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 **Table 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

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

CHALLENGE 1

MEDSEA_CH1_Product_1

1. The product quality score is **excellent** (1). The developed wind/wave database and the associated statistical analysis meet the targets set by the project for a complete assessment of wind farm siting. A wide range of environmental parameters (beyond the classic wind/wave information) were considered, over an area that extends the borders of the predefined region under study. The data were analyzed using a variety of conventional and advanced statistical tools that provide critical information on the data and their impact on wind farm siting.
2. All of the input characteristics contribute to the product quality. However, the wind components (zonal and meridional) are critical for estimating 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 influence the analysis used to define 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 of the characteristics contribute to the analysis, but the 2-dimensional wave spectra fail the most to meet the scope of the product because the data are limited to specific preselected grid points. In particular, while the other atmospheric and wave parameter data are in one-dimensional time series, the wave spectra are in 2-dimensional matrices that could not be stored in full due to storage limitations. Therefore, only the wave spectra for specific pre-defined points were stored in the data base. Nevertheless, these points are indicative for the coastline of interest.
6. There are no serious gaps in the input data sets, but as mentioned above, the 2-dimensional wave spectra data are only available for fixed pre-selected points rather than the whole domain under study, which 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 complete and detailed because it combines statistical indexes and provides mean values and variability.
2. Wind (zonal and meridional components) is the most important characteristic because 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. There were no serious gaps 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 available in and constraints on the targeted area. It provides crucial information regarding the suitability of the targeted area for wind farm siting.
2. All of 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 greatest impact on the product quality.
4. As we have very accurate and complete information on the sea depth and distance from shore (with a spatial resolution less than 1 km), 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 of the characteristics contribute to the analysis and meet the scope of the product. The biological data (marine protected areas and sediments) have the greatest potential for time and space evolution and, as stated above, their databases need to be updated as often as possible.
6. Individual biological species distributions are available, but not readily useable in a database and their presence is taken into account in the marine protected areas maps. Other characteristics could be important, but information on them was not available, either due to their real-time or non-free nature, such as commercial shipping routes, or due to data policy reasons, particularly regarding military areas.

CHALLENGE 2

MEDSEA_CH2_Product_1

1. The product's quality score is **very good** (2). However, both the North African MPAs and the management measures for each MPA need to be updated and quality controlled. At the time of the analysis, specific information on the management plans was not available for some of the MPAs, especially those located in the south of the Mediterranean. There was 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 MPA network. Scientific output for MPAs in the southern part of the Mediterranean is often not communicated and hence is unavailable.
2. The product considers a unique characteristic. The most important details for this product include the name of the protected area, date (year) of designation, type of designation and legal status (e.g. under EU legislation, international convention, or national mechanism), location of the protected area (coordinates; GIS polygon), size of the designated area (marine component) (km^2), biodiversity protected features (type of marine features being protected, i.e. habitats, species, ecosystems) and management measures in place (IUCN categories, management plans).
3. The spatial extent, accuracy and relevance of the information on 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 missing information, which decreases the overall quality of the product. A small percentage of the MPAs do not have complete 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 databases (EEA; MedPan and the EU CoCoNet project). The list of MPAs for the northern Mediterranean is comprehensive and the spatial resolution is adequate.
5. The conservation features and management measures of European MPA databases need to be updated, and management plans are often missing. 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 difficult to obtain. Collecting information on the implementation of management plans is challenging, but could prove crucial for an in-depth evaluation of the Mediterranean MPA network. More detailed information on the protected features (habitats, species, and ecosystems) and management measures in place are required to improve the product's quality.

MEDSEA_CH2_Product_2

1. The overall score is **excellent** (1), given 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), and constitute a valuable habitat descriptor for biological and conservation studies. FRAs are an important layer of

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

information for the assessment of protection initiatives. Both components are detailed enough to allow a thorough evaluation of the effectiveness of FRAs, accounting for the different impacts of fishing gears on different biological zones and/or depths.

2. The two most important characteristics for this product are the biological zones and FRA distribution layers. The main information for FRAs is the date (year) of designation, types of prohibited gear, legal information, location of FRAs (coordinates; GIS polygon), type of closure (temporal and spatial) and duration of temporal closures.
3. Spatial resolution has the greatest effect on the quality of this product. The resolution is high for this data set (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 databases (EMODnet Bathymetry, EMODnet Seabed Habitats, Mediseh FRAs), thus at present, there are no limitations on its use. The FRA component of the product should be updated to reflect changes in fisheries policies.
5. Both upstream characteristics are essential for the designation and assessment of MPAs. Bathymetry is indicative of habitats and is 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. No specific gaps are identified.

MEDSEA_CH2_Product_3

1. The overall score is **good** (3). The two characteristics summarize all of the information on proposed MPAs to date, at the scale of the entire Mediterranean basin. The product is useful for assessing the adequacy and appropriateness of the proposed network of protected areas, especially in relation to environmental change.
2. The most important characteristic is the conservation areas for the Mediterranean proposed by Green Peace and captured by the CoCoNet project.
3. The product information is useful for assessing the level of protection for Mediterranean conservation features under different strategic goals and considering 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 the use 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 characteristic that “fails the most” to meet the scope of the Targeted Product is the MPAs proposed by Greenpeace, as scientific information on these layers is not available.
6. There is a need for a thorough review of all initiatives relating to the designation of MPAs, regardless of whether they are successful. More detailed information on the proposed management plans for the proposed locations is needed to achieve insight into the driving forces behind the proposed MPAs.

MEDSEA_CH2_Product_4

1. The product is considered **sufficient** (4) because it only provides a qualitative indication of the connectivity between the Mediterranean MPA networks. Seasonal climatological currents and temperature fields represent the averages for the 1987-2014 period, thus they can be considered as probable larvae tracks if considered as passive tracers. However, for some species, where larval dispersion is driven by small-scale, transient oceanographic features, this resolution is not adequate.
2. The most important characteristics are the currents and temperature in the surface layer. However, to estimate the connectivity at the basin scale, further **information on larval biology** is needed to parameterize the 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 insufficient to provide quantitative information on the connectivity. Further analysis using biophysical modelling for larval dispersal simulations and Copernicus input datasets is needed (see *Andrello et al. 2013, Rossi et al. 2014*, *Berline et al. 2014*[*]), but would require much greater effort than that allocated by the current 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 years or generations, and even projections for the future. Although the literature documents many limitations to this methodology, it is the only one that considers 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, biophysical models can only provide unbiased estimates of connectivity if sufficient **knowledge of larval biology** is available to parameterize the models, and if there is a sufficiently precise hydrodynamic model for the study region. In our case, we can say that the Copernicus MED-MFC model is adequate for this purpose. Nevertheless, even if all of 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 related to the qualitative assessment of connectivity rather than the input dataset used. Again, t**he 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. No input data set has been identified within the project at the present 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*

5. None of the characteristics and respective data sets fails to meet the scope of the Targeted Product (fitness for use). However, high-quality, high-frequency and long time series ocean current data are necessary to develop 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 behaviour, favourable larval conditions) is crucial.

