritic bottom	CIRCA	<1% surface light >0.01% - in situ data	below P. oceanica until the break of continental slope, lower depth is 100 meters	gravel, sand and shell debris / COARSE & MIXED SEDIMENT/ MUDDY SAND / SAND

A5.38	4	Mediterranean biocoenosis of muddy detritic bottoms	IV.2.1.	Biocenosis of the muddy detritic bottom	CIRCA	<1% surface light >0.01% - in situ data	below P. oceanica until beginning of continental slope	very sandy mud or muddy sand, compact mud rich in shell debris, gravel and sand present but with constant mud predominance / SANDY MUD
A5.39	4	Mediterranean biocoenosis of coastal terrigenous muds	IV.1.1.	Biocenosis of coastal terrigenous muds	CIRCA	<1% surface light	25 – continental shelf	pure mud of fluvial origin, fine and rapid settling, more ore less clayey, can be both soft or sticky mud / MUD
A4.27	4	Faunal assemblages on deep moderate energy circalittoral rock	IV.3.3.	Biocenosis of shelf-edge rock	CIRCA	<0.01% - in situ data	120-180	hard substrata / ROCK
A5.47	4	Mediterranean assemblages of shelf-edge detritic bottoms	IV.2.3.	Biocenosis of shelf-edge detritic bottom	CIRCA	0 Note: low light is used as proxy of deeper depth range on which this habitat may occur, since information on thanatocenosis	-80 m to shelfbreak	detritic, high abundance dead shells, bryozoans and coral skeletons which are calcareous debris of quaternary thanatocenosis;

						distribution is not modellable		higher proportion of fine sand and mud rather than gravel / COARSE & MIXED SEDIMENT / MUDDY SAND / SAND / SANDY MUD
A6.1	3	Deep-sea rock and artificial hard substrata	V.3.	HARD BEDS AND ROCKS	BATHYAL	0	from the shelf-break (150-250m) to the beginning of the abyssal plain	ROCK
A6.2	3	Deep-sea mixed substrata		No corresponding Barcelona Convention habitat type but found in EUSeamap1 so could be present elsewhere in the Med	BATHYAL	0	from the shelf-break (150-250m) to the beginning of the abyssal plain	COARSE & MIXED SEDIMENT
A6.3	3	Deep-sea sand	V.2.	SANDS	BATHYAL	0	from the shelf-break (150-250m) to the beginning of the	SAND

							abyssal plain	
A6.4	3	Deep-sea muddy sand		No corresponding Barcelona Convention habitat type but found in EUSeamap1 so could be present elsewhere in the Med	BATHYAL	0	from the shelf-break (150-250m) to the beginning of the abyssal plain	MUDDY SAND
A6.51	4	Mediterranean biocenosis of bathyal muds	V.1.1.	Biocenosis of bathyal muds	BATHYAL	0	from the shelf-break (150-250m) to the beginning of the abyssal plain	fluid to compact mud (Clayey usually compact, yellowish or bluish, sometimes a bit sandy / MUD
A6.511	5	Facies of sandy muds with Thenea muricata	V.1.1.1.	Facies of sandy muds with Thenea muricata	BATHYAL	0	from the shelf-break (150-250m) to the beginning of the abyssal plain	SANDY MUD
A6.52	4	Assemblages of abyssal muds	VI.1.1.	Biocenosis of abyssal muds	ABYSSAL	0	abyssal plain	MUD / SANDY MUD

A6.2	3	Deep-sea mixed substrata		No corresponding Barcelona Convention habitat type but found in EUSeamap1 so could be present elsewhere in the Med	ABYSSAL	0	abyssal plain	COARSE & MIXED SEDIMENT
A6.3	3	Deep-sea sand		No corresponding Barcelona Convention habitat type but found in EUSeamap1 so could be present elsewhere in the Med	ABYSSAL	0	abyssal plain	SAND
A6.4	3	Deep-sea muddy sand		No corresponding Barcelona Convention habitat type but found in EUSeamap1 so could be present elsewhere in the Med	ABYSSAL	0	abyssal plain	MUDDY SAND

Black Sea

Broad scale habitat name	Biological Zone	Substrate	Light	Energy	Salinity	Temperature	Oxygen	Contains indicator association	Habitat distribution	Ground truth data available
Infralittoral rocks with photophilic algae	INFRA	ROCK	photophylic, PAR >10-20%					*Cystoseira barbata + Ulva rigida+ Polysiphonia subulifera Cladophora spp. - Ulva rigida - Ulva intestinalis - Gelidium spp.*	RO-BG-TR-UKR-RU	RO--BG
Infralittoral sand and muddy sand	INFRA	SAND; MUDDY SAND						Shallow fine sands with *Lentidium mediterraneum* Medium to coarse sands with *Donax trunculus* Infralittoral sand with *Chamelea gallina* (with *Cerastoderma glaucum, Lucinella divaricata, Gouldia minima*) (depends of region) Muddy sand with burrowing thalassinid *Upogebia pusilla/Pestarella candida*	RO-BG-TR-UKR	RO-BG
Infralittoral Coarse and Mixed Sediment	INFRA	COARSE; MIXED		moderate				Infralittoral shelly gravel and sand with *Chamelea gallina* and *Mytilus*	UKR-RU	

Infralittoral sand	INFRA (Mask)	SAND			< 15 PSU				RO-UKR	
Infralittoral muddy sand	INFRA (Mask)	MUDDY SAND			< 15 PSU				RO-UKR	
Circalittoral terrigenous muds (mask area)	CIRCA (Mask)	terrigenous mud / MUD			< 15 PSU			Danube and Dnieper mask areas (Mud with *Melinna palmata, Mya arenaria, Alitta succinea, Nephtys hombergii)*	RO-UKR	RO-UKR
Circalittoral rock	CIRCA	ROCK	PAR 5-15%	kinetyc energy				Scyaphilic algae *(Phyllophora* spp. + *Polysiphonia* spp. + Apoglosium + *Zanardinia* spp.+ *Gelidium* spp.), sponges and hydroids	RO-BG-TR-UKR-RU	RO-BG
Shallow circalittoral mud and organogenic sandy mud	CIRCA	MUD ; SANDY MUD; MIXED			on bottom > 15 PSU	8 - 18°C (13°C average seasonal variation)		*Muds with Abra prismatica - Pitar rudis - Spisula subtruncata, Acanthocardia paucicostata and Nephtys hombergii* Sandy muds with *Dipolydora* meadows and *Mytilus*	RO-BG-TR-UKR-RU	RO-BG-UKR
Shallow circalittoral shelly organogenic sand (clean shelly debris without mud)	CIRCA	SAND; COARSE (shelly with no mud)	sciaphilic with little sospension					*Mytilus* biogenic reefs *Coccotylus truncatus & Phyllophora crispa*on shelly organogenic sand	UKR (former phyllophora field)	
Deep circalittoral coarse mixed sediments	CIRCA	MUD			-	bottom t°C: = < 9.7	O2sat% <100	Shelly muds with Modiolula phaseolina	RO-TR-UKR-RU	RO-UKR

Deep circalittoral sand, muddy sand, and sandy mud	CIRCA	sand, muddy sand, and sandy mud			-	bottom t°C: = < 9.7	O2sat% <100	Sand, muddy sand, and sandy mud with tunicates	RO	RO
Deep circalittoral mud	CIRCA	MUD			-	bottom t°C: = < 9.7	O2sat% <100	Mud with Terebellides stroemii, Pachycerianthus solitarius, Amphiura stepanovi	BG	BG
Deep circalittoral suboxic calcareous muds	CIRCA	MUD			19-20 PSU	bottom t°C: 9-10	Σθ = 15.4 - 16.2	White muds with *Bougainvillia muscus (ramosa) and nematode communities* (RO)	RO	RO
Deep circalittoral anoxic muds	CIRCA	MUD			>20 PSU		Σθ =>16.4	Black muds with anaerobic sulphate reducing bacteria and methane - derived microbial carbonate buildups in methane seeps	all	not relevant
Bathyal anoxic muds seeps	BATHYAL	MUD			>20 PSU		Σθ =>16.4	Black muds of the slope and bathyal plain, with anaerobic sulphate reducing bacteria and methane - derived microbial carbonate buildups in methane		

Note: A couple of habitats of which one called “Infralittoral mud or sandy mud” (outside mask) and the other one “Shallow circalittoral mud” were flagged as “error” due to possibly an error of modelling or most probably due to overlapping of similar sediments type on limited portions. However, it is also possible that the former habitat had not been anticipated at the moment of the habitats list creation because of its very limited distribution in the sheltered zones of the Bulgarian and Caucasian coasts. The “Shallow circalittoral mud”, which appeared at the Romanian coast, is certainly an error due to the lack of good substrata data within the area. Further on, within the Oxic Deep circalittoral a new habitat has been validated “Deep circalittoral sand, muddy sand and sandy mud with ascidians community”. Within the same biological zone, a refinement of habitats types was operated. Thus, the former “Deep circalittoral coarse mixed sediments and mud” has been split in two distinct habitats: “Deep circalittoral coarse mixed sediments with *Modiolula* community” and “Deep circalittoral mud with *Terrebelides, Pachycerianthus and Amphiura*”. Within the Suboxic Deep circalittoral, several unexpected habitats were yielded by the model. These habitats are constituted of coarse sediments, mixed, sand and mud and muddy sand, respectively. All of them have been flagged as “uncertain” bargaining for the fact these might be present in areas designated by the model, but much information should be added in order to bear out the modelling results. Within the circalittoral anoxic a similar situation as above appeared. Very little knowledge on the real sediments types from that zone made us classify them also as “uncertain”. However, some literature sources (Oaie et al, 2010) confirmed a prevalence of muddy sediments but also the occurrence of coarse and sandy mud sediments in anoxic circalittoral and even deeper in the bathyal zone of the Caucasian and Anatolian part. Therefore, the unexpected habitats within the bathyal were all flagged as “uncertain”, too.

Appendix 2: Oceanographic data collation

Section 1 – Data sources

- *Tessa Project data*

  Forecasts/analysis (2011-2014) provided by Tessa's numerical model for the Adriatic Sea, have been used. Current, temperature and salinity data are provided by the Princeton Ocean Model implemented on a regular grid with a horizontal resolution of 1/45° (about 2.2 Km) and 31 vertical levels (*Oddo et al.,* 2006; Guarnieri et al.*,* 2008).

- MyOcean Project data

  Current and salinity data (1971-2001) provided by MyOcean's numerical model for the Black Sea, have been used. The model runs on a regular grid with a horizontal resolution of 1/16° for the latitude, 1/10° for the longitude and 35 vertical levels (*Demyshev, 2012*). It is important to specify that we used different products for temperature. This is due to a problem with the model used in MyOcean for the Black Sea. On the 1st October 2014, the model described so far was replaced with the model used for the Global forecast (NEMO model with a 1/12° resolution). Since the downloading of temperature data was in progress at that date, we were only able to download a few data. The resolution of Global model is worse than the previous one and hence it is not possible to use it in this framework. Thus, only data for the years 2012 and 2013 have been used in the analysis of temperature. These data come from an update of the model described earlier for the Black Sea and it runs on a regular grid with a horizontal resolution of about 1/22° for the latitude, about 1/16° for the longitude and 38 vertical levels.

- *Kassandra Project data*

  The system is aimed to the storm surge operational forecast for the Mediterranean and Black seas. It consists in a 3D finite element shallow water hydrodynamic model (SHYFEM), including a tidal model, and a third generation finite element spectral wave model (WWMII). The wave model is fully coupled with the hydrodynamic model. The operational system uses as input the surface fields obtained from a suite of meteorological models provided by ISAC-CNR. (Ferrarin et al., 2013) For the Black Sea, significant wave height and mean period (January 2012-December 2014) have been used to calculate the seabed energy. The triangular mesh grid used by the finite element and wave model is shown in the following Figure 1.

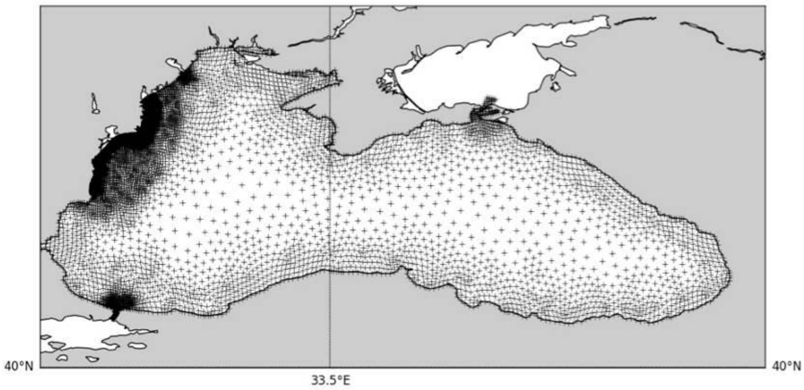


Figure 1 Model grid for Kassandra project

- *ISPRA Mc-WAF*

  Mc-WAF is an operational tool designed to merge different scales for the generation and propagation of the wave energy in the Mediterranean Sea. The system is effective in connecting the Mediterranean scale with the coastal scale using an intermediate nesting at regional scale. The system works on three levels of nesting: the Mediterranean model passes the boundary conditions to the regional runs (Figure 2a), each, in turn, creates the boundary conditions for all the coastal runs present in the particular regional grid (Figure 2b).

  Currently, the wind input is provided by the 0.1° BOLAM meteorological model: the same hourly wind fields are used by all wave models in the operational version of the system. The forecast range is 84 h, with 1 h frequency output.

The coastal system operates as a chain of numerical models nested from the Mediterranean domain at 1/30° resolution to 9 regional areas at 1/60° resolution. Some small selected coastal areas are nested on the regional grids in the Tyrrhenian Sea and in the northern Adriatic Sea. Coastal Areas are at very high resolution, from 400m in the Tyrrhenian Sea to 200 m in some test areas in the northern Adriatic. Both at the Mediterranean and regional scale, the WAve Model (WAM) cycle 4.5.3 has been used. WAM is a third-generation wave model, it integrates the wave energy-balance equation considering, as source functions the effects due to wind-wave interaction, resonant nonlinear wave-wave interaction and dissipation due to bottom and white-capping. In the WAM cycle 4.5.3 the wind-generation function and dissipation source terms implement the Janssen's formulation, and the nonlinear interaction source function is evaluated using the discrete interaction approximation (see, e.g., Janssen, 2008). In both WAM implementations the number of directions considered is 24, whereas the number of frequencies is 25, ranging from 0.04177

Hz to 0.4114 Hz. In the Mediterranean domain WAM is implemented on a grid extending from 5.5° W to 35.73° W in longitude and from 30.0° N to 46.0° N in latitude at 1/30° resolution. The bathymetry used is the general Bathymetric Chart of the Ocean (GEBCO) at 30 arc-second grid resolution. In all regional areas, WAM is implemented as in the Mediterranean grid, except for the position and dimension of the grids and for the resolution, which is 1/60° in latitude and longitude. As shown in Fig. 2, the nine regional areas covering all the Italian Seas are: Ligurian-North Tyrrhenian Sea, North Sardinia, South Sardinia, Central Tyrrhenian Sea- Sicily Channel, Ionian Sea, Gulf of Taranto-Otranto Channel, Central Adriatic Sea, Northern Adriatic Sea. The GEBCO bathymetry was locally corrected in each area using the Istituto Idrografico della Marina (IIM) digital maps.

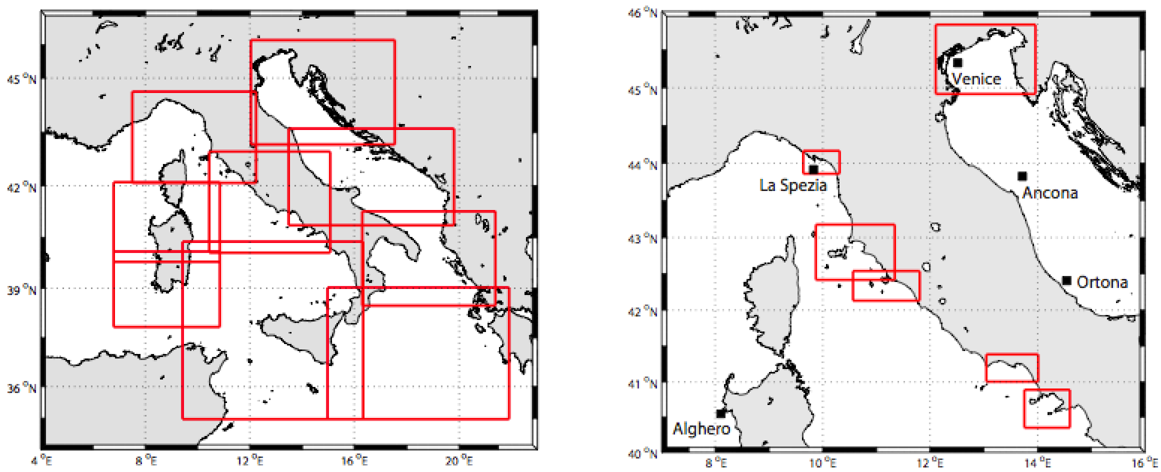


Figure 2 - a) ISPRA Mc-WAF regional areas | b) ISPRA Mc-WAF Coastal areas.

Section 2 – Estimate of the peak sea-bottom kinetic energy

The peak kinetic energy (KE) at the bottom has been calculated for the Mediterranean Sea, the Adriatic Sea and the Black Sea. Wind-wave and current contributions have been separately considered due to the very different spatial resolution available and the different time periods available. The spatial distribution of the 90 percentile of the kinetic energy at the bottom has been estimated by considering the statistics in the time period available at each grid point.

Current

The kinetic energy expressed as energy density in N/m2, is calculated as:

$$KE = \frac{1}{2} \rho v2$$

where ρ represents the mean density of the Mediterranean Sea and it is equal to 1029 kg/m3 and v is the velocity modulus, expressed in m/s.

As an improvement with respect to the first year of the project the 90th percentile of the annual average of the kinetic energy density at the bottom was considered. The aim of this new product is to obtain a more reliable representation of the maximum values of the kinetic energy density, by cutting out peak values. This analysis has been performed in the whole Mediterranean Sea, on the high resolution Adriatic Sea data and in the Black Sea.

Wave

In order to evaluate the KE at the bottom due to a single monochromatic wave , the first step would be to estimate the orbital velocity at the bottom (Ub), then the energy would be given by $E_b = \frac{1}{2}\rho U_b^2$, given ρ the average density of seawater.

In literature there are several straightforward algorithms based on the linear theory of wave propagation which could be easily used to estimate the orbital velocity under the waves as $\mathbf{U_b} = \frac{\mathbf{H}}{\mathbf{2}} \frac{\boldsymbol{\omega}}{\sinh(\mathbf{kh})}$.

The methods are easily implemented for monochromatic waves in terms of the angular frequency of the wave (ω), the wave height (H), the wavelength (k) of the wave and the local depth of the sea (k). The frequency and the wavelength are related by the dispersion formula $\omega^2 = \mathbf{gktanh(kh)}$

In the real sea, though, the significant wave height (H_{m0}) is a statistical parameter associated with the effect of the superposition of a large number of waves, each one at a different frequency. A Method for evaluating the energy associated with realistic situations, using reasonably assumptions about the spectral form of the waves, is described in Soulsby (1987). Here a simplified version of the method, the 'Soulsby and Smallman' method, has been applied (Soulsby, 2006). The method prescribes the use of an approximation formula, which provides the variance of the velocity $\mathbf{U_{rms}^2}$ at the bottom with an accuracy better than 1% where the velocities are significantly different from zero.

$$\frac{U_{rms}T_n}{H_{m0}} = \frac{0.25}{(1 + At^2)^3}$$

$$A = (6500 + (0.56 + 15.54t)^6)^{\frac{1}{6}}$$
$$t = \frac{T_n}{T_m}$$
$$T_n = \left(\frac{h}{g}\right)^{\frac{1}{2}}$$

Where h is the depth of the bottom sea and g is the gravity acceleration. The input to the algorithm are the Hm0, Tm, and h on the Mediterranean and Adriatic WAM grids. The bottom KE due to the field of random waves is then evaluated as $\mathbf{E_b} = \frac{1}{2}\rho \mathbf{U}^2_{\mathbf{rms}}$.
To obtain the spatial distribution of the 90-percentile of seabed energy due to wind waves, the hourly bottom energy fields have been statistically analysed in the period October 2012 – March 2015. For the Mediterranean Sea the resolution of the spatial distribution of peak seabed energy is 1/30 deg. It is 1/60 deg for the two Adriatic areas and arrives to 1/240 deg resolution in the coastal area in the Northern Adriatic Sea. In the Black Sea the resolution of the finite element grid is variable, as shown in Figure 1.

Section 3 – discussion of the results

<u>*Salinity*</u>

Figure 3 shows the average of salinity at the bottom in the Adriatic Sea, expressed in PSU, as obtained by Tessa project data.

The salinity ranges from 33 and 39 PSU, showing lower values (less than 37 PSU) in the North-Western area and on a stripe along the Italian coasts, mainly due to the run-off of Po River. This feature is interrupted by a small area of higher values in the Gulf of Manfredonia.

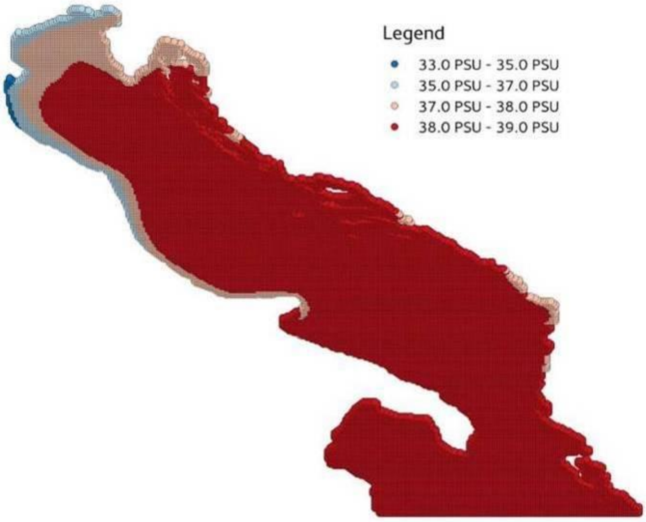


Figure 3 Average salinity at the bottom for the Adriatic Sea.

Figure 4 shows the average salinity at the surface. Likewise Figure 3 the lower values are in the North-western area, where the salinity ranges from 17 to 37 PSU. It is also possible to identify the fresh water input from rivers along the eastern coast.

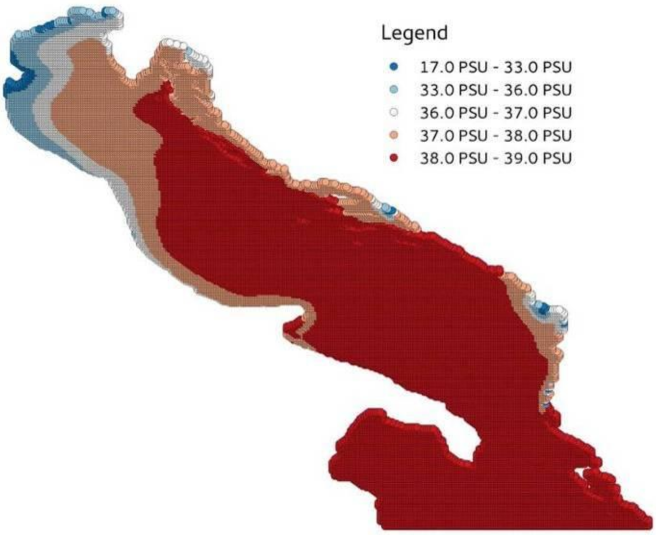


Figure 4 Average salinity at the surface for the Adriatic Sea.

Figure 5 to Figure 8 represent maxima and minima of salinity at the surface and at the bottom. They show similar features to Figure 3 and Figure 4. From Figure 8 it is also possible to identify river inlets on the northern coast. Figure 5 and Figure 6 show that generally the maxima of salinity are comprised between 38.0 and 39.0 PSU, with small areas of lower values in the North and small areas of Higher values in the South.

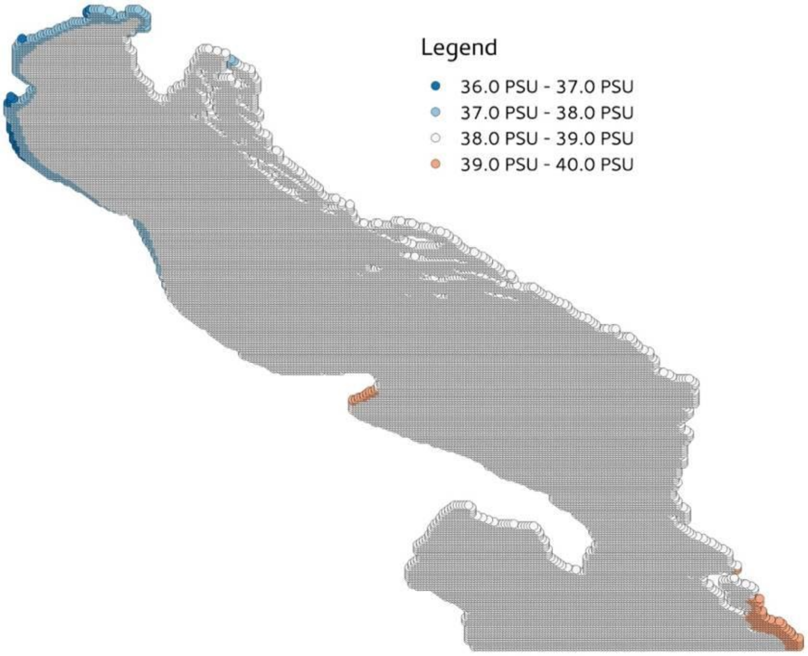


Figure 5 Maxima of salinity at the bottom for the Adriatic Sea

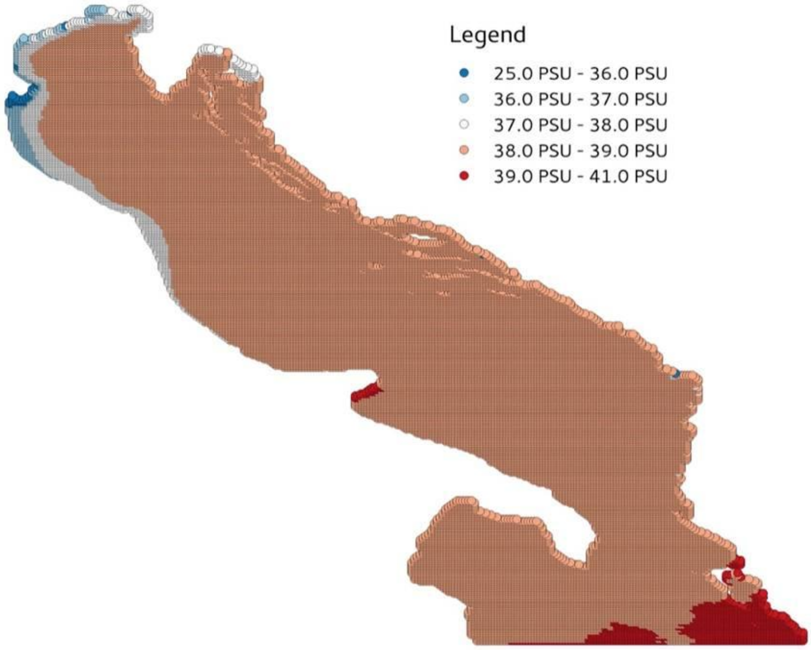


Figure 6 Maxima of salinity at the surface for the Adriatic Sea

Figure 7 and Figure 8 show a behaviour similar to Figure 5 and Figure 6, even if in the Northern area, the minima of salinity are highly influenced by the effect of fresh water inputs.

