Black Sea Checkpoint
Annex 5 to the Second DAR:
Expert evaluation of Targeted Products

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Author(s):	Violeta Slabakova	IO-BAS
	Vladyslav Lyubartsev	CMCC
	All the partners	

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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

BLACKSEA_CH01_Product_1

1. The product quality score is **excellent** (1). The wind/wave data base developed and the associated statistical analysis meet the targets set by the project towards a complete assessment analysis for windfarm siting. A wide number of environmental parameters (beyond the classical wind/wave information) have been covered over an area that extends the borders of the predefined region under study. These data have been analysed by a variety of conventional and advanced statistical tools providing critical information for the data and their impact to wind farm siting
2. All the Characteristics proposed are more than useful for the product quality. However, the wind components (Zonal and Meridional) keep the critical role for the estimation of the available wind power.
3. The spatial and temporal extent and resolution combined with the accuracy of the data are the most important quality elements that influence the analysis towards the definition of the optimal areas for wind farm development
4. The targeted products applicability is restricted, as planned, to the Black sea area and particularly over the sea borders between Bulgarian – Romanian, Turkish – Bulgarian, and Turkish - Georgian waters. Moreover, qualitatively speaking, the data and analysis provided, from a meteorological point of view, are limited by the resolution of the data which although high, still leaves sub-scale phenomena out of the range.
5. Although all the characteristics contribute in the general analysis, if one had to peak one that fails the most to meet the scope of the product, this could be the 2-dimensional wave spectra due to the limitation of the data to specific-preselected grid points.
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.

BLACKSEA_CH01_Product_2

1. The product's quality score is **excellent** (1). The statistical analysis of the wind/wave data base as well as the suitability index for wind farm development in the Black Sea based on the environmental resources is complete and detailed being a merger of statistical indexes providing information for mean values and variability with a very high spatially and temporally data set.
2. The 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 targeted products applicability is restricted, as planned, to the Black sea area and particularly over the sea borders between Bulgarian – Romanian, Turkish – Bulgarian, and Turkish - Georgian waters.
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.

BLACKSEA_CH01_Product_3

1. The product's quality score is **excellent** (1). It provides a complete assessment of the confidence limits of the data sets for the Black Sea regions under study supported by a detailed evaluation analysis of the data base which covers all the available resources in the data base.
2. The wind components (Zonal and Meridional) since they completely defined the available wind power potential.
3. The spatial and temporal resolution succeeded - 5 km and 1 hour respectively - which guarantee a detailed and accurate analysis of the suitability of an area for wind farm development.
4. The analysis obtained is based on a 10-year data base which is a statistically significant period posing, at the same time, some limitations in projecting the outcomes to a climatological level.
5. All of the characteristics contribute to the analysis and meet completely the scope of the product.
6. Other characteristics are important, but information on them was not available, due to data policy reasons, particularly regarding military areas. However, it is very unlikely that these data become ever available.

CHALLENGE 2

BLACKSEA_CH02_Product_1

1. The product's quality score is **VERY GOOD (2)**, the sub-components of the product covering most of the targeted aims of the overall product.
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. **Spatial extent**: the product covers the entire Black Sea basin, the sub-components focusing on specific areas and classification criteria (ecoregion, national, international, Natura 2000 protected sites). (2 x 2 km grid).
   Usability: the product is easy to understand and use.
   Logical consistency: the targeted product agrees with the format required.
   Thematic accuracy: the values reported in the targeted product are close to the true values at the highest level of correctness
4. There are no limitations on the use of this product. The information used is accurate and based on reliable databases (SINCRON, SIMSHAB, EU CoCoNet project). The list of MPAs for the Black Sea is comprehensive and the spatial resolution is adequate.
5. The conservation features and management measures of Black Sea MPA databases need to be updated, and management plans are often missing. The most detailed information for the Black Sea MPAs is available for SCIs (sites of Community Importance).
6. Gaps: The conservation features and management measures of Black Sea MPA databases need to be updated, and management plans are often missing. The most detailed

information for the Black Sea MPAs is available for Natura 2000 sites (Romania and Bulgaria).

BLACKSEA_CH02_Product_2

1. The product's quality score is **VERY GOOD (2)**, the sub-components of the product covering most of the targeted aims of the overall product.
2. The most important characteristics of this product are habitat type and distribution.
3. **Spatial extent**: the product covers Romanian and Bulgarian waters (EU waters, Habitats Directive), only the last sub-component covers the whole Black Sea (EU Sea Map) (2 x 2 km grid).
   Usability: the product is easy to understand and use.
   Logical consistency: the targeted product agrees with the format required.
   Thematic accuracy: the values reported in the targeted product are close to the true values at the highest level of correctness.
4. There are no limitations on the use of this product. The information used is accurate and based on reliable databases (SINCRON, SIMSHAB, EU CoCoNet project).
5. None of the characteristics and respective data sets fails to meet the scope of the Targeted Product (fitness for use). Seabed habitats are often indicative of marine communities and ecological processes.
6. No specific gaps are identified

BLACKSEA_CH02_Product_3

1. The product's quality score is **GOOD (3)**, the sub-components of the product covering only partly the targeted aims of the overall product.
2. The most important characteristics of this product are focused on biodiversity.
3. **Spatial extent**: the product covers Romanian and Bulgarian waters (EU waters,) (2 x 2 km grid).
   Usability: the product is easy to understand and use.
   Logical consistency: the targeted product agrees with the format required.
   Thematic accuracy: the values reported in the targeted product are close to the true values at the highest level of correctness
4. There are no limitations on the use of this product. The information used is accurate and based on reliable databases (SINCRON, SIMSHAB, EU CoCoNet project).
5. The characteristics that "fail the most" to meet the scope of the Targeted Product are the Black Sea cetacean, fish and birds distributions. There is a discrepancy between the limited data on the distribution of Black Sea biodiversity and and the distribution of the MPAs, the resolution of the first being very low. More detailed information on the abundance of cetaceans, fish and birds is required for the assessment of representativeness.
6. Gaps: data is available only for Romanian and Bulgarian waters, on a limited surface.

BLACKSEA_CH02_Product_4

1. The product's quality score is **EXCELLENT (1)**, the sub-components of the product covering only partly the targeted aims of the overall product.
2. The most important characteristic of this product are currents.
3. **Spatial extent**: the product covers the entire Black Sea (basin-scale coverage)
   Temporal extent: 2005-2015 (winter, spring, summer, autumn seasons)

Usability: the product is easy to understand and use.
Logical consistency: the targeted product agrees with the format required.
Thematic accuracy: the values reported in the targeted product are close to the true values at the highest level of correctness

4. There are no limitations on the use of this product. The information used is accurate and based on reliable databases.
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 Black Sea MPAs and their principal larval biological information (spawning time, larval lifetime, larval behaviour, favourable larval conditions) is crucial.
6. No specific gaps are identified.