MEDSEA_CH2_Product_5

1. Overall, the product's quality is considered to be **good** (3). The information available is insufficiently detailed to allow a full assessment of the adequacy of the MPA network in terms of marine biodiversity hotspots and priority species or habitats. Given that conservation of marine biodiversity is a primary goal of MPA networks, the product is considered to be incomplete. However, the information on some of the characteristics is adequate to assess the representativity and replication of the MPA network in the Mediterranean.
2. All characteristics are an important element of marine biodiversity and are crucial for MPA network assessment purposes. All characteristics related to this product provide good baseline information for conducting a representativity analysis in the Mediterranean Sea. However, there is room for improvement in each characteristic, with the level of improvement needed varying 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 extent is adequate, covering the entire Mediterranean. The bathymetry layer can be improved for coastal areas (resolution and accuracy), especially because most MPAs are coastal. The Mediterranean cetaceans layer affects the Targeted Product quality due to its low spatial resolution and accuracy.
4. The information used is accurate and based on reliable databases. However, the limited information on **marine biodiversity characteristics** lowers the usability of the data. More specific information on the abundance of priority species would lead to more accurate estimates of representativity. The input data for this product only indicate presence/absence, with a low spatial resolution.
5. The characteristic that "fails the most" to meet the scope of the Targeted Product is the Mediterranean cetacean distribution. There is a discrepancy between the distribution of Mediterranean cetaceans and the distribution of the MPA and FRA networks, the resolution of the first being very low. More detailed information on the abundance of 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. More information on this has recently become available, and these new data will be further elaborated and included in the database.

MEDSEA_CH2_Product_6

1. The overall product score is **sufficient** (4). The product aims to assess the capacity of the current biodiversity monitoring networks as they overlap with MPAs. The information is

limited to coastal areas, and it is difficult to obtain information on internal monitoring from MPA managers.

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, zooplankton water column habitats, phytoplankton water column habitats, zoobenthos seabed habitats, phytobenthos seabed habitats and non-indigenous species in coastal sites.
3. The quality element that affects the quality of this product the most is the data completeness, because information on the southern Mediterranean is missing. However, the information provided is very useful to evaluate the efficiency of biodiversity monitoring in MPAs. The biodiversity monitoring stations do not meet the quality principles for thematic accuracy and completeness because (i) the stations are restricted to monitoring networks in coastal areas and (ii) only metadata, not biodiversity data, are available.
4. The development of the product was based on accurate data collection and analysis from the IRIS-SES project, but the spatial extent and completeness of the data are inadequate.
5. The IRIS-SES database did not fail to meet the scope of this product, but the usability of the product would be greatly improved by the availability of data on the monitored parameters 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) The overall product quality score is **good (3)** for 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 model uncertainties. However, the results of the different scenarios were presented side-by-side to facilitate the 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 the coastal environment (e.g., beaches, protected sites) and human activities (e.g., tourist areas, MPAs, harbours). The availability of these characteristics and their integration within the OPL Bulletin structure were difficult tasks to address.
2) All characteristics needed to produce the OPL Bulletin are important:
    - specific input data on oil leaks (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 to implement the most realistic experimental set up or scenario;
    - hourly oceanographic forecasts for the Mediterranean Sea (currents and SST) were available through the CMEMS portal;
    - wave data from CYCOFOS were available;
    - ECMWF wind data were available, together with the higher-resolution SKYRON and POSEIDON systems.

Advances in operational oceanography and the establishment of CMEMS ensure full coverage of meteo-oceanographic data (wind, currents and waves) over the Mediterranean Sea, thus the availability of data is not a limitation for the OPL Bulletin. However, the importance of very high temporal and spatial resolutions for the accurate representation of oil transport is emphasized in the literature.

Additional data sets are required to evaluate the impacts of oil spills on human activities, the environment and 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 the EMODnet and MEDESS4MS portals, but were not integrated in the first OPL Bulletin.

3) The **meteo-oceanographic forecasts and analyses** available through the CMEMS portal provide full coverage of the Mediterranean Sea. However, the product quality would be improved by increasing the **spatial and temporal resolution** together with a longer temporal horizon (**time extent**). The 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 such as MEDESS4MS. Readiness and responsiveness are crucial because the 24-hr response time requires input datasets to be inserted automatically into the oil spill models.

   The availability (readiness and responsiveness) and **completeness** are the quality elements that most affect the assessment of the impact on human activities, the environment and

coastal habitats, in particular: coastal geomorphology, seabed substrate, mariculture, MPAs, 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. Satellite observations of the leak are crucial both to validate the oil spill model results and to update the prediction results after the initial alert.
5) None of the considered input characteristics fails to meet the scope of the targeted product.
6) MEDSEA_CH3_Product_1 is missing the coastal impact component, because most of the necessary input data sets were not available or were incomplete (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 the use of the highest-resolution data (the MEDESS4MS Decision Support System uses them all, but does not disseminate them) to increase the accuracy of the oil spill prediction, especially in coastal areas.