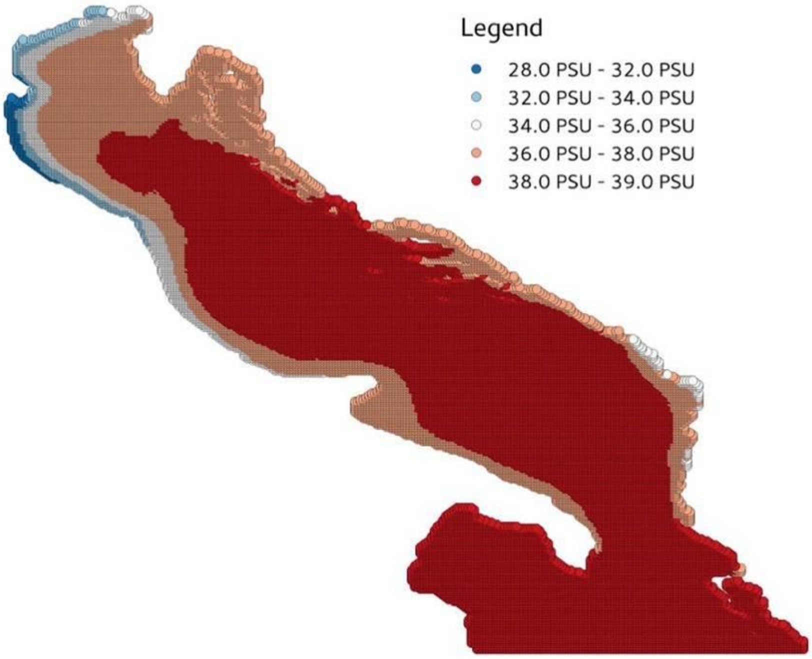


Figure 7 Minima of salinity at the bottom for the Adriatic Sea

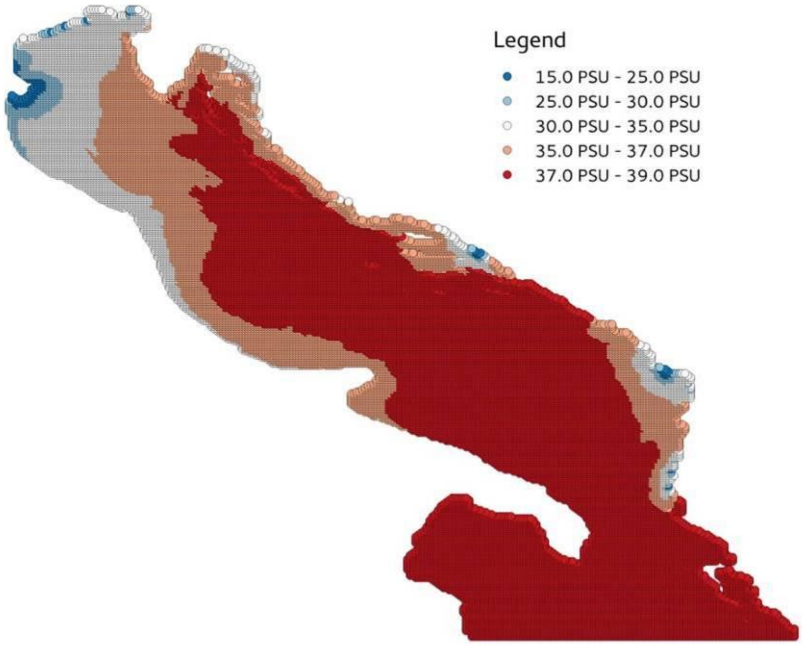


Figure 8 Minima of salinity at the surface for the Adriatic Sea

Figure 9 to Figure 14 shows the average, maxima and minima of salinity at the bottom and at the surface in the Black Sea, expressed in PSU, as obtained by MyOcean project data.

A large area of lower values of salinity is present in the North-West. This is due to the inlet of fresh water from rivers. The effects of rivers included in the model (Danube, Dnieper, Dniester, Sakarya, KizilIrmak, YesilIrmak, Rioni, Inguri, Kodori rivers) are identifiable by patches of lower salinity close to the coast. Looking at Figure 9 Figure 14, it is possible to identify a mean difference of about 4.0 PSU between the salinity on the surface and at the bottom in the big central area.

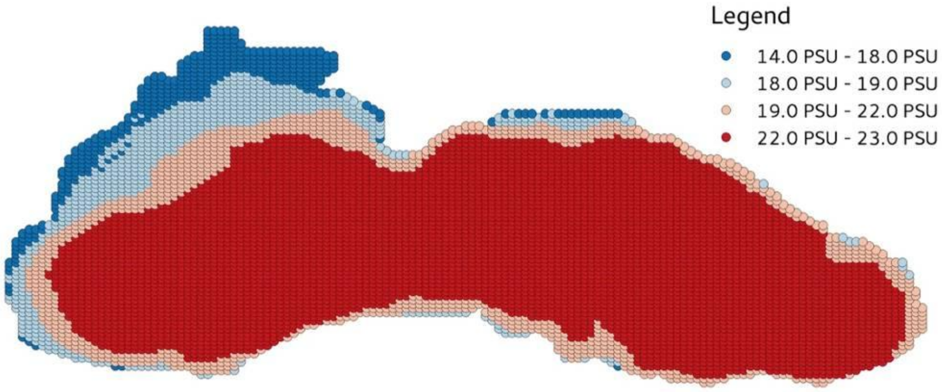


Figure 9 Average salinity at the bottom for the Black Sea.

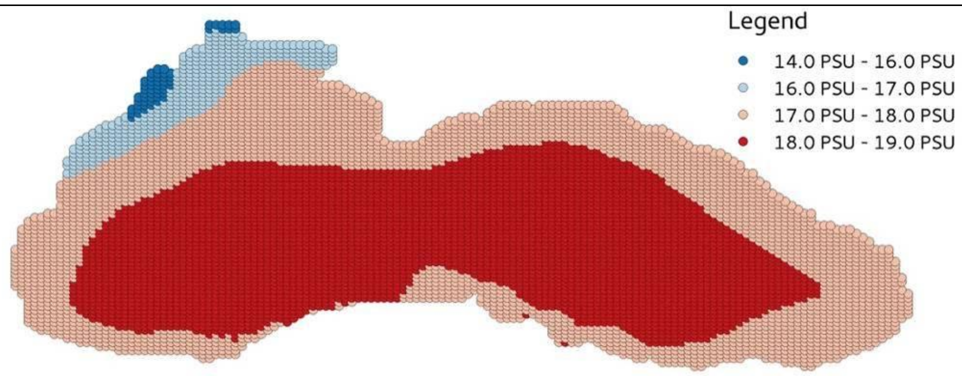


Figure 10 Average salinity at the surface for the Black Sea.

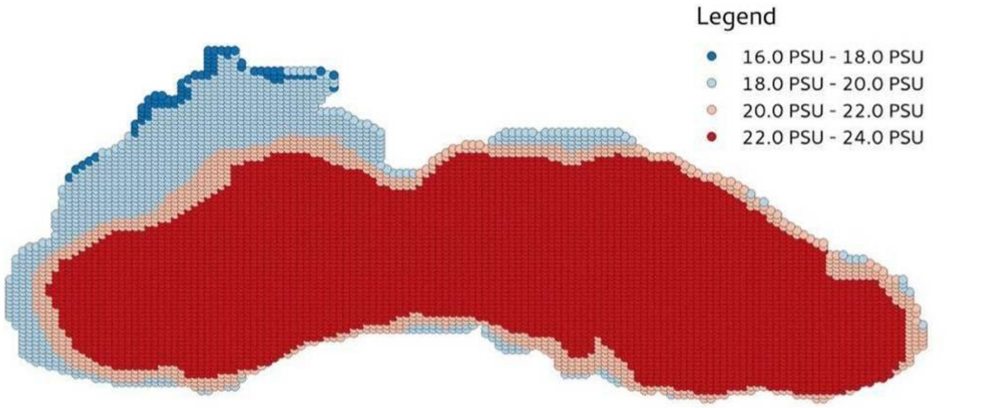


Figure 11 Maxima salinity at the bottom for the Black Sea.

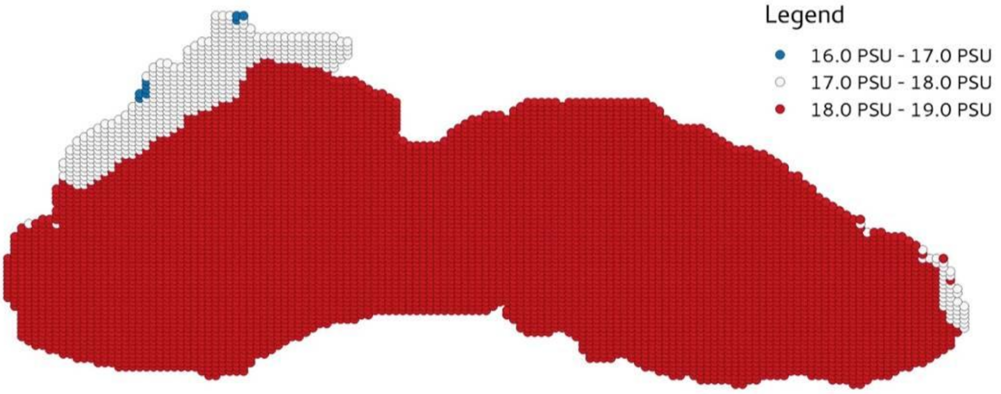


Figure 12 Maxima salinity at the surface for the Black Sea.

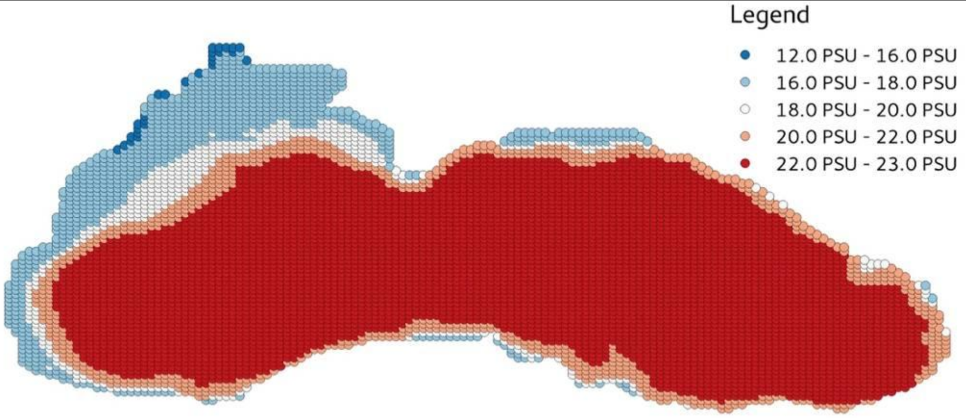


Figure 13 Minima salinity at the bottom for the Black Sea.

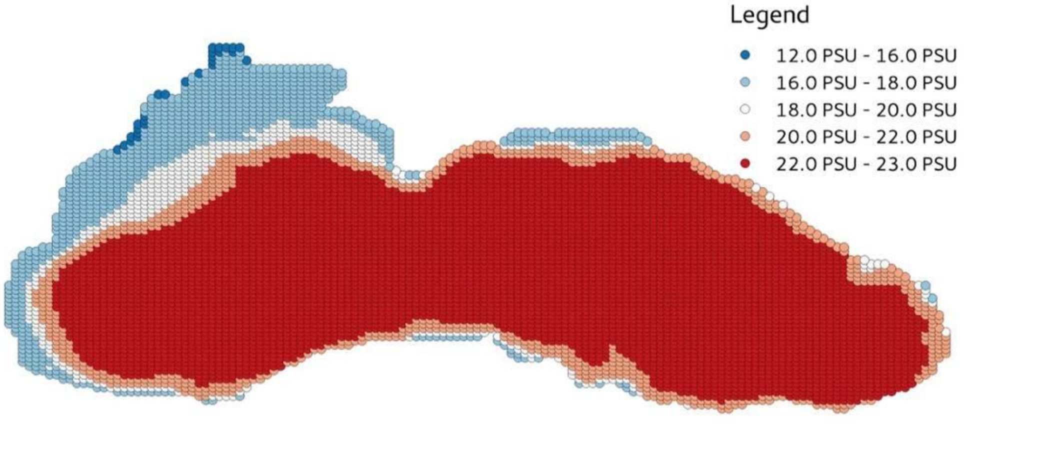


Figure 14 Minima salinity at the surface for the Black Sea.

Currents

Figure 15 to Figure 18 display the average of and the VAAM at the bottom and at the surface in the Adriatic Sea, expressed in m/s. The velocity modulus is higher along the coasts with an average value on the surface between 0.15 m/s and 0.41 m/s and a maximum value that can reach 1.5 m/s. On the bottom the current field is similar to the one on the surface, but velocities are lower. Along the coast they range from 0.05 m/s to 0.21 m/s with maxima values up to 0.5 m/s. $\overline{v}$

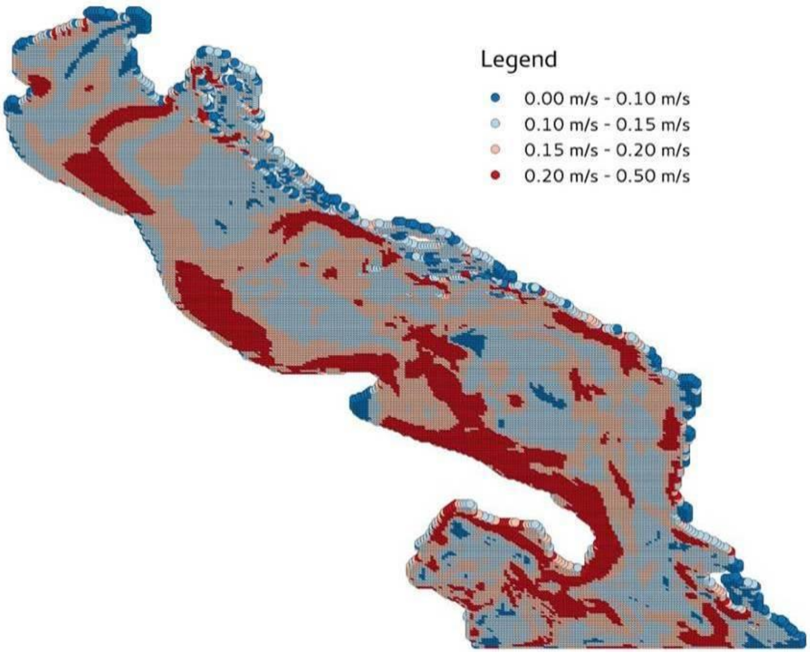


Figure 15 V_{AAM} at the bottom for the Adriatic Sea

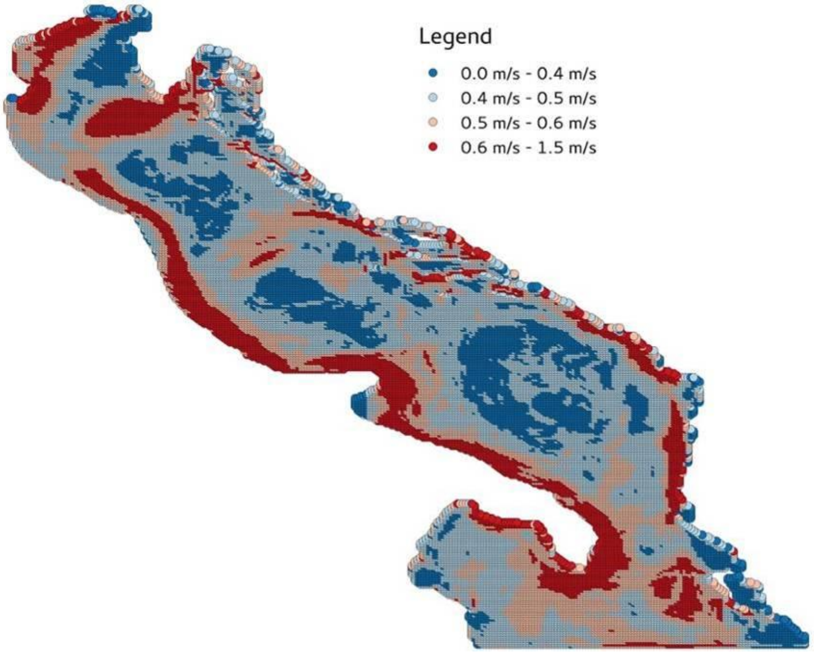


Figure 16 V_{AAM} at the surface for the Adriatic Sea

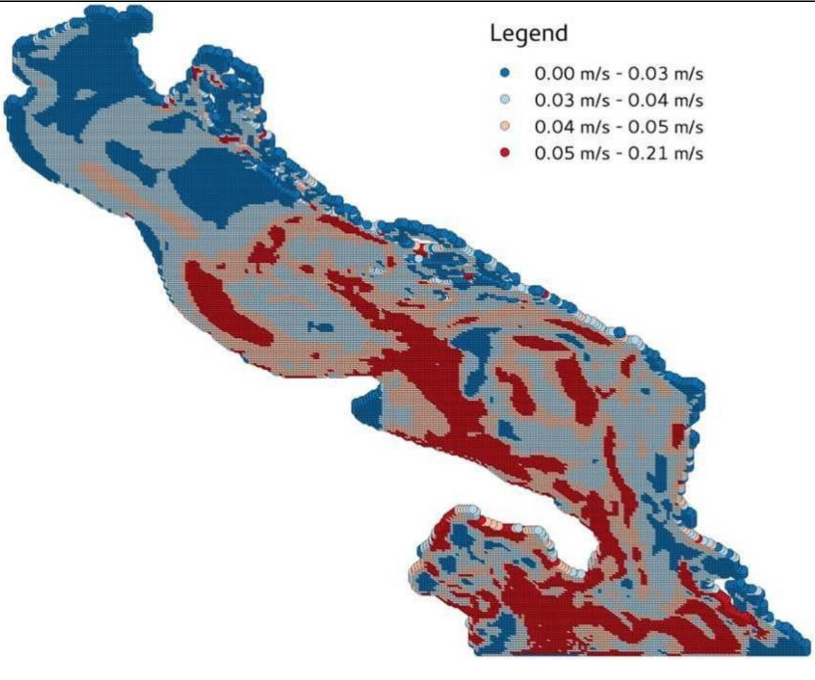


Figure 17 Average velocity at the bottom for the Adriatic Sea

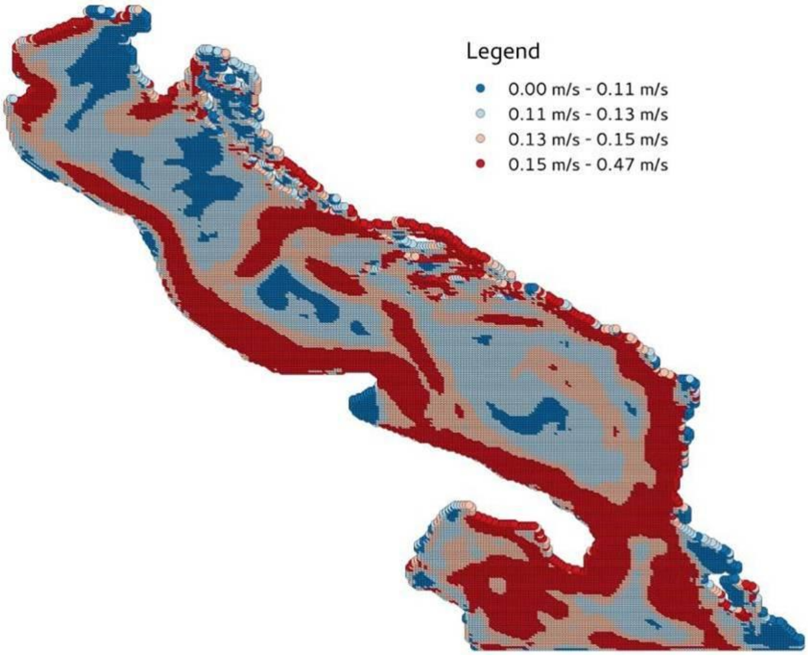


Figure 18 Average velocity at the surface for the Adriatic Sea

Figure 19 to Figure 22 display the average of the annual maxima of $\overline{v}$ and the average of $\overline{v}$ at the bottom and at the surface in the Black Sea, expressed in m/s. The velocity modulus is higher along the coasts and lower in the centre of the basin. The V_{AAM} at the bottom shows values greater than 0.1 m/s along the coasts and lesser than 0.03 m/s in the centre (Figure 18). Figure 20 shows that on the surface, the area of slower V_{AAM} is a little bit different from that at the bottom, with a patch of lower values (less than 0.25 m/s) even in the North of the basin. It is easier to identify this difference in Figure 21 and Figure 22 for the average values, that show the same different path between the bottom and the surface.

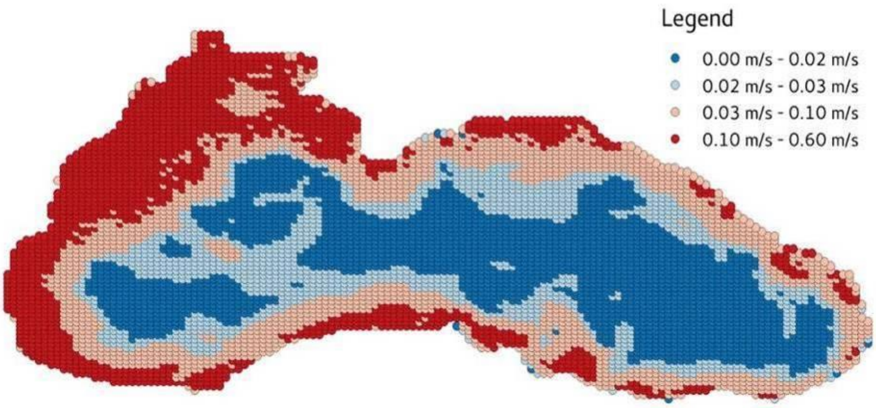


Figure 19 V_{AAM} at the bottom for the Black Sea

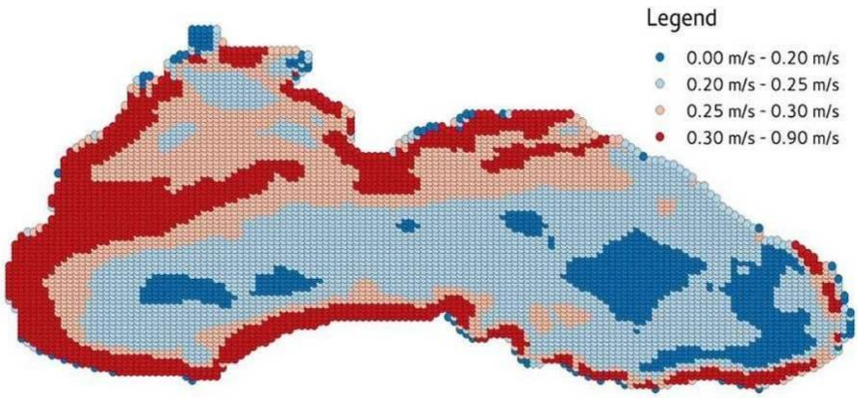


Figure 20 V_{AAM} at the surface for the Black Sea

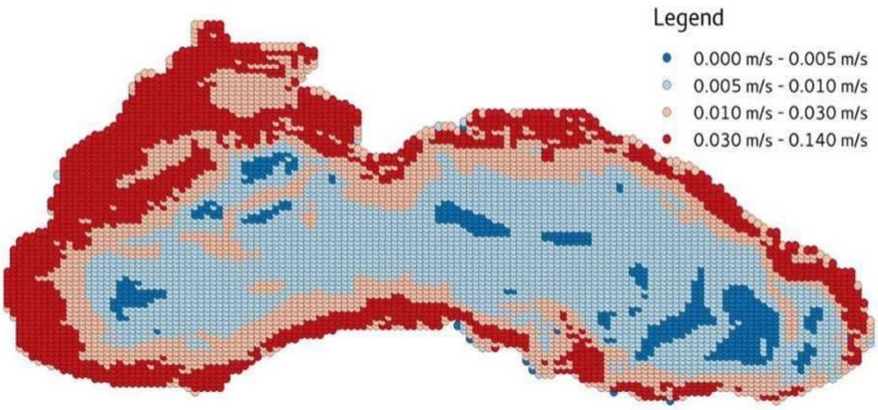


Figure 21 Average velocity at the bottom for the Black Sea

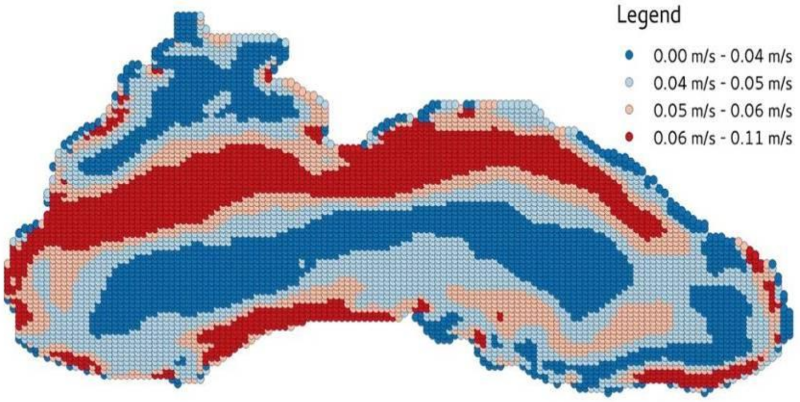


Figure 22 Average velocity at the surface for the Black Sea

Temperature

Figure 23 to Figure 25 show average, and annual average of maxima and minima of temperature at the bottom of the Adriatic Sea, as obtained by Tessa project data. The Northern area of the sea shows both the minima and maxima of temperature due to the small value of the bottom depth. Temperature values are comprised between 3.0°C (minima in Figure 24) and 31°C (maxima in Figure 24).