BLACKSEA_CH02_Product_5

1. The product's quality score is **EXCELLENT (1)**, the sub-components of the product covering only partly the targeted aims of the overall product.
2. The most important characteristic of this product is sea surface temperature.
3. **Spatial extent**: the product covers the entire Black Sea (basin-scale coverage)
   Temporal extent: 2005-2015 (winter, spring, summer, autumn seasons)
   Usability: the product is easy to understand and use.
   Logical consistency: the targeted product agrees with the format required.
   Thematic accuracy: the values reported in the targeted product are close to the true values at the highest level of correctness
4. There are no limitations on the use of this product. The information used is accurate and based on reliable databases.
5. None of the characteristics and respective data sets fails to meet the scope of the Targeted Product (fitness for use).
6. No specific gaps are identified.

CHALLENGE 3

BLACKSEA_CH03_Product_1

1) The overall product quality score is **GOOD** (3) for estimating the consequences of an oil spill 24 hours after the incident declared on 10th May 2016 by DG MARE. In order to compute the oil spill forecast in area of the interest and over a given period of time the hydrodynamic model outputs, bathymetry and geomorphology data, and environmental status data must have a rather high level appropriateness indicators as follows: (1) horizontal coverage; (2) temporal coverage; (3) horizontal resolution; (4) temporal resolution, (5) thematic accuracy, and (6) temporal validity. All these relevant indicators show a proper level for the BLACKSEA_CH03_Product_1.

According to the CH03 challenge's aim, the first Oil Platform Leak Bulletin was released on time, within 24 h after the DG MARE request. The bulletin included:

- likely trajectory of the slick at the sea surface,
- distribution of the dispersed oil fraction,
- subsurface behavior of the blowout,

- conclusion that the oil did not reach the coastlines,
- oil mass balance graph showing the distribution of the oil in the environment as a function of time,
- local sea surface currents in the leak area,
- wind speed in the oil mass center.

2) The product is based on the relevant UDs as follows:

- Bathymetry and Elevation | Sea-floor depth (below mean sea level) {bathymetric depth} in the water body by derivation from GEBCO_08 30 arc-second global grid | British Oceanographic Data Centre | General Bathymetry Chart of the Oceans (GEBCO);
- -Horizontal velocity of the water column (currents) | Eastward current velocity in the water body | seamod | SEAMOD.RO - Forecasts for the Black Sea;
- Horizontal velocity of the water column (currents) | Northward current velocity in the water body | Wave height and period statistics | Direction of waves on the water body | Orion | WAM Cycle 4 wave model - Black Sea;
- Temperature of the water column | Temperature of the water body | Seamod | SEAMOD.RO - Forecasts for the Black Sea;
- Wind strength and direction | Eastward wind velocity in the atmosphere | Institute of Accelerating Systems and Applications (IASA-UAT) | SKIRON meteorological model - Black Sea;
- Wind strength and direction | Northward wind velocity in the atmosphere | Institute of Accelerating Systems and Applications (IASA-UAT) | SKIRON meteorological model - Black Sea;
- Wave height and period statistics | Significant height of waves {Hs} on the water body | Orion | WAM Cycle 4 wave model - Black Sea;
- Wave height and period statistics | Average zero crossing period of waves {Tz} on the water body | Orion | WAM Cycle 4 wave model - Black;
- Geological sample density | Oil API | Orion | oilbase.txt;
- Coastal geomorphology | Coast Type | European Marine Observation and Data Network (EMODNET) | EMODnet Seabed substrate;
- Bathymetry and Elevation | Sea-floor depth (below mean sea level) {bathymetric depth} | European Marine Observation and Data Network | EMODnet - Digital Terrain Model (DTM).
- 3) The crucial elements for the quality of the product are: horizontal resolution of sea currents, SST and waves (~3 km), and temporal resolution of 6 hours for currents and SST, 1 hour for wind fields, and 3 hours for waves.
- 4) The limitations of the product quality are not described by the appropriateness indicators, and are related to not using the UDs on a full basis, as was planned initially. More specifically, the oil spill forecast was calculated by only one Lagrangian model, MEDSLIK. While MEDSLIK-II supplementary calculation was not conducted due to some technical problems. Additionally, the product did not include the environmental consequence of the spill due to some urgency in first bulletin delivery.
- 5) The product is based on 6 PO2 (Bathymetry and Elevation, Geological sample density, Horizontal velocity of the water column (currents), Temperature of the water column, Wave height and period statistics, Wind strength and direction) which meet completely the scope of the Targeted product.

- 6) The most important gap is not using the UDs that was planned for MEDSLIK-II calculations as follows:
  - Horizontal velocity of the water column (currents) | Eastward current velocity in the water body | Black Sea Forecasting System - hourly forecast |;
  - Horizontal velocity of the water column (currents) | Northward current velocity in the water body | Black Sea Forecasting System - hourly forecast |;
  - Wind speed and direction | Eastward wind velocity in the atmosphere | Max Planck Institute for Meteorology (MPI-M) | ECMWF_12.5km_6h forecast |;
  - Wind speed and direction | Northward wind velocity in the atmosphere | Max Planck Institute for -Meteorology (MPI-M) | ECMWF_12.5km_6h forecast |;
  - Temperature of the water column | Temperature of the water body | Black Sea Forecasting System - hourly forecast. Thus, the product score is GOOD.

BLACKSEA_CH03_Product_2

1) The overall product quality score with respect to scope is **VERY GOOD** (2). Using two model predictions instead of one would have reduced the forecast uncertainties.

- According to the CH03 challenge's aim, the second Oil Platform Leak Bulletin was released on time, within 72 h after the DG MARE request. The bulletin included:
  - likely trajectory of the slick at the sea surface,
  - distribution of the dispersed oil fraction,
  - subsurface behavior of the blowout,
  - conclusion that the oil did not reach the coastlines,
  - oil mass balance graph showing the distribution of the oil in the environment as a function of time,
  - local sea surface currents in the leak area,
  - wind speed in the oil mass center,
  - level of potential impact of the oil slick on the environment and human activity based on bathymetry; coastal and seabed geomorphology; environmental resources and fish stock; shipping lanes; and the European protected areas.

