



# GROWTH AND INNOVATION IN OCEAN ECONOMY – GAPS AND PRIORITIES IN SEA BASIN OBSERVATION AND DATA

## EMODNET MedSea CheckPoint

### Annex 5 to the Second DAR: Expert evaluation of Targeted Products

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## Expert evaluation of Targeted Product quality and gaps in the input data sets

The objective is to provide an expert evaluation of the “fitness for purpose and use” for each Targeted Product. The coordinator asked the challenge teams to provide the following information.

1. Assign an overall product quality score with respect to scope (fitness for purpose) and explain why, according to the scale in Error! Reference source not found.**A5.1**.
2. Identify the most important characteristic(s) for the Targeted Product quality (if all characteristics are important, please say so).
3. Identify which quality element(s) (see Annex 1) of the most important characteristic(s) affects the Targeted Product quality.
4. Identify the limitations of the quality of the Targeted products due to the input data set used.
5. Explain which of the characteristics “most fails” to meet the scope of the Targeted Product.
6. Provide an expert judgement of the most important **gaps in the input data sets** for each Targeted Product.

SCORE	MEANING
1	EXCELLENT → completely meets the scope of the Targeted Product
2	VERY GOOD → meets more than 70% of the scope of the Targeted Product
3	GOOD → meets less than 50% of the scope of the Targeted Product
4	SUFFICIENT → does not adequately meet the scope but is a starting point
5	INADEQUATE → does not fulfill the scope and is not usable

### A5.1 Targeted Products quality scores and their meaning.

## CHALLENGE 1

### MEDSEA\_CH1\_Product\_1

1. The product quality score is **excellent** (1). The wind/wave database developed and the associated statistical analysis meet the targets set by the project towards a complete assessment analysis for windfarm siting. A wide number of environmental parameters (beyond the classical wind/wave information) have been covered over an area that extends the borders of the predefined region under study. These data have been analyzed by a variety of conventional and advanced statistical tools providing critical information for the data and their impact to wind farm siting.
2. All the input characteristics contribute to the product quality. However, the wind components (zonal and meridional) keep the critical role for the estimation of the available wind power.
3. The **spatial and temporal extent and resolution** combined with the **accuracy** of the data are the most important quality elements that impact on the analysis for defining the optimal areas for wind farm development.
4. The product's quality is limited by the vertical and horizontal resolution of the wind data, which does not resolve the sub-scale phenomena especially horizontally.
5. All the characteristics contribute to the analysis, but the one that fails the most to meet the scope of the product is the 2-dimensional wave spectra due to the limitation of the data to specific-preselected grid points. In particular, while the rest of atmospheric and wave parameters are one dimensional time series, wave spectra are 2-dimensional matrices and their storage over all the grid points where not possible due to storage limitations. For this reason, wave spectra have been stored in the data base only for specific pre-defined points which, however, are indicative for the coastline of interest.
6. Serious gaps were not present in the input data sets, but as mentioned above, the 2-dimensional wave spectra data are available over fixed preselected points and not over the whole domain under study and this creates some restrictions.

### MEDSEA\_CH1\_Product\_2

1. The product's quality score is **excellent** (1). The suitability index developed for wind farm siting is completed and detailed because it is a combination of statistical indexes providing information on mean values and variability.
2. The wind (zonal and meridional components) is the most important characteristic since it defines the available wind power potential.
3. The spatial (5 km) and temporal (hourly) resolutions guarantee a detailed and accurate analysis of the suitability of an area for wind farm development.
4. The product's quality is limited by the vertical and horizontal resolution of the wind data, which although high, do not resolve the sub-scale phenomena especially horizontally.
5. All the characteristics contribute to the analysis and none of them fails to meet the scope of the product.
6. Serious gaps were not present in the input data sets.

### MEDSEA\_CH1\_Product\_3

1. The product's quality score is **very-good** (2). It covers the most important resources and constraints available on the targeted area. It provides crucial information regarding the suitability of the targeted area for wind farm siting.
2. All the input characteristics contribute to the product quality, however the presence of a national reserve or protected area prevents any wind farm deployment.

3. The spatial extent and resolution together with the accuracy and completeness have the largest impact on the product quality.
4. Since we have very accurate and complete information on the sea depth and distance from shore (with spatial resolution less than 1km), the product's quality is mainly driven by the biological or sediment dataset and the main concerns are their spatial accuracy and completeness. This would require updating the dataset as often as possible.
5. All the characteristics contribute to the analysis and meet the scope of the product. The biological data (marine protected areas and sediments) have the largest potential for time and space evolution and as said above, their databases are required to be updated as often as possible.
6. Individual biological species distribution is available, but not readily useable in a database and their presence is taken into account in the marine protected areas maps. Additional characteristics to the ones considered could be important but were not available due to their real-time or non-free nature like the ship commercial routes or due to data policy reasons, in particular, the information regarding military areas.

## CHALLENGE 2

### MEDSEA\_CH2\_Product\_1

1. The product's quality score is **very good** (2). However, both the north Africa MPAs and the management measures for each MPA, have to be updated and quality controlled. At the time of the analysis specific information on the management plans were not available for some of the MPAs, especially the ones located in the south part of the Mediterranean. There is also little information on enforcement. Detailed information on management measures and levels of enforcement are critical for a species or habitat level evaluation of an MPA network. MPAs that do not protect the specific species or habitat, or MPAs with low enforcement levels should be weighted down in an assessment of the Mediterranean MPAs network. Scientific output for MPAs from the Southern part of Mediterranean is often not communicated and hence unavailable.
2. The product considers a unique characteristic, however the most important details for this product are included: name of protected area; date (year) of designation; type of designation and legal status (e.g. under EU legislation, international convention or national mechanism); location of protected area (coordinates; GIS polygon); size of area designated (marine component) (km<sup>2</sup>); biodiversity protected features (type of marine features being protected, i.e. habitats, species, ecosystems); management measures in place (IUCN categories, management plans).
3. The spatial extent, accuracy, and relevance of the information of the product are important quality elements. Two inputs, namely biodiversity protected features (type of marine features being protected, i.e. habitats, species, ecosystems), and management measures in place (IUCN categories, management plans) have gaps (missing information), and thus decrease the overall quality of the product. A small percentage of the MPAs has not incomplete information regarding designation and management.
4. There are no limitations on the use of this product. The information used is accurate and based on reliable data bases (EEA; MedPan and EU project CoCoNet). The list of MPAs for the Northern Mediterranean is comprehensive and the spatial resolution is adequate.
5. European MPAs databases need to be updated on the conservation features and management measures. Management plans are often missing for MPAs. The most detailed information for the Mediterranean MPAs is available for SPAMIs (Specially Protected Areas of Mediterranean Importance).
6. As mentioned above, information on enforcement levels is lacking and is difficult to obtain. It is acknowledged that the collection of information on the implementation of management plans is challenging. However it could prove crucial for an in depth evaluation of the Mediterranean MPAs network. An improvement of the product's quality would need more detailed information on the protected features (habitats, species, and ecosystems) and the management measures in place

### MEDSEA\_CH2\_Product\_2

1. The overall score is **excellent** (1), considering that all product components are fit for purpose.\* Biological zones are based on high quality input data and models ([http://www.emodnet-seabedhabitats.eu/pdf/seabed\\_habitats\\_final\\_report\\_v3.pdf](http://www.emodnet-seabedhabitats.eu/pdf/seabed_habitats_final_report_v3.pdf)), and constitute a valuable habitat descriptor for biological and conservation studies. FRAs are an important layer of information for the assessment of protection initiatives. Both

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\* Component 1 (FRAs, Fisheries Restricted Areas) and component 2 (biological zones, depth zones).

components are detailed enough to allow for a thorough evaluation of the effectiveness of FRAs, accounting for the different impact that fishing gears have on different biological zones and/or depths.

2. The most important characteristics for this product are both the biological zones and FRAs distribution layers. The main information for FRAs is included: date (year) of designation, type of gear whose use is prohibited, legal information, location of FRAs (coordinates; GIS polygon), type of closure (temporal and spatial), and duration of temporal closures.
3. Spatial resolution was the element that affected most the quality of this product. For the creation of this data set the resolution is high (cell size is 250 meters). Both characteristics of the product are complete and relevant. Model improvements regarding the biological zones and regular updates of the FRAs dataset would further increase the quality of the product.
4. The information used is accurate and based on reliable data bases (EMODnet Bathymetry, EMODnet Seabed Habitats, Mediseh FRAs), thus there are no limitations on its usage at the time of the creation of the product. Changes in fisheries policies should lead to updates of the FRAs component of the product.
5. Both upstream characteristics are essential for the MPAs designation and assessment. Bathymetry is indicative of habitats and it represents a significant parameter for habitat and species distribution models. Seabed habitats are often indicative of marine communities and ecological processes. In contrast to European databases on MPAs, the FRAs database includes detailed information on the conservation features and management measures enforced.
6. None specific

### MEDSEA\_CH2\_Product\_3

1. The overall score is **good** (3). The two characteristics summaries all the available information on proposed MPAs to date, at the scale of the entire Mediterranean basin. The product is useful for the assessment of the adequacy and appropriateness of the proposed network of protected areas, especially under scenario of environmental change.
2. The most important characteristic is the proposed conservation areas for the Mediterranean proposed by Green Peace and captured by the CoCoNet project.
3. The product information is useful for the assessment of the level of protection for Mediterranean conservation features under different strategic goals and bearing in mind the agendas of stakeholders. The product is accurate but possibly incomplete. The spatial extent covers the entire Mediterranean basin. The spatial extent and completeness of the dataset are important quality elements.
4. The main data source, CoCoNet, is considered accurate and reliable, thus there are no limitations on usage of this product. Caution is needed when the product becomes out-of-date; regular updates are needed to capture new proposals for MPAs in the Mediterranean.
5. The characteristics “fails the most” to meet the scope of the Targeted Product are the proposed MPAs by Greenpeace. The scientific information of these layers is not available.
6. A thorough review of all initiatives towards the designation of MPAs, whether successful or not, is lacking. In order to achieve an insight on the driving forces behind proposed MPAs, we need more detailed information on the proposed management plans that accompany the proposed locations.