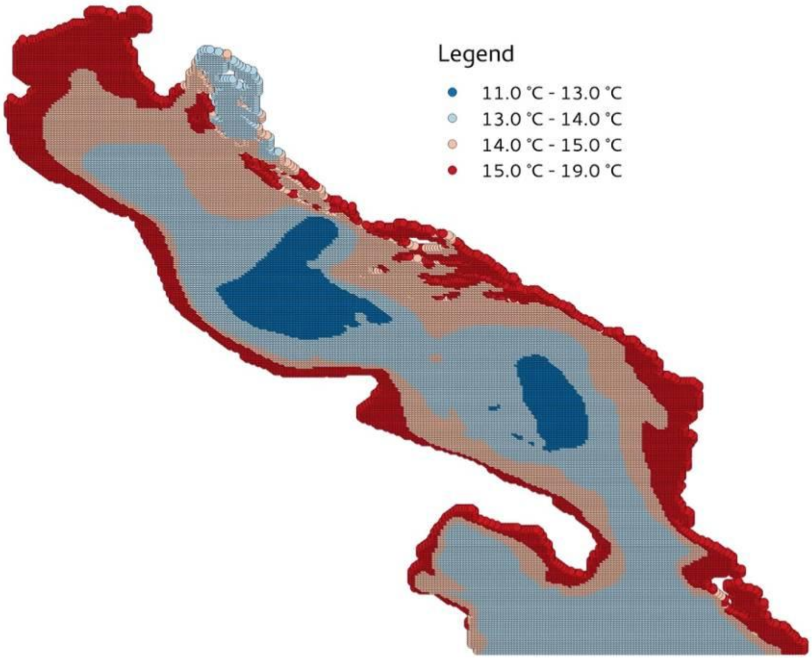


Figure 23 Average temperature at the bottom for the Adriatic Sea

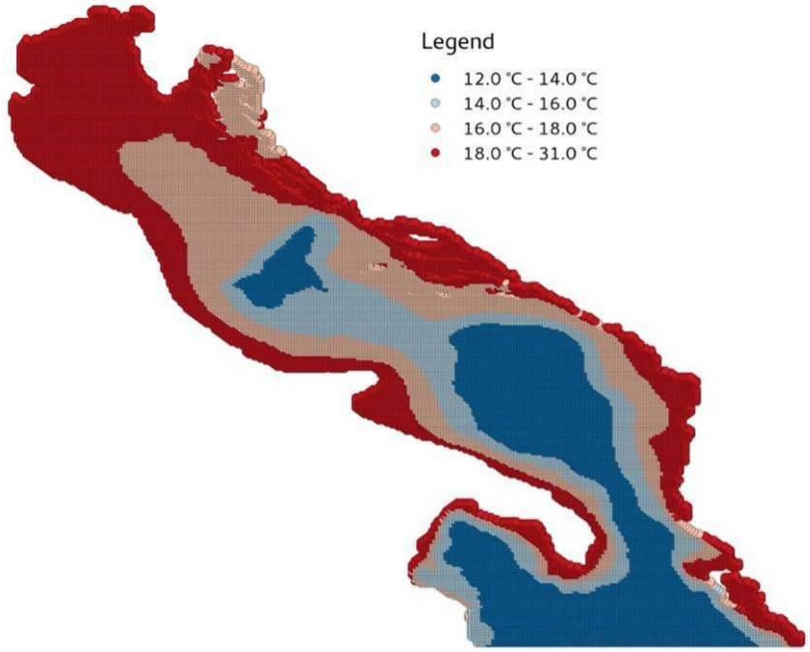


Figure 24 Maxima of temperature at the bottom for the Adriatic Sea

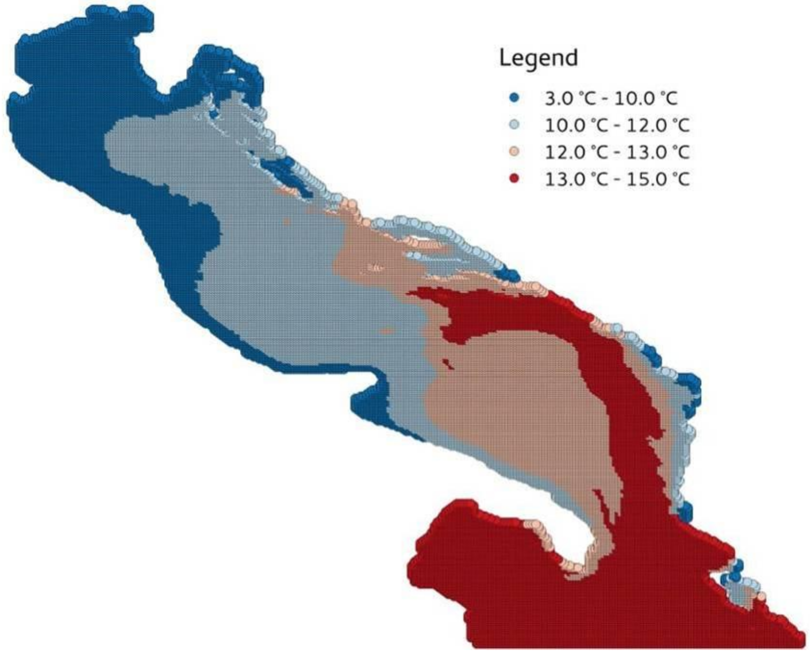


Figure 25 Minima of temperature at the bottom for the Adriatic Sea

Figure 26 to Figure 28 show average and annual average of maxima and minima of temperature at the bottom of the Black Sea, as obtained by MyOcean project data. Data show a very small variation of the values in the central area of the Black Sea, with a temperature always close to 9°C. On the other hand, the shallower area in the North-West shows both the maxima and minima of temperature (Figure 27 and Figure 28).

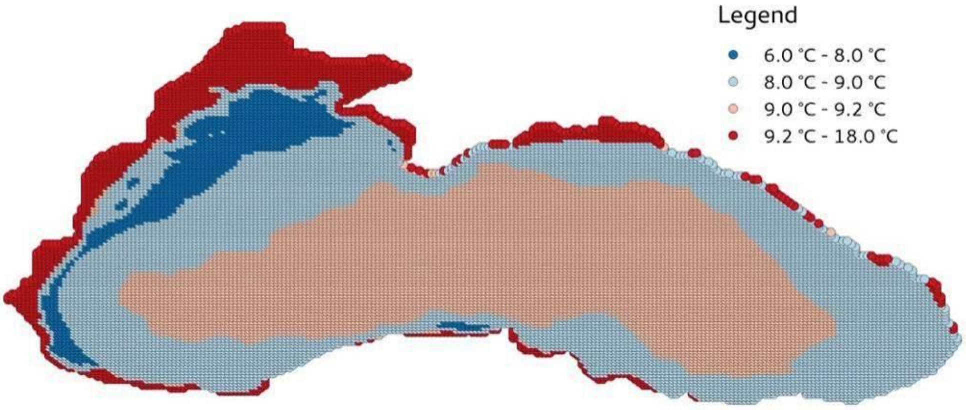


Figure 26 Average temperature at the bottom for the Black Sea

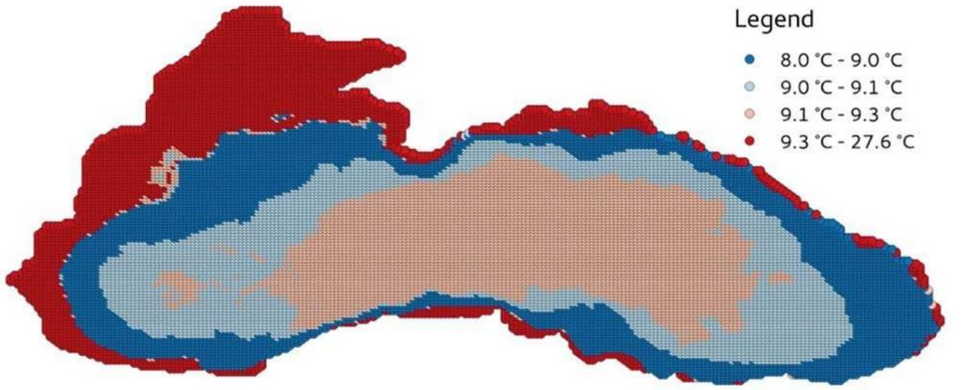


Figure 27 Maxima of temperature at the bottom for the Black Sea

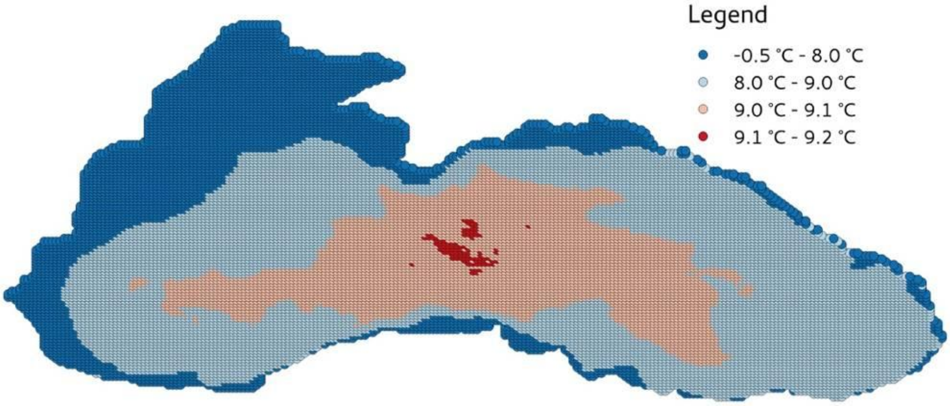


Figure 28 Minima of temperature at the bottom for the Black Sea

The kinetic energy density

Current

In Figure 29, the 90th percentile of the annual average KE density at the bottom (N/m^2) in the Mediterranean Sea is shown. Data come from MyOcean project. Values are generally lower than 5.0 N/m^2. The higher values are in the Western Mediterranean Sea, in the Gabs Gulf, along the Italian coast of the Adriatic Sea and in the Levantine basin.

In Figure 30, the 90th percentile of the annual average KE density at the bottom (N/m^2) in the Adriatic Sea is shown. Data come from Tessa project. Results are in line with those from MyOcean data, but since the resolution is higher the results are more precise than those shown in Figure 29.

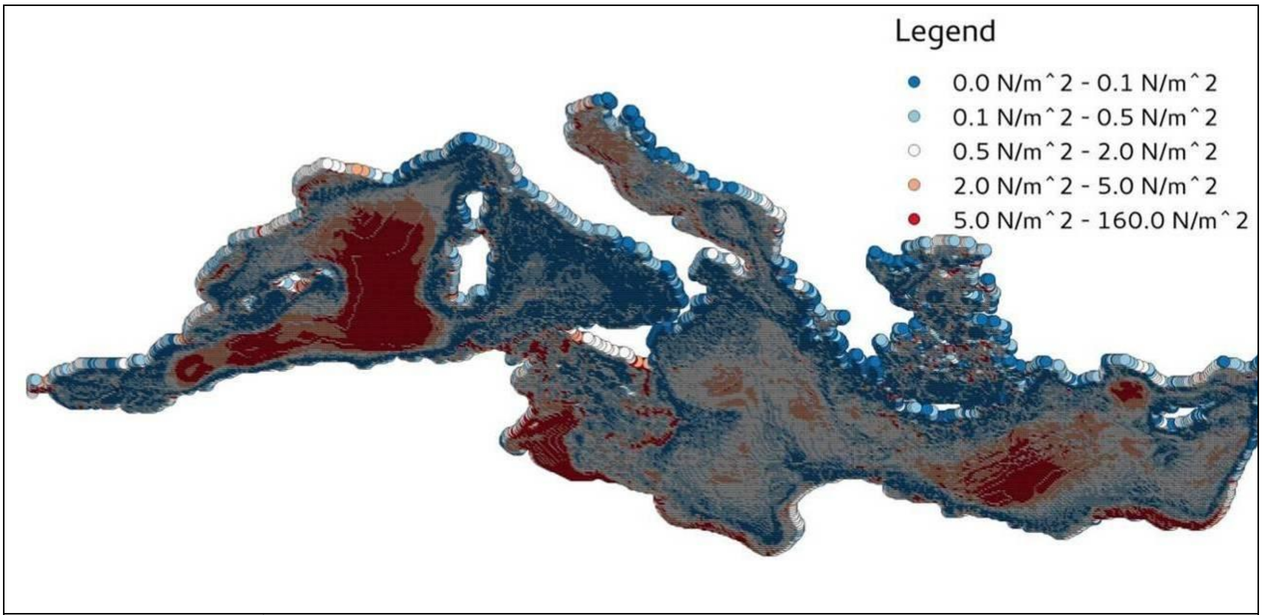


Figure 29 90th percentile of the kinetic energy density at the bottom in the Mediterranean Sea

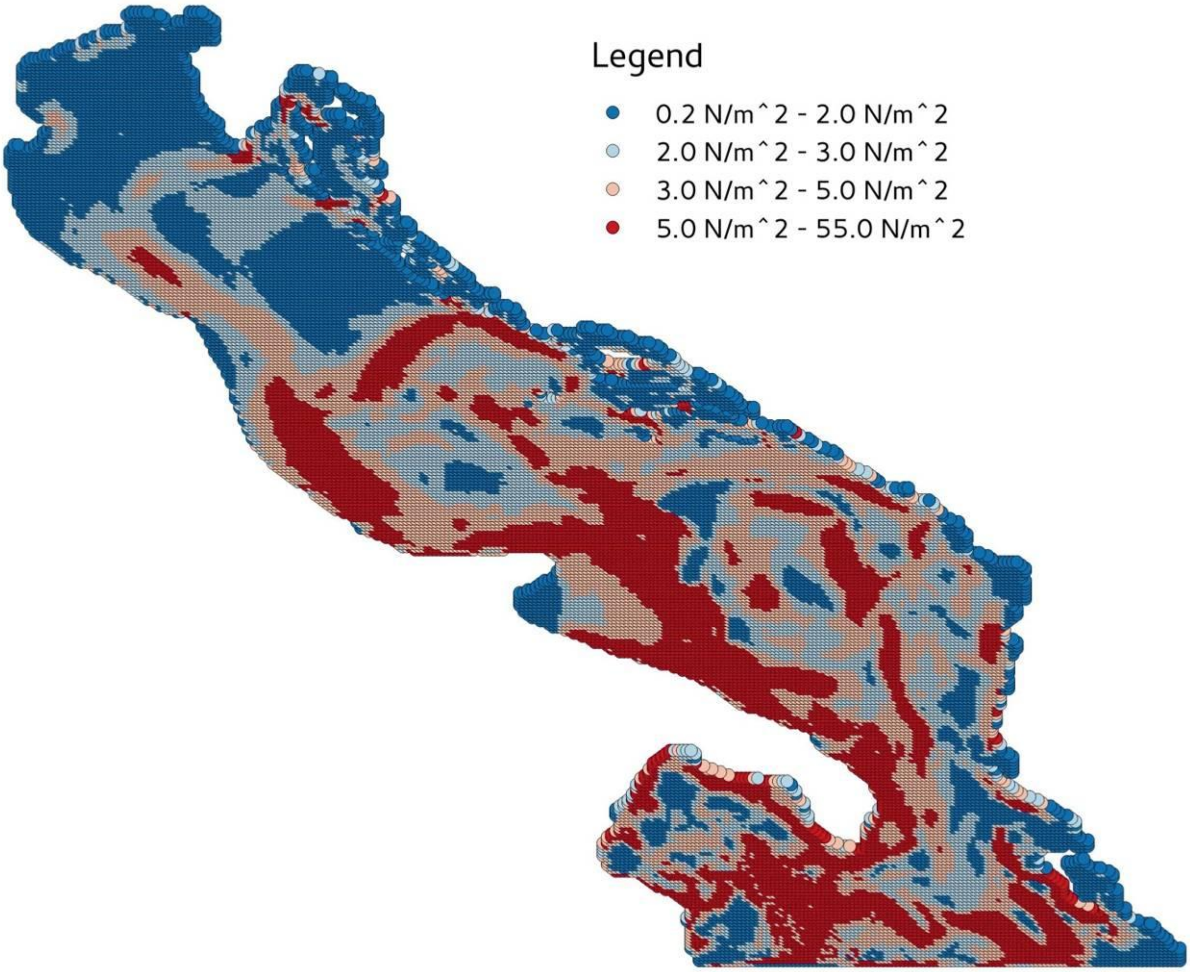


Figure 30 90th percentile of the kinetic energy density at the bottom in the Adriatic Sea

In Figure 31, the 90th percentile of the annual average KE density at the bottom (N/m^2) in the Black Sea is shown. Data come from MyOcean project. The higher values are along the coasts, while in the centre of the basin the values of the kinetic energy density are lesser than 0.2 N/m^2.

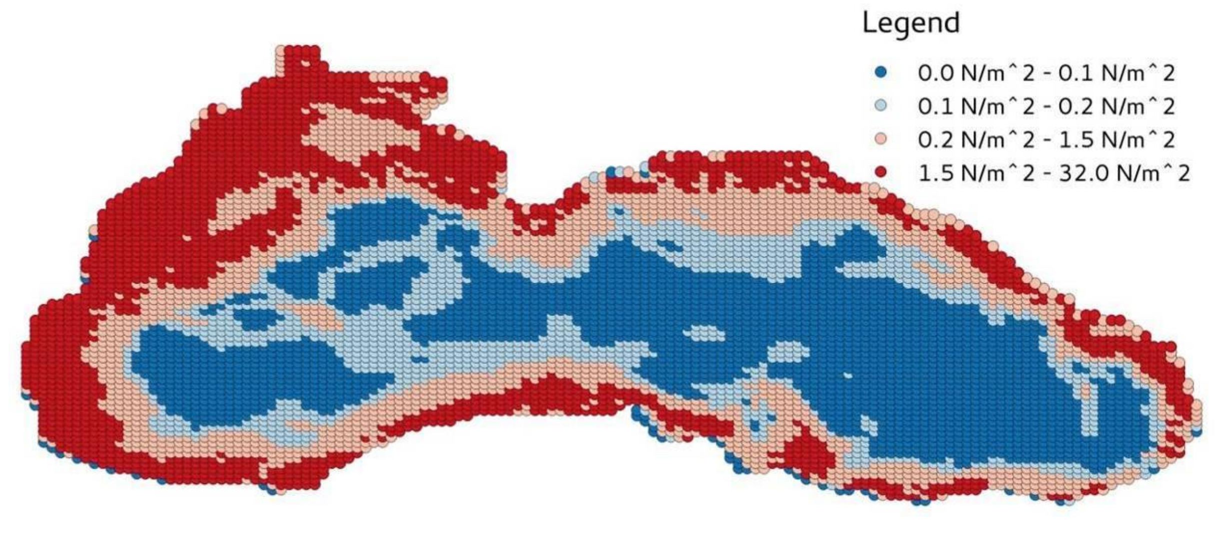


Figure 31 90th percentile of the kinetic energy density at the bottom in the Black Sea

Wind-Waves

The spatial distribution of wave energy at the bottom is related to the wave activity both in terms of H_{m0} and wavelength *k*, but it is also strongly modulated by the local bathymetry. The resolution of the numerical model become essential as the model interpolates the input bathymetry on the model domain. This fact is secondary in most of the open sea domain, but it limits severely the bottom peak KE estimates in near- coastal areas. For this reason, even with the use of high-resolution models and bathymetries, a severe post-processing analysis has been carried out in areas having depths inferior than 2 meters in order to provide reliable results in all the domain. A qualitative analysis of the distribution of 90 percentile wave energy at the bottom in the whole Mediterranean Sea (Figure 32) shows where the waves are critical for the peak energy at the bottom, i.e. the Adriatic Sea, the Sicily Channel, the northern part of the west Mediterranean Sea, the eastern Tyrrhenian Sea, the western coast of Sardinia and the Balearic Islands, the southern part of the eastern Mediterranean Sea.

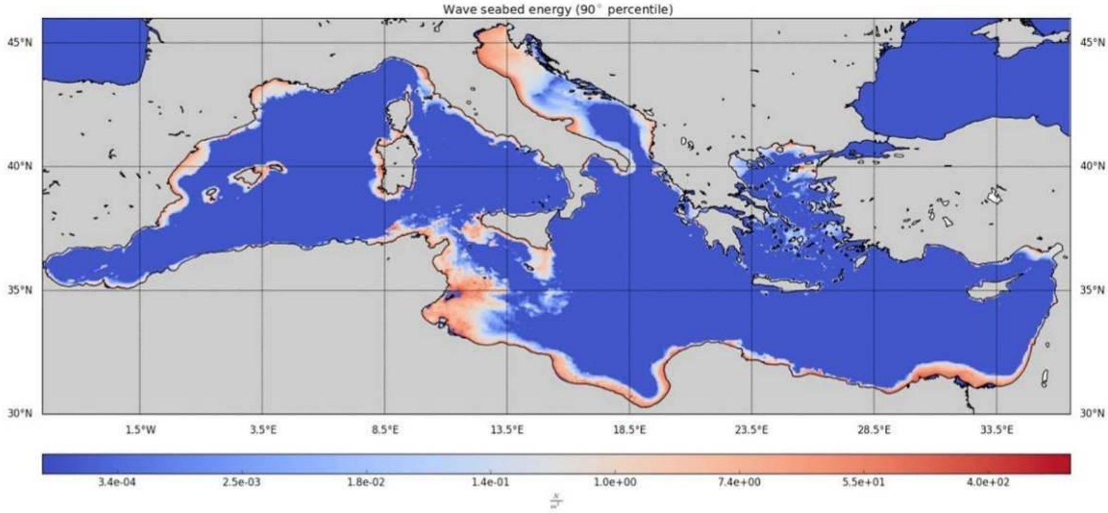


Figure 32 Distribution of 90° percentile wave energy at the bottom in the Mediterranean Sea

A qualitative analysis of the map of 90°-percentile wave energy at the bottom shows that all the northern Adriatic (Figure 33) is exposed to a high level of wave activity due to southern winds but the more exposed areas are on the western border due to the recurrence of north-eastern 'bora' winds.

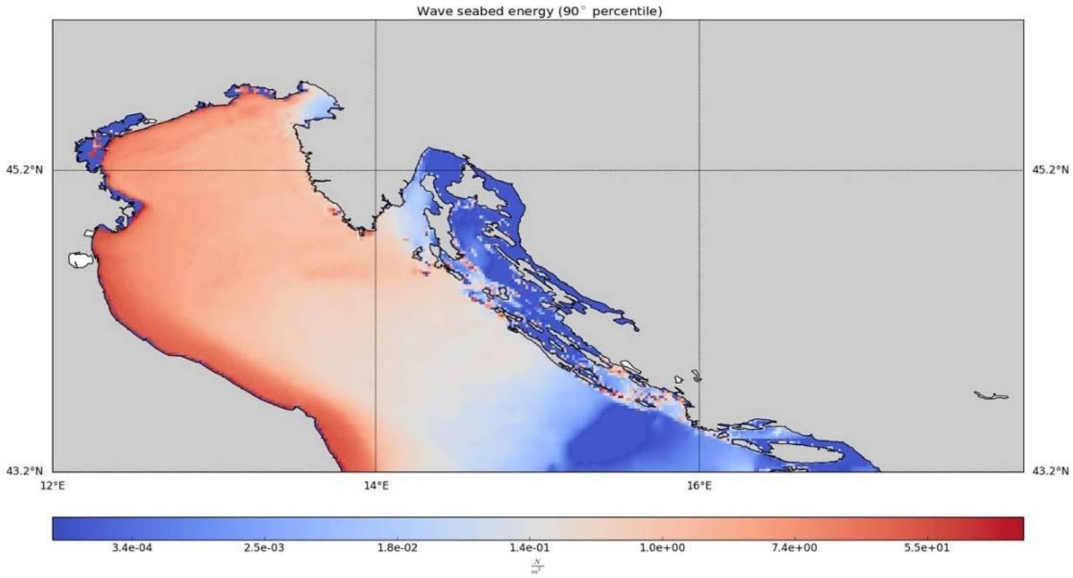


Figure 33 Distribution of 90° percentile wave energy at the bottom in the northern Adriatic Sea

The detailed spatial distribution of the 90° percentile wave energy at the bottom on the regional scale is a basis for the individuation of the coastal areas where the hydrological investigation have to be pursued in detail.

Starting from this study it has been implemented a coastal area including both the Venice and Trieste Gulfs (Figure 35).

The Gulf of Trieste is less exposed to the energy activity while the most interested area is the western coast due to the Bora wind role.

The map of wave energy distribution at the bottom in the regional area of the Southern Adriatic Sea (Figure 34) indicates that all the western coast is the more exposed to very energetic northern 'bora' wind-waves, while the eastern side is exposed to substantial southern waves generated locally by southern winds. In the southern part of the area the deepening of the bathymetry limits the presence of wave energy at the bottom in open sea.