2) The product is based on the relevant UDs as follows:

- Bathymetry and Elevation | Sea-floor depth (below mean sea level) {bathymetric depth} in the water body by derivation from GEBCO_08 30 arc-second global grid | British Oceanographic Data Centre | General Bathymetry Chart of the Oceans (GEBCO);
- Horizontal velocity of the water column (currents) | Eastward current velocity in the water body | seamod | SEAMOD.RO - Forecasts for the Black Sea;
- Horizontal velocity of the water column (currents) | Northward current velocity in the water body | seamod | SEAMOD.RO - Forecasts for the Black Sea;
- Temperature of the water column | Temperature of the water body | Seamod | SEAMOD.RO - Forecasts for the Black Sea;
- Wind strength and direction | Eastward wind velocity in the atmosphere | Institute of Accelerating Systems and Applications (IASA-UAT) | SKIRON meteorological model - Black Sea;
- Wind strength and direction | Northward wind velocity in the atmosphere | Institute of Accelerating Systems and Applications (IASA-UAT) | SKIRON meteorological model - Black Sea;

- Wave height and period statistics | Significant height of waves {Hs} on the water body | Orion | WAM Cycle 4 wave model - Black Sea;
- Wave height and period statistics | Direction of waves on the water body | Orion | WAM Cycle 4 wave model - Black Sea;
- Wave height and period statistics | Average zero crossing period of waves {Tz} on the water body | Orion | WAM Cycle 4 wave model - Black;
- Geological sample density | Oil API | Orion | oilbase.txt;
- Coastal geomorphology | Coast Type | European Marine Observation and Data Network (EMODNET) | EMODnet Seabed substrate;
- Bathymetry and Elevation | Sea-floor depth (below mean sea level) {bathymetric depth} | European Marine Observation and Data Network | EMODnet - Digital Terrain Model (DTM).
- Habitat extent | Marine Protected Areas | European Environment Agency (EEA) | Natura 2000 data - the European network of protected sites;
- Bathymetry and Elevation | Sea-floor depth (below mean sea level) {bathymetric depth} | European Marine Observation and Data Network | EMODnet - Digital Terrain Model (DTM);
- Terrestrial mapping | Coastline | European Environment Agency | EEA coastline for analysis .

3) The crucial elements for the quality of the product are the same: horizontal resolution of sea currents, SST and waves (~3 km), and temporal resolution of 6 hours for currents and SST, 1 hour for wind fields, and 3 hours for waves. Additionally, horizontal coverage of coastal geomorphology, terrestrial mapping, and Habitat extent are also very relevant.

4) The limitations of the product are related again to one model computing instead of two model computing.

5) The product is based on 9 PO2 (Bathymetry and Elevation, Coastal geomorphology, Geological sample density, Habitat extent, Horizontal velocity of the water column (currents), Temperature of the water column, Terrestrial mapping, Wave height and period statistics, Wind strength and direction) which meet completely the scope of the Targeted product.

- 6) The gap is not using the UDs that was planned for MEDSLIK-II calculations initially.Thus, the product score is VERY GOOD.

CHALLENGE 4

BLACKSEA_CH04_Product_1

1) The overall product quality score with respect to scope is **excellent** (1). In order to compute the trend over a given period the observations must be regular and uniform, thus the satellite observations present a proper solution. The input data CMEMS Black Sea - High Resolution L4 Sea Surface Temperature Reprocessed process the AVHRR satellite images in a regular manner during the 10-year period (2006-2015). The spatial and temporal coverage and resolution are good enough to compute the trends of SST for each grid point and to present consistent horizontal map.
2) The product is based on single characteristics PSST (P02), and TEMPAV01 (P01): it refers to the sea surface temperature of the water body obtained by the advanced very high resolution radiometer (AVHRR).

3) The crucial elements for the quality of the product are: horizontal coverage (Black Sea surface), horizontal resolution (~4 km), temporal extent (2006-2015), temporal resolution (daily), as well as the accuracy of the SST dataset used. These parameters give confidence to the computed temperature trends and the produced map of the change in the SST over the 10-year period.
4) The limitations of the product are related to errors due to the algorithm used to convert the brightness temperature obtained from the satellite image. This could affect the quality of the product in particular in the coastal areas.
5) The product is based on one characteristic (PSST) which meets completely the scope of the Targeted product
6) For this particular product there are no important gaps identified, except for the lack of consistent validation analysis comparing to In-situ data;

BLACKSEA_CH04_Product_2

1) The overall product quality score with respect to scope is **very good** (2). In order to compute the trend over a given period the observations must be regular and uniform over the entire water column. The input data CMEMS Black Sea Physics Reanalysis provides the temperature at mid-column in a regular manner during the 10-year period (2006-2015). The physical model assimilates water temperature from In-situ Argo autonomous profilers. The spatial and temporal coverage and resolution are good enough to compute the trends of the temperature for each grid point and to present consistent horizontal map. Mid-column depth is considered at 500 m depth.
2) The product is based on single characteristics TEMP (P02), and TEMPPR01 (P01): it refers to the temperature of the water body.
3) The crucial elements for the quality of the product are: spatial coverage (Black Sea basin), horizontal resolution (~3 km), vertical resolution (31 vertical levels), temporal extent (2006-2015), temporal resolution (daily), as well as the accuracy of the temperature 3D field used. These parameters give confidence to the computed temperature trends and the produced map of the change in the mid-column depth temperature over the 10-year period.
4) The limitations of the product are related to errors due to: (i) physical model used; (ii) discretisation and a parameterization of the physical processes on a grid; (iii) insufficient In-situ data for assimilation. This could affect the quality of the product in particular in the coastal and steep slope areas
5) The product is based on one characteristic (TEMP) which meets completely the scope of the Targeted product.
6) For this particular product there are no important gaps identified, except for the lack of consistent validation analysis comparing to independent In-situ data.

BLACKSEA_CH04_Product_3

1) The overall product quality score with respect to scope is **very good (2)**. In order to compute the trend over a given period the observations must be regular and uniform over the entire water column. The input data CMEMS Black Sea Physics Reanalysis provides the temperature at mid-column in a regular manner during the 10-year period (2006-2015). The physical model assimilates water temperature from In-situ Argo autonomous profilers. The spatial and temporal coverage and resolution are good enough to compute the trends

of the temperature for each grid point and to present consistent horizontal map. Bottom depth is considered at 1500 m depth.

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 crucial elements for the quality of the product are: spatial coverage (Black Sea basin), horizontal resolution (~3 km), vertical resolution (31 vertical levels), temporal extent (2006-2015), temporal resolution (daily), as well as the accuracy of the temperature 3D field used. These parameters give confidence to the computed temperature trends and the produced map of the change in the bottom temperature over the 10-year period.
4) The limitations of the product are related to errors due to: (i) physical model used; (ii) discretisation and a parameterization of the physical processes on a grid; (iii) insufficient In-situ data for assimilation. This could affect the quality of the product in particular in the steep slope areas.
5) The product is based on one characteristic (TEMP) which meets completely the scope of the Targeted product.
6) For this particular product there are no important gaps identified, except for the lack of consistent validation analysis comparing to independent In-situ data.

BLACKSEA_CH04_Product_4

1) The overall product quality score is **inadequate (5).** This product should be based on regular and uniform observations of the SST for the 50-year period 1966-2015. Sea Surface Temperature is measured in different locations in various campaigns (before and since satellite era), however they these measurements non-uniform in time and space and do not permit to create a consistent map of the SST trends over the Black Sea surface for 50-year period.

BLACKSEA_CH04_Product_5

1) The overall product quality score is **inadequate (5).** This product should be based on regular and uniform observations of the temperature at 500 m depth for the 50-year period 1966-2015. Water column temperature is measured in different locations in various campaigns, however these measurements are non-uniform in time and space and do not permit to create a consistent map of the mid-column depth temperature trends in the Black Sea basin for 50-year period.