### MEDSEA\_CH2\_Product\_4

1. The product is considered **sufficient** (4) because it gives only qualitative indications on the connectivity between the Mediterranean networks of MPAs. Seasonal climatological



currents and temperature fields represent averages computed over the 1987-2014 time-period, thus they can be considered as probable tracks of larvae if considered as passive tracers. However, for some species, where larval dispersion is driven by small-scale, ephemeral/transient oceanographic features this resolution is not adequate.

2. The most important characteristics are the currents and temperature in the surface layer. However, to get estimates of connectivity at the basin scale further **knowledge on larval biology** is needed to parameterize relevant biophysical models (not used here).
3. The information is a first attempt to evaluate the connectivity of MPAs in the Mediterranean Sea. The temporal resolution (seasonal maps) of the product is not sufficient to provide quantitative information on the connectivity. Further analysis using biophysical modeling for larval dispersal simulations and Copernicus input datasets is needed (see *Andrello et al. 2013, Rossi et al. 2014, Berline et al. 2014\**), but it requires a much larger effort than the one allocated by the project. Biophysical models can provide connectivity estimates over potentially large spatial scales, such as entire sea basins or oceans (*Lagabrielle et al. 2014\*\**) and can be used to derive estimates of connectivity over different years, generations, and even projections for the future. However, in literature there many recognized limitations to this methodology, which is however the only one considering the whole basin scale. Biophysical models provide estimates of **potential connectivity**, because they cannot take into account post-settlement processes (mortality and juvenile movements), while other methods provide estimates of realized connectivity. Moreover, unbiased estimates of connectivity through biophysical models are only possible if sufficient **knowledge on larval biology** is available to parameterize the models, and if there is an adequately precise hydrodynamic model for the study region. In our case, we can say that Copernicus MED-MFC model is adequate to this purpose. Instead, even if all the processes known to affect connectivity measurements in biophysical models can in theory be modelled and integrated, **the real limitation to producing accurate model-based connectivity assessments is the scarcity of knowledge and data about larval biology for most species, especially in natural (non-laboratory) conditions** (*Lagabrielle et al. 2014\*\**).
4. The main limitation on the quality of the product and its usability is not related to the input dataset used but to the qualitative assessment of connectivity. However, **the real limitation to producing accurate model-based connectivity assessments is the scarcity of knowledge and data about larval biology for most species, especially in natural (non-laboratory) conditions. None input data set has been identified within the project at the present time.**
5. None of the used characteristic and respective data set “fails” to meet the scope of the Targeted Product (fitness for use). However high quality, high frequency and long time

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\* *Andrello, M., Mouillot, D., Beuvier, J., Albouy, C., Thuiller, W., & Manel, S. (2013). Low connectivity between Mediterranean marine protected areas: a biophysical modeling approach for the dusky grouper *Epinephelus marginatus*. Plos One, 8(7), e68564.*

*Berline L, Rammou A-M, Doglioli A, Molcard A, Petrenko A (2014). A Connectivity-Based Eco-Regionalization Method of the Mediterranean Sea. PLoS ONE 9(11): e111978. doi:10.1371/journal.pone.0111978*

*Rossi, V., E. Ser-Giacomi, C. López, and E. Hernández-García (2014), Hydrodynamic provinces and oceanic connectivity from a transport network help designing marine reserves, Geophys. Res. Lett., 41, 2883–2891, doi:10.1002/2014GL059540.*

\*\* *E. Lagabrielle, E. Crochelet, M. Andrello, S. R. Schill, S. Arnaud-Haond, N. Alloncle, B. Ponge, Connecting MPAs - eight challenges for science and management. Aquatic Conservation: Marine and Freshwater Ecosystems, 2014, 24, S2, 94*

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series of ocean currents are necessary to perform statistical maps of connectivity, while a database of the main species populating the Mediterranean MPAs and their principal larval biological information (spawning time, larval lifetime, larval behavior, favorable larval conditions) are crucial.

### MEDSEA\_CH2\_Product\_5

1. Overall the product's quality is considered **good** (3). The level of detail of information available does not allow for the full assessment of the adequacy of the MPAs network regarding marine biodiversity hotspots, and priority species or habitats. Considering that conservation of marine biodiversity is a primary goal for MPA networks, the product is considered incomplete. However, the information on some of the characteristics are fit for purpose to assess the representativity and replication of the MPAs network in the Mediterranean.
2. All characteristics are important. Each characteristic is an important element of marine biodiversity and is crucial for MPA network assessment purposes. All characteristics related to this product are a good baseline of information for rerepresentativity analysis in Mediterranean Sea. However, there is room for improvements for each characteristic. The level of improvement needed varies between datasets.
3. The datasets are spatially accurate, complete, and, in the case of transitional waters, thematically accurate (coastal lagoons are a priority habitat for Natura 2000 sites). The spatial extend is adequate covering the entire Mediterranean. The bathymetry layer can to be improved for coastal areas (resolution and accuracy), especially because of most MPAs are coastal. The layer for Mediterranean cetaceans affect the Targeted Product quality due to low spatial resolution and low spatial accuracy.
4. The information used is accurate and based on reliable data bases. However, in the case of **characteristics related to marine biodiversity**, the limited information available lowers the usability of the data. Lack of specific information on the abundance of priority species would lead to more accurate estimate on representativity. The input data for this product are limited to presence - absence with a low spatial resolution.
5. The characteristic "fails the most" to meet the scope of the Targeted Product is the Mediterranean cetacean distribution. There is a discrepancy between the Mediterranean cetaceans' distribution and the distribution of the MPAs and FRAs network, the resolution of the first being very low. At the same time, more detailed information on the abundance on this and other cetacean species is required for the assessment of representativity.
6. The scientific information needs to be updated and completed. The main gaps were related to the **availability of biodiversity data** especially on protected species. Maps of the abundance of protected species are necessary to assess the current network and designate additional protected areas. The habitats directive specifically requires abundance estimates and maps for cetaceans and sea birds for MPA designation purposes. Currently more information on this has been found, which till now was restricted and therefore data will be further elaborated and included to the data base.

### MEDSEA\_CH2\_Product\_6

1. The overall score is **sufficient** (4). The product aims to assess the capacity of the current biodiversity monitoring network as these overlaps MPAs. The information is limited to coastal areas and information on monitoring within MPAs is difficult to obtain from the managers of the MPAs.
2. The most important characteristic for the product's quality is the biodiversity monitoring network, which includes the operational monitoring network of EU directives (mostly WFD)

on eutrophication, water column habitats zooplankton, water column habitats phytoplankton, seabed habitats zoobenthos, seabed habitats phytobenthos, and the Non-Indigenous Species (NIS) in coastal sites.

3. **Completeness** is the quality element that affects the most the quality of this product, since information is missing in the Southern Mediterranean. However, the provided information is very useful to evaluate the efficiency of biodiversity monitoring in MPAs. Thematic accuracy and completeness are the quality principles that are not met by the biodiversity monitoring stations because (i) the stations are restricted to monitoring networks in coastal areas, and (ii) only metadata are available, biodiversity data are missing.
4. The development of the product was based on accurate data collection and analysis from IRIS-SES project, but the spatial extent and completeness of the data is inadequate.
5. The IRIS-SES data base did not fail to meet the scope of this product, but the usability of the product would highly improve if the data of the monitored parameters became available and covering the whole Mediterranean basin. At the moment, only the monitoring scheme can be assessed.
6. Most of the characteristics related to marine biodiversity are considered insufficient due to the limited availability of scientific information (only the positions of the monitoring stations are given) and the insufficient information on monitoring in deep waters.

## CHALLENGE 3

### MEDSEA\_CH3\_Product\_1

- 1) Overall product quality score is **good (3)** in estimating the consequences of a spill in a previously unknown location, with only the barest details of the incident itself and within 24 hours. The implementation of different scenarios for the two spills illustrates the uncertainties related to this kind of application, which derive from the combination of ocean, wind, wave and oil spill models uncertainties. However, the results of the different scenarios could have been presented side by side to enable a better inter-comparison of results together with a clear presentation of the scenarios characteristics. Moreover, the OPL Bulletin did not provide any information about the impact of the incident on coastal environment (beaches, protected sites) and human activities (touristic areas, MPAs, harbors, ...). The availability of these characteristics and their integration within the OPL Bulletin structure represented the difficult task to address.
- 2) All characteristics needed to produce the OPL Bulletin are important:
  - specific oil leaks input data (leak position, date and time of the leak, type of oil, rate of spillage or total amount of oil spilled, slick satellite observations provided by EMSA) were provided in order to implement the most realistic experimental set up or scenario;
  - hourly oceanographic forecasts for the Mediterranean Sea (currents, and SST) were available through CMEMS portal;
  - waves data from CYCOFOS were available;
  - ECMWF wind data were available together with higher resolution systems SKYRON and POSEIDON.

The progresses in operational oceanography and the establishment of CMEMS assure the full coverage of meteo-oceanographic data (wind, currents and waves) over the Mediterranean Sea, thus it does not represent a limitation for the production of the OPL Bulletin. However, it is recognized in literature the importance of very high temporal and spatial resolution for an accurate representation of the oil transport.

Additional data sets are required in order to evaluate the impacts of the oil spill on the human activities, the environment and the coastal habitats (coastal geomorphology, seabed substrate, marine and coastal infrastructures, mariculture, MPAs, transport routes, use of coastal areas). Most of these characteristics were identified in EMODnet and MEDESS4MS portals, but they were not integrated in the first OPL Bulletin.

- 3) The availability of **meteo-oceanographic forecasts and analyses** through CMEMS portal assures a full coverage in the Mediterranean Sea. However, the increase of the **spatial and temporal resolution** together with a longer temporal horizon (**time extent**) would improve the product quality. The existence of very high resolution operational forecasting systems (national and experimental forecasting systems) nested within the CMEMS Mediterranean Forecasting System could provide higher resolution predictions, however the **availability** of these data is still limited and linked to projects like MEDESS4MS. Readiness and responsiveness are crucial since the 24 hrs response time requires input datasets to be ingested automatically by the oil spill models.