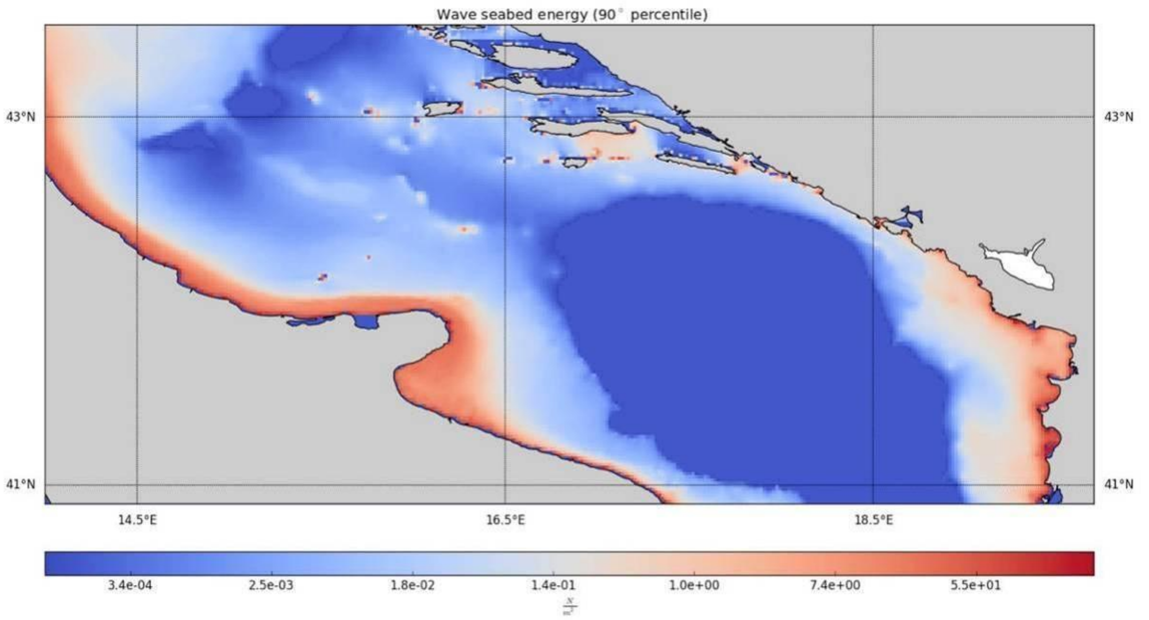


Figure 34 Distribution of 90° percentile wave energy at the bottom in Southern Adriatic Sea

The map of wave energy distribution at the bottom in the Black Sea (Figure 36) indicates that all the northern western coast and inside the Taman Bay are the only areas exposed to a high level of wave activity, while in the rest of the Black Sea the wave energy level is very low.

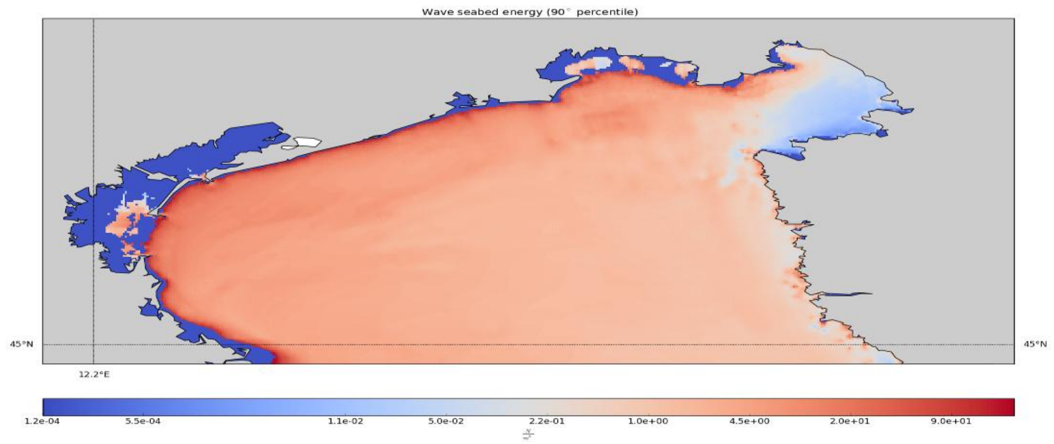


Figure 35 Distribution of 90° percentile wave energy at the bottom in the coastal area of northern Adriatic Sea

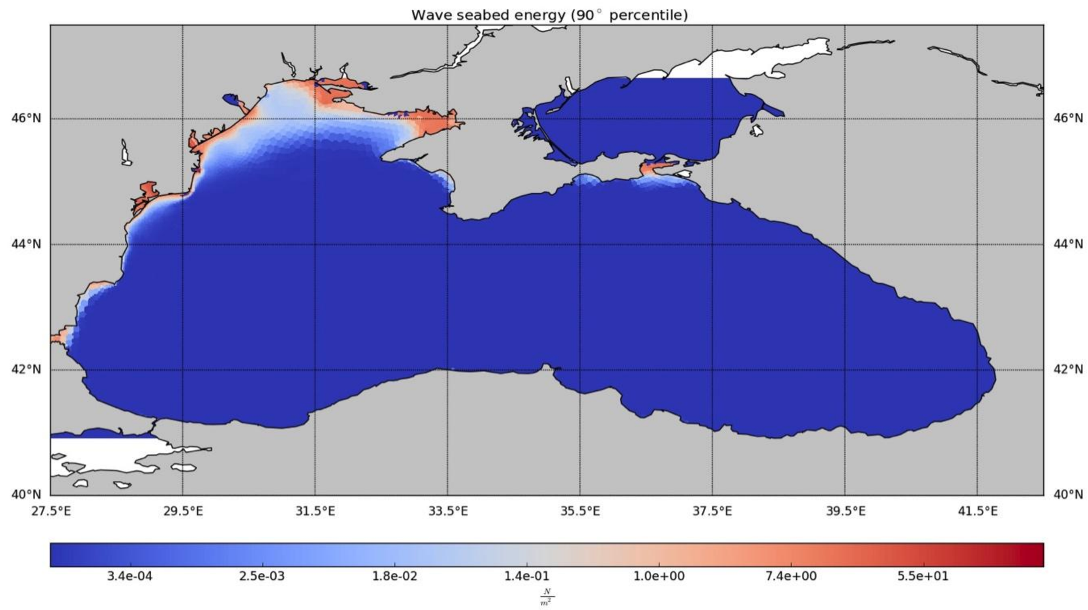


Figure 36 Distribution of 90° percentile wave energy at the bottom in the Black Sea

Section 4: List of deliverables

Deliverable 1. **Shapefile of average salinity at the bottom in the Adriatic Sea** [gis_adrimeansalbot.zip].
Deliverable 2. **Shapefile of average salinity at the surface in the Adriatic Sea** [gis_adrimeansalsur.zip].
Deliverable 3. **Shapefile of maxima of salinity at the bottom in the Adriatic Sea** [gis_adrimaxsalbot.zip].
Deliverable 4. **Shapefile of maxima of salinity at the surface in the Adriatic Sea** [gis_adrimaxsalsur.zip].
Deliverable 5. **Shapefile of minima of salinity at the bottom in the Adriatic Sea** [gis_adriminsalbot.zip].
Deliverable 6. **Shapefile of minima of salinity at the surface in the Adriatic Sea** [gis_adriminsalsur.zip].
Deliverable 7. **Shapefile of average salinity at the bottom in the Black Sea** [gis_bsmeansalbot.zip].
Deliverable 8. **Shapefile of average salinity at the surface in the Black Sea** [gis_bsmeansalsur.zip].
Deliverable 9. **Shapefile of maxima of salinity at the bottom in the Black Sea** [gis_bsmaxsalbot.zip].
Deliverable 10. **Shapefile of maxima of salinity at the surface in the Black Sea** [gis_bsmaxsalsur.zip].
Deliverable 11. **Shapefile of minima of salinity at the bottom in the Black Sea** [gis_bsminsalbot.zip].
Deliverable 12. **Shapefile of minima of salinity at the surface in the Black Sea** [gis_bsminsalsur.zip].
Deliverable 13. **Shapefile of average velocity at the bottom in the Adriatic Sea** [gis_adrimeanvelbot.zip].
Deliverable 14. **Shapefile of average velocity at the surface in the Adriatic Sea** [gis_adrimeanvelsur.zip].
Deliverable 15. **Shapefile of average of annual maxima velocity at the bottom in the Adriatic Sea** [gis_adrimaxvelbot.zip].
Deliverable 16. **Shapefile of average of annual maxima velocity at the surface in the Adriatic Sea** [gis_adrimaxvelsur.zip].
Deliverable 17. **Shapefile of average velocity at the bottom in the Black Sea** [gis_bsmeanvelbot.zip].
Deliverable 18. **Shapefile of average velocity at the surface in the Black Sea** [gis_bsmeanvelsur.zip].
Deliverable 19. **Shapefile of average of annual maxima velocity at the bottom in the Black Sea** [gis_bsmaxvelbot.zip].
Deliverable 20. **Shapefile of average of annual maxima velocity at the surface in the Black Sea** [gis_bsmaxvelsur.zip].
Deliverable 21. **Shapefile of average temperature at the bottom in the Adriatic Sea** [gis_adrimeantembot.zip].

Deliverable 22. **Shapefile of maxima of temperature at the bottom in the Adriatic Sea** [gis_adrimaxtembot.zip].

Deliverable 23. **Shapefile of minima of temperature at the bottom in the Adriatic Sea** [gis_adrimintembot.zip].

Deliverable 24. **Shapefile of average temperature at the bottom in the Black Sea** [gis_bsmeantembot.zip].

Deliverable 25. **Shapefile of maxima of temperature at the bottom in the Black Sea** [gis_bsmaxtembot.zip].

Deliverable 26. **Shapefile of minima of temperature at the bottom in the Black Sea** [gis_bsmintembot.zip].

Deliverable 27. **Shapefile of average 90th percentile of KE density at the bottom in the Mediterranean Sea** [gis_med90perckenerrhobot.zip]**.**

Deliverable 28. **Shapefile of average 90th percentile of KE density at the bottom in the Adriatic Sea** [gis_adri90perckenerrhobot.zip]**.**

Deliverable 29. **Shapefile of average 90th percentile of KE density at the bottom in the Black Sea** [gis_bs90perckenerrhobot.zip]**.**

Deliverable 30. **Mediterranean Sea wind-wave sea-bottom peak kinetic energy (90th percentile)** [wkbe_med.nc] **NetCDF file**

Deliverable 31. **Southern Adriatic Sea wind-wave sea-bottom peak kinetic energy (90th percentile)** [wkbe_g8.nc] **NetCDF file**

Deliverable 32. **Northern Adriatic Sea wind-wave sea-bottom peak kinetic energy (90th percentile)** [wkbe_g9.nc] **NetCDF file**

Deliverable 33. **North Adriatic Sea (coastal area) wind-wave sea-bottom peak kinetic energy (90th percentile)** [wkbe_g9a.nc] **NetCDF file**

Deliverable 34. **Black Sea wind-wave sea-bottom peak kinetic energy (90th percentile)** [wkbe_bs.nc] **NetCDF file**

For deliverable 30-33 the netcdf file structure is:

```
dimensions:
	lat = 479 ;
	lon = 1250 ;
variables:
	float latitudes(lon, lat) ;
		latitudes:units = "degrees north" ;
	float longitudes(lon, lat) ;
		longitudes:units = "degrees east" ;
	float wbke(lon, lat) ;
		wbke:units = "Newton/(meter*meter)" ;
```

Fr deliverable 34 the netcdf file structure is:

```
dimensions:
	nodes = 11668 ;
variables:
	float latitude(nodes) ;
		latitude:units = "degrees_north" ;
	float longitude(nodes) ;
```

```
    longitude:units = "degrees_east" ;
float kin.energy(nodes) ;
    kin.energy:units = "Newton/(m*m)" ;
```

Section 5: Bibliography

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Appendix 3: Synopsis of biological data collation

Country	Name of locations/code of the dataset	Number on the maps	Institution that acquired the data	Source of data	Type of data (sampling points, polygons)	Habitat name	Number of sample data per habitat	Fitness for purpose of data.	Reference
Black Sea									
ROMANIA	Midia Cape, Constanta, Tuzla Cape	1, 2, 3	GeoEcoMar	GeoEcoMar & EuroOBIS	point data	infralittoral soft bottom	56	infralittoral lower limit determination	BEGUN, T., TEACĂ, A., GOMOIU, M.-T. and PARASCHIV G. M., 2006 - Present state of the sandy invertebrate populations from two touristic beaches situated in the south sector of the Romanian Black Sea coast. GEO-ECO-MARINA, 12: 67-77. Teaca A., Begun T., Muresan M. - Chapter 7: Assessment of Soft-Bottom Communities and Ecological Quality Status Surrounding Constanta and Mangalia Ports (Black Sea), 67-74 pp., in Book: Stylios, C., Floqi, T., Marinski, J., Damiani, L., (eds.), 2015. Sustainable Development of Sea-Corridors and Coastal Waters, Springer International Publishing Switzerland 2015 DOI 10.1007/978-3-319-11385-2_1. http://www.springer.com/gp/book/9783319113845
BULGARIA	Whole coast (Kaliakra Cape, Varna Bay, Bourgas Bay-Tsarevo)	4,5,6	IO-BAS, GeoEcoMar	IO-BAS, GeoEcoMar & EuroOBIS	point data	infralittoral soft bottom	112 (BG: 92 points)	infralittoral lower limit determination	IO_BAS monitoring data (unpubl.); UNDP/GEF BSERP (IO-BAS); BG national monitoring under WFD (IO-BAS), ; 7FP EC CoCoNet Project (IO-BAS); "State of the environment of the Stradza-Igneada MPA" (www.misisproject.eu) (GeoEcoMar); State of the Environment. Report of the Western Black Sea based on Joint MISIS Cruise" (GeoEcoMar)
TURKEY	Igneada, Trabzon	7, 22	GeoEcoMar	GeoEcoMar & EuroOBIS	point data	soft bottom		infralittoral lower limit determination	"State of the environment of the Stradza-Igneada MPA" (www.misisproject.eu) (GeoEcoMar); State of the Environment. Report of the Western Black Sea based on Joint MISIS Cruise" (GeoEcoMar) (www.misisproject.eu)

Country	Name of locations/code of the dataset	Number on the maps	Institution that acquired the data	Source of data	Type of data (sampling points, polygons)	Habitat name	Number of sample data per habitat	Fitness for purpose of data.	Reference
UKRAINA	Prymorske-Zatoka, Odessa sand bank, Tendrovskaya kosa, Karkinitsky Bay	8,9,10, 11	GeoEcoMar	EuroOBIS	point data	infralittoral soft bottom	156	infralittoral lower limit determination	TEACĂ, A., BEGUN, T., GOMOIU, M.-T., 2001 - The meio- and macrozoobenthos of limans and shallow marine waters of the Ukrainian Blak Sea littoral. An. Univ. "Al. J. Cuza" Iaşi: 203-213. Petrov A., Povchun A.S., Zolotrev P.N. - Initial data set (1980-1989) on abundance and biomass of soft-bottom macrozoobenthos of Karkinitsky gulf, Western Crimea, Ukraine. Institute of Biology of Southern Seas, Ukraine. www.eurobis.org
RUSSIA (Crimeea)	Sevastopol, Fiolent Cape - Laspi Bay, Yalta	12, 13, 14	GeoEcoMar	EuroOBIS	point data	infralittoral soft bottom	69	infralittoral lower limit determination	Petrov, A, Milovidova, N. , Alyomov S., Shadrina L. - Initial data set (1982-1992) on abundance and biomass of soft-bottom macrozoobenthos , key abiotic variables in near-bottom layers of Sevastopol bay, SW Crimea, Ukraine. Institute of Biology of Southern Seas, Ukraine. www.eurobis.org
RUSSIA	Anapa - Novorossiysk, Gelendzhik - Dzhankhot, Betta - Lermontov, Novomikhaylovskiy - Shepsi	15, 16, 17, 18	GeoEcoMar	EuroOBIS	point data	infralittoral soft bottom	34	infralittoral lower limit determination	Petrov, A, Milovidova, N. , Alyomov S., Shadrina L. - Initial data set (1982-1992) on abundance and biomass of soft-bottom macrozoobenthos , key abiotic variables in near-bottom layers of Sevastopol bay, SW Crimea, Ukraine. Institute of Biology of Southern Seas, Ukraine. www.eurobis.org
GEORGIA	Gudaut, Sokhumi, Ochamchire - Batumi	19, 20, 21	GeoEcoMar	EuroOBIS	point data	infralittoral soft bottom	41	infralittoral lower limit determination	www.eurobis.org
RUSSIA (Crimeea)	Tarkhankut Peninsula, Sevastopol, Fiolent Cape-Laspi Bay, Simeiz, Kurortnoe-Planernyj Cape	46, 47, 48, 49, 50	GeoEcoMar	EuroOBIS	point data	Infralittoral hard bottom (*Cystoseira barbata* presence)	221	Infralittoral hard bottom lower limt (threshold 14 m isobath)	Milchakova N.A., Ryabogina V.G., Chernyshova E.B. Macroalgae of the Crimean coastal zone (the Black Sea, 1967-2007). Sevastopol, IBSS, 2011.

Country	Name of locations/code of the dataset	Number on the maps	Institution that acquired the data	Source of data	Type of data (sampling points, polygons)	Habitat name	Number of sample data per habitat	Fitness for purpose of data.	Reference
ROMANIA	Agigea-Vama Veche	51	GeoEcoMar	GeoEcoMar	point data	infralittoral hard bottom (*Cystoseira barbata* presence)	23	Infralittoral hard bottom lower limt (threshold 14 m isobath)	Environmental Baseline Survey Report, 2014
BULGARIA	Cape Atia, Sozopol, cape Agalina, cape Maslen Nos, Kiten, cape Emine, cape Sinemorets, Rodni Balkani, Ropotamo, Bolata, Kaliakra, Iailata, Zelenka, Tulenovo, Galata, Arapia, Veleka-Sinemoretz (Rezovo area)	52, 53, 54, 55, 56, 57	IBER, GeoEcoMar	IBER, GeoEcoMar	point data	infralittoral hard bottom (*Cystoseira barbata* presence)	32 (21 points - BG)	Infralittoral hard bottom lower limt (threshold 14 m isobath)	IBER monitoring data (unpubl.), MISIS project
ROMANIA + UKRAINA	Danube mouth	23	GeoEcoMar	GeoEcoMar & EuroOBIS	point data	mask area	406	Danube and Dniepr masks delineation; salinity threshold	GeoEcoMar monitoring data (unpubl.); Petrov, A, Milovidova, N. , Alyomov S., Shadrina L. - Initial data set (1982-1992) on abundance and biomass of soft-bottom macrozoobenthos , key abiotic variables in near-bottom layers of Sevastopol bay, SW Crimea, Ukraine. Institute of Biology of Southern Seas, Ukraine. www.eurobis.org; Petrov A., Povchun A.S., Zolotrev P.N. - Initial data set (1980-1989) on abundance and biomass of soft-bottom macrozoobenthos of Karkinitsky gulf, Western Crimea, Ukraine. Institute of Biology of Southern Seas, Ukraine. www.eurobis.org
UKRAINA	Dnieper mouth	24	GeoEcoMar	EuroOBIS	point data	mask area	40	Dniepr masks delineation; salinity threshold	Petrov A., Povchun A.S., Zolotrev P.N. - Initial data set (1980-1989) on abundance and biomass of soft-bottom macrozoobenthos of Karkinitsky gulf, Western Crimea, Ukraine. Institute of Biology of Southern Seas, Ukraine. www.eurobis.org

Country	Name of locations/code of the dataset	Number on the maps	Institution that acquired the data	Source of data	Type of data (sampling points, polygons)	Habitat name	Number of sample data per habitat	Fitness for purpose of data.	Reference
ROMANIA	whole inner shelf	25	GeoEcoMar	GeoEcoMar & EuroOBIS	point data	shallow circalittoral	491	shallow circalitoral delineation; temperature threshold	Begun T., Teaca A., Gomoiu, M.T., Muresan M., 2010 - Present structure and distribution of macrobenthic populations in the North - Western Black Sea – Romanian Shelf. Rapp. Comm. Int. Mer Médit., 39, 443.
UKRAINA	whole inner shelf	26	GeoEcoMar	GeoEcoMar & EuroOBIS	point data	shallow circalittoral	800	shallow circalitoral delineation; temperature threshold	www.eurobis.org.
BULGARIA	whole inner shelf	27	IO-BAS, GeoEcoMar	IO_BAS, GeoEcoMar & EuroOBIS	point data	shallow circalittoral	217 (BG: 132 points)	shallow circalitoral delineation; temperature threshold	IO_BAS monitoring data (unpubl.); UNDP/GEF BSERP (IO-BAS); WFD monitoring program (IO-BAS), ; CoCoNet project (IO-BAS); UNDP/GEF BSERP project (GeoEcoMar), MISIS project (www.misisproject.eu) (GeoEcoMar)
RUSSIA	Kerch Strait offcoast, Anapa - Bolshoy Utrish, Gelendzhik - Shepsi	28, 29, 30	GeoEcoMar	GeoEcoMar & EuroOBIS	point data	shallow circalittoral	141	shallow circalitoral delineation; temperature threshold	www.eurobis.org
GEORGIA	Bichventa Bay - Sochumi, Ochamchire - Batumi Bay	31, 32	GeoEcoMar	GeoEcoMar & EuroOBIS	point data	shallow circalittoral	67	shallow circalitoral delineation; temperature threshold	www.eurobis.org
TURKEY	Pazar-Findikli, Besikduzu-Gorele	33, 34	GeoEcoMar	GeoEcoMar & EuroOBIS	point data	shallow circalittoral	15	shallow circalitoral delineation; temperature threshold	MISIS project (www.misisproject.eu)

Country	Name of locations/code of the dataset	Number on the maps	Institution that acquired the data	Source of data	Type of data (sampling points, polygons)	Habitat name	Number of sample data per habitat	Fitness for purpose of data.	Reference
ROMANIA	whole outer shelf	35	GeoEcoMar	GeoEcoMar & EuroOBIS	point data	deep circalittoral	736	deep circa lower limit delineation;	Begun T., Teaca A., Gomoiu M.-T., 2010 - Ecological state of macrobenthic populations within *Modiolus phaseolinus* biocoenosis from Romanian Black Sea Continental Shelf. Geo-Eco-Marina, 16: 5-18. Friedrich, J., Janssen, F., Aleynik, D., Bange, H. W., Boltacheva, N., Çagatay, M. N., Dale, A. W., Etiope, G., Erdem, Z., Geraga, M., Gilli, A., Gomoiu, M. T., Hall, P. O. J., Hansson, D., He, Y., Holtappels, M., Kirf, M. K., Kononets, M., Konovalov, S., Lichtschlag, A., Livingstone, D. M., Marinaro, G., Mazlumyan, S., Naeher, S., North, R. P., Papatheodorou, G., Pfannkuche, O., Prien, R., Rehder, G., Schubert, C. J., Soltwedel, T., Sommer, S., Stahl, H., Stanev, E. V., Teaca, A., Tengberg, A., Waldmann, C., Wehrli, B., and Wenzhöfer, F.: Investigating hypoxia in aquatic environments: diverse approaches to addressing a complex phenomenon, Biogeosciences, 11, 1215-1259, doi:10.5194/bg-11-1215-2014, 2014
BULGARIA	whole outer shelf	36	IO_BAS, GeoEcoMar	IO_BAS, GeoEcoMar & EuroOBIS	point data	deep circalittoral	94 (BG: 38 points)	deep circa lower limit delineation;	IO_BAS monitoring data (unpubl.), GEF project, MISIS project (www.misisproject.eu)
UKRAINA	whole NW outer shelf	37	GeoEcoMar		point data	deep circalittoral	578	deep circa lower limit delineation;	www.eurobis.org
RUSSIA (CRIMEA)	Yalta (outer shelf)	38	GeoEcoMar	GeoEcoMar & EuroOBIS	point data	deep circalittoral	40	deep circa lower limit delineation;	www.eurobis.org
RUSSIA	Anapa - Novorossiysk, Krinitsa - Shepsi outer shelf	39, 40	GeoEcoMar	GeoEcoMar & EuroOBIS	point data	deep circalittoral	81	deep circa lower limit delineation;	www.eurobis.org
GEORGIA	Pitsunda - Sokhumi, Kodori Bay-Kobuleti	41, 42	GeoEcoMar	GeoEcoMar & EuroOBIS	point data	deep circalittoral	153	deep circa lower limit delineation;	www.eurobis.org

Country	Name of locations/code of the dataset	Number on the maps	Institution that acquired the data	Source of data	Type of data (sampling points, polygons)	Habitat name	Number of sample data per habitat	Fitness for purpose of data.	Reference
TURKEY	Igneada outer shelf	43	GeoEcoMar	GeoEcoMar	point data	deep circalittoral	8	deep circa lower limit delineation;	MISIS project (www.misisproject.eu)
ROMANIA	Sf. Gheorghe, Mangalia outershelf	44, 45	GeoEcoMar	GeoEcoMar & EuroOBIS	point data	suboxic deep circalittoral	17	suboxic deep circa; isopcnic values threshold	Muresan M., 2014. Diversity and distribution of free-living nematodes within periazoic level on the Romanian shelf of the Black Sea, Geo-Eco-Marina 20, 19-28 pp
BULGARIA	Varna outershelf	58	IO-BAS	IO-BAS	point data	suboxic deep circalittoral	1	suboxic deep circa; isopcnic values threshold	IO_BAS monitoring data (unpubl.)
Mediterranean Sea, Adriatic and Ionian Sea									
SLOVENJA	Koper/Izola	1	ISPRA	Institute of the Republic of Slovenia for Nature Conservation, Slovenia	polygon data	Posidonia oceanica	n/a	integrative substrate layer	Makovec, T., Turk, R., Mapping of the *Posidonia oceanica* meadow on the Slovenian coast. In: UNEP-MAP-RAC/SPA, 2006. Proceedings of the second Mediterranean symposium on marine vegetation (Athens, 12-13 December 2003) RAC-SPA edit., Tunis:255pp.
CROATIA	Uvala Planka, Strazika, Unije, Losinj	2	ISPRA	International Marine Center, Oristano	lower limit point data	Posidonia oceanica	11	infralittoral lower limit light threshold determination	
CROATIA	Lojisce (Dug Otok), Rukavac (Vis), Saplun Island (Lastovo)	3, 4, 5	ISPRA	University of Zagreb, Faculty of Science, Division of Biology , Croatia	lower limit point data	Posidonia oceanica	3	infralittoral lower limit light threshold determination	