MEDSEA_CH3_Product_2

1) The overall quality score is **very good (2)** for 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 scenario characteristics. The bulletin also provided information about the possible impact of the incident on the coastal environment and human activities.
2) All characteristics needed to produce the OPL Bulletin are important.
3) The high-resolution **meteo-oceanographic forecasts and analyses** available through the CMEMS portal and other national and experimental forecasting systems provide full coverage of the Mediterranean Sea. However, the OPL Bulletin quality would be improved by increasing the **spatial and temporal resolution** of the data analyses. The **completeness** is the quality element that most affects the characteristics needed to assess the impact on the coastal environment.
4) CMEMS is the only service that provides historical oceanographic data to produce the oil spill simulations for the specific exercise requested by the customer, a hindcast of a past event. However, the input data time resolution is daily instead of hourly, which impacts on the oil spill transport, as shown in the literature. Hourly data are maintained in the CMEMS catalogue for the past 30 days in a rolling archive. Thus, the quality of the simulation is limited by the lack of time resolution in the CMEMS historical data, but we could not validate the results with observations or quantify the prediction accuracy.
5) Ocean analyses that provide currents and temperature are the characteristics that fail the most to meet the scope of the Targeted Product. Data from CMEMS are only available at an hourly resolution for the past 30 days; otherwise, they are available as daily averages, thus reduces the product accuracy.
6) MEDSEA_CH3_Product_2 was produced using CMEMS daily analyses as the oceanographic input data (currents), limiting the accuracy of the oil slick trajectory simulation. These are the only data in existence; in fact, the CMEMS hourly analyses are archived only for the

past 30 days and 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 assessment 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 that provides SST observations for the Global Ocean over a very long period (1870-ongoing). A limitation is that the data have a low spatial resolution of 1 degree (~100 km).
2) The most important characteristic is TEMP (P02), and TEMPAV01 (P01) in particular because it refers to the sea surface temperature of the water body obtained by the advanced very high resolution radiometer (AVHRR).
3) The quality element that most affects the product quality is the low spatial resolution (1 degree).
4) The limitations on the quality of the product due to the input dataset used (fitness for use) are that the product is not suitable to represent the SST close to the coast, and the computation of trends only considers a few points due to the low resolution of the dataset.
5) The HadISST dataset is the only one that provides SST for a very long period (1870-ongoing).
6) The most important gap is 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 the temperature of the Mediterranean Sea for mid and bottom water and with a high spatial resolution (1/16 degrees, ~6.25 km). A limitation is the low temporal coverage of 27 years (1987-2013).
2) The most important Characteristic is TEMP (P02), and TEMPPR01 (P01) in particular because it refers to the temperature of the water body.
3) The quality element that most affects the product quality is the short temporal coverage (1987-2013).
4) The product is not suitable to represent mid and bottom temperatures for the last 50 (1963-2012) and 100 years (1913-2012).
5) The CMEMS Mediterranean Physics Reanalysis dataset is the only one to provide mid and bottom temperatures for the Mediterranean Sea with a high spatial resolution (~6.25 km).
6) The most important gap is 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 the temperature of the whole water column for the Mediterranean Sea and with a high spatial resolution (1/16 degrees, ~6.25 km). This allowed the internal energy t be computed for the last 20 years (1993-2012).
2) The most important Characteristic is TEMP (P02), and TEMPPR01 (P01) in particular because it refers to the temperature of the water body.
3) The product quality is very high due to the availability of the CMEMS ocean reanalysis dataset. The dataset has been extensively 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,

the reanalysis system only assimilates observations in the first 1000 m of the water column, so the accuracy decreases below this depth.

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

MEDSEA_CH4_Product_4

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

the sea-level trends obtained from the reconstruction are also affected by this lack of information.

MEDSEA_CH4_Product_5

1) The overall product quality score is **excellent** (1). The global MSL was calculated by combining the time series from all three TOPEX/Poseidon, Jason-1 and Jason-2 missions since the first TOPEX/Poseidon mission (1992). As Jason-2 is still in flight, the computation of 10-year sea-level trends from satellite altimetry is relevant to 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 also very important. In fact, the altimeter datasets are checked and evaluated before dissemination thanks to Cal/Val activities, thus they are considered reliable for 10-year sea-level monitoring.
3) The quality elements that affect the Targeted Product quality are the spatial resolution, time resolution and completeness.
4) The limitations on the quality of the Targeted product due to the input dataset used (fitness for use) are:
    - different results regarding the 10/50/100-year sea-level trends;
    - data gaps in the resulting maps and datasets; and
    - large errors in the estimates 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 provides along-track data while Copernicus provides gridded products). The differences between these datasets give access to different space/time resolution information, and the 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-year 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 datasets 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 with the number of available time series in the PSMSL data bank. A historical bank of data 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 database.
2) There is only one characteristic (ASLVMNMO).
3) The quality elements (Annex 1) 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, which is why this period was not considered here. In fact, this period is too short to obtain useful values for two 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); and

- 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±5.6 mm/y and 7.3±8.6 mm/y, respectively (error corresponding to 95% confidence).

4) The limitations on the quality of the Targeted Product due to the input dataset 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 dataset (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; and c) the frequently missing monthly means, and therefore years, even in relatively long time series.

MEDSEA_CH4_Product_7

1) In contrast to the sea-level and sea-surface temperature datasets, there is a lack of valid data on the sediment mass balance and coastal erosion accretion at a basin level. The EUROSION dataset provides a qualitative estimate of the sediment mass balance, coded as stable, eroded or accreted, but does not specify the time extent, methods and approaches used. Other available data from the EMODnet Portal, OneGeology Portal and 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. Therefore, the overall product quality score is **inadequate (5)**, despite the challenge having explored the existence of alternative data sources and datasets, as described in the report entitled "D5.3.5.1 Sediment Mass Balance Data Assessment in the Mediterranean".
2) There are no usable characteristics for generating this product.
3) To justify why we did not construct the requested product, we pursued two approaches: (1) a specific survey of the national agencies dealing with coastal protection, and (2) a scientific literature survey. In both cases, the quality of the exploitable characteristics in the resulting datasets is doubtful.
4) The main limitations of the resulting products relate to the type and nature of the available data. First, the specific surveys (i.e., surveys originating from national agencies or the scientific literature) identified a plethora of data sources that would be appropriate for the Tender request. However, in most cases the data were neither visible nor easily available. Locating and accessing them to determine their usefulness and value for the purposes of the Tender or potential use by non-expert users would require additional analyses and supplementary effort. The data from specific surveys indicate that the resolution for the spatial layers of sediment mass balance is only adequate for 10% of Mediterranean NUTS3 regions. Only four regions have adequate temporal resolution. We discarded local studies that could provide time series at a specific location, but not at the scale requested by the tender. Second, our scientific literature survey showed that despite the existence of numerous studies in the Mediterranean, they are usually local and with an incoherent frequency. Furthermore, the studies use very different methods, making it very difficult to use and compare the resulting data. There is some additional concern over whether the locations surveyed are sufficiently representative for use as NUTS3 regional indicators.