The availability (readiness and responsiveness) and **completeness** represents instead the quality element that mostly affect the assessment of the impact on human activities, the environment and the coastal habitats: coastal geomorphology, seabed substrate, mariculture, Marine Protected Areas, Fisheries Restricted Areas, seabed habitats, coralligenous, eco/bio

- significant areas, special areas for cetaceans, marine and coastal infrastructures (major ports, ocean energy facilities, wind farms, oil offshore installations), transport routes (commercial shipping, recreational shipping, not yet available) and the use of coastal areas (tourism).
- 4) The lack of assessment of the impact on the coastal environment limits the quality of the product. The availability of satellite observations of the leak is crucial both to validate the oil spill models results but also to update the prediction results after the initial alert.
  - 5) None of the considered input characteristics failed to meet the scope of the targeted product.
  - 6) MEDSEA\_CH3\_Product\_1 is missing the coastal impact component, since most of the necessary input data sets were not available or complete (spatial coverage) at the time of the first OPL Bulletin request. The availability of satellite observations of the leak is crucial as stated before. The availability of all regional (limited area models) high resolution models in a web portal would allow to use the highest resolutions data (MEDESS4MS Decision Support System uses them all but do not disseminate them) increasing the accuracy of the oil spill prediction, especially in the coastal areas.

### MEDSEA\_CH3\_Product\_2

- 1) The overall quality score is **very good (2)** in estimating the consequences of a spill in a previously unknown location, with only the barest details of the incident itself and within 24 hours. The implementation of different scenarios illustrates the uncertainties related to this kind of application. The results of the different scenarios have been presented side by side, together with a clear specification of the scenarios characteristics. The bulletin provided also information about the possible impact of the incident on coastal environment and human activities.
- 2) All characteristics needed to produce the OPL Bulletin are important.
- 3) The availability of high-resolution **meteo-oceanographic forecasts and analyses** provided through CMEMS portal and other national and experimental forecasting systems assure a full coverage in the Mediterranean Sea. However, the increase of the **spatial and temporal resolution** of data analyses would improve the OPL Bulletin quality. The **completeness** represents the quality element that mostly affects the characteristics needed to assess the impact on the coastal environment.
- 4) In the specific exercise requested by the customer, an hindcast of a past event, CMEMS is the only service that provides historical oceanographic data to produce the oil spill simulations. Although, the input data time resolution is daily instead of hourly and this impacts on the oil spill transport, as shown in the literature. Hourly data are maintained in CMEMS catalogue for the latest 30 days in a rolling archive. Thus, the simulation has a degraded quality due to the lack of time resolution in the CMEMS historical data, but we could not validate the results with observations and quantify the skill of prediction.
- 5) Ocean analyses which provide currents, temperature are the characteristics that fail the most to meet the scope of the Targeted Product. Data from CMEMS are available at hourly resolution only for the past 30 days, otherwise they are available as daily averages. This implies a degeneration of the product accuracy.
- 6) MEDSEA\_CH3\_Product\_2 was produced considering CMEMS daily analyses as oceanographic input data (currents), limiting the accuracy of the oil slick trajectory simulation. These data are the only one existing, in fact CMEMS hourly analyses are archived only for the past 30 days, older data are deleted. This represents a gap for hindcast simulations of oil spills which might be crucial for risk assessment. The quality of the impact on the coastal environment is connected to the non-homogeneous spatial coverage of the information (coastal geomorphology, seabed substrate, marine and coastal

infrastructures, mariculture, MPAs, transport routes, use of coastal areas). The Southern Mediterranean area is not fully covered.

## CHALLENGE 4

### MEDSEA\_CH4\_Product\_1

- 1) The overall product quality score with respect to scope is: very good (2). The HadISST dataset is the only dataset covering a very long time period (1870-ongoing) collecting the Sea Surface Temperature observations for the Global Ocean. A limit concerns the data low spatial resolution of 1 degree (~100km).
- 2) The most important characteristics is TEMP (P02), TEMPAV01 (P01) in particular since it is referred to the skin temperature of the water body obtained by advanced very high resolution radiometer (AVHRR).
- 3) The quality element that affects the product quality is the low spatial resolution (1 degree)
- 4) The limitations on the quality of product due to the input data set used (fitness for use) are: the product is not suitable to represent sea surface temperature close to the coast and the computation of trends is done only considering few points due to the low resolution of the dataset.
- 5) The HadISST dataset is the only one providing Sea Surface Temperature for a very long time period (1870-ongoing).
- 6) The main gap is represented by the low spatial resolution in the Mediterranean Sea.

### MEDSEA\_CH4\_Product\_2

- 1) The overall product quality score is good (3). The CMEMS Mediterranean Physics Reanalysis dataset is the only dataset that provides temperature of the Mediterranean Sea for mid and bottom water and with high spatial resolution (1/16 degrees, ~6.25 km). A limit concerns the data low temporal coverage of 27 years (1987-2013).
- 2) The most important Characteristics is TEMP (P02), TEMPPR01 (P01) in particular since it is referred to the temperature of the water body
- 3) The quality element that affects the product quality is its short temporal coverage (1987-2013)
- 4) The product not suitable to represent mid and bottom temperature for the last 50 (1963-2012) and 100 years (1913-2012).
- 5) CMEMS Mediterranean Physics Reanalysis dataset is the only one providing mid and bottom temperature for the Mediterranean Sea with high spatial resolution (~6.25km).
- 6) The main gap is represented by the relatively short time span.

### MEDSEA\_CH4\_Product\_3

- 1) The overall product quality score is excellent (1). The CMEMS Mediterranean Physics Reanalysis dataset is the only dataset that provides temperature of the Mediterranean Sea for all the water column and with high spatial resolution (1/16 degrees, ~6.25 km). This allows to compute the internal energy for the last 20 years (1993-2012).
- 2) The most important Characteristics is TEMP (P02), TEMPPR01 (P01) in particular since it is referred to the temperature of the water body.
- 3) The product quality is very high thanks to the availability of CMEMS ocean reanalysis data set. The dataset has been deeply validated using in situ and satellite observations and the results of this validation are contained in the Quality Information document at <http://marine.copernicus.eu/documents/QUID/CMEMS-MED-QUID-006-004.pdf>.

However, since the reanalysis system is assimilating observations only in the first 1000m of water column the skill is reducing below this depth.

- 4) There are no major limitations on the quality of product due to the input data set used. However, since the numerical model is not adjusted by assimilating observations below 1000m, the resulting trends should be carefully considered.
- 5) CMEMS Mediterranean Physics Reanalysis dataset is the only one providing daily temperature values for all the water column at high spatial resolution (~6.25km) for the Mediterranean Sea over 27 years.
- 6) No gap for this product.

#### MEDSEA\_CH4\_Product\_4

- 1) The overall product quality score is good (3). Sea-level reconstructions allow to merge the spatial and temporal information provided by remote-sensing and in-situ observations. In the Mediterranean Sea, the big lack of in-situ observations in the Southern part of the basin is an issue that affects all the scientific studies that aim to describe the sea-level variability and trends in the basin. As a consequence, also the sea-level trends obtained from the reconstruction can be affected by this lack of information.
- 2) Due to the different spatial and temporal coverage, both the characteristics involved in the realization of this product are equally important. In-situ sea-level observation, provide seminal information about sea-level in the Mediterranean, covering a time window of approximately 100 years. Satellite altimetry data spans only two decades (1993-ongoing) over a continuous spatial domain.
- 3) The quality elements that affects the most the product quality are:
  - **Spatial Extent** because in-situ data are almost absent in the Southern part of basin;
  - **Completeness** because in-situ data time series are often affected by significant gaps over the periods considered, and as a consequence it is not possible to consider the entire observational data-set in the reconstruction.
- 4) The principal limitations on the quality of the product due to the input data set used (fitness for use) are:
  - **Spatial Extent:** sea level in-situ observations, by definition, are spatially discontinuous. The lack of in-situ data in the Southern part of the basin can lead to an underestimation of the sea-level temporal amplitudes used in the reconstruction.
  - **Temporal Extent:** sea level remote-sensing data are available during the last 20 years, that represent a relatively short period with the respect to the time window covered by the reconstruction. This period represents also the training period where the Empirical Orthogonal Functions (EOFs) are computed, in order to consider the sea-level spatial variability in the reconstruction. In consequence, the temporal extent of the remote-sensing data can affect the assumption that EOFs are stationary in time.
- 5) The characteristics and respective data set which “fails the most” to meet the scope of the Targeted Product (fitness for use) is the PSMSL data set, which contains the in-situ sea-level records.
- 6) Sea-level reconstructions allow to merge the spatial and temporal information provided by remote-sensing and in-situ observations. In the Mediterranean Sea, **the big lack of in-situ observations in the Southern part of the basin is an issue that affect all the scientific studies that aim to describe the sea-level variability and trends in the basin.** As a consequence, also the sea-level trends obtained from the reconstruction can be affected by this lack of information.



## MEDSEA\_CH4\_Product\_5

- 1) The overall product quality score is excellent (1). The global MSL is calculated by combining the time series from all three TOPEX/Poseidon, Jason-1 and Jason-2 missions since the beginning of the TOPEX/Poseidon mission (1992). Since Jason-2 is still in flight, the computation of 10-years sea level trends from satellite altimeter is relevant with these input data.
- 2) The most important characteristic for the product quality is the sea level (ASLVNL60). Its accuracy and the methodology applied to build the product are very important too. In fact, the altimeter datasets are qualified before their dissemination thanks to Cal/Val activities thus they are considered reliable for 10 years' sea level monitoring.
- 3) The quality element that affects the Targeted Product quality are: spatial resolution, time resolution, completeness.
- 4) The limitations on the quality of Targeted Products due to the input data set used (fitness for use) are:
  - different results regarding the 10/50/100-years sea level trends;
  - data gaps in the resulting maps and datasets;
  - large errors in the estimate of sea level trends.
- 5) The characteristic ASLVNL60 used for this product generation does not fail to meet the scope of the Targeted Product. Both AVISO and Copernicus datasets are available for different case studies (AVISO is along-track data while Copernicus is gridded products). The differences between these datasets give access to different space/time resolution information, which latter can be combined with in-situ measurements to provide added-value products. In the framework of this WP, altimeter datasets are used to compute 10-years sea level trends over the Mediterranean Sea, and the resulting time series can be compared to tide gauge measurements to provide key performance indicators.
- 6) The most important gaps in the input data sets are the unavailability of altimeter data and the geographical coverage due to the repetitiveness of the altimeter mission.