BLACKSEA_CH04_Product_6

1) The overall product quality score is **inadequate (5)**. This product should be based on regular and uniform observations of the temperature at 500 m depth for the 50-year period 1966-2015. Water column temperature is measured in different locations in various campaigns, however these measurements are non-uniform in time and space and do not permit to create a consistent map of the mid-column depth temperature trends in the Black Sea basin for 50-year period.

BLACKSEA_CH04_Product_7

1) The overall product quality score is **inadequate (5).** This product should be based on regular and uniform observations of the SST for the 100-year period 1916-2015. Sea Surface Temperature is measured in different locations in various campaigns (before and since satellite era), however these measurements are non-uniform in time and space and

do not permit to create a consistent map of the SST trends over the Black Sea surface for 100-year period.

BLACKSEA_CH04_Product_8

1) The overall product quality score is **inadequate (5)**. This product should be based on regular and uniform observations of the temperature at 500 m depth for the 100-year period 1916-2015. Water column temperature in different locations is measured in various campaigns, however these measurements are non-uniform in time and space and do not permit to create a consistent map of the mid-column depth temperature trends in the Black Sea basin for 100-year period.

BLACKSEA_CH04_Product_9

1) The overall product quality score is **inadequate (5)**. This product should be based on regular and uniform observations of the temperature at 1500 m depth for the 100-year period 1916-2015. Water column temperature in different locations is measured in various campaigns, however these measurements are non-uniform in time and space and do not permit to create a consistent map of the bottom temperature trends in the Black Sea basin for 100-year period.

BLACKSEA_CH04_Product_10

1) The overall product quality score with respect to scope is **excellent** (1). In order to compute the average sea ice extent over a given period the observations must be regular and uniform, thus the satellite observations present a proper solution. It was a difficult task to find an input data for Black Sea latitude as most of the observations are focused in high latitudes. The input data Multisensor Analyzed Sea Ice Extent - Northern Hemisphere (MASIE-NH) combines images from several satellite missions in a regular manner during the 10-year period (2006-2015). The spatial and temporal coverage and resolution are good enough to calculate the average sea ice extent for each grid point and to present consistent horizontal map.
2) The product is based on single characteristics CRYS (P02), and SICECSAT (P01): it refers to the coverage (by area) of ice on the water body by image analysis.
3) The crucial elements for the quality of the product are: horizontal coverage (Black Sea surface), horizontal resolution (4 km), temporal extent (2006-2015), and temporal resolution (daily). These parameters give confidence to the produced map of the average sea ice extent over the 10-year period.
4) The limitations of the product are related to errors due to the algorithm used to process the different satellite images; (ii) the sea ice presence in the large river mouths. This could affect the quality of the product in particular in the coastal areas.
5) The product is based on one characteristic (CRYS) which meets completely the scope of the Targeted product.
6) For this particular product there are no important gaps identified, except for the lack of consistent validation analysis comparing to In-situ data.

BLACKSEA_CH04_Product_11

1) This product should be based on regular and uniform observations of the Black Sea ice coverage for the 50-year period 1966-2015. There are maps of the sea ice extent referring to this period published in the literature, however the observations are non-uniform in

time and space and do not permit to create a consistent map of the average sea ice extent on the Black Sea surface for 50-year period.

BLACKSEA_CH04_Product_12

1) The overall product quality score is inadequate (5). This product should be based on regular and uniform observations of the Black Sea ice coverage for the 100-year period 1916-2015. There are maps of the sea ice extent published in the literature referring to different periods, however the observations are non-uniform in time and space and do not permit to create a consistent map of the average sea ice extent on the Black Sea surface for 100-year period.

BLACKSEA_CH04_Product_13

1) The overall product quality score with respect to scope is **excellent (1)**. In order to compute the annual average Sea Surface Temperature the observations must be regular and uniform over the whole Black Sea surface, thus the satellite observations are chosen as a base. The input data *CMEMS Black Sea - High Resolution L4 Sea Surface Temperature Reprocessed* process the AVHRR satellite images in a regular manner during the 35-year period (1982-2016). During this period the spatial and temporal coverage and resolution are good enough to compute the annual average SST for each year. However, in the prior periods the measurements are non-uniform in time and space and do not permit to calculate it adequately enough.
2) The product is based on single characteristics PSST (P02), and TEMPAV01 (P01): it refers to the sea surface temperature of the water body obtained by the advanced very high resolution radiometer (AVHRR).
3) The crucial elements for the quality of the product are: horizontal coverage (Black Sea surface), horizontal resolution (~4 km), temporal extent (1982-2015), temporal resolution (daily), as well as the accuracy of the SST dataset used. These parameters give confidence to the computed annual average sea surface temperature.
4) The limitations of the product are related to errors due to the algorithm used to convert the brightness temperature obtained from the satellite image. Another limitation is related to the unavailability of data prior 1982.
5) The product is based on one characteristic (PSST) which meets completely the scope of the Targeted product.
6) The most important gap is the relatively short extent of the time series.

BLACKSEA_CH04_Product_14

1) The overall product quality score with respect to scope is **very good (2)**. In order to compute the annual average mid-water temperature the observations must be regular and uniform over the entire water column. The input data *CMEMS Black Sea Physics Reanalysis* provides the temperature at mid-water (taken as the 500 m depth) in a regular manner during the 24-year period (1992-2015). The physical model assimilates water temperature from In-situ Argo autonomous profilers. During this period the spatial and temporal coverage and resolution are good enough to compute the annual average temperature at 500 m depth for each year. However, in the prior periods the measurements are non-uniform in time and space and do not permit to calculate it adequately enough.
2) The product is based on single characteristics TEMP (P02), and TEMPPR01 (P01): it refers to the temperature of the water body.

3) The crucial elements for the quality of the product are: spatial coverage (Black Sea basin), horizontal resolution (~3 km), vertical resolution (31 vertical levels), temporal extent (1992-2015), temporal resolution (daily), as well as the accuracy of the temperature 3D field used. These parameters give confidence to the computed annual average mid-water temperature.
4) The limitations of the product are related to errors due to: (i) physical model used; (ii) discretisation and a parameterization of the physical processes on a grid; (iii) insufficient In-situ data for assimilation. Another limitation is related to the unavailability of data prior 1992.
5) The product is based on one characteristic (TEMP) which meets completely the scope of the Targeted product.
6) The most important gap is the relatively short extent of the time series.

BLACKSEA_CH04_Product_15

1) The overall product quality score with respect to scope is **very good (2)**. In order to compute the annual average bottom temperature the observations must be regular and uniform over the entire water column. The input data *CMEMS Black Sea Physics Reanalysis* provides the bottom temperature (taken as the 1500 m depth) in a regular manner during the 24-year period (1992-2015). The physical model assimilates water temperature from In-situ Argo autonomous profilers. During this period the spatial and temporal coverage and resolution are good enough to compute the annual average temperature at 500 m depth for each year. However, in the prior periods the measurements are non-uniform in time and space and do not permit to calculate it adequately enough.
2) The product is based on single characteristics TEMP (P02), and TEMPPR01 (P01): it refers to the temperature of the water body.
3) The crucial elements for the quality of the product are: spatial coverage (Black Sea basin), horizontal resolution (~3 km), vertical resolution (31 vertical levels), temporal extent (1992-2015), temporal resolution (daily), as well as the accuracy of the temperature 3D field used. These parameters give confidence to the computed annual average bottom temperature.
4) The limitations of the product are related to errors due to: (i) physical model used; (ii) discretisation and a parameterization of the physical processes on a grid; (iii) insufficient In-situ data for assimilation. Another limitation is related to the unavailability of data prior 1992.
5) The product is based on one characteristic (TEMP) which meets completely the scope of the Targeted product.
6) The most important gap is the relatively short extent of the time series.