5) Regarding the limitations of this product, both the scientific literature survey and the specific surveys showed persistent differences in the amount and quality of data 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 collects SST observations for the Global Ocean and is the only dataset that covers a very long period (1870-ongoing). A limitation concerns the data's low spatial resolution of 1 degree (~100 km).
2) The most important characteristic is TEMP (P02), and TEMPAV01 (P01) in particular because it refers to the sea surface temperature of the water body obtained by the AVHRR.
3) The quality element that affects the product quality is the low **spatial resolution** (1 degree)
4) The limitation on the quality of the product due to the input dataset used (fitness for use) is that the product is not suitable to represent the sea-surface temperature close to the coast because of the low resolution of the dataset.
5) The HadISST dataset is the only one to provide SSTs over a very long period (1870-ongoing).
6) The gap is 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 one that provides mid and bottom water temperatures for the Mediterranean Sea with a high spatial resolution (1/16 degrees, ~6.25 km). A limitation concerns the low temporal coverage of 27 years (1987-2013).
2) The most important Characteristic is TEMP (P02), and TEMPPR01 (P01) in particular because it refers 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 the mid and bottom temperature for the last 50 (1963-2012) and 100 years (1913-2012).
5) The CMEMS Mediterranean Physics Reanalysis dataset is the only one to provide mid and bottom water temperatures for the Mediterranean Sea with a high spatial resolution (~6.25km).
6) The main gap is 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 the temperature of the Mediterranean Sea for the entire water column and with a high spatial resolution (1/16 degrees, ~6.25 km). This allowed us to compute the internal energy for the last 20 years (1993-2012).
2) The most important Characteristic is TEMP (P02), and TEMPPR01 (P01) in particular because it refers to the temperature of the water body.
3) The product quality is very high due to the availability of the CMEMS ocean reanalysis dataset. The dataset was extensively 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, as the reanalysis system only assimilates observations for the first 1000 m, the data accuracy is reduced below this depth.

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

MEDSEA_CH4_Product_11

1) The overall product quality score is **good (3)**. Sea-level reconstructions allowed us to merge the spatial and temporal information provided by remote sensing and in-situ observations. In the Mediterranean Sea, the lack of in-situ observations in the Southern part of the basin affects all scientific studies that aim to describe the sea-level variability and trends in the basin. As a consequence, the sea-level trends obtained from the reconstruction may also be affected by this lack of information.
2) Both of the characteristics involved in the realization of this product are equally important because of their different spatial and temporal coverage. The in-situ sea-level observations provide seminal information about the sea level in the Mediterranean, and cover a period of approximately 100 years. The satellite altimetry data span 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; and
    - **Completeness,** because in-situ data time series are often affected by significant gaps, and consequently 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 dataset used (fitness for use) are:
    - **Spatial extent**, because sea-level in-situ observations are spatially discontinuous by definition. The lack of in-situ data in the Southern part of the basin can lead to underestimation of the sea-level temporal amplitudes used in the reconstruction.
    - **Temporal extent**, because sea-level remote-sensing data are only available for the last 20 years, which is a relatively short period compared with the time window covered by the reconstruction. This period also represents the training period in which the EOFs are computed to determine the sea-level spatial variability in the reconstruction. Consequently, the temporal extent of the remote-sensing data can affect the assumption that EOFs are stationary in time.
5) The characteristic and respective dataset that most fails to meet the scope of the Targeted Product (fitness for use) is the PSMSL dataset, which contains the in-situ sea-level records.
6) Sea-level reconstructions allowed us to merge the spatial and temporal information provided by remote sensing and in-situ observations. In the Mediterranean Sea, **the lack of in-situ observations in the Southern part of the basin affects all scientific studies that aim to describe the sea-level variability and trends in the basin**. As a consequence, the sea-level trends obtained from the reconstruction are also 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 with the number of available time series in the PSMSL data bank. A historical bank of data 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 database.
2) There is only one characteristic (ASLVMNMO).
3) The quality elements (Annex 1) 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 and 100 years. The time series often start too late or end too early to estimate sea-level trends over 10 years, which is why it was not considered here. In fact, this period is too short to obtain useful values for two 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); and
    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±5.6 mm/y and 7.3±8.6 mm/y, respectively (error corresponding to 95% confidence).
4) The limitations on the quality of the Targeted Product due to the input dataset 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 dataset (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; and c) 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 first TOPEX/Poseidon mission (1992). As Jason-2 is still in flight, the computation of 10-year sea-level trends from satellite altimetry is relevant to 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 also very important. In fact, the altimeter datasets are checked before dissemination thanks to Cal/Val activities, thus they are considered reliable for 10-year sea-level monitoring.
3) The quality elements that affect the Targeted Product quality are the spatial resolution, time resolution and completeness.
4) The limitations on the quality of the Targeted Product due to the input dataset used (fitness for use) are:
    - different results regarding the 10/50/100-year sea-level trends;
    - data gaps in the resulting maps and datasets; and
    - large errors in the estimates 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 provides along-track data while Copernicus provides gridded products). The differences between these datasets give access to different space/time resolution information, and the 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-year 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 datasets 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) The overall product quality score for scope is **good** (3). The landing data have good coverage in terms of mass, but only the DCF data provide numbers (only EU MS).
2) All characteristics are important because they have different spatial and temporal coverage.
3) The following quality aspects have the greatest effect on the product quality:
    - **Spatial extent**: the product covers the entire Mediterranean basin only in terms of mass.
    - **Time extent**: the product is time limited due to the availability of the different data sets used: from 2002, landing data are available in number only from the DCF data set (EU MS); from 1970, landing data in mass are available from Fao Fishstat; and from 1950, mass data on tuna-like species are available from ICCAT.
    - **Usability***:* the product is easy to understand and use.
    - **Completeness**: because of the limited spatial and temporal data, the data sets contain quite high levels of missing data.
    - **Thematic accuracy**: the values reported in the targeted product are close to the true values at the highest level of correctness.
4) The limitations of the targeted product due to the data sets used are as follows:
    - data on the number of fish landed are not available for the whole region or over a long time; and
    - the data are not up-to-date because they are not usually available for 1-2 years, depending on the dataset.
5) The greatest limitation of the characteristics and their respective data sets is that they fail to meet the scope of the Targeted Product due to the incomplete spatial and temporal coverage, especially of in the number of fish landed.
6) The most important gaps in this targeted product are related to the characteristics that are required but not available (FAO-GFCM Task 1). There is a gap in geographical coverage because landing data in numbers are unavailable from non-EU countries. The gap in temporal coverage is due to the absence of data in numbers before 2002.