## MEDSEA\_CH4\_Product\_6

- 1) The overall product quality score is sufficient (4). The number of useful sea level time series is extremely low compared to the number of available time series in the PSMSL data bank. A historical bank of data coming from different countries cannot be assumed to provide uniform time and space data coverage. Moreover, local vertical land motion makes it impossible to combine the time series without introducing information external to the data base.
- 2) There is only one characteristic (ASLVMNMO).
- 3) The quality elements that affect the Targeted Product quality are the **time extent** and **completeness**. The time series are often affected by significant gaps in both time periods, the last 50 years and the last 100 years. The time series often start too late or end too early to estimate sea-level trends over 10 years that is why it was not considered here. In fact, this is a too short time period to obtain useful values for the two following reasons:
  - the trend estimate is biased by the incomplete sampling of the 18.6-year lunar nodal cycle, even though its amplitude is relatively small (less than 1 cm);
  - the small sample size makes the statistical error comparatively large relative to the trend itself; for instance, the 2003-2012 trends for the two centennial stations of

Marseille and Trieste are  $5.9\pm 5.6$  mm/y and  $7.3\pm 8.6$  mm/y, respectively (error corresponding to 95% confidence).

- 4) The limitations on the quality of the Targeted Product due to the input data set used (fitness for use) are related to their time extent (time series often include too few annual means for a reliable estimation of 50-year and 100-year trends) and completeness (time series often include too few annual means for a reliable estimation of 50-year and 100-year trends).
- 5) There is only one Characteristic (ASLVMNMO) and one data set (PSMSL).
- 6) Gaps are represented by: a) the low number of time series in the Mediterranean Sea; b) the relatively short time span of most of the available time series; 3) the frequently missing monthly means, and, therefore, years, even in relatively long time series.

## MEDSEA\_CH4\_Product\_7

- 1) Contrarily to sea-level or sea surface temperature datasets, there is a lack of valid data on sediment mass-balance or coastal erosion-accretion at a basin level. The EUROSION dataset provides a qualitative estimation of sediment mass balance coded as stable, eroded, or accreted, without being specific on time extent, methods and approaches used. Other available data from EMODnet Portal, OneGeology Portal or from the European Atlas of the Seas provide data (i.e. sediment type, deep-sea water bathymetries) that do not fulfil the minimum requirements for a sediment mass balance assessment and therefore **the overall product quality score is inadequate (5)**, despite the challenge have explored the existence of alternative data sources and datasets described in the report entitled “D5.3.5.1 Sediment Mass Balance Data Assessment in the Mediterranean”.
- 2) There are not characteristics usable for generating this product.
- 3) To justify why we did not constructed the requested product, two approaches were addressed: (1) a specific survey to the national agencies dealing with coastal protection and (2) a scientific literature survey. In both cases the resulting datasets incorporates doubts about the quality of the exploitable characteristics.
- 4) The main limitations of the resulting products relate to the type and nature of available data. Firstly, the specific surveys identified (i.e. surveys originated from national agencies or scientific literature) a plethora of data sources that would be appropriate for the Tender request. However, in most cases this data is not visible, neither easily available. Additional analyses and supplementary effort would be needed to locate and access them, and determine their usefulness and value to address the Tender purposes or the potential use for non-expert users. The data from specific surveys indicate that in relation to spatial layers of sediment mass balance, adequate resolution can be obtained for only 10% of Mediterranean NUTS3 regions. Only 4 regions have adequate temporal resolution. We have discarded local studies that can provide time series at a specific location, but not at the scale requested by the tender. Secondly, the scientific literature survey carried out shows that despite the existence of numerous studies in the Mediterranean, they are usually local and with an incoherent frequency. In addition, very different methods are used and as a consequence, it is very difficult to use and compare the resulting data. Additionally, there is some concern on the representativeness of the locations surveyed for being used as NUTS3 regional indicators.
- 5) Regarding to the limitations of this products, both the scientific literature survey and the specific surveys showed a persistent difference about the amount of data and the quality between countries and between the northern and southern coasts of the Mediterranean.

### MEDSEA\_CH4\_Product\_8

- 1) The overall product quality score with respect to scope is: **very good (2)**. The HadISST dataset is the only dataset covering a very long time period (1870-ongoing) collecting the Sea Surface Temperature observations for the Global Ocean. A limit concerns the data low spatial resolution of 1 degree (~100km).
- 2) The most important characteristics is TEMP (P02), TEMPAV01 (P01) in particular since it is referred to the skin temperature of the water body obtained by advanced very high resolution radiometer (AVHRR).
- 3) The quality element that affects the product quality is the low **spatial resolution** (1 degree)
- 4) The limitations on the quality of product due to the input data set used (fitness for use) are: the product is not suitable to represent sea surface temperature close to the coast due to the low resolution of the dataset.
- 5) The HadISST dataset is the only one providing Sea Surface Temperature for a very long time period (1870-ongoing).
- 6) Gap is represented by the low spatial resolution in the Mediterranean Sea.

### MEDSEA\_CH4\_Product\_9

- 1) The overall product quality score is **good (3)**. The CMEMS Mediterranean Physics Reanalysis dataset is the only dataset that provides temperature of the Mediterranean Sea for mid and bottom water and with high spatial resolution (1/16 degrees, ~6.25 km). A limit concerns the data low temporal coverage of 27 years (1987-2013).
- 2) The most important Characteristics is TEMP (P02), TEMPPR01 (P01) in particular since it is referred to the temperature of the water body.
- 3) The quality element that affects the product quality is its short temporal coverage (1987-2013).
- 4) The product not suitable to represent mid and bottom temperature for the last 50 (1963-2012) and 100 years (1913-2012).
- 5) CMEMS Mediterranean Physics Reanalysis dataset is the only one providing mid and bottom temperature for the Mediterranean Sea with high spatial resolution (~6.25km).
- 6) The main gap is represented by the relatively short time span.

### MEDSEA\_CH4\_Product\_10

- 1) The overall product quality score is **excellent (1)**. The CMEMS Mediterranean Physics Reanalysis dataset is the only dataset that provides temperature of the Mediterranean Sea for all the water column and with high spatial resolution (1/16 degrees, ~6.25 km). This allows to compute the internal energy for the last 20 years (1993-2012).
- 2) The most important Characteristics is TEMP (P02), TEMPPR01 (P01) in particular since it is referred to the temperature of the water body.
- 3) The product quality is very high thanks to the availability of CMEMS ocean reanalysis data set. The dataset has been deeply validated using in situ and satellite observations and the results of this validation are contained in the Quality Information document at <http://marine.copernicus.eu/documents/QUID/CMEMS-MED-QUID-006-004.pdf>. However, since the reanalysis system is assimilating observations only in the first 1000m, the skill is reducing below this depth.
- 4) There are no major limitations on the quality of product due to the input data set used. However, since the numerical model is not adjusted by assimilating observations below 1000m, the resulting trends should be carefully considered.
- 5) CMEMS Mediterranean Physics Reanalysis dataset is the only one providing daily temperature values for all the water column at high spatial resolution (~6.25km) for the Mediterranean Sea over 27 years.

- 6) No main gaps for this product.

#### MEDSEA\_CH4\_Product\_11

- 1) The overall product quality score is **good (3)**. Sea-level reconstructions allow to merge the spatial and temporal information provided by remote-sensing and in-situ observations. In the Mediterranean Sea, the big lack of in-situ observations in the Southern part of the basin is an issue that affects all the scientific studies that aim to describe the sea-level variability and trends in the basin. As a consequence, also the sea-level trends obtained from the reconstruction can be affected by this lack of information.
- 2) Due to the different spatial and temporal coverage, both the characteristics involved in the realization of this product are equally important. In-situ sea-level observation, provide seminal information about sea-level in the Mediterranean, covering a time window of approximately 100 years. Satellite altimetry data spans only two decades (1993-ongoing) over a continuous spatial domain.
- 3) The quality elements that affects the most the product quality are:
  - **Spatial extent** because in-situ data are almost absent in the Southern part of basin;
  - **Completeness** because in-situ data time series are often affected by significant gaps over the periods considered, and as a consequence it is not possible to consider the entire observational data-set in the reconstruction.
- 4) The principal limitations on the quality of the product due to the input data set used (fitness for use) are:
  - **Spatial extent:** sea level in-situ observations, by definition, are spatially discontinuous. The lack of in-situ data in the Southern part of the basin can lead to an underestimation of the sea-level temporal amplitudes used in the reconstruction.
  - **Temporal extent:** sea level remote-sensing data are available during the last 20 years, that represent a relatively short period with the respect to the time window covered by the reconstruction. This period represents also the training period where the Empirical Orthogonal Functions (EOFs) are computed, in order to consider the sea-level spatial variability in the reconstruction. In consequence, the temporal extent of the remote-sensing data can affect the assumption that EOFs are stationary in time.
- 5) The characteristics and respective data set which “fails the most” to meet the scope of the Targeted Product (fitness for use) is the PSMSL data set, which contains the in-situ sea-level records.
- 6) Sea-level reconstructions allow to merge the spatial and temporal information provided by remote-sensing and in-situ observations. In the Mediterranean Sea, **the big lack of in-situ observations in the Southern part of the basin is an issue that affect all the scientific studies that aim to describe the sea-level variability and trends in the basin**. As a consequence, also the sea-level trends obtained from the reconstruction can be affected by this lack of information.

#### MEDSEA\_CH4\_Product\_12

- 1) The overall product quality score is **sufficient (4)**. The number of useful sea level time series is extremely low compared to the number of available time series in the PSMSL data bank. A historical bank of data coming from different countries cannot be assumed to provide uniform time and space data coverage. Moreover, local vertical land motion makes it impossible to combine the time series without introducing information external to the data base.
- 2) There is only one characteristic (ASLVMNMO).