BLACKSEA_CH04_Product_16

1) The overall product quality score with respect to scope is **very good (2)**. In order to compute the annual average internal energy the observations must be regular and uniform over the entire water column. The input data *CMEMS Black Sea Physics Reanalysis* provides the water column temperature in a regular manner during the 24-year period (1992-2015). The physical model assimilates water temperature from In-situ Argo autonomous profilers. During this period the spatial and temporal coverage and resolution are good enough to compute the annual average internal energy for each year. However, in the prior periods the measurements are non-uniform in time and space and do not permit to calculate it adequately.

2) The product is based on single characteristics TEMP (P02), and TEMPPR01 (P01): it refers to the temperature of the water body.
3) The crucial elements for the quality of the product are: spatial coverage (Black Sea basin), horizontal resolution (~3 km), vertical resolution (31 vertical levels), temporal extent (1992-2015), temporal resolution (daily), as well as the accuracy of the temperature 3D field used. These parameters give confidence to the computed annual average bottom temperature.
4) The limitations of the product are related to errors due to: (i) physical model used; (ii) discretisation and a parameterization of the physical processes on a grid; (iii) insufficient In-situ data for assimilation. Another limitation is related to the unavailability of data prior 1992.
5) The product is based on one characteristic (TEMP) which meets completely the scope of the Targeted product.
6) The most important gap is the relatively short extent of the time series.

BLACKSEA_CH04_Product_17

1) The overall product quality score with respect to scope is **sufficient (4)**. In order to compute the total sea ice cover over past 100 years the observations must be regular and uniform. The only data source found to meet the requirements is *Multisensor Analyzed Sea Ice Extent - Northern Hemisphere (MASIE-NH),* which combines images from several satellite missions in a regular manner during the period 2006-2017. The spatial and temporal coverage and resolution are good enough to calculate the total sea ice cover for each year.
2) The product is based on single characteristic CRYS (P02), and SICECSAT (P01): it refers to the coverage (by area) of ice on the water body by image analysis.
3) The crucial elements for the quality of the product are: horizontal coverage (Black Sea surface), horizontal resolution (4 km), temporal extent (2006-2017), and temporal resolution (daily). These parameters give confidence to the computed total sea ice cover.
4) The limitations of the product are related to errors due to the algorithm used to process the different satellite images; (ii) the sea ice presence in the large river mouths.
5) The product is based on one characteristic (CRYS) which meets completely the scope of the Targeted product.
6) The most important gap is the relatively short extent of the time series, covering 12% of the targeted 100-year period.

BLACKSEA_CH04_Product_18

1) The overall product quality score with respect to scope is **good (3)**. In order to estimate the abundance of three most abundant species of phytoplankton the observations must be regular and uniform in the whole Black Sea basin. The input databases of the Black Sea Commission and NATO ODMBS Black Sea Project compile measurements of the phytoplankton concentration during various campaigns in different locations and time periods. Nevertheless, they provide a good base to estimate the phytoplankton abundance in different years, chosen as follows: Emiliania huxleyi in May-June, Pseudosolenia calcar-avis in August-November and Ceratium tripos in April-August.
2) The most important characteristic is VATX (P02), and ABUN6730 (P01): it refers to the phytoplankton generic abundance in water bodies.

3) The crucial elements for the quality of the product are: horizontal coverage (Black Sea 0-200 m layer) and time span (1968-2016). These parameters give confidence to the estimated phytoplankton abundance.
4) The limitations of the product are related to the non-uniform measurements in time and space.
5) The product is based on one characteristic (VATX) which meets adequately the scope of the Targeted product.
6) Gaps in the product exist due to unavailability of data in certain periods.

CHALLENGE 5

BLACKSEA_CH05_Product_1

1) The purpose of this product is to show variations in the Black Sea level for the past 10 years as detected from altimetry. Overall, the product quality score is **excellent (1)**. The Sea Level trend for the last 10 year is calculated by using CMEMS L4 gridded maps of Sea Level Anomaly from all three TOPEX/Poseidon, Jason-1 and Jason-2 missions.
2) The sea level (ASLVMNDY) is the most important characteristic for the product quality.
3) The quality elements that affect the quality of this product are the spatial and time resolution and the completeness of the used dataset.
4) The limitations on the quality of Targeted products due to the input data set used are:
    - horizontal resolution
    - large errors in the estimates of sea-level trends

    Statistical errors are large relative to the trend itself; for instance, the mean 10 years trend is 0.002±0.013 mm/y (error corresponding to 97.5% confidence).
5) The characteristic ASLVMNDY used to generate this product does not fail to meet the scope of the Targeted Product. Altimeter datasets are checked before dissemination thanks to Cal/Val activities, thus they are considered reliable for 10-year sea-level monitoring. In this product altimeter datasets are used to compute 10-years sea-level trend for the Black Sea.
6) The most important gaps in the input dataset is the unavailability of altimeter data and the horizontal resolution.

BLACKSEA_CH05_Product_2

1) The purpose of this product is to show regional variations in the sea level for the past 10 years from satellite altimetry for a number of sub-regions of the Back Sea. Overall, the product quality score is **good (3)**. Eleven sub-regions are identified in order to cover a range of hydrodynamic conditions in the Black Sea: shallow shelf areas, dynamically inactive central deep-water areas, dynamically active (including meandering, jets and eddies formation processes) zone associated with the intensive circular current (Rim Current) and attached to the continental slope and persistent Batumi and Sevastopol anticyclonic gyres. Sea Level trends for the last 10 year for the 11 sub-regions are calculated by using CMEMS L4 gridded maps of Sea Level Anomaly from all three TOPEX/Poseidon, Jason-1 and Jason-2 missions.
2) The sea level (ASLVMNDY) is the most important characteristic for the product quality.

3) The quality elements that affect the quality of this product are the spatial and time resolution and the completeness of the used dataset.
4) The limitations on the quality of Targeted products due to the input data set used are:
    - horizontal resolution
    - large errors in the estimates of sea-level trends

   Statistical errors are very large relative to the trend itself; for example, the 10 years trend for sub-region 1 is 9.7±21.7 mm/y and the 10 years trend for sub-region 5 is 8.7±19.6 mm/y (error corresponding to 97.5% confidence).
5) The characteristic ASLVMNDY used to generate this product does not fail to meet the scope of the Targeted Product. Altimeter datasets are checked before dissemination thanks to Cal/Val activities, thus they are considered reliable for 10-year sea-level monitoring. In this product altimeter datasets are used to compute 10-years sea-level trend for the Black Sea.
6) The most important gaps in the input dataset is the unavailability of altimeter data and the horizontal resolution.