Country	Name of locations/code of the dataset	Number on the maps	Institution that acquired the data	Source of data	Type of data (sampling points, polygons)	Habitat name	Number of sample data per habitat	Fitness for purpose of data.	Reference
CROATIA	Kamenjak, Cres, Vis	6, 7, 4	ISPRA	Institute for oceanography and fisheries , Split, Croatia	lower limit point data	Posidonia oceanica	3	infralittoral lower limit light threshold determination	
CROATIA	Dugi Otok, Telascica, Hvar, Kornati, Brijuni, Lastovo, Brač	3, 5, 8, 9, 10	ISPRA	State Institute for Nature Protection, Croatia	polygon data	Posidonia oceanica	n/a	integrative substrate layer and infralittoral lower limit light threshold determination for meadows coinciding with lower limits indicated above	1.) Rudjer Bokovi Institute, Center for Marine Research Rovinj (2009). Mapping of marine habitats at biocenose according to the National Habitat Classification, Rovinj; 2.) University of Zagreb, Faculty of Science (2009). Report of the Natura 2000 habitats: infralittoral in Kornati National Park, Zagreb; 3.) Natural History Museum Rijeka (2010). Report on the mapping of marine habitats of Kvarner and Kvarner islands at biocenose according to the National Habitat Classification with relevant classes of habitats listed in Annex I of the Directive on the conservation of natural habitats and of wild fauna and flora together with biological evaluation of the area; Rijeka; 4.) Institute for Oceanography and Fisheries, Split (2010). Mapping of marine habitats: south side of the island Hvar, Sv. Nedjelja - Gromin dolac, Split; 5.) Jakl, Z. (201). Mapping of marine habitats and species of Brijuni National Park (2010-2011), Final report, Project MedPAN South - Pilot project "Strengthening the network of marine protected areas in Croatia", Sunce Association, Split; 6.) Jakl Z., Brajcic D. et al. (2010). Professional studies. Mapping of marine species and habitats of Split - Dalmatia county, Sunce association, Split; 7.) Jakl Z., Brajcic D., Baucic M. (2009). Marine biodiversity along with significant landscape in the waters of northwestern part of Dugi otok island, Sunce Association, Split; 8.) Jakl Z. (2012). Mapping of marine habitats and species in Telascica Nature Park (2011). Final report, Project MedPAN South - Pilot project "Strengthening the network of marine protected areas in Croatia", Sunce association, Split; 9.) Jakl Z. (2013). Mapping of marine habitats and species in Lastovo Nature Park, Sunce Association, Split

Country	Name of locations/code of the dataset	Number on the maps	Institution that acquired the data	Source of data	Type of data (sampling points, polygons)	Habitat name	Number of sample data per habitat	Fitness for purpose of data.	Reference
ALBANIA	Himare-Dhermi, Durazzo, Capo Rondon, Gulf of Vlora, Lukove, Sarande,	11, 12, 13, 14, 15	ISPRA	International School for Scientific Diving, Lucca, Italy	polygon data	Posidonia oceanica	n/a	integrative substrate layer	Acunto S, Bulgheri G, Cinelli F. (2008?) Mappatura delle praterie di Posidonia oceanica lungo le coste albanesi. Attività di survey ambientale subacqueo e descrizione dello stato di salute delle praterie. Relazione tecnica dell'International School for Scientific Diving. 32 pp.
ITALY	Puglia: Alimini-Otranto, Tremiti, P. Cesareo-T.Colimena, Ugento, T. Colimena-T.Ovo,	16, 17, 18, 19, 20	ISPRA	Agenzia Regionale per la Prevenzione e la Protezione dell'Ambiente, Puglia, Italy	lower limit point data and respective meadow polygon data	Posidonia oceanica	7	infralittoral lower limit light threshold determination	
ITALY	Puglia: Le Cesine, Ugento, Gallipoli	19, 21, 22	ISPRA	see reference document	lower limit point data and respective meadow polygon data	Posidonia oceanica	3	infralittoral lower limit light threshold determination	Regione Puglia e CRISMA (2004). Inventario e cartografia delle praterie di Posidonia nei compartimenti marittimi di Manfredonia, Molfetta, Bari, Brindisi, Gallipoli e Taranto. Relazione Generale. 105 pp.
ITALY	Puglia: entire coastline	23	ISPRA	Agenzia Regionale per la Prevenzione e la Protezione dell'Ambiente, Puglia, Italy	polygon data	Posidonia oceanica	7	Integrative substrate layer	

Country	Name of locations/code of the dataset	Number on the maps	Institution that acquired the data	Source of data	Type of data (sampling points, polygons)	Habitat name	Number of sample data per habitat	Fitness for purpose of data.	Reference
ITALY	Sicily: meadow 17, 21, 22, 26,39,40, 41, 43	32	ISPRA	see reference document	lower limit point data and respective meadow polygon data	Posidonia oceanica	14	infralittoral lower limit light threshold determination	Ministero dell'Ambiente - Servizio Difesa del Mare. 2001. Mappatura delle praterie di *Posidonia oceanica* lungo le coste della Sicilia e delle isole minori circostanti. Relazione finale Fase 3 "Elaborazione dati e relazioni conclusive". Pp. 644.
ITALY	Sicily: entire coastline	32	ISPRA	see reference document	polygon data		n/a	Integrative substrate layer	Ministero dell'Ambiente - Servizio Difesa del Mare. 2001. Mappatura delle praterie di *Posidonia oceanica* lungo le coste della Sicilia e delle isole minori circostanti. Relazione finale Fase 3 "Elaborazione dati e relazioni conclusive". Pp. 644.
GREECE	Aegean, Ionian and Levantine Sea		HCMR	Salomidi M. & V. Gerakaris, HCMR, unpubl data	lower limit point data and respective meadow polygon data	Posidonia oceanica	13	infralittoral lower limit light threshold determination	Monitoring of the Greek NATURA 2000 Network (work in progress, M. Salomidi chief scientist)
GREECE	Greek NATURA 2000 network		HCMR	Greek Ministry of the Environment	polygon data	Posidonia oceanica	n/a	integrative substrate layer	Ministry of Environment, 2001. Identification and description of habitat types at sites of interest for conservation. Synecology. Panayotidis P, Siakavara A, Orfanidis S, Haritonidis S (Eds). In: Network NATURA-2000, EPPER– Subproject 3, Measure 3.3. Study 5: Marine habitats. Final Technical Report, Athens, 15 pp.
CYPRUS	Nisia, Cavo Greko, Moulia, Polis, Limassol - Basilikos	24, 25, 26, 27, 28	ISPRA	Department of Fisheries and Marine Research (DFMR), Cyprus	lower limit point data and respective meadow polygon data	Posidonia oceanica	5	infralittoral lower limit light threshold determination	Petrou A., Patsalidou M., Chrysanthou K., 2013. Services for mapping the meadow of marine phanerogam *Posidonia oceanica* in coastal waters of Cyprus, within the operational programme for fisheries 2007-2013". Final report, April 2013, 1-54pp.
CYPRUS	Polis/Peyia, Kato Pafos, Larnaca, Agia Napa	24, 29, 30, 31	ISPRA	Department of Fisheries and Marine	polygon data	Posidonia oceanica	n/a	integrative substrate layer and infralittoral lower limit light threshold	Petrou A., Patsalidou M., Chrysanthou K., 2013. Services for mapping the meadow of marine phanerogam *Posidonia oceanica* in coastal waters of Cyprus, within the operational programme for fisheries 2007-2013". Final report, April 2013, 1-54pp.

Country	Name of locations/code of the dataset	Number on the maps	Institution that acquired the data	Source of data	Type of data (sampling points, polygons)	Habitat name	Number of sample data per habitat	Fitness for purpose of data.	Reference
				Research (DFMR), Cyprus				determination	
LIBYA	Tajoura, Tajoura/Castelverde, Castelverde, Al Tamimi/Tobruk	34, 35	ISPRA	UNEP/MAP - RAC/SPA, Tunis, Tunisia	polygon data	Posidonia oceanica	4	integrative substrate layer	UNEP (DEC)/MED WG. 331/Inf.5 10. April 2009. State of knowledge on the geographical distribution of marine magnoliophyta meadows in the Mediterranean. 376 pp. (and references therein)
MALTA	whole country	33	ISPRA	Malta Environment and Planning Authority, Malta	lower limit point data	Posidonia oceanica	17	infralittoral lower limit light threshold determination	
TUNISIA	Zembra island	36	ISPRA	Andromède Océanologie, France	polygon data	Posidonia oceanica	1	integrative substrate layer	www.medtrix.fr
TUNISIA	Sousse/Monastir, Sharqi island, Gulf of Gabes, Djerba	37, 38, 39, 40	ISPRA	UNEP/MAP - RAC/SPA, Tunis, Tunisia	polygon data	Posidonia oceanica	4	integrative substrate layer	UNEP(DEC)/MED WG. 331/Inf.5 10. April 2009. State of knowledge on the geographical distribution of marine magnoliophyta meadows in the Mediterranean. 376 pp. (and references therein)

Country	Name of locations/code of the dataset	Number on the maps	Institution that acquired the data	Source of data	Type of data (sampling points, polygons)	Habitat name	Number of sample data per habitat	Fitness for purpose of data.	Reference
NORTH SEA - CELTIC SEA									
UK and Ireland	Light threshold extract from the Marine recorder snapshot V51 February 2015 All over UK and Ireland		Joint Nature Conservation Committee	Centre for Environmental Data and Recording (CEDaR, Northern Ireland) Data Archive for Seabed Species and Habitats (DASSH) Joint Nature Conservation Committee Natural England Natural Resources Wales (formerly Countryside Council for Wales and referred to as such or	points	Biotopes/ communities on rock. Mostly kelp (for presence) and many others for absence in the case (in the case of light thresholds). Or low/high/energy communities on rock for the energy thresholds	2735 (IR), 5344 (CR)	Light threshold extract from the Marine recorder snapshot V51 February 2015	"Infralittoral and Circalittoral Rock from the Marine recorder snapshot V51 February 2015 for Light threshold analysis" Marine Recorder is the database application used by JNCC and other organisations in the the UK to store marine benthic sample data such as species, physical attributes and biotopes.biotopes are classified according to the biotope Marine classification for Britain and Ireland, which is compatible with EUNIS. Good fitness for purpose. for more information on the full marine reocrder snapshot visit http://jncc.defra.gov.uk/page-1538

Country	Name of locations/code of the dataset	Number on the maps	Institution that acquired the data	Source of data	Type of data (sampling points, polygons)	Habitat name	Number of sample data per habitat	Fitness for purpose of data.	Reference
				CCW in this version) Porcupine Marine Natural History Society Scottish Natural Heritage Seasearch (Marine Conservation Society) Shoresearch Kent Wildlife Trust					
UK and Ireland			Joint Nature Conservation Committee	Centre for Environmental Data and Recording (CEDaR, Northern Ireland) Data Archive for Seabed Species and Habitats (DASSH) Joint Nature Conservati	points	Selected Infralittoral and Circalittoral Rock		energy threshold analysis	"Energy threshold extract from the Marine recorder snapshot V51 February 2015." Marine Recorder is the database application used by JNCC and other organizations in the UK to store marine benthic sample data such as species, physical attributes and biotopes. Biotopes are classified according to the biotope Marine classification for Britain and Ireland, which is compatible with EUNIS. Lack of clear definition in EUNIS of energy classes and confusing terminology for wave/tide swept biotopes makes it hard to relate biotopes to high/moderate and low energy classes. for more information on the full marine reocrder snapshot visit http://jncc.defra.gov.uk/page-1538

Country	Name of locations/code of the dataset	Number on the maps	Institution that acquired the data	Source of data	Type of data (sampling points, polygons)	Habitat name	Number of sample data per habitat	Fitness for purpose of data.	Reference
				on Committee Natural England Natural Resources Wales (formerly Countryside Council for Wales and referred to as such or CCW in this version) Porcupine Marine Natural History Society Scottish Natural Heritage Seasearch (Marine Conservation Society) Shoresearch Kent Wildlife Trust					

Country	Name of locations/code of the dataset	Number on the maps	Institution that acquired the data	Source of data	Type of data (sampling points, polygons)	Habitat name	Number of sample data per habitat	Fitness for purpose of data.	Reference
Norway	Norwegian coast		NIVA (Norwegian Institute for Water Research)	NIVA projects, but mainly the National program for Mapping for Diversity - Coast	points	Presence kelp or true absence of kelp due to light (Bare rocks or boulders)	3082 (kelp), 394 (absence kelp)	Mainly collected in order to model the kelp forest distribution. Good fitness for purpose for presence of kelp. Analysis would benefit from a larger number of absences	for more information on the mapping program (in Norwegian only): Mwww.miljødirektoratet.no/no/Tema/Miljoovervakning/Kartlegging-av-natur/Kartlegging-av-naturtyper/Marine-naturtyper/. Publications: eu.wiley.com/WileyCDA/WileyTitle/productCd-0470657561.html AND brage.bibsys.no/xmlui/bitstream/handle/11250/102389/G0711.pdf?sequence=1

Appendix 4: Basins habitat tables and maps

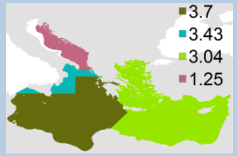
Table A4.1 EUNIS habitat types in the Adriatic, Central Mediterranean, Ionian, Aegean and Levantine Seas, which can be identified from the data layers seabed substrate and biological zone. Grey cells are for those combinations that are irrelevant. Fr means "Fraction of incident light reaching the seabed"

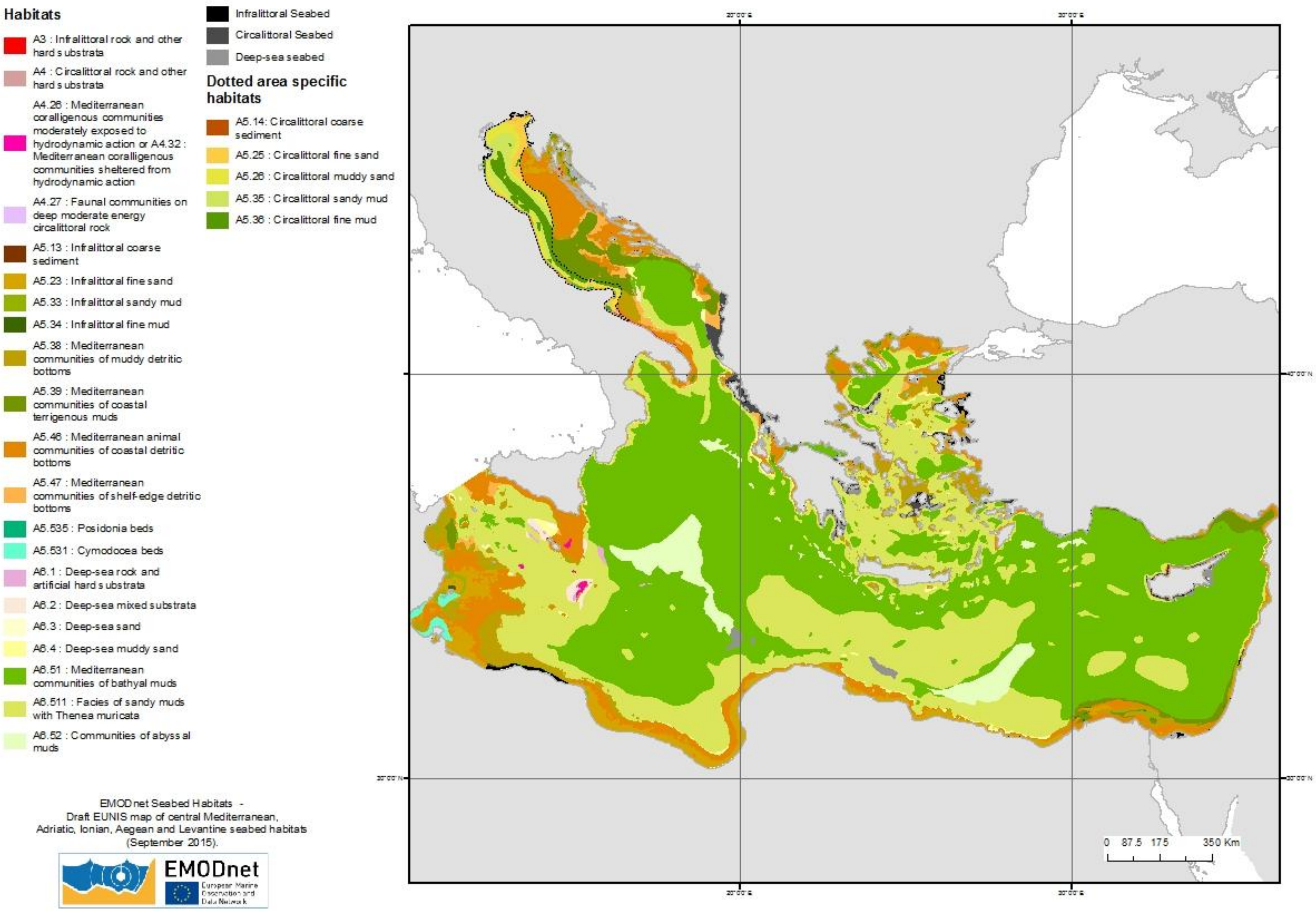
Biological zone	Seabed substrate						
	Rock/Reef	Coarse and mixed sediment	Sand	Muddy Sand	Sandy Mud	Mud	No substrate
Infralittoral	A3	A5.13	A5.23	A5.23	A5.33	A5.34	Infralittoral seabed
Circalittoral Fr > 0.0001	A4.26 or A4.32	A5.46	A5.46	A5.46	A5.38	A5.39	Circalittoral seabed
Circalittoral Fr < 0.0001	A4.27	A5.47	A5.47	A5.47	A5.47	A5.39	Circalittoral seabed
Bathyal	A6.1	A6.2	A6.3	A6.4	A6.511	A6.51	Bathyal seabed
Abyssal	A6.1	A6.2	A6.3	A6.4	A6.52	A6.52	Abyssal seabed

Table A4.2 EUNIS habitat types within the Adriatic mask. Those are identified from the data layers seabed substrate and biological zone. Grey cells are for those combinations that are irrelevant.

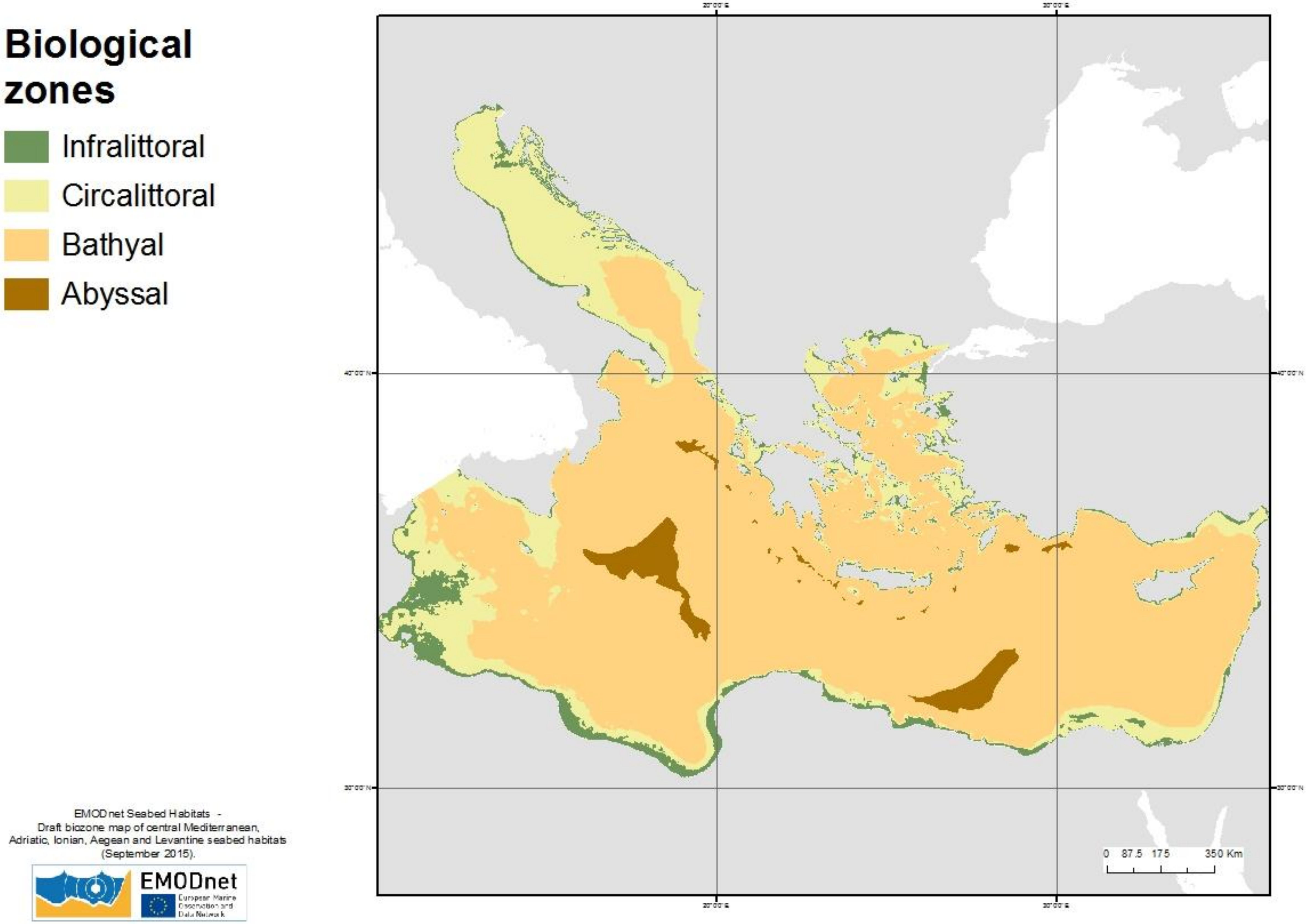
Biological zone	Seabed substrate						
	Rock/Reef	Coarse sediment	Sand	Muddy Sand	Sandy Mud	Mud	No substrate
Infralittoral	A3	A5.13	A5.23	A5.23	-	-	Infralittoral seabed
Circalittoral	A4	A5.14	A5.25	A5.26	A5.35	A5.36	Circalittoral seabed

Table A4.3 Overview of the input data in the Mediterranean region.

	EUSeaMap Phase 2		
Layer	**Class**	**Parameter**	**Threshold**
Biological zone	Infralittoral/ Circalittoral	Light energy at the seabed $I = I_0 \times e^{-h \times kdpar}$ With I_0 = surface light energy averaged over 5 years (2005-2009) h = absolute value of Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015 kdpar = KdPar averaged over 5 years (2005-2009)	Variable (depending on region) between 1.25 and 3.7 
	Circalittoral/ Bathyal	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015	Shelf edge manually delimited from depth layer and slope
	Bathyal/ Abyssal	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015	Foot of slope manually delimited from depth layer and slope
Substrate	Rock/ Sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	Presence of rock
	Coarse & mixed sediment/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	%gravel > 5 %.
	Fine mud/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	Sand:mud < 1:9 and %gravel < 5 %
	Sandy mud/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	1:9 < sand:mud < 1:1 and %gravel < 5 %
	Muddy sand/Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	1:1 < sand:mud < 9:1 and %gravel < 5 %
	Sand/Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	Sand:mud > 9:1 and %gravel < 5 %



EMODnet Seabed Habitats - Draft EUNIS map of central Mediterranean, Adriatic, Ionian, Aegean and Levantine seabed habitats (September 2015).



EMODnet Seabed Habitats - Draft biozone map of central Mediterranean, Adriatic, Ionian, Aegean and Levantine seabed habitats (September 2015).

Table A4.4 Habitat types in the Black Sea which can be identified from the data layers seabed substrate, biological zone and, within the deep circalittoral, oxygen conditions. Grey cells are for those combinations that don't occur, pink cells are for those that are acknowledged, orange cells are for those that are considered as errors (i.e. the habitat is not acknowledged but occurs in some places), and brown cells are for those that are uncertain (i.e. the combination requires validation where it occurs).