- 3) The quality elements that affect the Targeted Product quality are the **time extent** and **completeness**. The time series are often affected by significant gaps in both time periods, the last 50 years and the last 100 years. The time series often start too late or end too early to estimate sea-level trends over 10 years that is why it was not considered here. In fact, this is a too short time period to obtain useful values for the two following reasons:
  - a. the trend estimate is biased by the incomplete sampling of the 18.6-year lunar nodal cycle, even though its amplitude is relatively small (less than 1 cm);
  - b. the small sample size makes the statistical error comparatively large relative to the trend itself; for instance, the 2003-2012 trends for the two centennial stations of Marseille and Trieste are  $5.9 \pm 5.6$  mm/y and  $7.3 \pm 8.6$  mm/y, respectively (error corresponding to 95% confidence).
- 4) The limitations on the quality of the Targeted Product due to the input data set used (fitness for use) are related to their time extent (time series often include too few annual means for a reliable estimation of 50-year and 100-year trends) and completeness (time series often include too few annual means for a reliable estimation of 50-year and 100-year trends).
- 5) There is only one Characteristic (ASLVMNMO) and one data set (PSMSL).
- 6) Gaps are represented by: a) the low number of time series in the Mediterranean Sea; b) the relatively short time span of most of the available time series; 3) the frequently missing monthly means, and therefore, years, even in relatively long time series.

#### MEDSEA\_CH4\_Product\_13

- 1) The overall product quality score is **excellent (1)**. The global MSL is calculated by combining the time series from all three TOPEX/Poseidon, Jason-1 and Jason-2 missions since the beginning of the TOPEX/Poseidon mission (1992). Since Jason-2 is still in flight, the computation of 10-years sea level trends from satellite altimeter is relevant with these input data.
- 2) The most important characteristic for the product quality is the sea level (ASLVNL60). Its accuracy and the methodology applied to build the product are very important too. In fact, the altimeter datasets are qualified before their dissemination thanks to Cal/Val activities thus they are considered reliable for 10 years' sea level monitoring.
- 3) The quality element that affects the Targeted Product quality are: spatial resolution, time resolution, completeness.
- 4) The limitations on the quality of the Targeted Product due to the input data set used (fitness for use) are:
  - different results regarding the 10/50/100-years sea level trends;
  - data gaps in the resulting maps and datasets;
  - large errors in the estimate of sea level trends.

Sea-level reconstructions allow to merge the spatial and temporal information provided by remote-sensing and in-situ observations. In the Mediterranean Sea, the big lack of in-situ observations in the Southern part of the basin is an issue that affects all the scientific studies that aim to describe the sea-level variability and trends in the basin. As a consequence, also the sea-level trends obtained from the reconstruction can be affected by this lack of information.

- 5) The characteristic ASLVNL60 used for this product generation does not fail to meet the scope of the Targeted Product. Both AVISO and Copernicus datasets are available for different case studies (AVISO is along-track data while Copernicus is gridded products). The differences between these datasets give access to different space/time resolution information, which latter can be combined with in-situ measurements to provide added-value products. In the framework of this WP, altimeter datasets are used to compute 10-

years sea level trends over the Mediterranean Sea, and the resulting time series can be compared to tide gauge measurements to provide key performance indicators.

- 6) The most important gaps in the input data sets are the unavailability of altimeter data and the geographical coverage due to the repetitiveness of the altimeter mission.

## CHALLENGE 5

### MEDSEA\_CH5\_Product\_1

- 1) Overall product quality score with respect to scope is **good** (3). Landings data have a good coverage only in terms of mass, while only the data from DCF are available in number (only EU MS).
- 2) All Characteristics are important because they have different spatial and temporal coverage.
- 3) The quality elements of the most important characteristics that affect the product quality are:
  - **Spatial Extent:** the product covers all the Mediterranean basin only in terms of mass.
  - **Time Extent:** the product is time limited due to the availability of the different data sets used: it starts from 2002 as regards the landing data in number only for DCF data set (EU MS), from 1970 for Fao Fishstat landing data in mass, and from 1950 for ICCAT mass data of tuna like species.
  - **Usability:** the product is easy to be understood and used.
  - **Completeness:** due to the lack of data reported in the first two points (spatial extent and time extent) the degree of absence of data in the data sets is relatively high.
  - **Thematic Accuracy:** the values reported in the targeted product are close to be true at the highest level of correctness.
- 4) The limitations of the targeted product due to the data sets used are:
  - the absence of number of fish landed for the whole region and of long time series;
  - the unavailability of updated data in the data sets: data are usually made available after 1-2 years depending on the dataset.
- 5) The greatest limitation of the characteristics and respective data sets is that they fail to meet the scope of the Targeted Product due to the not complete spatial and temporal coverage especially in number of fish landed.
- 6) The most important gaps for this targeted product are related with the Characteristics required but not available (FAO-GFCM Task 1). The gap in geographical coverage is due to the absence of landing data in term of numbers from the non-EU countries. The gap in temporal coverage is due to the absence of data in terms of numbers before 2002.

### MEDSEA\_CH5\_Product\_2

- 1) Overall product quality score with respect to scope (fitness for purpose): **sufficient** (4). Discard data have a good coverage in terms of mass and number only from DCF (only EU MS).
- 2) All characteristics are important because they have different spatial and temporal coverage.
- 3) The quality elements of the most important Characteristics that affect the Targeted product quality are:
  - **Spatial Extent:** the product covers only the EU Mediterranean countries in terms of number and mass.
  - **Time Extent:** the product is time limited due to the availability only of DCF data set (EU MS) which started in 2002.
  - **Usability:** the product is easy to be understood and used.
  - **Completeness:** due to the lack of data reported in the first two points (spatial extent and time extent) the degree of absence of data in the data set is relatively high.
  - **Thematic Accuracy:** the values reported in the targeted product are close to be true at the highest level of correctness.



- 4) The limitations of the targeted product due to the data sets used are:
  - the absence of mass and number of discarded fish for the whole region and of long time series;
  - the unavailability of updated data in the DCF data set: data are usually made available after 1 year.
- 5) The greatest limitation of the characteristics and respective data sets is that they fail to meet the scope of the Targeted Product due to the incomplete spatial and temporal coverage of discarded fish data.
- 6) The most important gaps for this targeted product are related with the Characteristics required but not available (FAO-GFCM Task 1). The gap in geographical coverage is due to the absence of discard data in term of numbers and mass from the non-EU countries. The gap in temporal coverage is due to the absence of data in terms of numbers and mass before 2002.

### MEDSEA\_CH5\_Product\_3

- 1) Overall product quality score with respect to scope (fitness for purpose): **inadequate** (5). In spite of by-catch of vulnerable species is required by DCF, data were available only from Cyprus.
- 2) The product is made only of two Characteristics: mass and number of species, both of them are very relevant.
- 3) The quality elements of the most important Characteristics that affect the Targeted product quality are:
  - **Spatial Extent:** the product covers only Cyprus fleet.
  - **Time Extent:** the product is time limited due to the availability only of DCF data set which started in Cyprus in 2005.
  - **Usability:** the product is easy to be understood and used.
  - **Completeness:** due to the lack of spatial extent and time extent the completeness is very low.
  - **Thematic Accuracy:** the values reported in the targeted product are close to be true at the highest level of correctness.
- 4) The limitations of the targeted product due to the data sets used are:
  - the absence of mass and number of by-catch vulnerable species for the whole region as well as of long time series;
  - the unavailability of updated data in the DCF data set: data are usually made available after 1 year.
- 5) The greatest limitation of the characteristics and respective data sets is that they fail to meet the scope of the Targeted Product due to the incomplete spatial and temporal coverage of by-catch ETP species.
- 6) The most important gap for this targeted product is the absence of data covering the target area (the Med Sea).

### MEDSEA\_CH5\_Product\_4

- 1) Overall product quality score with respect to scope (fitness for purpose): **sufficient** (4). The VMS maps cover only EU MS fishing in the Mediterranean Sea. Moreover, the data were not available for all the countries (Italy, Croatia, and Spain did not provide them) while partially available for the other EU countries, and the time series does not cover the same period in the different countries (Table 2).



- 2) All characteristics are important because they have different spatial and temporal coverage.
- 3) The quality elements of the most important Characteristics that affect the Targeted product quality are:
  - **Spatial Extent:** the product does not cover the whole Mediterranean for the following reasons: a) VMS is only adopted by EU countries; b) not all EU countries are available to provide this kind of data.
  - **Spatial Resolution:** the targeted product is based on a 0.05°x0.05° grid that may be suitable to describe the extent of fisheries impact on the sea floor.
  - **Spatial Accuracy:** VMS data have high accuracy being acquired through GPS system.
  - **Time Extent:** the product is time limited because the VMS system was implemented only since 2006 and not simultaneously by all the EU Mediterranean countries.
  - **Time Resolution:** as required by the Tender, the targeted product is based on monthly grid maps that may be suitable to describe the temporal extent of fisheries impact on the sea floor.
  - **Time Accuracy:** the targeted product is based on data recorded at time intervals ranging from 20 min (i.e., Slovenia) to 120 min (e.g., Malta), hence the level of accuracy could be considered not uniform and quite low.
  - **Usability:** the product is easy to be understood and used.
  - **Completeness:** due to the lack of data reported in the first two points (spatial extent and time extent) the degree of absence of data in the data set is high. Moreover, the trawling pressure could be underestimated because each country provided maps related to their own GSAs, consequently, the portion of their fleets operating in remote GSAs were generally not mapped.
  - **Logical Consistency:** the targeted product agrees with the format required.
  - **Thematic Accuracy:** due to the not availability of raw data from most of countries, to the lack of data from the portion of fleets operating outside the GSAs of their own country, as well as to uncertain on the accuracy adopted by each country for data processing, it is not possible to evaluate the accuracy of the maps provided by the different countries.
- 4) The limitations of the product due to the data sets used are:
  - the absence of maps covering the whole Mediterranean region and of long time series;
  - the time interval on which the VMS data are recorded in the different countries cannot assure a same level of accuracy of maps. This limitation is further stressed by the lack of coordination in the data processing between the different countries.
- 5) The greatest limitation of the characteristics and respective data sets is that they fail to meet the scope of the product due to the incomplete spatial and temporal coverage of the data sets.
- 6) The most important gaps for these targeted products regard the geographical and temporal coverage related to the incompleteness of the Characteristics because the VMS system has been implemented only in the EU Mediterranean countries starting from different years. Another important gap is related to a few Characteristics required but not available due to confidentiality concerns related to the European laws on privacy, which makes access to raw data extremely difficult in most cases.  
 On the other hand, VMS data processing and production of anonymous maps requires for technical capability not always developed in each country and, also in the case that the country has such competence, accessibility to the data set is still not easy as the competent

authorities and/or the scientific bodies responsible for the data storage and processing do not often facilitate data access (e.g., Italy).