MEDSEA_CH5_Product_2

1) The overall product quality score with respect to scope (fitness for purpose) is **sufficient** (4). The discard data have good coverage in terms of mass and number only from the DCF (only EU MS).
2) All characteristics are important because they have different spatial and temporal coverage.
3) The following quality aspects have the greatest effect on the Targeted product quality:
    - **Spatial extent**: the product covers only the EU Mediterranean countries in terms of number and mass.
    - **Time extent**: the product is time limited because data are only available from the DCF data set (EU MS), which started in 2002.
    - **Usability**: the product is easy to understand and use.

- **Completeness**: due to the lack of spatial and temporal data, the data set contains quite high levels of missing data.
- **Thematic accuracy**: the values reported in the targeted product are close to the true values at the highest level of correctness.

4) The limitations of the targeted product due to the data sets used are:
   - data on the mass and number of discarded fish are not available for the whole region or for long time series; and
   - the data in the DCF data set are not up-to-date because they are usually only 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 in this targeted product are related to the characteristics that are required but not available (FAO-GFCM Task 1). The gap in geographical coverage is due to the absence of discard data in numbers and mass from 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) The overall product quality score with respect to scope (fitness for purpose) is **inadequate** (5).
   Despite the DCF requiring data on by-catches of vulnerable species, these data are available only from Cyprus.
2) The product comprises only two characteristics, the mass and number of species, both of which are highly relevant.
3) The following aspects of quality have the greatest effect on the Targeted product quality:
   - **Spatial extent**: the product covers only the Cyprus fleet.
   - **Time extent**: the product is time limited because the DCF data set only started in Cyprus in 2005.
   - **Usability**: the product is easy to understand and use.
   - **Completeness**: due to the limited spatial and temporal data, the data completeness is very low.
   - **Thematic accuracy**: the values reported in the targeted product are close to the true values at the highest level of correctness.
4) The limitations of the targeted product due to the data sets used are:
   - data on the mass and number of by-catches of vulnerable species are very limited in their spatial and temporal coverage; and
   - the DCF data are not up-to-date because they are usually only 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 Mediterranean Sea).

MEDSEA_CH5_Product_4

1) The overall product quality score with respect to scope (fitness for purpose) is **sufficient** (4). The VMS maps cover only EU MS fishing in the Mediterranean Sea. Moreover, data are not available for Italy, Croatia and Spain, and only partially available for the other EU countries, and the time series does not cover the same period in each country (Table 2).
2) All characteristics are important because they have different spatial and temporal coverage.
3) The following aspects of quality have the greatest effect on the Targeted product quality:
    - **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 provide this kind of data.
    - **Spatial resolution**: the targeted product is based on a 0.05°x0.05° grid that may by suitable to describe the impact of fisheries on the sea floor.
    - **Spatial accuracy:** VMS data have high accuracy as they are acquired through GPS.
    - **Time extent**: the product is time limited because the VMS system was only implemented in 2006 and was not implemented simultaneously by all 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 the impact of fisheries 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 is not uniform and quite low.
    - **Usability**: the product is easy to understand and use.
    - **Completeness**: due to the lack of spatial and temporal data, the level of missing data is high. Moreover, the trawling pressure could be underestimated because each country provided maps related to their own GSAs; consequently, the proportions of their fleets operating in remote GSAs were generally not mapped.
    - **Logical consistency**: the targeted product agrees with the format required.
    - **Thematic accuracy**: it is not possible to evaluate the accuracy of the maps provided by the different countries because of the lack of raw data from most of them, the lack of data on the proportion of fleets operating outside the GSAs of their own country, and the uncertain accuracy of the data processing conducted by each country.
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; and
    - the maps may not have the same level of accuracy because different countries record VMS data at different time intervals. This limitation is further enhanced by the differences in data processing between 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 in these targeted products are related to the limited geographical and temporal coverage, because the VMS system was implemented in the EU Mediterranean countries in different years.

Another important gap is related to the unavailability of a few required characteristics due to confidentiality concerns related to the European laws on privacy, which makes access to raw data extremely difficult in most cases.

VMS data processing and production of anonymous maps requires a level of technical capability that is not available in every country, and even in countries that do have such competence, it is still not easy to access the data because the competent authorities and/or scientific bodies responsible for data storage and processing often do not facilitate access (e.g., Italy).

MEDSEA_CH5_Product_5

1) The overall product quality score with respect to scope (fitness for purpose) is **sufficient** (4). The VMS maps cover only EU MS fishing in the Mediterranean Sea. Data are not available for Croatia and Spain and only partially available for the remaining EU countries. Moreover, the time series does not cover the same period in each country. Hence, the change in the level of disturbance to the seabed from trawling could only be calculated over a shorter period than that required by the Tender.
2) All characteristics are important because they have different spatial and temporal coverage.
3) This product is characterised by the same quality features as MEDSEA_CH5_product_4, from which it was derived, although it includes the Italian yearly data.
4) This product is characterised by the same quality limitations as MEDSEA_CH5_product_4, from which it was derived, although it includes the Italian yearly data.
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 in these targeted products relate to the incompleteness of the geographical and temporal coverage because the VMS system was implemented in EU Mediterranean countries in different years.

   Another important gap is related to a few characteristics that are 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.

   VMS data processing and production of anonymous maps requires technical capabilities that are not always developed in each country, and even in countries that have such competence, accessibility to data is still not easy because the competent authorities and/or scientific bodies responsible for data storage and processing often do not facilitate access (e.g., Italy).

MEDSEA_CH5_Product_6

1) The overall product quality score with respect to scope (fitness for purpose) is **good** (3).

   The AIS data have a higher spatial coverage than the VMS data mainly because non-EU vessels are also equipped with this system. Therefore, although data are unavailable for some fishing fleets because the requirement to adopt this system was gradually extended over the years, overall they provide more complete spatial coverage of the Mediterranean basin.
2) The characteristic is important to the product because it is the only one available.