BLACKSEA_CH05_Product_3

1) The purpose of this product is to show regional variations in the sea level for the past 50 years from selected coastal stations for a number of coastal sub-regions of the Back Sea. Overall, the product quality score is **good (3)**. The number of useful sea-level time series is low and does not cover the entire Black Sea coast. Five coastal sub-regions have been identified by considering the geographical locations of available coastal stations and the physical characteristics of the Black Sea. Sea Level trends for the last 50 year for the 5 sub-regions are calculated by using yearly data from Batumi, Burgas, Coastanza, Poti, Sevastopol, Tuapse and Varna coastal stations from the http://www.psmsl.org/data/obtaining/ portal for the designed period.
2) The sea level (ASLVMNMO) is the most important characteristic for the product quality.
3) Quality elements that affect the quality of this product are:
    - **time extent**
    - **time completeness**
    - **geographical location of available coastal stations**
    - **sampling methods and accuracy of the measurements**

   Time series data are often affected by significant gaps. Moreover, local land motions affect the accuracy of local sea level observations. For these reasons, statistical errors are large relative to the trend itself; for instance, the 50 years trend for sub-region 3 (Sevastopol station) is -1.4±1.1 mm/y and the 50 years trend for sub-region 5 (Poti and Batumi stations) is 6.6±7.7 mm/y (error corresponding to 97.5% 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 and completeness and the geographical location of available coastal stations: time series are often affected by significant time gaps and/or do not include enough data for a reliable estimation of 50-year trends and available coastal stations do not cover the entire Black sea coastline.
5) The characteristic ASLVMNMO used to generate this product and the dataset used (PSMSL) fail to meet the scope of the Targeted Product.
6) Gaps are represented by

a) low number of available coastal stations in the Black Sea
b) relatively short time span of some of the available time series
c) frequently missing monthly means

BLACKSEA_CH05_Product_4

1) The purpose of this product is to show regional variations in the sea level for the past 100 years from selected coastal stations for a number of coastal sub-regions of the Back Sea. Overall, the product quality score is **good (3)**. The number of useful sea-level time series is low and does not cover all the Black Sea coast. Five coastal sub-regions have been identified by considering the geographical locations of available coastal stations and the physical characteristics of the Black Sea. Sea Level trends for the last 100 year for the 5 sub-regions are calculated by using yearly data from Batumi, Burgas, Coastanza, Poti, Sevastopol, Tuapse and Varna coastal stations from the http://www.psmsl.org/data/obtaining/ portal for the designed period.
2) The sea level (ASLVMNMO) is the most important characteristic for the product quality.
3) Quality elements that affect the quality of this product are:
    - **time extent**
    - **time completeness**
    - **geographical location of available coastal stations**
    - **sampling methods and accuracy of the measurements**

   Time series data are often affected by significant gaps. Moreover, local land motions affect the accuracy of local sea level observations. For these reasons, statistical errors are very large relative to the trend itself; for instance, the 100 years trend for sub-region 2 (Costanza station) is 1.3±2.1 mm/y and the 100 years trend for sub-region 3 (Sevastopol station) is 1.4±2.0 mm/y (error corresponding to 97.5% 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 and completeness and the geographical location of available coastal stations: time series are often affected by significant time gaps and/or do not include enough data for a reliable estimation of 100-year trends and available coastal stations do not cover the entire Black sea coastline.
5) The characteristic ASLVMNMO used to generate this product and the dataset used (PSMSL) sufficiently meet the scope of the Targeted Product.
6) Gaps are represented by
    a) low number of available coastal stations in the Black Sea
    b) relatively short time span of some of the available time series
    c) frequently missing monthly means

BLACKSEA_CH05_Product_5

1) The purpose of this product is to show variations in the sea level for the past 10 years from selected coastal stations for each NUTS3 of the Black Sea. Overall, the product quality score is **sufficient (4)**. The number of useful sea-level time series is low and does not cover all the Black Sea coast. Data are available for 4 NUTS3 zones in Turkey. Sea Level trends for the last 10 year for 4 NUTS3 zones in Turkey are calculated by using yearly data from Sile, Igneada, Sinop and Trabzon coastal stations from TUDES data set.
2) The sea level (ASLVMNMO) is the most important characteristic for the product quality.
3) Quality elements that affect the quality of this product are:

- **time extent**
- **time completeness**
- **geographical location of available coastal stations**
- **sampling methods and accuracy of the measurements**

Time series data are often affected by significant gaps. Moreover, local land motions affect the accuracy of local sea level observations. For these reasons, statistical errors are very large relative to the trend itself; for instance, the 10 years trend for TR100 zone (Sile station) is 0.06±0.26 mm/y and the 10 years trend for TR901 zone (Trabzon station) is 0.06±0.23 mm/y (error corresponding to 97.5% 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 and completeness and the geographical location of available coastal stations: time series are often affected by significant time gaps and/or do not include enough data for a reliable estimation of 10-year trends and available coastal stations do not cover the entire Black sea coastline.
5) The characteristic ASLVMNMO used to generate this product and the dataset used (PSMSL) fail to meet the scope of the Targeted Product.
6) Gaps are represented by
    a) low number of available coastal stations in the Black Sea
    b) relatively short time span of some of the available time series
    c) frequently missing monthly means

BLACKSEA_CH05_Product_6

1) The purpose of this product is to show variations in the sea level for the past 50 years from selected coastal stations for each NUTS3 of the Black Sea. Overall, the product quality score is **inadequate (5)**. The number of useful sea-level time series is extremely low and is not sufficient to cover all the Black Sea coast. Data are available only for 3 NUTS3 zones, which occupies less than 10% of the coastline. Sea Level trends for the last 50 year for those 3 NUTS3 zones are calculated by using yearly data from Costanza, Varna and Burgas coastal stations from PSMSL dataset.
2) The sea level (ASLVMNMO) is the most important characteristic for the product quality.
3) Quality elements that affect the quality of this product are:
    - **time extent**
    - **time completeness**
    - **geographical location of available coastal stations**
    - **sampling methods and accuracy of the measurements**

    Time series data are often affected by significant gaps. Moreover, local land motions affect the accuracy of local sea level observations. For these reasons, statistical errors are very large relative to the trend itself; for example, the 50 years trend for BG341 zone (Burgas station) is 0.2±2.6 mm/y (error corresponding to 97.5% 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 and completeness and the geographical location of available coastal stations: time series are often affected by significant time gaps and/or do not include enough data for a reliable estimation of 50-year trends and available coastal stations do not cover the entire Black sea coastline.
5) The characteristic ASLVMNMO used to generate this product and the dataset used (PSMSL) fail to meet the scope of the Targeted Product.

6) Gaps are represented by
    a) low number of available coastal stations in the Black Sea;
    b) relatively short time span of some of the available time series
    c) frequently missing monthly means.