### MEDSEA\_CH5\_Product\_5

- 1) Overall product quality score with respect to scope (fitness for purpose): **sufficient** (4). The VMS maps cover only EU MS fishing in the Mediterranean Sea. Moreover, the data were not available for all the countries (Croatia and Spain did not provide them) and only partially available for the remaining EU countries. Moreover, the time series does not cover the same time period in the different countries. Hence, also the change of the level of disturbance of trawling on the seabed could be calculated on a shorter time period in respect to that required by the Tender.
- 2) All characteristics are important because they have different spatial and temporal coverage.
- 3) This product derived from MEDSEA\_CH5\_Product\_4 and, even though the Italian yearly data were included, it is characterised by the same quality features of MEDSEA\_CH5\_Product\_4.
- 4) This product derived from MEDSEA\_CH5\_Product\_4, even though the Italian yearly data were included, it is characterised by the same quality limitations of MEDSEA\_CH5\_Product\_4.
- 5) The greatest limitation of the characteristics and respective data sets is that they fail to meet the scope of the Targeted Product due to the incomplete spatial and temporal coverage.
- 6) The most important gaps for these targeted products regard the geographical and temporal coverage related to the incompleteness of the Characteristics because the VMS system has been implemented only in the EU Mediterranean countries starting from different years. Another important gap is related to a few Characteristics required but not available due to confidentiality concerns related to the European laws on privacy, which makes access to raw data extremely difficult in most cases.  
On the other hand, VMS data processing and production of anonymous maps requires for technical capability not always developed in each country and, also in the case that the country has such competence, accessibility to the data set is still not easy as the competent authorities and/or the scientific bodies responsible for the data storage and processing do not often facilitate data access (e.g., Italy).

### MEDSEA\_CH5\_Product\_6

- 1) Overall product quality score with respect to scope (fitness for purpose): **good** (3).  
The AIS data have a higher spatial coverage in respect to VMS data mainly because also non-EU vessels are equipped with this system. Therefore, although in the available time period there are not data for a part of the fishing fleets due to the fact that the obligation of adopting this system was gradually extended over the years, they allow to get a more spatial complete coverage of the overall Mediterranean basin in respect to VMS.
- 2) The characteristic is important to obtain the product because it is the only one available.
- 3) The quality elements of the Characteristic that affect the Targeted product quality are:
  - **Spatial extent:** the product well covers the northern Mediterranean basin, while the rest of the basin is not completely covered because fleets in several African countries are not yet equipped with AIS.
  - **Spatial resolution:** given the high frequency of AIS data they allow to get very detailed maps of the trawling impact on the sea floor.
  - **Spatial Accuracy:** AIS data have high accuracy being acquired through GPS system. However, the lack of receiver coverage as well as the intentional switch off of the system by the crew can sometimes compromise the accuracy.

- **Time extent:** the product is time limited because the AIS system was implemented only recently and not simultaneously by all the Mediterranean countries.
- **Time resolution:** as required by the Tender, the targeted product is based on monthly grid maps that may be suitable to describe the temporal extent of fisheries impact on the sea floor.
- **Time Accuracy:** the targeted product is based on data recorded at time intervals of 5 min, hence the level of accuracy can be considered high.
- **Usability:** the product is easy to be understood and used.
- **Completeness:** due to the lack of data reported in the first point (lack of data from a part of the fishing fleets) the degree of absence of data in the data set is high especially in 2012.
- **Logical Consistency:** the targeted product agrees with the format required.
- **Thematic Accuracy:** being the product based on raw data, the accuracy of the product is uniform in the whole gridded layers produced and checkable in terms of the applied filters.

- 4) The limitations of the targeted product due to the data sets used are:
- the time interval on which the AIS system has been gradually adopted cannot assure a high level of completeness of the maps produced in 2012 and 2013;
  - the lack of receiver coverage as well as the intentional switch off of the system by the crew can compromise the spatial accuracy.

Moreover, data processing required a long time since a standardized and scientifically validated processing method is not yet available.

- 5) The greatest limitation of the characteristic and the respective data set is that they fail to meet the scope of the Targeted product due to the incomplete spatial and temporal coverage of the data set.
- 6) The most important gap for these targeted products regards the temporal and geographical coverage related to the recent adoption of AIS system by the fishing fleets of most Mediterranean countries and that this system has still to be implemented by most of North-African vessels. A gap due to geographical coverage is also related to the limited range of VHF signals and managing of the system up to the vessel crew. Another gap is that the data are not always made available by the competent authorities and they have to be purchased by private providers.

## MEDSEA\_CH5\_Product\_7

- 1) Overall product quality score with respect to scope (fitness for purpose): **sufficient** (4).  
Given that AIS became compulsory from 2012, the available temporal dataset only covers three years, hence also the change of the level of disturbance of trawling on the seabed could be calculated on a shorter time period in respect to that required by the Tender.
- 2) The characteristic is important to obtain the product because it is the only one available.
- 3) Being this product derived from MEDSEA\_CH5\_Product\_6, it is characterised by the same quality features.
- 4) Being this product derived from MEDSEA\_CH5\_Product\_6, it is characterised by the same quality limitations.
- 5) The greatest limitations of the characteristic and respective data set are that it fails to meet the scope of the Targeted Product due to the incomplete spatial and temporal coverage of the data set.
- 6) The most important gap for these targeted products regards the temporal and geographical coverage related to the recent adoption of AIS system by the fishing fleets of most

Mediterranean countries and that this system has still to be implemented by most of North-African vessels. A gap due to geographical coverage is also related to the limited range of VHF signals and managing of the system up to the vessel crew. Another gap is that the data are not always made available by the competent authorities and they have to be purchased by private providers.

## MEDSEA\_CH5\_Product\_8

- 1) Overall product quality score with respect to scope (fitness for purpose): **sufficient** (4).  
The ESIF system was worked out at an experimental level using only a few trawlers in the framework of the EC Tender ESIF carried out in the northern Adriatic Sea and finished in 2009 as testing phase. After the end of the project CNR-ISMAR has continued to test the ESIF system increasing the number of fishing vessels equipped with it. Nevertheless, the available data set is still too limited, both as number of vessels and in time/space, to achieve the scope of the Medsea Tender. Indeed, the ESIF system was included in the Medsea project as term of comparison to evaluate accuracy and performance of VMS and AIS systems to monitor the trawl disturbance on the sea floor.  
Moreover, taking into account the high precision of the system, it could represent a valuable *ad hoc* continuous monitoring system to estimate the spatial and temporal distribution of the interaction between fishing activities and the marine environment.
- 2) The Characteristic is important to obtain the product because it is the only one available.
- 3) The quality elements of the characteristic that affect the Targeted Product quality are:
  - **Spatial extent:** the product covers only a limited portion of the northern and central Adriatic Sea.
  - **Spatial resolution:** given the high time rate of the acquired data they allow to get very detailed maps of the trawling impact on the sea floor.
  - **Spatial Accuracy:** ESIF system data have high accuracy being acquired through GPS system.
  - **Time extent:** the product is time limited because the ESIF system was implemented only recently and within an experimental study.
  - **Time resolution:** as required by the Medsea Tender the targeted product is based on monthly grid maps that may be suitable to describe the temporal extent of fisheries impact on the sea floor.
  - **Time Accuracy:** the targeted product is based on data recorded at time intervals less than 1 min, hence the level of accuracy can be considered high.
  - **Usability:** the product is easy to be understood and used.
  - **Completeness:** due to the availability of data only for a few vessels and for limited time periods the degree of absence of data in the data set is high.
  - **Logical Consistency:** the targeted product agrees with the format required.
  - **Thematic Accuracy:** being the product based on raw data the accuracy of the product is uniform in the whole gridded layers produced and checkable in terms of the applied filters.
- 4) The limitations of the targeted product due to the data sets used are:
  - the time and vessel coverage do not currently assure a high level of completeness of the produced maps.
  - The data are of CNR property, hence not freely available, but this does not affect the data quality.
- 5) The greatest limitation of the characteristic and respective data set is that they fail to meet the scope of the Targeted Product due to the incomplete spatial and temporal coverage.

- 6) The most important gap for this targeted product regards the temporal and geographical coverage related to the recent installation of the system, at an experimental level, only on few vessels operating in a limited area (northern and central Adriatic Sea).

### **Expert evaluation of gaps**

The main gaps of the present Challenge derive from different issues. In the case of MEDSEA\_CH5\_Products\_1-3 the poor availability of data and the lack of standardization in the data collection process are the two main shortcomings. In the case of MEDSEA\_CH5\_Products\_4-8 the accessibility of data and the lack in spatial and temporal coverage are the main gaps. Moreover, it is worthy to note that data monitoring systems available at present and used for MEDSEA\_CH5\_Products\_4-8 are opportunity systems as they were initially developed for other purposes than monitoring the trawling pressure on the seafloor.

## CHALLENGE 6

### MEDSEA\_CH6\_Product\_1

- 1) Overall product quality score with respect to scope quality: **very good** (2). The synopticity of satellite-based data allows for a complete retrieval of chlorophyll concentration seasonal maps. Moreover, the ESA-CCI L4 product is very suitable for mapping chlorophyll pattern both offshore and along the coast without any voids. However, we here assumed that chlorophyll concentration is a proxy of phytoplankton biomass. This strong assumption may lead to some under/overestimation of phytoplankton concentration.
- 2) For this product, the most important characteristic is the chlorophyll-a concentration.
- 3) Usability of satellite-based chlorophyll concentration can be an issue for users who are not familiar with satellite data analysis. The targeted product is indeed produced after some scripting that i) reads the satellite data and ii) perform climatological averages.
- 4) The Copernicus Marine Environment Monitoring Service is the most important dataset we could find and fully satisfied the necessary requirements to build this targeted product.
- 5) Overall, due to the synopticity of satellite-based data the Copernicus Marine Environment Monitoring Service provided the best characteristics to build our targeted product.