3) The following aspects of quality have the greatest effect on the Targeted product quality:
    - **Spatial extent**: the product covers the northern Mediterranean basin well, but the rest of the basin is not completely covered because fleets in several African countries are not yet equipped with AIS.
    - **Spatial resolution**: the high frequency of the AIS data allows very detailed maps of the trawling impact on the sea floor.
    - **Spatial accuracy**: the AIS data are highly accurate as they are acquired through GPS. However, the lack of receiver coverage and the intentional switching 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 the 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 understand and use.
    - **Completeness**: due to the lack of data from some of the fishing fleets, the level of missing data is high, especially in 2012.
    - **Logical consistency**: the targeted product is consistent with the required format.
    - **Thematic accuracy**: as the product is based on raw data, its accuracy is uniform across all of the gridded layers and checkable in terms of the applied filters.
4) The limitations of the targeted product due to the data sets used are:
    - the gradual adoption of the AIS system means that the completeness of the maps produced in 2012 and 2013 cannot be assured; and
    - the lack of receiver coverage and intentional switching off of the system by the crew may compromise the spatial accuracy.

    Moreover, data processing is time consuming because no standardized and scientifically validated processing method is 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 in these targeted products is the limited temporal and geographical coverage, because the fishing fleets of most Mediterranean countries have only recently adopted the AIS system and it is still to be implemented by most North-African vessels. Limited geographical coverage is also related to the limited range of VHF signals and management of the system by the vessel crew. Another gap is due to the difficulty of obtaining data from the competent authorities, which means they have to be purchased from private providers.

MEDSEA_CH5_Product_7

1) The overall product quality score with respect to scope (fitness for purpose) is **sufficient** (4).

    As the AIS only became compulsory from 2012, the available temporal dataset only covers three years. Hence, the change in the level of trawling disturbance on the seabed could not be calculated over the period required by the Tender.

2) The characteristic is important to obtain the product because it is the only one available.
3) This product has the same quality features as MEDSEA_CH5_product_6, from which it was derived.
4) This product has the same quality limitations as MEDSEA_CH5_product_6, from which it was derived.
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 in this targeted product relates to the limited temporal and geographical coverage because the fishing fleets of most Mediterranean countries have only recently adopted the AIS system and it is still to be implemented by most North-African vessels. There is a gap in geographical coverage due to the limited range of VHF signals and management of the system by the vessel crew. Another gap is due to the difficulty of obtaining data from the competent authorities, which means they have to be purchased from private providers.

MEDSEA_CH5_Product_8

1) The overall product quality score with respect to scope (fitness for purpose) is **sufficient** (4).
   The ESIF system was implemented at an experimental level with only a few trawlers in the northern Adriatic Sea, under the framework of the EC Tender ESIF. The test phase finished in 2009. Since the end of the project, CNR-ISMAR has continued to test the ESIF system by increasing the number of fishing vessels equipped with it. Nevertheless, the available data set is still too limited, both in the 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 a comparison to evaluate the accuracy and performance of the VMS and AIS systems for monitoring the trawling 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 for estimating 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 following aspects of quality affect the Targeted Product quality:
   - **Spatial extent**: the product covers only a limited portion of the northern and central Adriatic Sea.
   - **Spatial resolution**: the high data acquisition rate allows very detailed maps of the trawling impact on the sea floor.
   - **Spatial accuracy**: ESIF system data are highly accurate as they are acquired through GPS.
   - **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 the impact of fisheries 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 understand and use.

- **Completeness**: as data are only available for a few vessels and for limited periods, the level of missing data is high.
- **Logical consistency**: the targeted product agrees with the format required.
- **Thematic accuracy**: as the product is based on raw data, the accuracy of the product is uniform across the gridded layers and is 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; and
    - the data are the property of CNR, and hence are 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 in this targeted product is the limited temporal and geographical coverage due to the recent installation of the system, at an experimental level, on only a few vessels operating in a limited area (northern and central Adriatic Sea).

Expert evaluation of gaps

The main gaps in Challenge 5 derive from different issues. In the case of MEDSEA_CH5_products_1-3, the two main shortcomings are the poor availability of data and the lack of standardization in the data collection process. In the case of MEDSEA_CH5_products_4-8, the main gaps are the accessibility of data and the limited spatial and temporal coverage. Moreover, the 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) The overall product quality score with respect to scope is **very good** (2). The synopticity of satellite-based data allows for the complete retrieval of chlorophyll concentration seasonal maps. Moreover, the ESA-CCI L4 product is very suitable for mapping chlorophyll patterns both offshore and along the coast without any voids. However, we used the chlorophyll concentration as a proxy of phytoplankton biomass. This strong assumption may have led to some under or overestimation of phytoplankton concentrations.
2) For this product, the most important characteristic is the chlorophyll-a concentration.
3) The usability of satellite-based chlorophyll concentrations may be an issue for users who are unfamiliar with satellite data analysis. The targeted product was produced after some scripting that i) read the satellite data and ii) calculated climatological averages.
4) The Copernicus Marine Environment Monitoring Service was the most important dataset that we could find and it 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) The overall product quality score with respect to scope is **very good** (2). The synopticity of satellite-based data allows for the complete retrieval of chlorophyll concentration seasonal maps. Moreover, the ESA-CCI L4 product is very suitable for mapping chlorophyll patterns both offshore and along the coast without any voids. However, we used the chlorophyll concentration as a proxy of phytoplankton biomass. This strong assumption may have led to some under or overestimation of undesirable modifications of phytoplankton concentrations (i.e., eutrophication).
2) The most important characteristic for this product is the chlorophyll-a concentration.
3) The usability of satellite-based chlorophyll concentration data could be an issue for users who are unfamiliar with satellite data analysis. The targeted product was produced after some scripting to i) read the satellite data; ii) de-seasonalized the chlorophyll time series by means of the X-11 technique (see Description of methodology to produce the Targeted Products); and iii) applied the non-parametric Mann-Kendall test and Sen's method (see Description of methodology to produce the Targeted Products).
4) The Copernicus Marine Environment Monitoring Service was the most important dataset we could find and it 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). Historical data on the Mediterranean Sea surface properties, obtained from public databases, only allowed us to estimate an average 5-year TRIX map for the second half of the last decade (assuming the decade range to be between 2003 and 2012) and two other averaged 5-year TRIX maps for the earlier decade between 1993 and 2002 for comparison. The TRIX was used to assess the