Biological zone		Seabed substrate							
		Rock/Reef	Coarse sediment	Sand	Muddy Sand	Sandy Mud	Mud	Mixed sediment	No substrate
Infralittoral		Infralittoral rock	Infralittoral coarse and mixed sediment	Infralittoral sand and muddy sand	Infralittoral sand and muddy sand	Infralittoral mud or sandy mud	Infralittoral mud or sandy mud	Infralittoral coarse and mixed sediment	Infralittoral seabed
Circalittoral		Circalittoral rock	-	-	-	-	-	-	-
Shallow circalittoral		-	Shallow circalittoral shelly organogenic sand	Shallow circalittoral shelly organogenic sand	Shallow circalittoral Muddy sand	Shallow circalittoral mud and organogenic sandy mud	Shallow circalittoral mud and organogenic sandy mud	Shallow circalittoral mud and organogenic sandy mud	Shallow circalittoral seabed
Deep circalittoral	conditions: Oxic	-	Deep circalittoral coarse mixed sediments	Deep circalittoral sand, muddy sand, and sandy mud	Deep circalittoral sand, muddy sand, and sandy mud	Deep circalittoral sand, muddy sand, and sandy mud	Deep circalittoral mud	Deep circalittoral coarse mixed sediments	Deep circalittoral seabed
	Suboxic	-	Deep circalittoral suboxic coarse sediment	Deep circalittoral suboxic sand	Deep circalittoral suboxic muddy sand	Deep circalittoral suboxic sandy mud	Deep circalittoral suboxic calcareous muds	Deep circalittoral suboxic mixed sediment	Deep circalittoral suboxic seabed
	Anoxic	-	Deep circalittoral anoxic coarse sediment	Deep circalittoral anoxic sand	Deep circalittoral anoxic muddy sand	Deep circalittoral anoxic sandy mud	Deep circalittoral anoxic muds	Deep circalittoral anoxic mixed sediment	Deep circalittoral anoxic seabed
Bathyal		-	Bathyal anoxic coarse sediment	Bathyal anoxic sand	Bathyal anoxic muddy sand	Bathyal anoxic sandy mud	Bathyal anoxic muds seeps	Bathyal anoxic mixed sediment	Bathyal anoxic seabed
Abyssal		Abyssal seabed	Abyssal seabed	Abyssal seabed	Abyssal seabed	Abyssal seabed	Abyssal seabed	Abyssal seabed	Abyssal seabed

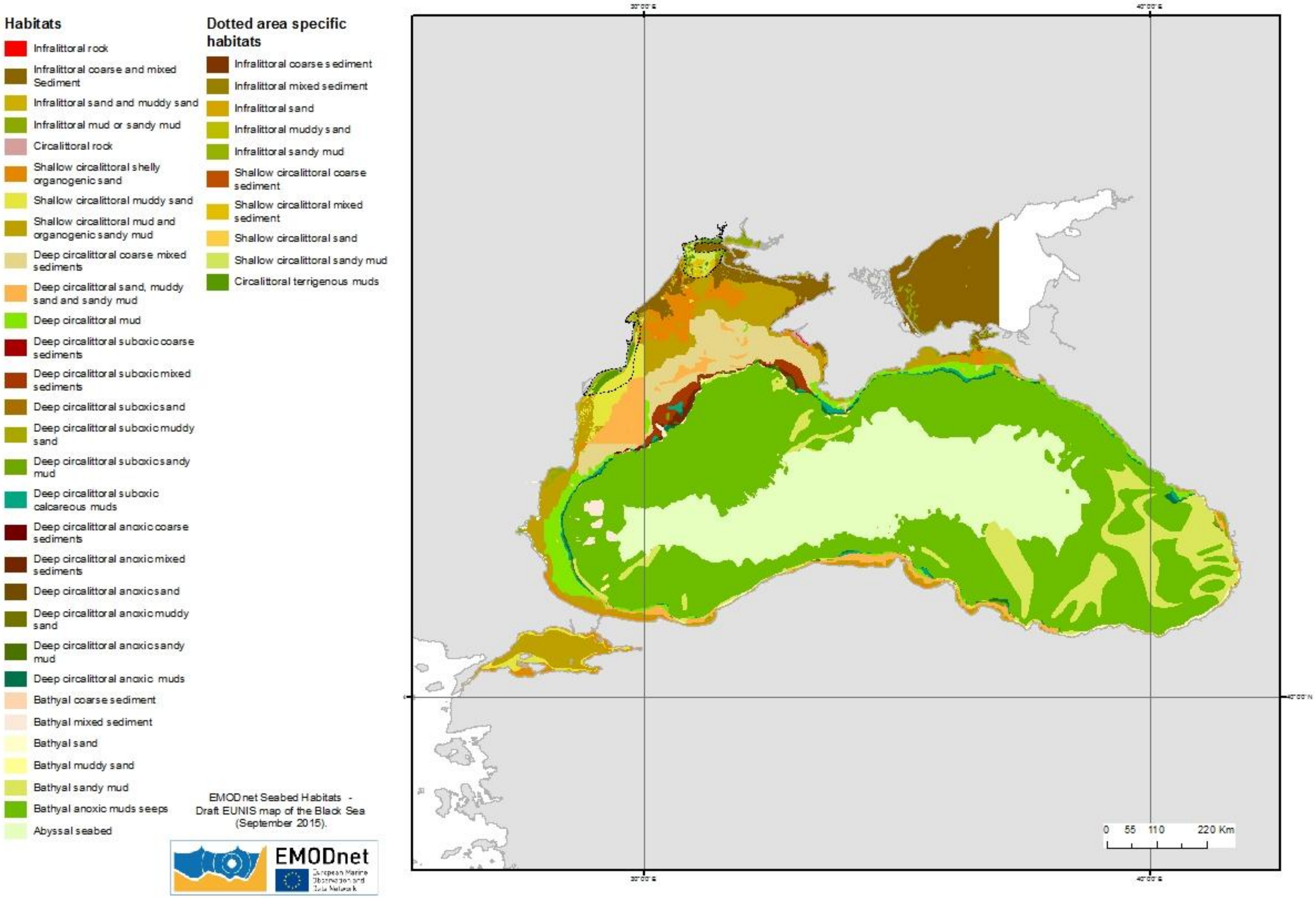
Table A4.5 Habitat types within the Danube and Dnieper masks. Those are identified from the data layers seabed substrate and biological zone. Grey cells are for those combinations that are irrelevant.

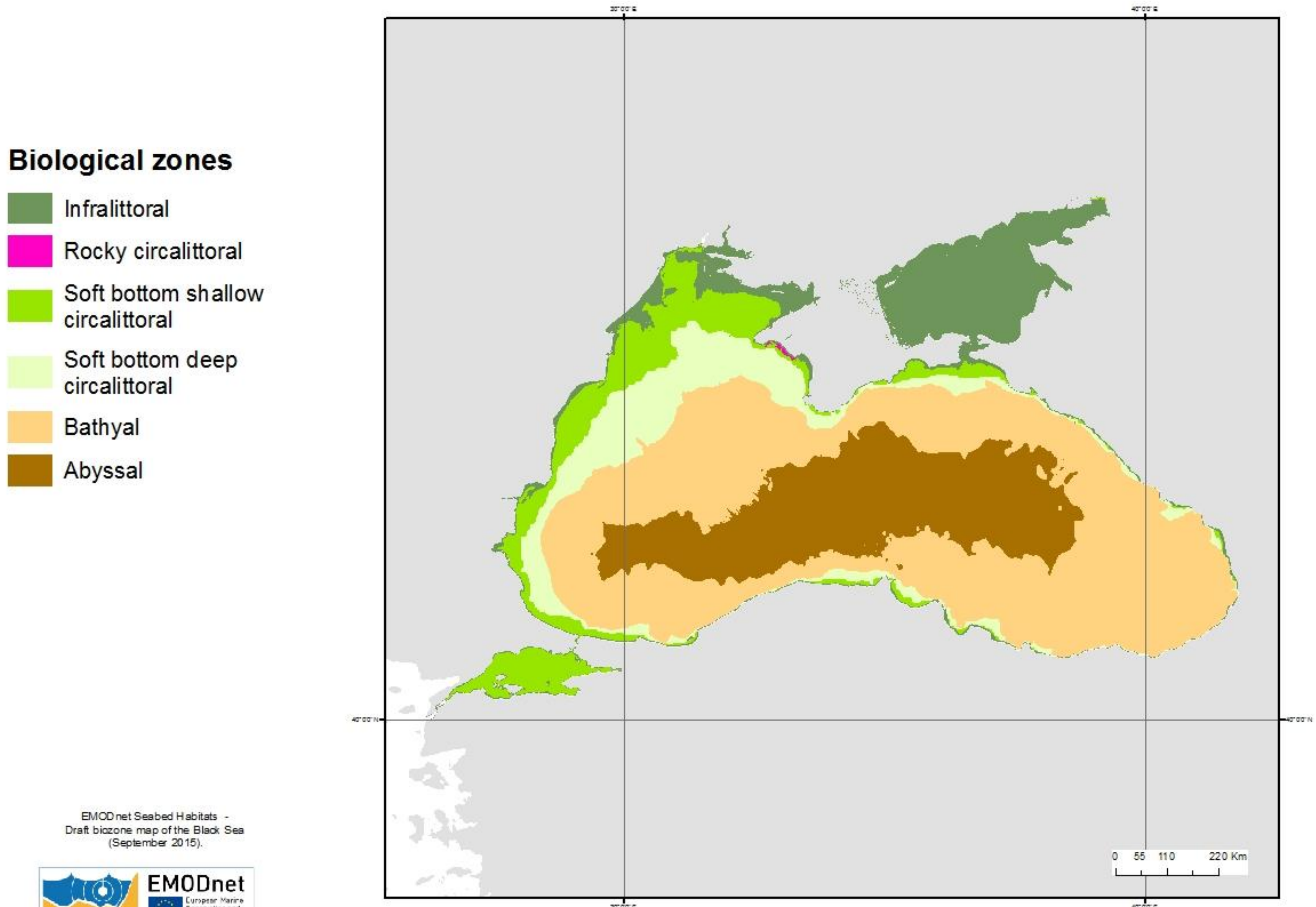
Biological zone	Seabed substrate						
	Rock/Reef	Coarse sediment	Sand	Muddy Sand	Sandy Mud	Mud	Mixed sediment
Infralittoral	Infralittoral rock	Infralittoral coarse sediment	Infralittoral sand	Infralittoral muddy sand	Infralittoral sandy mud	-	Infralittoral mixed sediment
Circalittoral	Circalittoral rock	Circalittoral coarse sediment	Circalittoral sand	Circalittoral muddy sand	Circalittoral sandy mud	Circalittoral terrigenous muds	Circalittoral mixed sediment

Table A4.6 Overview of the input data in the Black Sea.

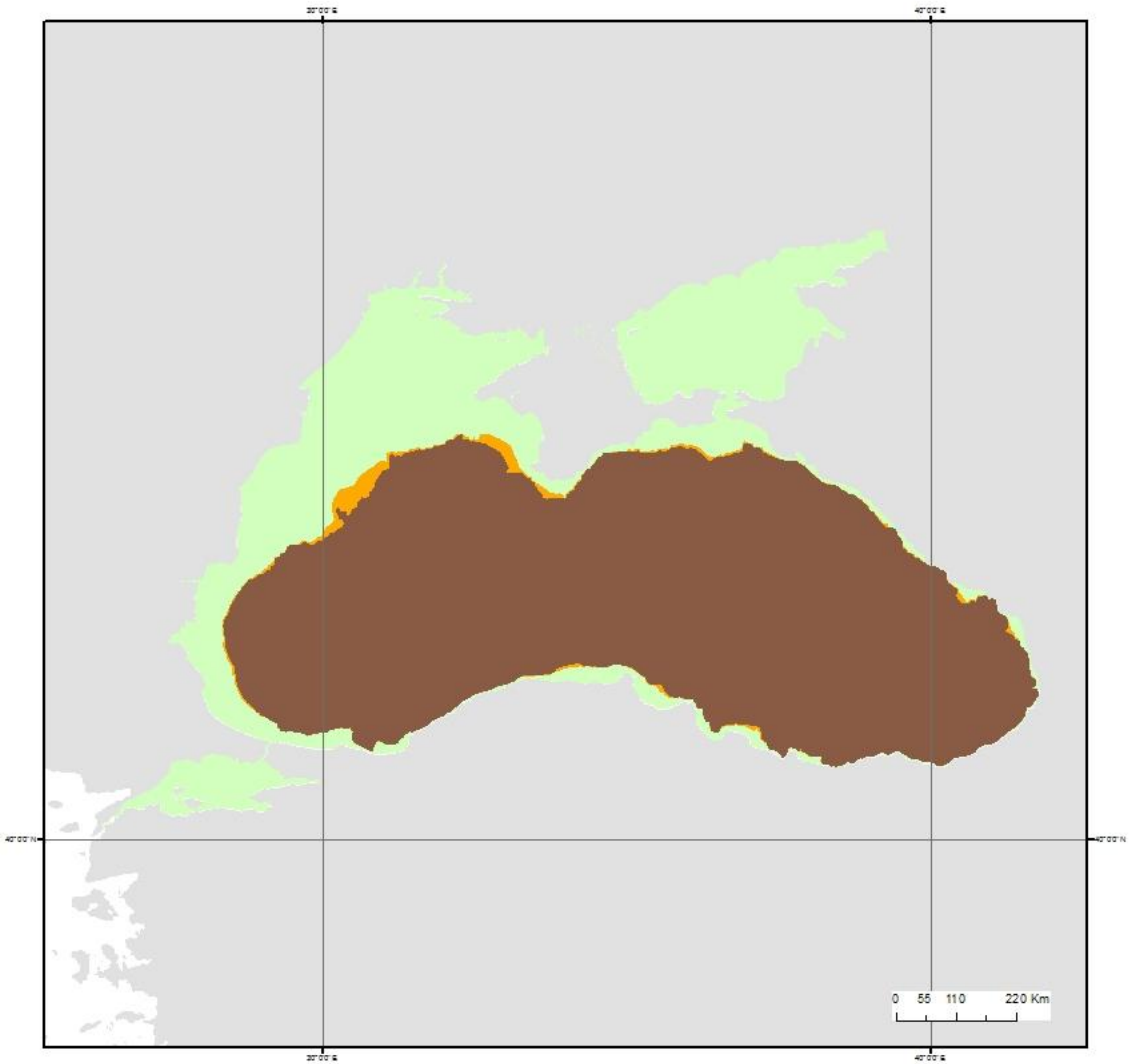
	EUSeaMap Phase 2		
Layer	**Class**	**Parameter**	**Threshold**
Biological zone	Infralittoral/ Circalittoral on rocks	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015	14 m
	Infralittoral/ Shallow Circalittoral (soft bottoms)	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015	19m
	Shallow Circalittoral/ Deep Circalittoral (soft bottoms)	MyOcean temperature data. Percentile 95th integrated over 2 summers (2013-2014)	9.7°C
	Circalittoral (rock) or deep Circalittoral (soft bottoms)/ Bathyal	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015	Shelf edge manually delimited from depth layer and slope
	Bathyal/ Abyssal	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015	2,100 m
Oxic, suboxic and anoxic conditions	Oxic/ Suboxic	December 1993 MyOcean dentity values	Polyline corresponding to the intersection of the isopicnic 15.6 surface with the seabed
	Suboxic/ Anoxic	December 1993 MyOcean dentity values	Polyline corresponding to the intersection of the isopicnic 16.4 surface with the seabed
Substrate	Rock/ Sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	Presence of rock
	Coarse sediment/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet	If sand:mud < 9:1 then %gravel = 80 %.

		Geology 1:250k and 1:1M substrate maps, July 2015	If sand:mud > 9:1 then %gravel = 5 %
	Mixed sediment/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	Sand:mud < 9:1 and 5 % < %gravel < 80 %
	Fine mud/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	Sand:mud < 1:9 and %gravel < 5 %
	Sandy mud/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	1:9 < sand:mud < 1:1 and %gravel < 5 %
	Muddy sand/Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	1:1 < sand:mud < 9:1 and %gravel < 5 %
	Sand/Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	Sand:mud > 9:1 and %gravel < 5 %


Habitats
Infralittoral rock
Infralittoral coarse and mixed Sediment
Infralittoral sand and muddy sand
Infralittoral mud or sandy mud
Circalittoral rock
Shallow circalittoral shelly organogenic sand
Shallow circalittoral muddy sand
Shallow circalittoral mud and organogenic sandy mud
Deep circalittoral coarse mixed sediments
Deep circalittoral sand, muddy sand and sandy mud
Deep circalittoral mud
Deep circalittoral suboxic coarse sediments
Deep circalittoral suboxic mixed sediments
Deep circalittoral suboxic sand
Deep circalittoral suboxic muddy sand
Deep circalittoral suboxic sandy mud
Deep circalittoral suboxic calcareous muds
Deep circalittoral anoxic coarse sediments
Deep circalittoral anoxic mixed sediments
Deep circalittoral anoxic sand
Deep circalittoral anoxic muddy sand
Deep circalittoral anoxic sandy mud
Deep circalittoral anoxic muds
Bathyal coarse sediment
Bathyal mixed sediment
Bathyal sand
Bathyal muddy sand
Bathyal sandy mud
Bathyal anoxic muds seeps
Abyssal seabed
Dotted area specific habitats
Infralittoral coarse sediment
Infralittoral mixed sediment
Infralittoral sand
Infralittoral muddy sand
Infralittoral sandy mud
Shallow circalittoral coarse sediment
Shallow circalittoral mixed sediment
Shallow circalittoral sand
Shallow circalittoral sandy mud
Circalittoral terrigenous muds
EMODnet Seabed Habitats - Draft EUNIS map of the Black Sea (September 2015).
EMODnet
0 55 110 220 Km



EMODnet Seabed Habitats - Draft biozone map of the Black Sea (September 2015).



Oxic, suboxic and anoxic conditions at seabed

- Oxic
- Suboxic
- Anoxic

EMODnet Seabed Habitats -
Draft biozone map of the Black Sea
(September 2015).

Table A4.7 Example of EUNIS habitat types in the Atlantic region at Level 3 and 4 which can be identified from the data layers seabed substrate, biological zone and, for rock substrate, energy conditions. Grey cells are for those combinations that do not have a EUNIS habitat equivalent

Biological zone	Seabed substrate								
	Rock/Reef								
	Energy								
	High	Moderate	Low	Coarse sediment	Sand	Muddy Sand	Sandy Mud	Mud	Mixed sediment
Infralittoral	A3.1	A3.2	A3.3	A5.13	A5.23 or A5.24	A5.33	A5.33	A5.34	A5.43
Shallow circalittoral	A4.1	A4.2	A4.3	A5.14	A5.25 or A5.26	A5.35	A5.35	A5.36	A5.44
Deep circalittoral	A4.12	A4.27	A4.33	A5.15	A5.27	A5.37	A5.37	A5.37	A5.45
All Deep Sea	A6.1	A6.1	A6.1	-	A6.3 or A6.4	A6.5	A6.5	A6.5	A6.2

Table A4.8 Extended version of Table A4.7 for the Atlantic region, with names given to the habitats in the deep sea that do not have a EUNIS code

Biological zone	Seabed substrate										
	Rock/Reef										
	Energy										
	High	Moderate	Low	Coarse sediment	Sand	Muddy sand	Sandy mud	Mud	Mixed sediment	Mud to muddy sand	No substrate
Infralittoral	A3.1	A3.2	A3.3	A5.13	A5.23 or A5.24	A5.33	A5.33	A5.34	A5.43	A5.34 or A5.33	Infralittoral seabed
Shallow circalittoral	A4.1	A4.2	A4.3	A5.14	A5.25 or A5.26	A5.35	A5.35	A5.36	A5.44	A5.36 or A5.35	Circalittoral seabed
Deep Circalittoral	A4.12	A4.27	A4.33	A5.15	A5.27	A5.37	A5.37	A5.37	A5.45	A5.37	Deep circalittoral seabed
Atlantic Upper Bathyal	Atlantic upper bathyal rock or reef	Atlantic upper bathyal rock or reef	Atlantic upper bathyal rock or reef	Atlantic upper bathyal coarse sediment	*Atlantic upper bathyal sand and muddy sand*	*Atlantic upper bathyal sandy mud*	*Atlantic upper bathyal sandy mud*	Atlantic upper bathyal mud	Atlantic upper bathyal mixed sediment	Atlantic upper bathyal mud or sandy mud	Atlantic upper bathyal seabed

Atlantic Mid Bathyal	Atlantic mid bathyal rock or reef	Atlantic mid bathyal rock or reef	Atlantic mid bathyal rock or reef	Atlantic mid bathyal coarse sediment	Atlantic mid bathyal sand and muddy sand	Atlantic mid bathyal sandy mud	Atlantic mid bathyal sandy mud	Arctic mid bathyal mud	Ataıntic mid bathyal mixed sediment	Atlantic mid bathyal mud or sandy mud	Atlantic mid bathyal seabed
Atlantic Lower Bathyal	Atlantic lower bathyal rock or reef	Atlantic lower bathyal rock or reef	Atlantic lower bathyal rock or reef	Atlantic lower bathyal coarse sediment	Atlantic lower bathyal sand and muddy sand	Atlantic lower bathyal sandy mud	Atlantic lower bathyal sandy mud	Atlantic lower bathyal mud	Atlantic lower bathyal mixed sediment	Atlantic lower bathyal mud or sandy mud	Atlantic lower bathyal seabed
Atlantic Upper Abyssal	Atlantic upper abyssal rock or reef	Atlantic upper abyssal rock or reef	Atlantic upper abyssal rock or reef	Atlantic upper abyssal coarse sediment	Atlantic upper abyssal sand	Atlantic upper abyssal sandy mud	Atlantic upper abyssal sandy mud	Atlantic upper abyssal mud	Atlantic upper abyssal mixed sediment	Atlantic upper abyssal mud or sandy mud	Atlantic upper abyssal seabed
Atlantic Mid Abyssal	Atlantic mid abyssal rock or reef	Atlantic mid abyssal rock or reef	Atlantic mid abyssal rock or reef	Atlantic mid abyssal coarse sediment	Atlantic mid abyssal sand and muddy sand	Atlantic mid abyssal sandy mud	Atlantic mid abyssal sandy mud	Atlantic mid abyssal sandy mud	Atlantic mid abyssal mixed sediment	Atlantic mid abyssal mud or sandy mud	Atlantic mid abyssal seabed
Atlantic Lower Abyssal	Atlantic lower abyssal rock or reef	Atlantic lower abyssal rock or reef	Atlantic lower abyssal rock or reef	Atlantic lower abyssal coarse sediment	Atlantic lower abyssal sand and muddy sand	Atlantic lower abyssal sandy mud	Atlantic lower abyssal sandy mud	Atlantic lower abyssal sandy mud	Atlantic lower abyssal mixed sediment	Atlantic lower abyssal mud or sandy mud	Atlantic lower abyssal seabed

Table A4.9 Extended version of Table xx for the Arctic region, with names given to the habitats in the deep sea that do not have a EUNIS code.

	Seabed substrate											
	Rock/Reef											
	Energy											
Biological zone	High	Moderate	Low	Coarse sediment	Sand	Muddy sand	Sandy mud	Mud	Mixed sediment	Mud to muddy sand	No substrate
Infralittoral	A3.1	A3.2	A3.3	A5.13	A5.23 or A5.24	A5.33	A5.33	A5.34	A5.43	A5.34 or A5.33	Infralittoral seabed
Shallow circalittoral	A4.1	A4.2	A4.3	A5.14	A5.25 or A5.26	A5.35	A5.35	A5.36	A5.44	A5.36 or A5.35	Circalittoral seabed
Deep Circalittoral	A4.12	A4.27	A4.33	A5.15	A5.27	A5.37	A5.37	A5.37	A5.45	A5.37	Deep circalittoral seabed
Atlantic Upper Bathyal	Atlantic upper bathyal rock or reef	Atlantic upper bathyal rock or reef	Atlantic upper bathyal rock or reef	Atlantic upper bathyal coarse sediment	Atlantic upper bathyal sand and muddy sand	Atlantic upper bathyal sandy mud	Atlantic upper bathyal sandy mud	Atlantic upper bathyal mud	Atlantic upper bathyal mixed sediment	Atlantic upper bathyal mud or sandy mud	Atlantic upper bathyal seabed
Atlanto-Arctic upper bathyal	Atlanto-Arctic upper bathyal rock or reef	Atlanto-Arctic upper bathyal rock or reef	Atlanto-Arctic upper bathyal rock or reef	Atlanto-Arctic upper bathyal coarse sediment	Atlanto-Arctic upper bathyal sand and muddy sand	Atlanto-Arctic upper bathyal sandy mud	Atlanto-Arctic upper bathyal sandy mud	Atlanto-Arctic upper bathyal mud	Atlanto-Arctic upper bathyal mixed sediment	Atlanto arctic upper bathyal mud or sandy mud	Atlanto-Arctic upper bathyal seabed
Arctic Mid Bathyal	Arctic mid bathyal rock or reef	Arctic mid bathyal rock or reef	Arctic mid bathyal rock or reef	Arctic mid bathyal coarse sediment	Arctic mid bathyal sand and muddy sand	Arctic mid bathyal sandy mud	Arctic mid bathyal sandy mud	Arctic mid bathyal mud	Arctic mid bathyal mixed sediment	Arctic mid bathyal mud or sandy mud	Arctic mid bathyal seabed
Arctic Lower Bathyal	Arctic lower bathyal rock or reef	Arctic lower bathyal rock or reef	Arctic lower bathyal rock or reef	Arctic lower bathyal coarse sediment	Arctic lower bathyal sand and muddy sand	Arctic lower bathyal sandy mud	Arctic lower bathyal sandy mud	Arctic lower bathyal mud	Arctic lower bathyal mixed sediment	Arctic lower bathyal mud or sandy mud	Arctic lower bathyal seabed
Arctic Upper Abyssal	Arctic upper abyssal rock or reef	Arctic upper abyssal rock or reef	Arctic upper abyssal rock or reef	Arctic upper abyssal coarse sediment	Arctic upper abyssal sand	Arctic upper abyssal sandy mud	Arctic upper abyssal sandy mud	Arctic upper abyssal mud	Arctic upper abyssal mixed sediment	Arctic upper abyssal mud or sandy mud	Arctic upper abyssal seabed

Table A4.10 Overview of the input data in the Arctic region.