### MEDSEA\_CH6\_Product\_2

- 1) Overall product quality score with respect to scope quality: **very good** (2).  
The synopticity of satellite-based data allows for a complete retrieval of chlorophyll concentration seasonal maps. Moreover, the ESA-CCI L4 product is very suitable for mapping chlorophyll pattern both offshore and along the coast without any voids. However, we here assumed that chlorophyll concentration is a proxy of phytoplankton biomass. This strong assumption may lead to some under/overestimation of undesirable modifications of phytoplankton concentration (i.e., eutrophication).
- 2) For this product, the most important characteristic is the chlorophyll-a concentration.
- 3) Usability of satellite-based chlorophyll concentration can be an issue for users who are not familiar with satellite data analysis. The targeted product is indeed produced after some scripting that i) reads the satellite data; ii) de-seasonalizes the chlorophyll time series by means of the X-11 technique (see Description of methodology to produce the Targeted Products); iii) applies the non-parametrical Mann-Kendall test and the and the Sens's method (see Description of methodology to produce the Targeted Products).
- 4) The Copernicus Marine Environment Monitoring Service is the most important dataset we could find and fully satisfied the necessary requirements to build this targeted product.
- 5) Overall, due to the synopticity of satellite-based data the Copernicus Marine Environment Monitoring Service provided the best characteristics to build our targeted product.

### MEDSEA\_CH6\_Product\_3

- 1) The overall product quality score with respect to scope is **sufficient** (4).  
Public databases provided historical data of Mediterranean Sea surface properties allowing estimates of the trophic index TRIX for the only second half of the last decade (assuming the decade range to be between 2003 and 2012) and therefore TRIX calculations were extended back in time covering the earlier decade between 1993 and 2002 for comparison.  
TRIX was used to provide an insight of the eutrophication level of Mediterranean Sea, following *Fiori et al (2016)*. However, some of variables required for the original TRIX not

available in the datasets, were replaced by available and closely related variables. Thus, nitrogen contained in nitrate was used instead of using dissolved inorganic nitrogen. Phosphorous in phosphates was used instead of using the total phosphorous.

Replacement of variables in the equation may have produced lowering TRIX values within the expected range scale between 0 and 10. The significance of such difference between the present results and the expected results using original variables criteria should be minor as the final TRIX scale is similar to that provided by Fiori et al (2016) and *Giovanardi and Vollenweider (2004)*. Nevertheless, comparisons of present TRIX magnitudes against magnitudes of TRIX estimates calculated following the original nutrient variables criteria should be taken cautiously. Missing historical data for the six variables required for calculating TRIX: chlorophylls, DIN, total phosphorous, dissolved oxygen, water temperature and salinity (the last three variables required to calculate dissolved oxygen concentration saturation), covering all the targeted years and covering all the Mediterranean Sea areas was expected. The most complete variable covering all the Mediterranean Sea for the longest period was the satellite sea surface chlorophyll. Satellite sea surface temperature data were also available at similar periods as for chlorophylls, though there were not used in the present work.

At present, time evolution of yearly TRIX estimates can be provided for fixed monitoring stations, such as the Station OOCs (<http://www2.ceab.csic.es/oceans/>) and other similar stations, collecting time series data for the variables required to calculate TRIX.

- 2) All the above-mentioned characteristics are required to calculate TRIX. Therefore, they all are important. As explained above, eutrophication levels in a water body are dependent on a number of variables (i.e. not a single variable) included in the TRIX equation.
- 3) Satisfactory time and space coverage of the water characteristics is the most important quality element affecting the targeted products. For assessing time variability of the eutrophic conditions of the marine ecosystem using TRIX, representative data for all the yearly seasons and for a number of consecutive years covering the whole study area is required (and it is non-existent from public datasets).
- 4) Scarceness in space and time of available data in public databases is the most important limitation on the quality of TRIX estimates. The present TRIX estimates may benefit from additional data existing from different sources (research institutions, observing systems, etc.) not available to the public or subject to negotiation. Future TRIX construction may also consider using validated numerical modelling products covering the whole Mediterranean area for a number of consecutive years.
- 5) Dissolved oxygen, water salinity and nutrients (dissolved inorganic nitrogen (DIN) and total phosphorous) were the relatively scarcer variables (characteristics) in time and space. Available dissolved oxygen (DO) data are generally obtained with sensor attached to moored and profiler CTDs. Comparison of DO values from CTD with values obtained by chemical methods (e.g. Winkler method) at the St. OOCs (<http://www2.ceab.csic.es/oceans/>) suggests a trend of CTD sensors to underestimate DO values. This may alter the TRIX estimates. Regarding nutrients at sea, DIN and total phosphorous values are overall scarcer in the data sets than nitrate+nitrite and phosphate values with lower magnitudes (i.e. concentrations). In the present study, the use of nitrate+nitrite instead of DIN and the use of phosphate instead of total phosphorous may also be impacting TRIX estimates. Finally, increasing availability in time and space of surface salinity with the use of recently launched SMOS and AQUARIUS satellites, though providing very low resolution values for the Mediterranean Sea, are expected to improve future TRIX calculations.

#### MEDSEA\_CH6\_Product\_4

- 1) The overall product quality score with respect to scope is **sufficient** (4). Even though data for the period between 2003 and 2007 were very scarce, preventing the construction of the TRIX



MAP, the data available from the previous decade (1993-2002) made trends (differing) estimates possible. TRIx trends were calculated as the difference between the index at the period 2008-2012 and the index calculated for the periods 1993-1997 and 1998-2002.

- 2) All the above-mentioned characteristics are required to calculate TRIx trends. Therefore, they all are important. As explained above, eutrophication levels in a water body are dependent on a number of variables (i.e. not a single variable) included in the TRIx equation.
- 3) Satisfactory time and space coverage of the water variables (characteristics), are the most important quality elements affecting the targeted products. Representative data for all the yearly seasons for a number of years covering the whole study area are required to provide more accurate trends.
- 4) Scarceness in space and time of available data in public databases is the most important limitation on the quality of TRIx trends. The present TRIx trends may benefit from additional data existing from different sources (research institutions, observing systems, etc.) not available to the public or subject to negotiation.
- 5) Dissolved oxygen, water salinity and nutrients (dissolved inorganic nitrogen (DIN) and total phosphorous) were the relatively scarcer variables (characteristics) in time and space. Available dissolved oxygen (DO) data are generally obtained with sensor attached to moored and profiler CTDs. Comparison of DO values from CTD with values obtained by chemical methods (e.g. Winkler method) at the St. OOCs (<http://www2.ceab.csic.es/oceans/>) suggests a trend of CTD sensors to underestimate DO values. This may alter the TRIx estimates. Regarding nutrients at sea, DIN and total phosphorous values are overall scarcer in the data sets than nitrate+nitrite and phosphate values with lower magnitudes (i.e. concentrations). In the present study, the use of nitrate+nitrite instead of DIN and the use of phosphate instead of total phosphorous may also be impacting TRIx estimates. Finally, increasing availability in time and space of surface salinity with the use of recently launched SMOS and AQUARIUS satellites, though providing very low resolution values for the Mediterranean Sea, are expected to improve future TRIx calculations.

### Expert evaluation of gaps

Targeted Products MEDSEA\_CH6\_product\_1 and \_2 are based on the assumption that assumed chlorophyll concentration is a proxy of phytoplankton biomass. This strong assumption may lead to some under/overestimation eutrophication, in particular in coastal environments.

Targeted Products MEDSEA\_CH6\_product\_3 and \_4 are based on a relatively high number of characteristics (six characteristics in total), most of them with limited geographical and temporal coverage in public databases. This prevents the eutrophication evolution to be assessed with a temporal resolution higher than 5-year periods and even prevents assessing periods with very scarce representation (as happened with the period between 2003 and 2007). Limited data also prevents improving the current space resolution. Consequently, time and space limited data availability may lead to under/overestimation of eutrophication in open sea and coastal environments.



## CHALLENGE 7

### MEDSEA\_CH7\_Product\_1

- 1) The overall product quality score with respect to fitness for purpose: **very good** (2). The updated model component (MEDSEA\_CH\_7\_Product\_1\_2) incorporates quite complete river discharge time series of 138 rivers from E-hype model data set for the period 1980-2009, in which however, North African rivers are not included. On the other hand, the component MEDSEA\_CH\_7\_Product\_1\_1 includes annual discharge measurements from in situ data from 55 rivers that contain mainly SESAME time-series for the period 1960-2000, whereas CISL and RIVDIS usually include previous years but end earlier than 2000.
- 2) For this product, the most important characteristic is the River Discharge.
- 3) **Usability is the major issue** for this Targeted Product. Regarding model time series, the SMHI-Hypeweb-Europe was not a user friendly and intuitive web interface (see point 4 of MEDSEA\_CH\_7\_Product\_6). In addition, there was a **spatial accuracy issue** regarding the CISL Research Data Archive, since the co-ordinations of the stations were given in 1 or 2 decimal places.
- 4) Regarding in situ data, the Global Runoff Data Centre (GRDC) was expected to be one of the most important input data bases related to river discharge. However, there was a lack in raw data. Only aggregated min, max and average values were provided. Therefore, data from this source was not incorporated in the final targeted products. However, the mean annual discharge values might be included in an updated version of the product.  
The CISL Research Data Archive and Global River Discharge (Rivdis) databases, contained largely the same measurement values for the same periods. This might be a case of duplication, however in some very few occasions data values were different for the same period, as well as both datasets provided some additional measurements before or after their common period.
- 5) Overall, GRDC was the data source that failed the most to meet the scope of the discharge targeted products.

### MEDSEA\_CH7\_Product\_2

See MEDSEA\_CH7\_product\_1 for the assessment of the “fitness for purpose and use”. For this product, no data from Global Runoff Data Centre (GRDC) were used since monthly data are not available from this dataset.