BLACKSEA_CH05_Product_7

1) The purpose of this product is to show variations in the sea level for the past 100 years from selected coastal stations for each NUTS3 of the Black Sea. Overall, the product quality score is **inadequate (5)**. The number of useful sea-level time series is extremely low and is not sufficient to cover all the Black Sea coast. Data are available only for 3 NUTS3 zones, which occupies less than 10% of the coastline. Sea Level trends for the last 100 year for those 3 NUTS3 zones are calculated by using yearly data from Costanza, Varna and Burgas coastal stations from PSMSL dataset.
2) The sea level (ASLVMNMO) is the most important characteristic for the product quality.
3) Quality elements that affect the quality of this product are:
    - **time extent**
    - **time completeness**
    - **geographical location of available coastal stations**
    - **sampling methods and accuracy of the measurements**

    Time series data are often affected by significant gaps. Moreover, local land motions affect the accuracy of local sea level observations. For these reasons, statistical errors are very large relative to the trend itself; for example, the 100 years trend for RO223 zone (Costanza station) is 1.3±2.1 mm/y and the 100 years trend for BG341 zone (Burgas station) is 1.8±2.5 mm/y (error corresponding to 97.5% 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 and completeness and the geographical location of available coastal stations: time series are often affected by significant time gaps and/or do not include enough data for a reliable estimation of 50-year trends and available coastal stations do not cover the entire Black sea coastline.
5) The characteristic ASLVMNMO used to generate this product and the dataset used (PSMSL) fail to meet the scope of the Targeted Product.
6) Gaps are represented by
    a) low number of available coastal stations in the Black Sea
    b) relatively short time span of some of the available time series
    c) frequently missing monthly means

BLACKSEA_CH05_Product_8

1) The purpose of this product is to show variations in the sea level for the past 100 years from selected coastal stations for each NUTS3 of the Black Sea. Overall, the product quality score is **inadequate (5)**. The number of useful sea-level time series is extremely low and is not sufficient to cover all the Black Sea coast. Data are available only for 3 NUTS3 zones, which occupies less than 10% of the coastline. Sea Level trends for the last 100 year for those 3 NUTS3 zones are calculated by using yearly data from Costanza, Varna and Burgas coastal stations from PSMSL dataset.
2) The sea level (ASLVMNMO) is the most important characteristic for the product quality.
3) Quality elements that affect the quality of this product are:

- **time extent**
- **time completeness**
- **geographical location of available coastal stations**
- **sampling methods and accuracy of the measurements**

Time series data are often affected by significant gaps. Moreover, local land motions affect the accuracy of local sea level observations. For these reasons, statistical errors are very large relative to the trend itself; for example, the 100 years trend for RO223 zone (Costanza station) is 1.3±2.1 mm/y and the 100 years trend for BG341 zone (Burgas station) is 1.8±2.5 mm/y (error corresponding to 97.5% 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 and completeness and the geographical location of available coastal stations: time series are often affected by significant time gaps and/or do not include enough data for a reliable estimation of 50-year trends and available coastal stations do not cover the entire Black sea coastline.
5) The characteristic ASLVMNMO used to generate this product and the dataset used (PSMSL) fail to meet the scope of the Targeted Product.
6) Gaps are represented by
    i. low number of available coastal stations in the Black Sea
    ii. relatively short time span of some of the available time series
    iii. frequently missing monthly means

BLACKSEA_CH05_Product_9

1) The purpose of this product is to show variations in the sediment mass balance for the last 50 years. Overall, the product quality score is **inadequate (5)**. The number of available time series is extremely low (only two regions for the Georgian coast, Poti and Adjara) and hence it is not sufficient to cover all or even majority of the Black Sea coast. Additionally, the sampling frequency is 10 years.
2) The Seabed – Riverbed/Coastal geomorphology is the most important characteristic for the product quality.
3) Quality elements that affect the quality of this product are:
    - **time completeness**
    - **sampling frequency**
    - **number of available coastal stations**
    - **geographical location of available coastal stations**

    Time-series include decadal data (10 years mean values). This means that for Poti region we have 2 observations (4% of the total period, if we consider yearly data) and for Adjara region we have 6 observations (12% of the total period, if we consider yearly data) to compute the 50 years sediment mass balance trend. Our scientific opinion is that the trend of a dataset which includes a very small coverage of the total range of data (less than 10%) can not be considered useful for statistical analysis. Therefore, this product can not be done.
4) The limitations on the quality of the Targeted Product due to the input dataset used (fitness for use) are related to their sampling frequency and the geographical location and number of available coastal stations.

5) The characteristic Seabed – Riverbed/Coastal geomorphology used to generate this product and the dataset used (Tbilisi State University dataset) fail to meet the scope of the Targeted Product.
6) Gaps are represented by
    a) low number of available coastal stations in the Black Sea
    b) low sample frequency.

BLACKSEA_CH05_Product_10

1) The purpose of this product is to show variations in the sediment mass balance for the last 100 years. Overall, the product quality score is **inadequate (5)**. The number of available time series is extremely low (only two regions for the Georgian coast, Poti and Adjara) and it is not sufficient to cover all the Black Sea coast. Additionally, the sampling frequency is 10 years.
2) The Seabed – Riverbed/Coastal geomorphology is the most important characteristic for the product quality.
3) Quality elements that affect the quality of this product are:
    - **time extent**
    - **time completeness**
    - **sampling frequency**
    - **number of available coastal stations**
    - **geographical location of available coastal stations**

    Time-series include decadal data (10 years mean values). This means that for Poti region we have 2 observations (2% of the total period, if we consider yearly data) and for Adjara region we have 6 observations (6% of the total period, if we consider yearly data) to compute the 100 years sediment mass balance trend. Our scientific opinion is that the trend of a dataset which includes a very small coverage of the total range of data (less than 10%) can not be considered useful for statistical analysis. Therefore, this product can not be done.
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, completeness and sampling frequency and the geographical location and number of available coastal stations.
5) The characteristic Seabed – Riverbed/Coastal geomorphology used to generate this product and the dataset used (Tbilisi State University dataset) fail to meet the scope of the Targeted Product.
6) Gaps are represented by
    a) low number of available coastal stations in the Black Sea
    b) low sample frequency.
    c) relatively short time span of some of the available time series
    d) frequently missing observations

CHALLENGE 6

BLACKSEA_CH06_Product_1

1) The overall product quality score with respect to scope (fitness for purpose) is **exellent (1)**. Landings data cover the entire Black Sea (for mass).

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 covers the entire Black Sea basin only in terms of mass.
    - **Time extent**: the product covers the period starting with 2008 until 2015.
    - **Time resolution**: the targeted product is based on yearly reporting under the EU DCF (STECF) and GFCM.
    - **Usability**: the product is easy to understand and use.
    - **Completeness**: data are complete for mass.
    - **Logical consistency**: the targeted product agrees with the format required.
    - **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 product due to the data sets used are:
    - 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 product is based on one characteristic [Abundance of Fish (WoRMS 11676) per unit area of the bed by picking] which covers the scope of the Targeted product.
6) The most important gaps in these targeted products are related to incomplete spatial and temporal coverage, especially of in the number of fish landed.