eutrophication level of the Mediterranean Sea, following *Fiori et al. (2016)*. However, as some of the variables required for the original TRIX were not available in the datasets, they were replaced by available and closely related variables. Thus, nitrogen contained in nitrate was used instead of DIN, and phosphorous in phosphates was used instead of TP. The replacement of variables in the equation may have produced lower TRIX values within the expected range scale between 0 and 10. However, the difference between the present results and the expected results using the original variables should be minor as the final TRIX scale is similar to that provided by Fiori et al. (2016) and *Giovanardi and Vollenweider (2004)*. Nevertheless, the present TRIX values and those calculated following the original nutrient variables should be compared with caution. Inevitably, there were some missing historical data for the six variables required for calculating TRIX, chlorophylls, DIN, TP, DO, water temperature and salinity (the last three variables are required to calculate the DO concentration saturation), covering all of the targeted years and covering all Mediterranean Sea areas. The satellite sea surface chlorophyll data were the most complete in terms of geographical and temporal coverage. Satellite sea surface temperature data were available for similar periods as for chlorophylls, although they were not used in the present work. At present, the time evolution of yearly TRIX estimates can be provided for fixed monitoring stations (i.e. not areas) such as the OOCS (http://www2.ceab.csic.es/oceans/), collecting time series data of closely related variables required to calculate TRIX.

2) All of the above-mentioned characteristics were required to calculate the TRIX and thus they are all important. As explained above, eutrophication levels in a water body are dependent on a number of variables that need to be included in the TRIX equation.
3) The satisfactory temporal and spatial coverage of the water characteristics is the most important quality element affecting the targeted products. Assessment of the time variability of the eutrophic conditions of the marine ecosystem using the TRIX requires representative data covering the whole study area, for every season and for a number of consecutive years, but such data are not available from public datasets.
4) The limited spatial and temporal extent of the data available from publicly available databases is the most important limitation on the quality of TRIX estimates. The present TRIX estimates could be improved by the use of additional data from different sources (research institutions, observation systems, etc.) that are not available to the public or are subject to negotiation. Future TRIX construction could also use validated numerical modelling products covering the whole Mediterranean area for a number of consecutive years.
5) DO, water salinity and nutrients (DIN and TP) were the variables with the greatest temporal and spatial limitations. DO data are generally obtained using sensors attached to moored and profiler CTDs. Comparison of DO values obtained from CTD and chemical methods (e.g. the Winkler method) at the OOCS station (http://www2.ceab.csic.es/oceans/) suggests that CTD sensors tend to underestimate DO values, which may have affected the TRIX estimates. Regarding nutrients at sea, DIN and TP values are generally scarcer in the datasets 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 TP may also have affected the TRIX estimates. Finally, the increased temporal and spatial coverage of surface salinity data from the recently launched SMOS and AQUARIUS satellites, despite providing very low resolution values for the Mediterranean Sea, should improve future TRIX calculations.

MEDSEA_CH6_Product_4

1) The overall product quality score with respect to scope is **sufficient (4)**. TRIX trends were calculated as the difference between the TRIX map for the 2008-2012 period and the TRIX map for the 1993-1997 and 1998-2002 periods. Data for 2003 - 2007 were very scarce, preventing the construction of the TRIX map to compare against the map for 2008-2012.
2) All of the above-mentioned characteristics were required to calculate TRIX trends; therefore, they are all 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) The satisfactory temporal and spatial coverage of the water variables (characteristics) are the most important quality elements affecting the targeted products. Representative data for each season for a number of years covering the whole study area are required to provide more accurate trends.
4) The limited temporal and spatial coverage of the data available from public databases is the most important limitation on the quality of TRIX trends. The present TRIX trends may benefit from the use of additional data from different sources (research institutions, observation systems, etc.) that are not available to the public or subject to negotiation.
5) DO, water salinity and nutrients (DIN and TP) are the variables (characteristics) with the most limited temporal and spatial coverage. DO data are generally obtained with sensors attached to moored and profiler CTDs. A comparison of DO values obtained by CTD with those obtained by chemical methods (e.g. Winkler method) at the OOCS station (http://www2.ceab.csic.es/oceans/) suggests that CTD sensors tend to underestimate DO values. This may have affected the TRIX estimates. Regarding nutrients at sea, DIN and TP values were generally scarcer in the datasets 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 TP may also have affected the TRIX estimates. Finally, the increased temporal and spatial coverage of surface salinity data from the recently launched SMOS and AQUARIUS satellites, despite providing very low resolution values for the Mediterranean Sea, should improve future TRIX calculations.

Expert evaluation of gaps

Targeted Products MEDSEA_CH6_product_1 and _2 are based on the assumption that the assumed chlorophyll concentration is a proxy of phytoplankton biomass. This strong assumption may lead to some under or overestimation of eutrophication, particularly 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 which were obtained from public databases with limited geographical and temporal coverage. This meant that it was not possible to assess the evolution of eutrophication with a temporal resolution higher than 5-year periods and even prevented the assessment of periods with very scarce representation (as was the case for the 2003 to 2007 period). The limited data also prevents any improvement in the current spatial resolution. Consequently, the limited data availability may lead to under or 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 is **very good** (2). The updated model component (MEDSEA_CH_7_Product_1_2) incorporates quite complete river discharge time series for 138 rivers from the E-hype model data set for the 1980-2009 period; however, North African rivers are not included. 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 1960-2000 period, whereas CISL and RIVDIS usually include previous years but end earlier than 2000.
2) The most important characteristic for this product is the River Discharge.
3) **Usability is the major issue** for this Targeted Product. The SMHI-Hypeweb-Europe is not a user-friendly and intuitive web interface for obtaining the model times series (see point 4 of MEDSEA_CH_7_Product_6). The **spatial accuracy** of the CISL Research Data Archive may also be an issue because the station co-ordinates were only given to one or two decimal places.
4) Regarding in situ data, the GRDC was expected to be one of the most important input data bases related to river discharge. However, there was a lack of raw data and only aggregated min, max and average values were provided. Therefore, data from this source were not incorporated in the final targeted products. However, the mean annual discharge values might be included in an updated version.