### MEDSEA\_CH7\_Product\_3

- 1) The overall quality score for this product, with respect to fitness for purpose: **very good** (2). The synopticity of satellite-based data allows for a complete (daily and monthly) retrieval of TSM concentration at the mouth of the 13 rivers we considered. However, the CoastColour TSM satellite product is strictly related to the MERIS instrument (8 years in space) and thus time series are restricted for this period only.
- 2) For this product, the most important characteristic is the TSM concentration.
- 3) **Usability** of the TSM concentration can be an issue for users who are not familiar with satellite data analysis. The targeted product is indeed produced after some **data pre-processing** that i) reads the main characteristic above a given geographic box, ii) averages it over the box and iii) write a monthly and annual mean time series. Moreover, **spatial resolution** of this product is relatively small (i.e., 6 km for L3 products) with respect to the need of simulating a fix station at the river mouth. This may lead to underestimation of TSM concentration.

- 4) The CoastColour Project is the most important dataset we could find and fully satisfied the necessary requirements to build this targeted product. The spatial resolution of this product can be increased by developing an ad hoc algorithm for TSM concentration retrieval starting either from the CoastColour L1 reflectance (300 m) or L1 products from other sensors.
- 5) Overall, due to the synopticity of satellite-based data the CoastColour Project provided the best characteristics to build our targeted product.

#### MEDSEA\_CH7\_Product\_4

See MEDSEA\_CH7\_product\_3 for the assessment of the “fitness for purpose and use”.

#### MEDSEA\_CH7\_Product\_5

- 1) The first component of the product (MEDSEA\_CH\_7\_Product\_5\_1) includes 44 rivers. The score for this component is **5 (inadequate)**, since there were several availability, accessibility and usability issues (see points 3, 4, and 5) regarding the EUROWATERNET and SESAME databases of in situ nutrient parameters. However, SESAME includes nitrate data for the period 1960-2000. The second component of the product (MEDSEA\_CH\_7\_Product\_5\_2) incorporates quite complete TN time series of 138 rivers from E-hype model data set, in which however North African rivers are not included. Within the updated version of the product we used the discharge file connected to TN (where discharge and TN were modelled for the same catchment area) for the years 1980-2012. Therefore, **it scores 2 (very good)** with respect to the fitness for purpose.
- 2) For this product, the most important characteristic is the Total Nitrogen parameter for the model component, whereas for the in situ component is either Total Nitrogen or Nitrates parameter.
- 3) **Availability** and **usability** of Total Nitrogen and nitrates data sources are the elements that affect the most the quality of this product.
- 4) As far as the in situ nitrogen product components are concerned, among the investigated data sources, EUROWATERNER and SESAME seemed to be the most comprehensive ones, since there were cases of well-known useful data bases i.e., MedHycos, that are no longer operating. In the case of EUROWATERNET, most of the stations were off shore therefore not applicable for river inputs. In addition, it was not possible to relate the station’s spatial information with the time series of nutrient data provided by the same database. Regarding SESAME, it was not possible to locate the nutrient data, since it is still of restricted use, as it was confirmed by the scientific coordinator of the project. So, despite the fact that we could actually obtain the SESAME data set through PERSEUS project, we were not allowed to use it.
- 5) Both EUROWATERNET and SESAME data bases failed to meet the scope of this targeted product. In the first case, no targeted product was produced from a EUROWATERNET data set. SESAME was used as a data source for the production of the in situ nutrient product components, even though SESAME data is officially not available.

#### MEDSEA\_CH7\_Product\_6

- 1) The overall product quality score with respect to fitness for purpose is **very good (2)**, since the total nitrogen time series from E-hype model data set do not include the North African rivers.
- 2) For this product, the most important characteristic is the Total Nitrogen parameter.
- 3) **Usability** and **spatial resolution** were the most important quality elements that affected this product.

- 4) Regarding model time series, the SMHI-Hypeweb-Europe was not a user friendly and intuitive web interface. Even if a visualized version of several parameters was provided in order to download the data, the user had to visit several different pages in order to locate the relating download link. In addition, there was not a multi basin selection option. Finally, the spatial resolution of the model could be characterized as poor, resulting in river basin limits rather coarsely defined and in many cases not even forming a usual or expected river basin's shape.
- 5) The SMHI-Hypeweb-Europe data source was used for the production of the model time series for the relevant components of all the targeted products. It did not fail to meet the scope of the targeted products, despite the encountered difficulties.

#### MEDSEA\_CH7\_Product\_7

- 1) As for MEDSEA\_CH7\_Product\_5, the model component MEDSEA\_CH7\_Product\_7\_2 could score **very good** (2), while the score for the in-situ component MEDSEA\_CH7\_Product\_7\_1 is **inadequate** (5).
- 2) For this product, the most important characteristic is the Total Phosphorous parameter for the model component, whereas for the in-situ component is either Total Phosphorous or Phosphates parameter.
- 3) **Availability** and **usability** of Total phosphorous and phosphates data sources are the elements that affect most the quality of this product.
- 4) See MEDSEA\_CH7\_Product\_5 evaluation.
- 5) See MEDSEA\_CH7\_Product\_5 evaluation.

#### MEDSEA\_CH7\_Product\_8

- 1) The quality score with respect to fitness for purpose is **very good** (2), for the same reasons of MEDSEA\_CH7\_product\_6.
- 2) The most important characteristic for this product is the Total Phosphorous parameter.
- 3) See MEDSEA\_CH\_7\_Product\_6 evaluation.
- 4) See MEDSEA\_CH\_7\_Product\_6 evaluation.
- 5) See MEDSEA\_CH\_7\_Product\_6 evaluation.

#### MEDSEA\_CH7\_Product\_9

- 1) The quality score with respect to fitness for purpose would be **sufficient** (4), because there are many gaps in the time series.
- 2) The most important characteristic is Eels capture production.
- 3) **Completeness** is the element that affects most the quality of this product, since there is a great absence of data in the corresponding dataset. There is also a **thematic accuracy** issue, since each country has developed a different recording system for eels, let alone the fact that in some cases this has been active very recently. According to COUNCIL REGULATION (EC) No 1100/2007: “Establishing measures for the recovery of the stock of European eel”, there has been a unified effort for an official recording system of eels measurements. EU countries with eel habitats in their territory have drawn up and are currently implementing national eel management plans at river-basin level.
- 4) The majority of available data concerning eels are possibly related to lagoon catches since in the majority of the Mediterranean countries there is no professional fishing activity in rivers and if so, eels catches are not officially recorded. The origination of data is not clarified in the database, therefore there is no data reliability control.

- 5) There are some scatter data from small studies and reports related to eels production mostly at a national level. FAO data base was used for the production of eels time series. Although it didn't provide a complete dataset, it could be a starting point for the fitness of purpose of this Targeted Product.

### Expert evaluation of gaps

The gaps of the input data sets might be summarized considering: a) in-situ, and b) model data.

- a) In some cases, river-basin to river-basin comparisons may fail to retrieve results appropriate for our fitness of purpose since not all monitoring programs were designed to record river inputs to the sea. Therefore, even if a great amount of effort was dedicated during the data binding process to select the most representative stations from each different dataset, only considering the ones located within short distances from the estuaries or the river's mouth, this was not always the case. The decision to include long distance stations (within the 100 km threshold) was taken due to the limited data availability for some basins. Due to the heterogeneous nature of the data sources compiled, a data quality control procedure is strongly recommended before any further use of the data.

Regarding eels, according to EU legislation No 1100/2007, EU countries need to take measures that allow 40 % of adult eels to escape from inland waters to the sea, where they can spawn. In order to meet this 40% escapement target, EU countries with eel habitats in their territory have drawn up and are currently implementing national eel management plans at river-basin level. This could be an actual starting point for the recording and reporting of realistic eel's data.

- b) The spatial resolution of the SMHI-Hypeweb-Europe data source could be characterized as poor since river-basin boundaries were rather coarsely defined and in many cases not even forming a usual or expected river basin's shape. In addition, no river's or basin's name were provided, so there was a need to combine the downloaded data with other sources in order to retrieve each river's name. Therefore, some "NA" values in the river and country columns were given, due to the fact that each basin was recorded only with a basin identification code, while no other coding or spatial coordinates were included. In the cases where the basin's identification code was not included in the E-HYPE'S webpage provided GIS (shape) file, then that specific discharge basin's name and country fields were given an "NA" value.

At the same time, there wasn't a unique identification code for each basin regarding the different characteristics (e.g. discharge and nutrients). Specifically, there was a different code and a different discharge value in the discharge tab, compared to the corresponding discharge value given by the nutrient (TN, TP) pages, thus making the data comparison and unification an extremely difficult task.

## Conclusions

**A5.2** summarizes the quality scores assigned by the MedSea challenges experts to the Targeted Products developed within the project in order to evaluate the adequacy of the observational system at the Mediterranean Sea basin level. The color scale defined in **Table A5.1** helps to identify the challenges that encountered the major difficulties to fulfil the scope of the products due to the Upstream Data gaps, both in terms of availability and appropriateness.

Challenge 5 (fishery management) encountered the largest problems since the low data availability, together with Challenge 7 (river input) for which the availability of in situ observations is totally inadequate.

Challenge 4 reported a lack of information on the sediment mass balance and gaps on the sea level data which do not allow to compute long time series of information or need to carefully judge the obtained trends.

Challenge 2 faced the open issue of assessing MPA connectivity at the whole basin scale, which lack of input data like for example larval behavior and spawning time, but also it misses a consolidated methodology, like the biophysical modeling. The assessment of MPA network representativity is still an open issue.

TP	CH1	CH2	CH3	CH4	CH5	CH6	CH7
1	1	2	3	2	3	2	2
2	1	1	2	3	4	2	2
3	2	3		1	5	4	2
4		4		3	4	4	2
5		3		1	4		5   2
6		4		4	3		2
7				5	4		5   2
8				2	4		2
9				3			4
10				1			
11				3			
12				4			
13				1			

**Table A5.2** Summary of the quality scores associated to each Targeted Products according to the expert's evaluations and the evaluation scheme presented in Error! Reference source not found..