	EUSeaMap Phase 2		
Layer	**Class**	**Parameter**	**Threshold**
Biological zone	Infralittoral/ Shallow Circalittoral	Light energy at the seabed $I = I_0 \times e^{-h \times kdpar}$ With I_0 = surface light energy averaged over 5 years (2005-2009) h = absolute value of Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015 kdpar = KdPar averaged over 5 years (2005-2009)	0.8 mol. phot. m^2 d^{-1}
	Shallow Circalittoral/ Deep Circalittoral	Surface wave exposure index (90th percentile) calculated from wind data	1,200
	Deep Circalittoral/ Upper Bathyal	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015	200 m
	Arctic Upper Bathyal/ Atlanto-Arctic Upper Bathyal	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015	400 m
	Atlanto-Arctic Upper Bathyal/Arctic Mid Bathyal	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015	800 m
	Arctic Mid Bathyal/Arctic Lower Bathyal	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015)	1,600 m
	Arctic Lower Bathyal/Arctic Upper Abyssal	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015	2,500 m
	Arctic Upper Abyssal/Arctic Mid Abyssal	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015	3,300 m
Energy	High/ Moderate Wave Energy	Surface wave exposure index (90th percentile) calculated from wind data	500,000
	Moderate/ Low Wave Energy	Surface wave exposure index (90th percentile) calculated from wind data	100,000
	High/ Moderate Current Energy	Kinetic energy at the seabed due to currents (90th percentile)	1,160 N m^{-2}
	Moderate/ Low Current Energy	Kinetic energy at the seabed due to currents (90th percentile)	130 N m^{-2}
Substrate	Rock/ Sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	Presence of rock
	Coarse sediment/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	If sand:mud < 9:1 then %gravel = 80 %. If sand:mud > 9:1 then %gravel = 5 %
	Mixed sediment/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	Sand:mud < 9:1 and 5 % < %gravel < 80 %
	Fine mud/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	Sand:mud < 1:9 and %gravel < 5 %
	Sandy mud/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	1:9 < sand:mud < 9:1 and %gravel < 5 %
	Sand/Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	Sand:mud > 9:1 and %gravel < 5 %

Table A4.11 Overview of the input data in the North and Celtic Sea region and comparison with previous versions of the map

	EUSeaMap Phase 2			EUSeaMap Phase 1 – 2012 version			
Layer	Class	Parameter	Threshold	Class	Parameter	Threshold	Notes
Biological zone	Infralittoral/ Shallow Circalittoral	Light energy at the seabed $I = I_0 \times e^{-h \times kdpar}$ With I_0 = surface light energy averaged over 5 years (2005-2009) h = absolute value of Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015 kdpar = KdPar averaged over 5 years (2005-2009)	0.8 mol. phot. $m^2 d^{-1}$	Infralittoral/ Shallow Circalittoral	Fraction of incident light reaching the seabed $Fr = e^{-h \times kdpar}$ light With h = absolute value of Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015 kdpar = KdPar averaged over 5 years (2005-2009)	4.3 %	The new I thresholds corresponds to a Fr of about 2.8%, this makes the infralittoral areas smaller than in the previous version (when Fr was 4.3%). A new more accurate bathymetry has improved the Fr layer accuracy, and the introduction of I_0 should make latitude effects les significant at Atlantic scale.
	Shallow Circalittoral/ Deep Circalittoral	Wave base ratio calculated by dividing wave length (L, 90th percentile) by depth to the seabed (d)	2	Shallow Circalittoral/ Deep Circalittoral	Wave base ratio calculated by dividing wave length (L, annual (maxima)	2	Smaller wave lengths (for same water depth) produce a significantly smaller shallow circalittoral area and increase in deep circalittoral areas. The bathymetry layer has increased resolution, therefore also the wavebase layer resolution has improved
	Deep circalittoral/ Upper Bathyal	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015	200 m	Deep Circalittoral/ Upper slope	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2011 + UKHO 6 Arcsec. DEM	200 m	Previously the thresholds were obtained following Howell et al., 2010. In this version the deep sea classification from the Marine habitat classification for Britain and Ireland described in Parry et al 2015, informed by new studies on deep sea biogeographic region modelling and analysis of deep sea assemblages. Upper slope renamed to upper bathyal. Bathyal zone divided into 3 classes following
	Upper Bathyal/ Mid Bathyal	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015	600 m	Upper Slope/ Upper Bathyal	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2011 + UKHO 6 Arcsec. DEM	750 m	
	Mid Bathyal/ Lower Bathyal	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015	1300 m	Upper Bathyal/ Mid Bathyal	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2011 + UKHO 6 Arcsec. DEM	1100 m	The abyssal zone is now divided into 3 zones The extent of abyssal areas has generally increased in this version of the map. The bathymetry layer increased resolution improved the deep sea boundary delineation.
	Lower Bathyal/ Upper Abyssal	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015	2100 m	Mid Bathyal/ Lower Bathyal	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2011 + UKHO 6 Arcsec. DEM	1800 m	In this version patches of deep sea within the continental shelf

	EUSeaMap Phase 2			EUSeaMap Phase 1 – 2012 version			
Layer	**Class**	**Parameter**	**Threshold**	**Class**	**Parameter**	**Threshold**	**Notes**
	Upper Abyssal/ Mid Abyssal	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015	3100 m	Lower Bathyal/ Abyssal	Depth to the seabed (d) from Bathymetry Feb. 2011 + UKHO 6 Arcsec. DEM	2700 m	have been manually reclassified as deep circalittoral, if they were not connected to the upper bathyal biological zone. For example all Scottish lochs deeper than 200m are disconnected from bathyal areas and are no longer classified as deep sea.
	Mid Abyssal/ Lower Abyssal	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015	4100 m	N/A	N/A	N/A	
Energy	High/ Moderate Wave Energy	Kinetic energy at the seabed due to waves (90th percentile)	90 N m^{-2}	High/ Moderate Wave Energy	Kinetic energy at the seabed due to waves (annual maxima)	1200 N m^{-2}	In this version the wave energy layer is characterised by smaller values of wave energy and reclassified using new thresholds. For the currents layer the old thresholds were used (as defined in EUNIS) but the current energy values are smaller because the 90th percentile statistics was used. The extent of moderate energy rock habitats (combined waves and currents) are generally reduced compared to EUSeaMap 1, and the extent of low energy rock has increased in some areas. This change is clear in the Outer Hebrides and in the Western English Channel.
	Moderate/ Low Wave Energy	Kinetic energy at the seabed due to waves (90th percentile)	19 N m^{-2}	Moderate/ Low Wave Energy	Kinetic energy at the seabed due to waves (annual maxima)	210 N m^{-2}	
	High/ Moderate Current Energy	Kinetic energy at the seabed due to currents (90th percentile)	1160 N m^{-2}	High/ Moderate Current Energy	Kinetic energy at the seabed due to currents (annual maxima)	1160N m^{-2}	
	Moderate/ Low Current Energy	Kinetic energy at the seabed due to currents (90th percentile)	130 N m^{-2}	Moderate/ Low Current Energy	Kinetic energy at the seabed due to currents (annual maxima)	130 N m^{-2}	
Substrate	Rock/ Sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps- Modified , August 2015	Presence of rock	Rock/ Sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k substrate map, January 2012	Presence of rock	The BGS Hard substrate layer (used in this and in the previous version) tends to overestimate the amount of rock in UK waters. Different sand:mud ratio creates a reduction of areas of habitat classified as "Sand" or "Muddy sand", compared to EUSeaMap I.
	Coarse sediment/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, Modified , August 2015	If sand:mud < 9:1 then %gravel = 80 %. If sand:mud > 9:1 then %gravel = 5 %	Coarse sediment/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k substrate map, January 2012	If sand:mud < 9:1 then %gravel = 80 %. If sand:mud > 9:1 then %gravel = 5 %	
	Mixed sediment/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, Modified , August 2015	Sand:mud < 9:1 and 5 % < %gravel < 80 %	Mixed sediment/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k substrate map, January 2012	Sand:mud < 9:1 and 5 % < %gravel < 80 %	

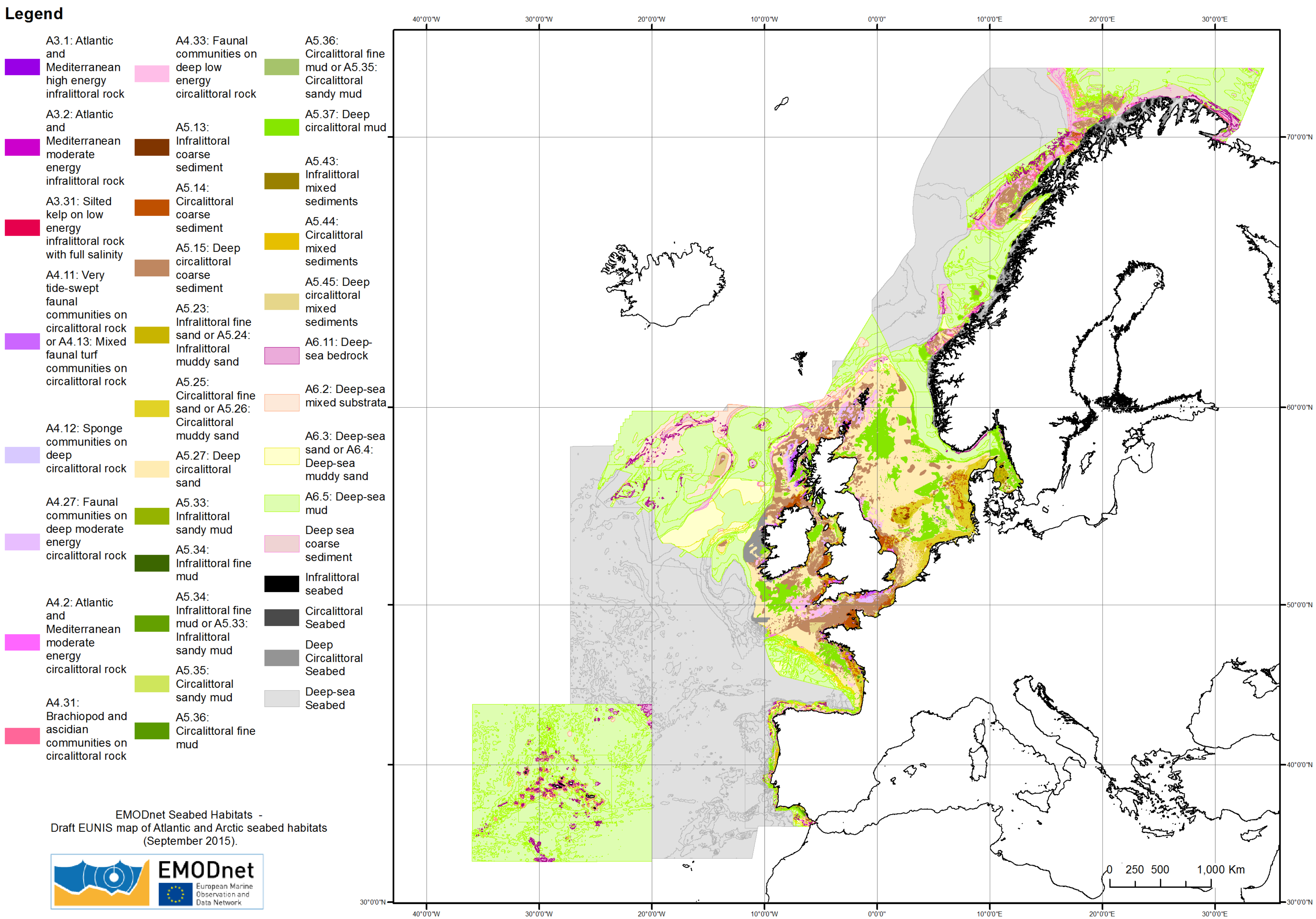
	EUSeaMap Phase 2			EUSeaMap Phase 1 – 2012 version			
Layer	Class	Parameter	Threshold	Class	Parameter	Threshold	Notes
	Fine mud/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, Modified , August 2015	Sand:mud < 1:9 and %gravel < 5 %	Mud/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k substrate map, January 2012	Sand:mud < 4:1 and %gravel < 5 %	
	Sandy mud/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	1:9 < sand:mud < 9:1 and %gravel < 5 %	As above	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k substrate map, January 2012	As above	
	Sand/Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	Sand:mud > 9:1 and %gravel < 5 %	Sand/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k substrate map, January 2012	Sand:mud > 4:1 and %gravel < 5 %	

Table A4.12 Overview of the input data in the Bay of Biscay, Iberia and Azores, and comparison with previous versions of the map.

	EUSeaMap Phase 2			MESH Atlantic broad-scale map– 2013 version			
Layer	**Class**	**Parameter**	**Threshold**	**Class**	**Parameter**	**Threshold**	**Notes**
Biological zone	Infralittoral/ Shallow Circalittoral	Light energy at the seabed $I = I_0 \times e^{-hxkdpar}$ With I_0 = surface light energy averaged over 5 years (2005-2009) h = absolute value of Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015 kdpar = KdPar averaged over 5 years (2005-2009)	0.8 mol. phot. m^{2} d^{-1}	Infralittoral/ Shallow Circalittoral	Fraction of incident light reaching the seabed $Fr = e^{-hxkdpar}$ light With h = absolute value of Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015 kdpar = KdPar averaged over 5 years (2005-2009)	0.01	The new I thresholds corresponds to a Fr of about 2.8%, this makes the infralittoral areas smaller than in the previous version A new more accurate bathymetry has improved the Fr layer accuracy, and the introduction of I_0 should make latitude effects les significant at Atlantic scale.
	Shallow Circalittoral/ Deep Circalittoral	Wave base ratio calculated by dividing wave length (L, 90th percentile) by depth to the seabed (d)	Variable (depending on region) between 1.5 and 2.67 (see WP4)	Shallow Circalittoral/ Deep Circalittoral	Wave base ratio calculated by dividing wave length (L, annual (maxima)	2.53	In Bay of Biscay, by integrating recent wave data (Boudiere et al, 2013) the resolution of wave data has improved a lot. Elsewhere bathymetry layer has increased resolution, therefore also the wavebase layer resolution has improved.
	Deep circalittoral/ Upper Bathyal	Shelf edge, manually delineated	Edge of continental shelf	Deep Circalittoral/ Upper slope	Shelf edge, manually delineated	Edge of continental shelf	Previously the thresholds were obtained following Howell et al., 2010. In this version the deep sea classification from the Marine habitat classification for Britain and Ireland described in in Parry et al 2015, informed by new studies on deep sea biogeographic region modelling and analysis of deep sea assemblages Upper slope renamed to upper bathyal. Bathyal zone divided into 3 classes following The abyssal zone is now divided into 3 zones The extent of abyssal areas has generally increased in this version of the map, for example Rockall trough is now abyssal , not longer lower bathyal. The area of Upper abyssal it is larger than before on the Mid Atlantic Ridge near the Azores, however along the shelf off
	Upper Bathyal/ Mid Bathyal	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015	600 m	Upper Slope/ Upper Bathyal	Depth to the seabed (d) from MeshAtlantic bathymetry compilation (Mata Chacon et al, 2013)	750 m	
	Mid Bathyal/ Lower Bathyal	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015	1300 m	Upper Bathyal/ Mid Bathyal	Depth to the seabed (d) from MeshAtlantic bathymetry compilation (Mata Chacon et al, 2013)	1100 m	
	Lower Bathyal/ Upper Abyssal	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015	2100 m	Mid Bathyal/ Lower Bathyal	Depth to the seabed (d) from MeshAtlantic bathymetry compilation (Mata Chacon et al, 2013)	1800 m	
	Upper Abyssal/ Mid Abyssal	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015	3100 m	Lower Bathyal/ Abyssal	Manually delineated from slope of the seabed	Edge of abyssal plain	

	EUSeaMap Phase 2			MESH Atlantic broad-scale map– 2013 version			
Layer	**Class**	**Parameter**	**Threshold**	**Class**	**Parameter**	**Threshold**	**Notes**
	Mid Abyssal/ Lower Abyssal	Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015	4100 m	N/A	N/A	N/A	France/Spain/Portugal it has decrease in extent. The bathymetry layer increased resolution improved the deep sea boundary delineation.
Energy	High/ Moderate Wave Energy	Kinetic energy at the seabed due to waves (90th percentile)	Variable (depending on region) between 90 and 22 N m^{-2} (see WP4)	High/ Moderate Wave Energy	Kinetic energy at the seabed due to waves (90th percentile)	Variable (depending on region)	Same thresholds (as defined in EUNIS) and datasets for the current induced energy layer. The wave energy thresholds and dataset (Boudiere et al, 2013) have been updated in French waters, but not elsewhere. This has resulted in a decrease in the extent of low energy rock and an increase in high and moderate energy rock habitats, in those regions.
	Moderate/ Low Wave Energy	Kinetic energy at the seabed due to waves (90th percentile)	Variable (depending on region) between 3 and 60 N m^{-2} (see WP4)	Moderate/ Low Wave Energy	Kinetic energy at the seabed due to waves (90th percentile)	Variable (depending on region)	
	High/ Moderate Current Energy	Kinetic energy at the seabed due to currents (90th percentile)	1160 N m^{-2}	High/ Moderate Current Energy	Kinetic energy at the seabed due to waves (90th percentile)	1160N m^{-2}	
	Moderate/ Low Current Energy	Kinetic energy at the seabed due to currents (90th percentile)	130 N m^{-2}	Moderate/ Low Current Energy	Kinetic energy at the seabed due to waves (90th percentile)	130 N m^{-2}	
Substrate	Rock/ Sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps- Modified , August 2015	Presence of rock	Rock/ Sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in MeshAtlantic seabed substrate compilation (Mata Chacon et al, 2013)	Presence of rock	A new update substrate layer was used. No changes in the rock , coarse, mixed sediment and fine mud habitats extent. The different sand:mud ratio used in this version results in changes to the Sandy mud and Sand habitat extent: the amount of muddy habitat has increased and the amount of sandy habitat has decreased
	Coarse sediment/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, Modified , August 2015	If sand:mud < 9:1 then %gravel = 80 %. If sand:mud > 9:1 then %gravel = 5 %	Coarse sediment/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in MeshAtlantic seabed substrate compilation (Mata Chacon et al, 2013)	If sand:mud < 9:1 then %gravel = 80 %. If sand:mud > 9:1 then %gravel = 5	

	EUSeaMap Phase 2			MESH Atlantic broad-scale map– 2013 version			
Layer	Class	Parameter	Threshold	Class	Parameter	Threshold	Notes
						%	
	Mixed sediment/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, Modified , August 2015	Sand:mud < 9:1 and 5 % < %gravel < 80 %	Mixed sediment/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in MeshAtlantic seabed substrate compilation (Mata Chacon et al, 2013)	Sand:mud < 9:1 and 5 % < %gravel < 80 %	
	Fine mud/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, Modified , August 2015	Sand:mud < 1:9 and %gravel < 5 %	Mud/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in MeshAtlantic seabed substrate compilation (Mata Chacon et al, 2013)	Sand:mud < 1:9 and %gravel < 5 %	
	Sandy mud/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	1:9 < sand:mud < 9:1 and %gravel < 5 %	Sandy mud/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in MeshAtlantic seabed substrate compilation (Mata Chacon et al, 2013)	1:9<Sand:mud < 1:1 and %gravel < 5 %	
	Sand/Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	Sand:mud > 9:1 and %gravel < 5 %	Sand and muddy sands/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in MeshAtlantic seabed substrate compilation (Mata Chacon et al, 2013)	Sand:mud > 1:1 and %gravel < 5 %	


Legend
A3.1: Atlantic and Mediterranean high energy infralittoral rock
A3.2: Atlantic and Mediterranean moderate energy infralittoral rock
A3.31: Silted kelp on low energy infralittoral rock with full salinity
A4.11: Very tide-swept faunal communities on circalittoral rock or A4.13: Mixed faunal turf communities on circalittoral rock
A4.12: Sponge communities on deep circalittoral rock
A4.27: Faunal communities on deep moderate energy circalittoral rock
A4.2: Atlantic and Mediterranean moderate energy circalittoral rock
A4.31: Brachiopod and ascidian communities on circalittoral rock
A4.33: Faunal communities on deep low energy circalittoral rock
A5.13: Infralittoral coarse sediment
A5.14: Circalittoral coarse sediment
A5.15: Deep circalittoral coarse sediment
A5.23: Infralittoral fine sand or A5.24: Infralittoral muddy sand
A5.25: Circalittoral fine sand or A5.26: Circalittoral muddy sand
A5.27: Deep circalittoral sand
A5.33: Infralittoral sandy mud
A5.34: Infralittoral fine mud
A5.34: Infralittoral fine mud or A5.33: Infralittoral sandy mud
A5.35: Circalittoral sandy mud
A5.36: Circalittoral fine mud
A5.36: Circalittoral fine mud or A5.35: Circalittoral sandy mud
A5.37: Deep circalittoral mud
A5.43: Infralittoral mixed sediments
A5.44: Circalittoral mixed sediments
A5.45: Deep circalittoral mixed sediments
A6.11: Deep-sea bedrock
A6.2: Deep-sea mixed substrata
A6.3: Deep-sea sand or A6.4: Deep-sea muddy sand
A6.5: Deep-sea mud
Deep sea coarse sediment
Infralittoral seabed
Circalittoral Seabed
Deep Circalittoral Seabed
Deep-sea Seabed
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70°0'0"N
60°0'0"N
50°0'0"N
40°0'0"N
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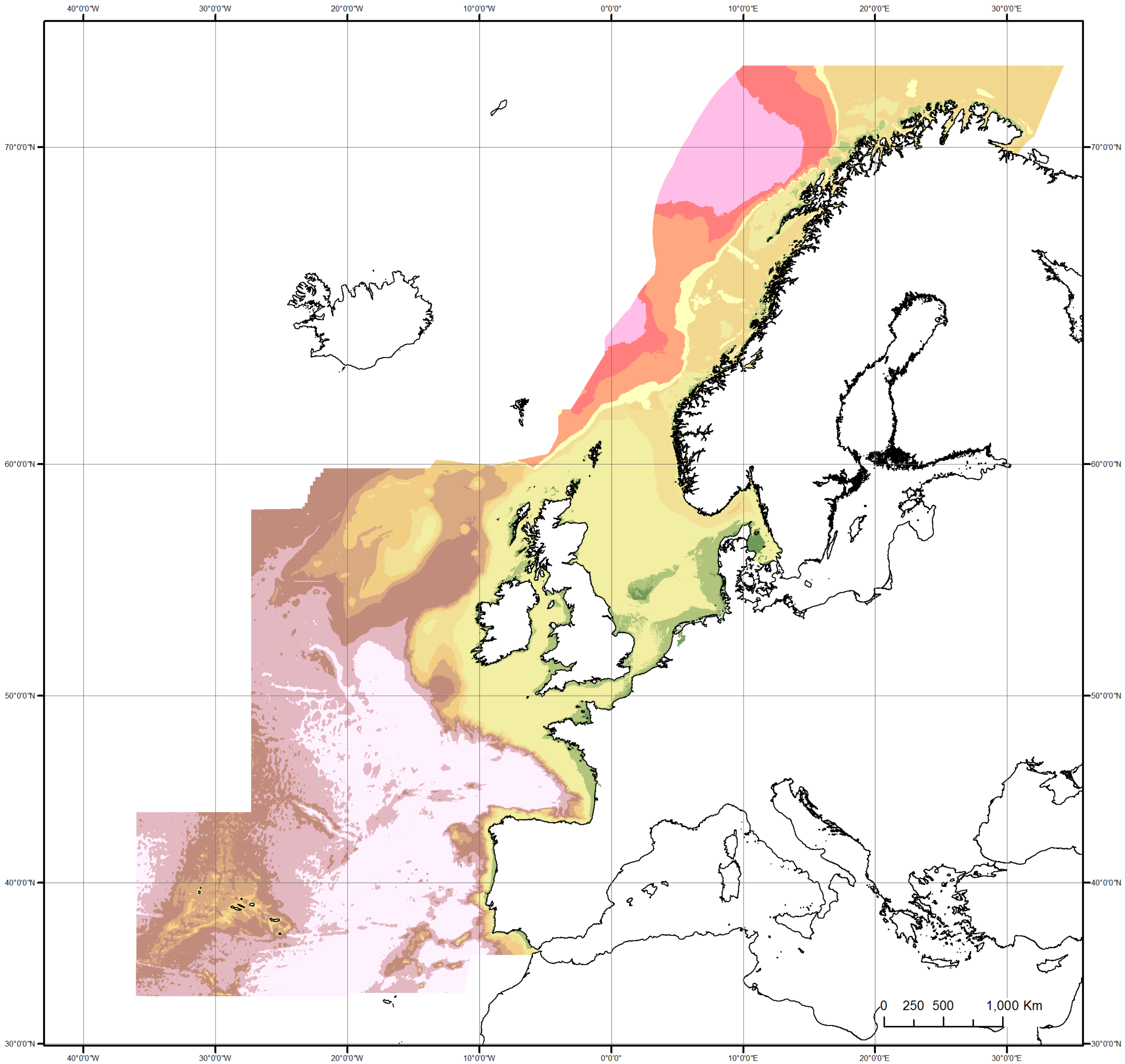
EMODnet Seabed Habitats -
Draft EUNIS map of Atlantic and Arctic seabed habitats
(September 2015).
EMODnet
European Marine Observation and Data Network