   The CISL Research Data Archive and RIVDIS databases contained largely the same measurement values for the same periods. This might indicate duplication; however, on a very few occasions the data values differed for the same period, and both datasets provided some additional measurements before or after the period in common.
5) Overall, the data source that most failed to meet the scope of the discharge targeted products was the GRDC.

MEDSEA_CH7_Product_2

See MEDSEA_CH7_product_1 for the assessment of the “fitness for purpose and use”. No data from the GRDC were used or this product because the dataset does not provide monthly data.

MEDSEA_CH7_Product_3

1) The overall quality score for this product, with respect to fitness for purpose, is **very good** (2). The synopticity of satellite-based data allowed the complete (daily and monthly) retrieval of TSM concentrations at the mouths 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 to this period only.
2) The most important characteristic for this product is the TSM concentration.
3) The **usability** of the TSM concentration can be an issue for users who are unfamiliar with satellite data analysis. Production of the targeted product required some **data pre-processing** to i) read the main characteristic above a given geographic box, ii) average it over the box and iii) write a monthly and annual mean time series. Moreover, the **spatial resolution** of this product is relatively low (i.e., 6 km for L3 products) for simulating a fixed station at a river mouth, which may lead to underestimation of TSM concentrations.

4) The CoastColour Project was the most important dataset we could find that fully satisfied the necessary requirements to build this targeted product. The spatial resolution of the product can be increased by developing an ad hoc algorithm for retrieving TSM concentrations starting from either the CoastColour L1 reflectance (300 m) or the 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)**, because there were several availability, accessibility and usability issues (see points 3, 4, and 5) regarding the in situ nutrient parameters from the EUROWATERNET and SESAME databases. However, SESAME includes nitrate data for the 1960-2000 period. The second component of the product (MEDSEA_CH_7_Product_5_2) incorporates a relatively complete TN time series of 138 rivers from the E-hype model data set, although North African rivers are not included. In 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 1980-2012. Therefore, **it scores 2 (very good)** with respect to fitness for purpose.
2) The most important characteristic for this product is the Total Nitrogen parameter for the model component, and either the Total Nitrogen or the Nitrates parameter for the in situ component.
3) The elements that most affect the quality of this product are the **availability** and **usability** of the Total Nitrogen and nitrate data sources.
4) EUROWATERNET and SESAME seemed to be the most comprehensive of the investigated data sources for the in situ nitrogen product components; some of the well-known useful databases such as MedHycos are no longer operating.
   In the case of EUROWATERNET, most of the stations were offshore and therefore not applicable for river inputs. In addition, it was not possible to relate a station's spatial information to the time series of nutrient data provided by the same database.
   Regarding SESAME, it was not possible to locate the nutrient data because, as was confirmed by the scientific coordinator of the project, use of the data is still restricted. Therefore, despite the fact that we could actually obtain the SESAME data set through the PERSEUS project, we were not allowed to use it.
5) Both the EUROWATERNET and SESAME databases failed to meet the scope of this targeted product. In the first case, no targeted product was produced from a EUROWATERNET dataset. SESAME was used as a data source for the production of the in situ nutrient product components, even though SESAME data is not officially available.

MEDSEA_CH7_Product_6

1) The overall product quality score with respect to fitness for purpose is **very good (2)** because the total nitrogen time series from the 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) The most important elements that affect the quality of this product are the **usability** and **spatial resolution**.
4) The SMHI-Hypeweb-Europe used for the model time series is not a user friendly and intuitive web interface. Even if visualized versions of several parameters were available for downloading the data, the user would have to visit several pages to locate the download link. Nor is there a multi-basin selection option. Finally, the spatial resolution of the model could be characterized as poor, resulting in rather coarsely defined river basin limits that in many cases do not even form a normal or expected river basin shape.
5) The SMHI-Hypeweb-Europe data source was used to produce the model time series for the relevant components of all of 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 score for the model component MEDSEA_CH7_Product_7_2 is **very good** (2), while the score for the in-situ component MEDSEA_CH7_Product_7_1 is **inadequate** (5).
2) The most important characteristic for this product is the Total Phosphorous parameter for the model component, whereas for the in-situ component it is either Total Phosphorous or the Phosphates parameter.
3) The elements that most affect the quality of this product are the **availability** and **usability** of the total phosphorous and phosphate data sources.
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 as for 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 is **sufficient (4)**, because there are many gaps in the time series.
2) The most important characteristic is the eel capture production.
3) The element that most affects the quality of this product is the **completeness** because there is a large amount of missing data in the corresponding dataset. **Thematic accuracy** is also an issue because each country has developed a different system for recording eels, and in some cases this has only very recently been implemented. 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 to develop an official system of recording eels measurements. EU countries with eel habitats in their territory have drawn up and are currently implementing national eel management plans at the river-basin level.

4) The majority of available data concerning eels are possibly related to lagoon catches because in the majority of Mediterranean countries there is no professional fishing activity in rivers and, if there is, eel catches are not officially recorded. The origin of the data is not clarified in the database, therefore there is no data reliability control.
5) There are some scattered data from small studies and reports related to eel production, mostly at a national level. The FAO database was used to produce the eel time series. Although it did not 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 in the input datasets can be summarized considering: a) in-situ data 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 because not all monitoring programs were designed to record river inputs to the sea. Therefore, despite the great effort dedicated to selecting the most representative stations from each dataset during the data binding process, only considering those located within short distances from the estuaries or the river mouth, this was not always possible. 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.
   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. 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 the river-basin level. This could be a starting point for the recording and reporting of realistic eel data.
b) The spatial resolution of the SMHI-Hypeweb-Europe data source could be characterized as poor because river-basin boundaries were rather coarsely defined and in many cases did not even form a normal or expected river basin shape. In addition, no river or basin names were provided, so the downloaded data had to be combined with other sources to retrieve each river's name. Therefore, some "NA" values were recorded in the river and country columns because each basin only had a basin identification code and no other coding or spatial coordinates were included. In cases were the basin's identification code was not included in the GIS (shape) file on the E-HYPE webpage, “NA” was entered for that specific discharge basin’s name and country fields.
   At the same time, there were no unique identification codes for the different characteristics (e.g. discharge and nutrients) of each basin. Specifically, there was a different code and a different discharge value in the discharge tub, 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

Table 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 Table A5.1.