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Draft biozone map of Atlantic and Arctic seabed habitats
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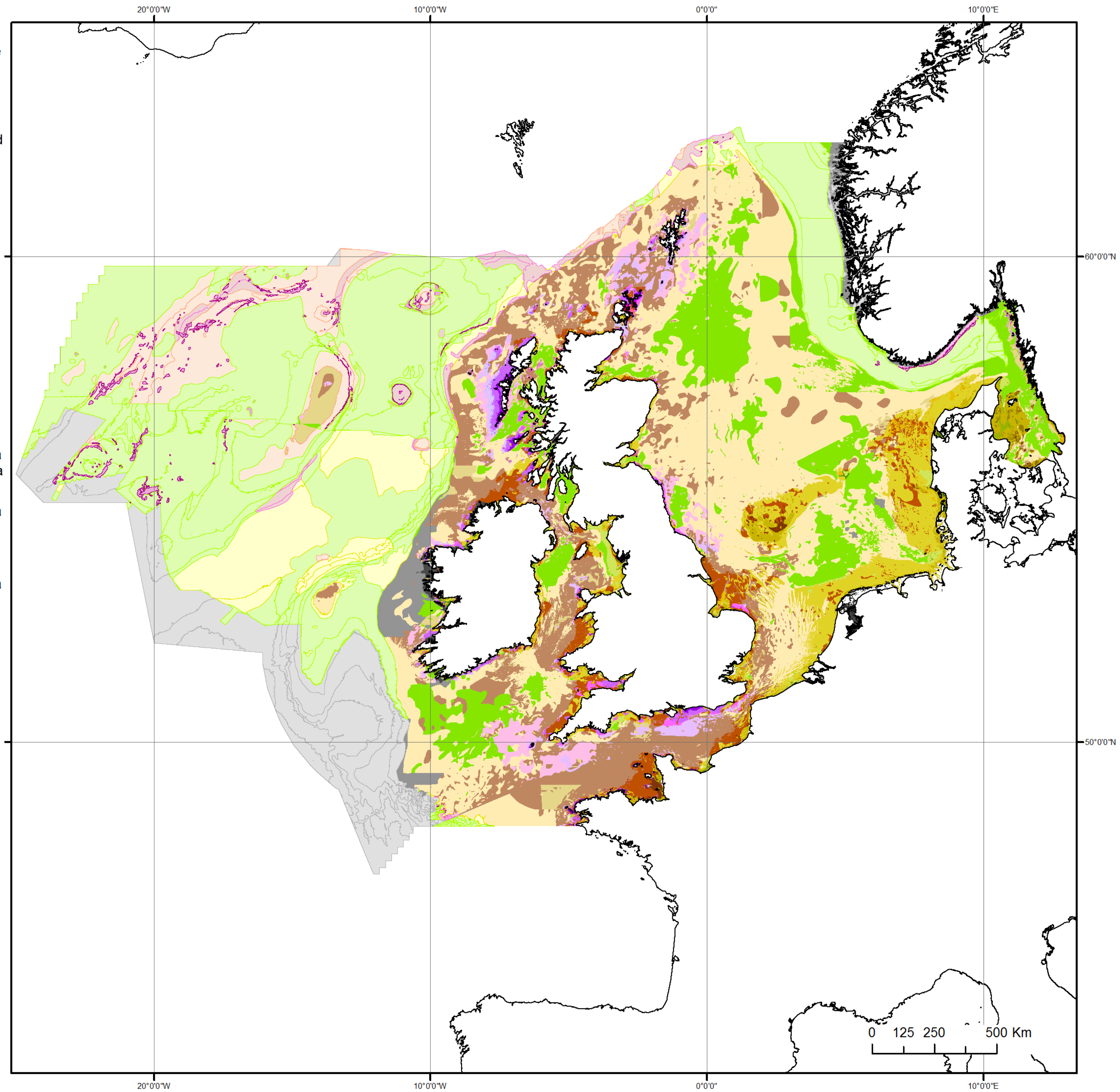
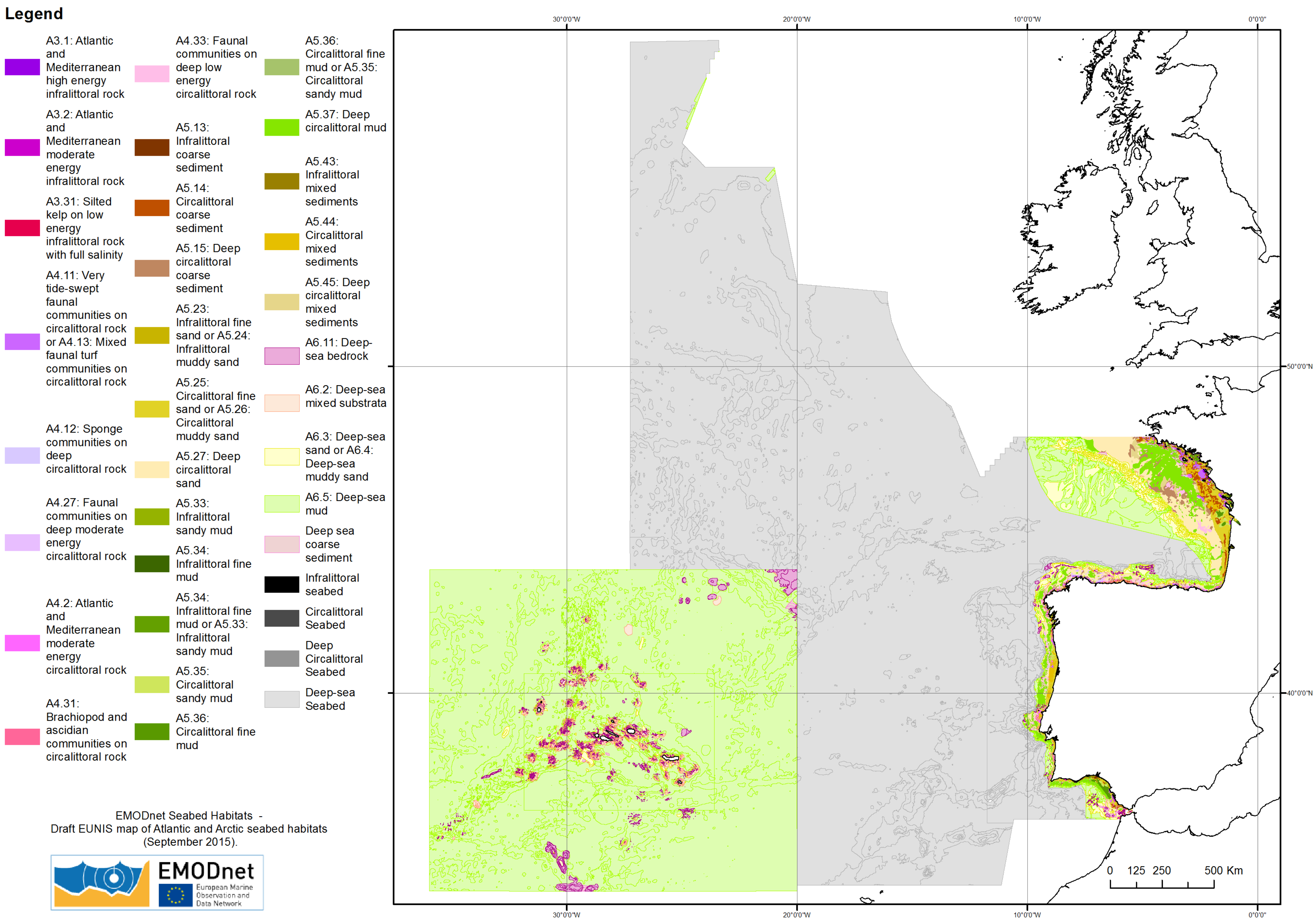


EMODnet Seabed Habitats - Draft EUNIS map of Atlantic and Arctic seabed habitats (September 2015).



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Deep sea coarse sediment
Infralittoral seabed
Circalittoral Seabed
Deep Circalittoral Seabed
Deep-sea Seabed
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(September 2015).
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European Marine Observation and Data Network
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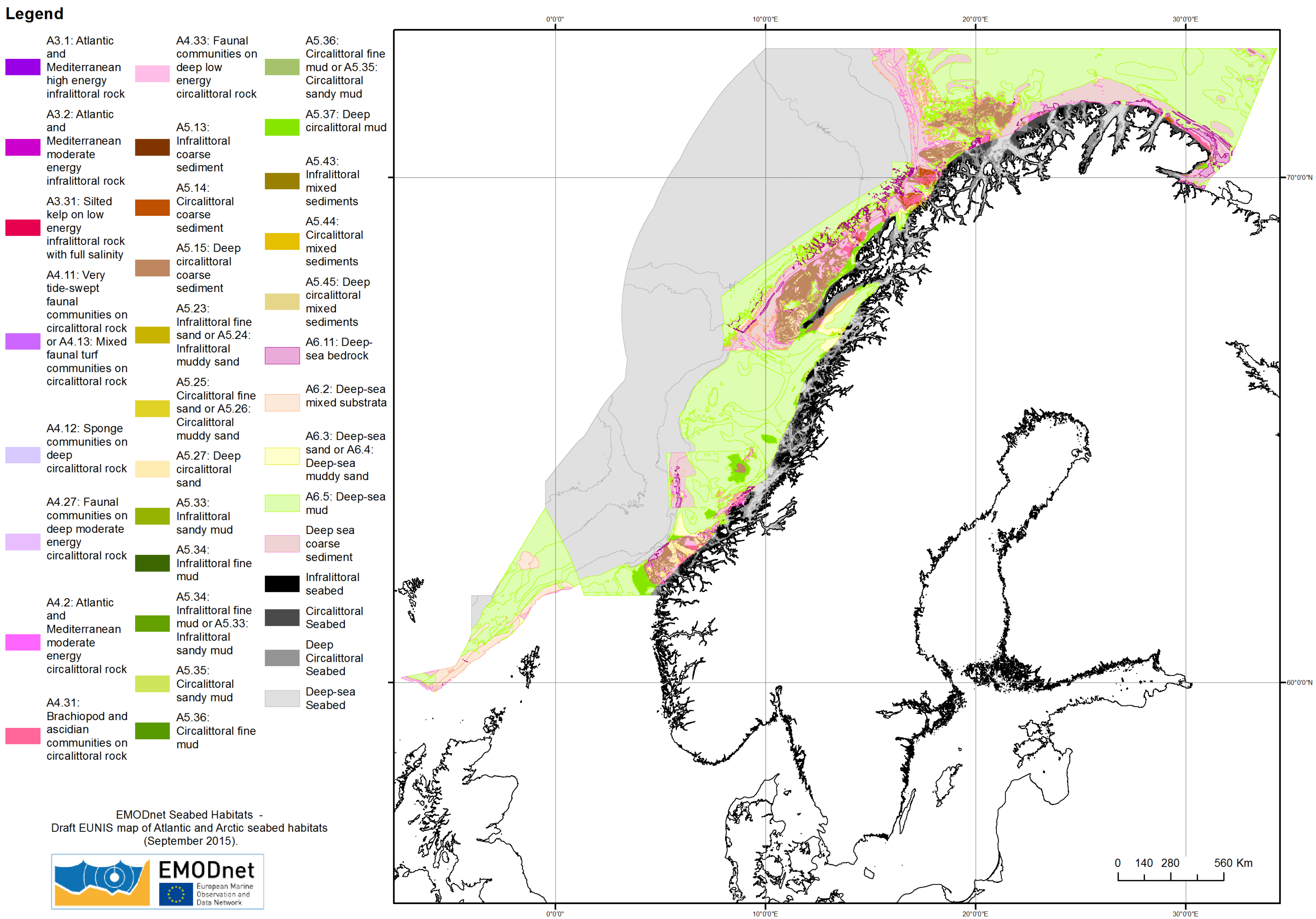

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Draft EUNIS map of Atlantic and Arctic seabed habitats
(September 2015).

#

Legend

- Infralittoral
- Circalittoral
- Deep circalittoral
- Atlantic upper bathyal
- Atlantic mid bathyal
- Atlantic lower bathyal
- Atlantic upper abyssal
- Atlantic mid abyssal
- Atlantic lower abyssal
- Atlanto-A... upper bathyal
- Arctic mid bathyal
- Arctic lower bathyal
- Arctic upper abyssal

Legend

- A3.1: Atlantic and Mediterranean high energy infralittoral rock
- A3.2: Atlantic and Mediterranean moderate energy infralittoral rock
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- A6.11: Deep-sea bedrock
- A6.2: Deep-sea mixed substrata
- A6.3: Deep-sea sand or A6.4: Deep-sea muddy sand
- A6.5: Deep-sea mud
- Deep sea coarse sediment
- Infralittoral seabed
- Circalittoral Seabed
- Deep Circalittoral Seabed
- Deep-sea Seabed

Table A4.13 EUNIS habitat types in the Baltic Sea, which can be identified from the data layers seabed substrate and biological zone. Grey cells are for those combinations that do not have a EUNIS habitat equivalent.

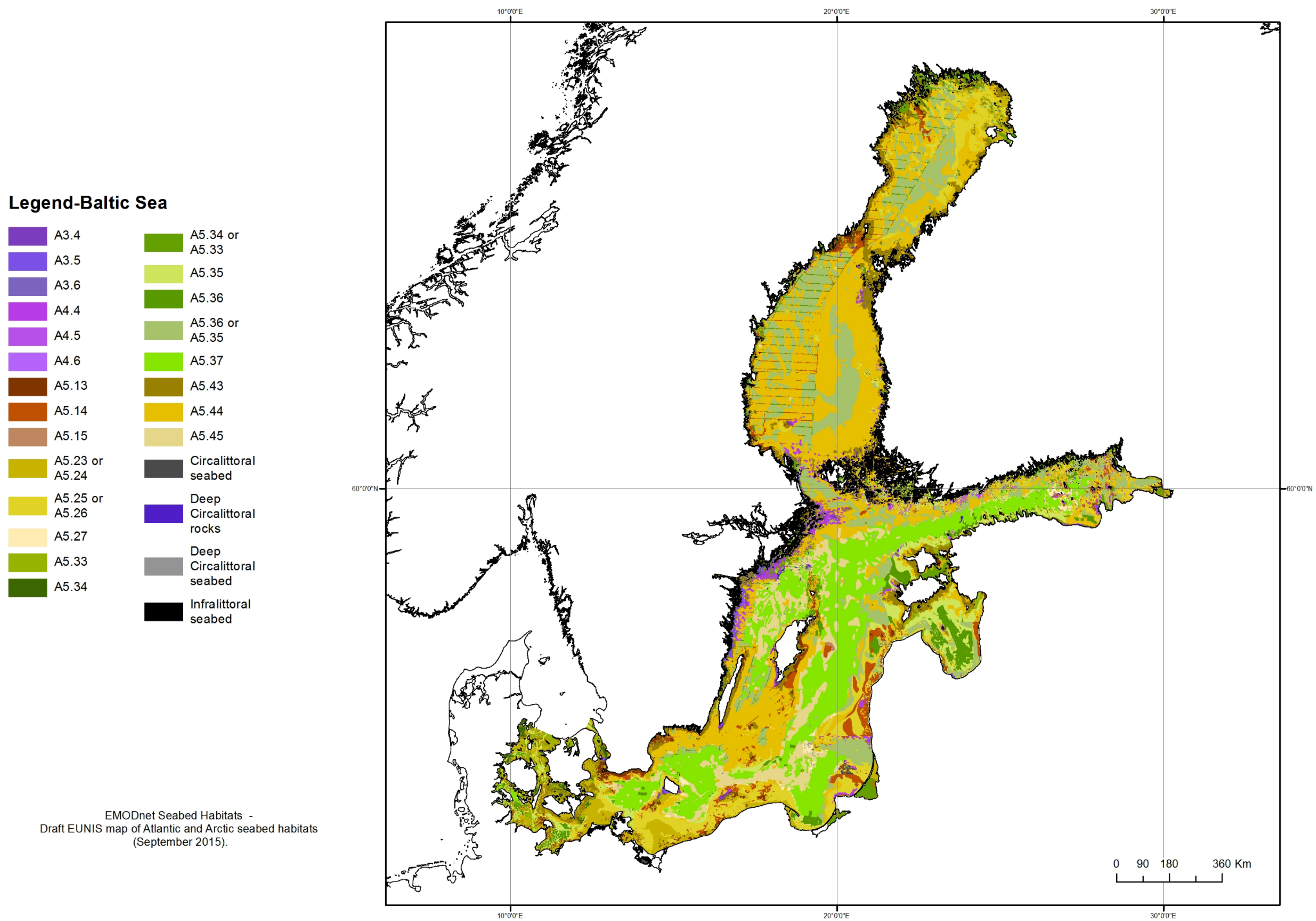
Biological zone	Seabed substrate										
	Rock			Coarse sediment	Sand	Muddy Sand	Sandy Mud	Mud	Mixed sediment	No Substrate	Mud to muddy sand*
	Energy										
	Exposed	Moderate	Sheltered								
Infralittoral	A3.4	A3.5	A3.6	A5.13	A5.23 or A5.24	A5.33	A5.33	A5.34	A5.43	Infralittoral seabed	A5.34 or A5.33
Shallow circalittoral	A4.4	A4.5	A4.6	A5.14	A5.25 or A5.26	A5.35	A5.35	A5.36	A5.44	Circalittoral seabed	A5.36 or A5.35
Deep circalittoral	-	-	-	A5.15	A5.27	A5.37	A5.37	A5.37	A5.45	Deep circalittoral seabed	A5.37

Table A4.14 Overview of the input data in the Baltic Sea, and comparison with previous versions of the map.

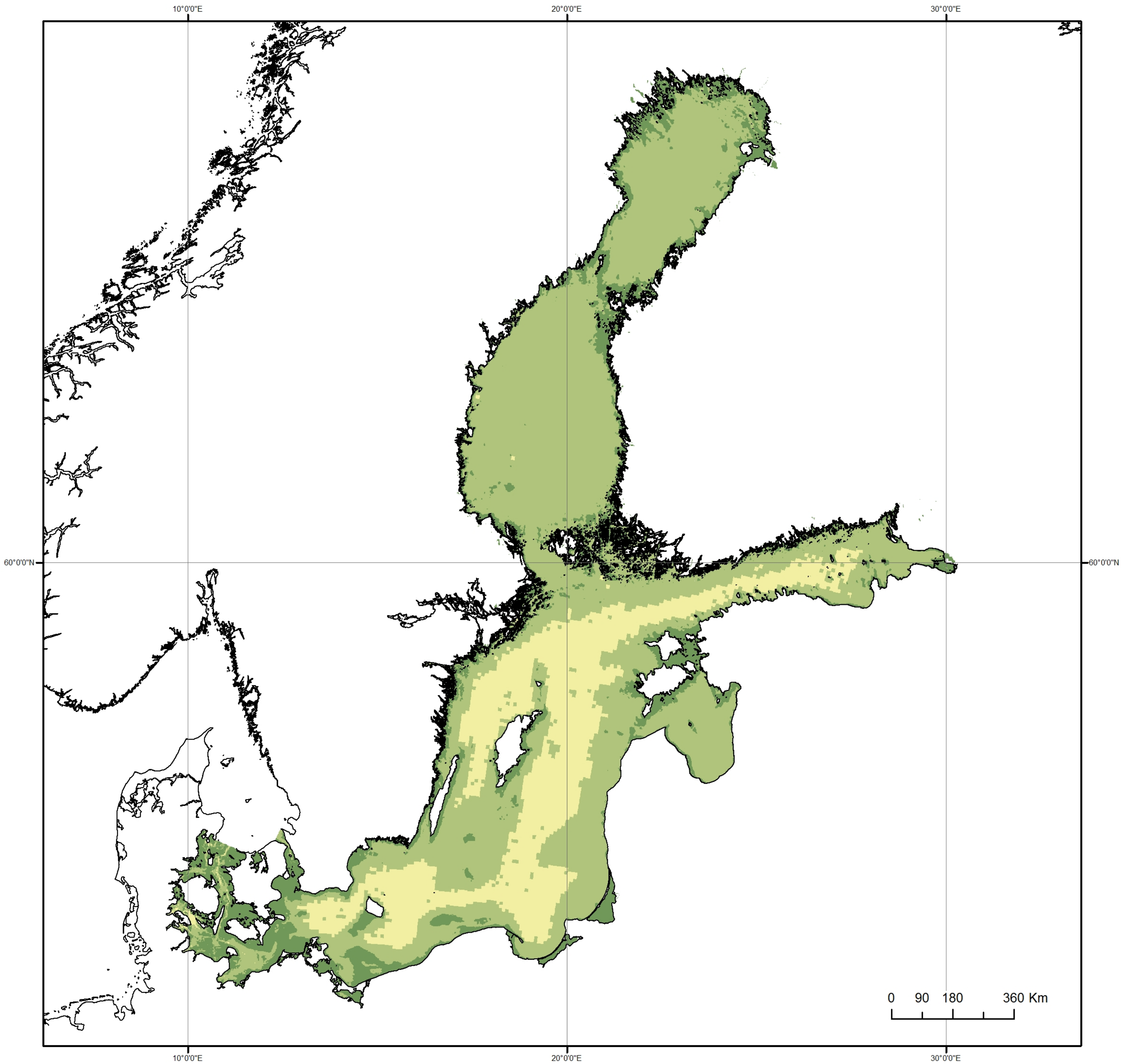
	EUSeaMap Phase 2			EUSeaMap Phase 1 – 2012 version			
Layer	**Class**	**Parameter**	**Threshold**	**Class**	**Parameter**	**Threshold**	**Notes**
Biological zone	Infralittoral/ Shallow Circalittoral	Ratio of Bathymetry /light energy at the seabed (I) calculated from the Secchi disk depth records. Also Kdpar 1% light	1.6 ratio in the Oligohaline . 2.5 the ratio in the Mesohaline, and 1% of (Kdpar) light in Polyhaline and Marine salinity regime.	Infralittoral	Ratio of Bathymetry /light energy at the seabed (I) calculated from the Secchi disk depth records. Also Kdpar 1% light	1.6 ratio in the Oligohaline . 2.5 the ratio in the Mesohaline, and 1% of (Kdpar) light in Polyhaline and Marine salinity regime.	No new thresholds
	Shallow Circalittoral/ Deep Circalittoral	Upper limit is Infralittoral, lower limit is the Halocline (60-70m depth). Same ratio used in the Infralittoral for the upper limit. In the lower limit the Wave Base ratio was used.	1.6 ratio in the Oligohaline. 2.5 the ratio in the Mesohaline, and 1% of (Kdpar) light in Polyhaline. At Marine salinity the Wave base ratio 2 is used.	Shallow Circalittoral	Upper limit is Infralittoral, lower limit is the Halocline (60-70m depth). Same ratio used in the Infralittoral for the upper limit. In the lower limit the Wave Base ratio was used (Wavelength/Wave Hight).	2	New high resolution Bathymetry layer. No thresholds change.
	Deep circalittoral/ Upper Bathyal	Upper limit is the Halocline, lower limit is seabed.Depth to the seabed (d) from EMODnet Bathymetry Feb. 2015	At Mesohaline: Halocline 0.9. At Polyhaline: Maris Kdpar 0.01% . At Marine: wave Base ratio of 2 is used.	Deep Circalittoral	Halocline at about 60-70m depth.	At Mesohaline: Halocline 0.9. At Polyhaline: Maris Kdpar 0.01% . At Marine: wave Base ratio of 2 is used.	New high resolution Bathymetry layer
Energy	High/ Moderate Wave Energy	Fetch value from Simple Wave Model, at deep waters combined with MIKE3 spectral wave model	600000	High wave Energy	Fetch value from Simple Wave Model, at deep waters combined with MIKE3 spectral wave model	600000	No change in thresholds
	Moderate/ Low Wave Energy	Fetch value from Simple Wave Model, at deep waters combined with MIKE3 spectral wave model	60000 - 600000	Moderate wave Energy	Fetch value from Simple Wave Model, at deep waters combined with MIKE3 spectral wave model	60000 - 600000	No change in thresholds
	Low/ Moderate Current Energy	Fetch value from Simple Wave Model, at deep waters combined with MIKE3 spectral wave model	60000	Low wave Energy	Fetch value from Simple Wave Model, at deep waters combined with MIKE3 spectral wave model	60000	No change in thresholds

Substrate	Rock/ Sediment	Rocks and boulders. EMODNet2015, 1:250k sediment map.	Presence of rock.	Bedrock & boulders	EMODNet 2012, 1Mil Substrate map	Bedrock outcrop, boulders, large stones, some gravel	New EMODNet 1:250k substrate map.At deep waters a covering thin layer of mud might be observed
	Coarse sediment/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	If sand:mud < 9:1 then %gravel = 80 %. If sand:mud > 9:1 then %gravel = 5 %	Coarse sediment	Relative proportions of gravel, sandy gravel and gravely sand, in EMODnet Geology 1:1Mil substrate map, 2012	If sand:mud < 9:1 then %gravel = 80 %. If sand:mud > 9:1 then %gravel = 5 %	New EMODNet 1:250k substrate map.
	Mixed sediment/ Other sediment	Relative proportions of gravel, sand and mud or presence of Till. in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	Sand:mud < 9:1 and 5 % < %gravel < 80 %	Mixed sediment/ Other sediment	Relative proportions of gravel, sand and mud in EMODnet Geology 1:1Mil substrate map, 2012	Sand:mud < 9:1 and 5 % < %gravel < 80 %	New EMODNet 1:250k substrate map. New definition of mixed sediment that includes Till (Diamicton) and hard clay.
	N/A	N/A	N/A	Till (Diamicton)	Complex bottom, mud, sand, gravel, and boulders.	minimum 5% of three differnt material should exist plus boulders.	Till was merged with Mixed sediment in 2015 sediment map.
	Fine mud/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	Sand:mud < 1:9 and %gravel < 5 %	Mud and sandy mud	Relative proportions of gravel, sand and mud in EMODnet Geology 1:1Mil substrate map, 2012	Sand:mud < 4:1 and %gravel < 5 %	New EMODNet 1:250k substrate map.
	Sandy mud/ Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	1:9 < sand:mud < 9:1 and %gravel < 5 %	Mud and sandy mud	Relative proportions of gravel, sand and mud in EMODnet Geology 1:1Mil substrate map, 2012	Sand:mud < 4:1 and %gravel < 5 %	New EMODNet 1:250k substrate map.

	Sand/Other sediment	Relative proportions of gravel, sand and mud or presence of rock pre-classified in EMODnet Geology 1:250k and 1:1M substrate maps, July 2015	Sand:mud > 9:1 and %gravel < 5 %	Sand and muddy sand	Relative proportions of gravel, sand and mud in EMODnet Geology 1:1Mil substrate map, 2012	Sand:mud > 4:1 and %gravel < 5 %	New EMODNet 1:250k substrate map. Muddy sand is a new class in the Folk 7 classification.
salinity	Oligohaline	Tolerence limit of a number of marine species	4.5psu	Oligohaline	Tolerence limit of a number of marine species	4.5psu	No change in thresholds
	Mesohaline1	Area where Fukus serratus has its distributional boundary.	7.5psu	Mesohaline1	Area where Fukus serratus has its distributional boundary.	7.5psu	No change in thresholds
	Mesohaline2	Required for cod egg to float.	11psu	Mesohaline2	Required for cod egg to float.	11psu	No change in thresholds
	Mesohaline3	Tolerence limit of kelp, echinoderms and others	18psu	Mesohaline3	Tolerence limit of kelp, echinoderms and others	18psu	No change in thresholds
	Polyhaline	EU Water Framework Directive defined interval	30psu	Polyhaline	EU Water Framework Directive defined interval	30psu	No change in thresholds
	marine	required for stenohaline species. Parts of Kattegat and Skagerrak region.	>30psu	marine	required for stenohaline species. Parts of Kattegat and Skagerrak region.	>30psu	No change in thresholds



EMODnet Seabed Habitats -
Draft EUNIS map of Atlantic and Arctic seabed habitats
(September 2015).



Legend-Baltic Sea

- Infralittoral
- Circalittoral
- Deep circalittoral

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(September 2015).

References used in the current appendice

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