BLACKSEA_CH06_Product_2

1) The overall product quality score with respect to scope (fitness for purpose) is **good (3)**. Discard data cover only Romanian waters, both for mass and number.
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 covers Romanian waters, both for mass and number.
    - **Time extent**: the product covers the period starting with 2010 until 2016.
    - **Time resolution**: the targeted product is based on yearly reporting under the EU DCF (STECF) and GFCM.
    - **Usability**: the product is easy to understand and use.
    - **Completeness**: data are complete for mass and number.
    - **Logical consistency**: the targeted product agrees with the format required.
    - **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 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 product is based on one characteristic [Abundance of Fish (WoRMS 11676) per unit area of the bed by picking]. The greatest limitation of the characteristic and the respective data sets is that they fail to meet the scope of the Targeted Product due to the incomplete spatial and temporal coverage, especially for discards (only Romania covered)

6) The most important gaps in these targeted products are related to incomplete spatial and temporal coverage.

BLACKSEA_CH06_Product_3

1) The overall product quality score with respect to scope (fitness for purpose) is **very good (2)**. By-catch data cover Romanian and Bulgarian waters, for mass.
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 covers Romanian and Bulgarian waters, for mass.
    - **Time extent**: the product covers the period starting with 2009 until 2016.
    - **Time resolution**: the targeted product is based on yearly reporting under the EU DCF (STECF) and GFCM.
    - **Usability**: the product is easy to understand and use.
    - **Completeness**: data are complete for mass.
    - **Logical consistency**: the targeted product agrees with the format required.
    - **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 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 data in the DCF data set are not up-to-date because they are usually only made available after 1 year.
5) The product is based on one characteristic [Abundance of Fish (WoRMS 11676) per unit area of the bed by picking]. The greatest limitation of the characteristic and the respective data sets is that they fail to meet the scope of the Targeted Product due to the incomplete spatial and temporal coverage, especially for by-catches (only Romania and Bulgaria covered
6) The most important gaps in these targeted products are related to incomplete spatial and temporal coverage

CHALLENGE 7

BLACKSEA_CH07_Product_1

1) The overall product quality score with respect to scope (fitness for purpose) is **good (3)**. The VMS maps cover only Romanian fishing zones in the Black Sea.
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 Black Sea for the following reasons: a) VMS is only adopted by EU countries; b) not all EU countries provide this kind of data (Romanian data available only).
    - **Spatial resolution**: the targeted product is based on a 2 x 2 km 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 is not implemented simultaneously by all Black Sea countries.
- **Time resolution**: the targeted product is based on yearly grid maps that may be suitable to describe the temporal extent of the impact of fisheries on the sea floor.
- **Usability**: the product is easy to understand and use.
- **Completeness**: due to the lack of spatial and temporal data from all around the Black Sea, the level of missing data is high.
- **Logical consistency**: the targeted product agrees with the format required.
- **Thematic accuracy**: uniform.

4) The limitations of the product due to the data sets used are:
   - the absence of maps covering the whole Black Sea region and of long time series.
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 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 Black Sea countries in different years.

BLACKSEA_CH07_Product_2

1) The overall product quality score with respect to scope (fitness for purpose) is **good (3).** The maps cover only Romanian and Turkish fishing zones in the Black Sea.
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 Black Sea, data was available only for Romania and Turkey (FP7 Benthis project).
   - **Spatial resolution**: the targeted product is based on a 2 x 2 km grid that may by suitable to describe the impact of fisheries on the sea floor.
   - **Spatial accuracy:** data are highly accurate as they are acquired through GPS.
   - **Time extent**: the product is time limited because data were available only for 2014 (Turkey) and 2016 (Romania).
   - **Time resolution**: the targeted product is based on yearly grid maps that may be suitable to describe the temporal extent of the impact of fisheries on the sea floor.
   - **Usability**: the product is easy to understand and use.
   - **Completeness**: due to the lack of spatial and temporal data from all around the Black Sea, the level of missing data is high.
   - **Logical consistency**: the targeted product agrees with the format required.
   - **Thematic accuracy**: uniform.
4) The limitations of the product due to the data sets used are:
   - the absence of maps covering the whole Black Sea region and of long time series.
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 the data sets.
6) The most important gaps in these targeted products are related to the limited geographical and temporal coverage.

CHALLENGE 08

BLACKSEA_CH08_Product_1

1) The overall product quality score with respect to scope (fitness for purpose) is **very good (2).** Chlorophyll concentration data cover the entire Black Sea. The synopticity of satellite-based data allows for the complete retrieval of chlorophyll concentration seasonal maps. The product is represented by 4 components including the winter, spring, summer, and autumn seasons.
2) The most important characteristic for this product is chlorophyll concentration.
3) The following aspects of quality have the greatest effect on the Targeted product quality:
    - Spatial extent: the product covers the entire Black Sea basin
    - Temporal extent: the product covers the period 2005-2014, 10 years.
    - Temporal resolution: 90-92 days, depending on the season
    - Horizontal resolution: 1000 m
    - Usability: the product is easy to understand and use.
    - Completeness: data are complete.
    - Logical consistency: the targeted product agrees with the format required.
    - Thematic accuracy: the values reported in the targeted product are close to the true values at the highest level of correctness.
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.
6) The product gap stems from temporal validity of 3 years, while it should be 1 year according to Data Product Specification. The reason for this gap is a time delay in publication of the data. This delay does not allow rating of “Excellence” for the target product.

BLACKSEA_CH08_Product_2

1) The overall product quality score with respect to scope (fitness for purpose) is **very good (2).** Mean chlorophyll trend data cover the entire Black Sea.
2) The most important characteristic for this product is chlorophyll concentration.
3) The following aspects of quality have the greatest effect on the Targeted product quality:
    - Spatial extent: the product covers the entire Black Sea basin
    - Temporal extent: the product covers the period 2005-2014, 10 years.
    - Temporal resolution: 28-30 days, depending on the month
    - Horizontal resolution: 1000 m
    - Usability: the product is easy to understand and use.
    - Completeness: data are complete.
    - Logical consistency: the targeted product agrees with the format required.
    - Thematic accuracy: the values reported in the targeted product are close to the true values at the highest level of correctness.

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.
6) The product gap stems from temporal validity of 3 years, while it should be 1 year according to Data Product Specification. The reason for this gap is a time delay in publication of the data. This delay does not allow rating of "Excellence" for the target product.

CHALLENGE 09

BLACKSEA_CH09_Product_1

1) The overall product quality score with respect to scope (fitness for purpose) is **excellent (1)**. The data covering all important river discharge in the Black Sea.
2) All characteristics are important because they have different spatial coverage.
3) The following aspects of quality have the greatest effect on the Targeted product quality:
    - **Spatial extent**: the product covers the important Black Sea river tributaries.
    - **Spatial resolution**: the targeted product is based on in-situ river discharge data collected in the same point more than a decade that is suitable to describe and to evaluate the River Inputs trend and the impact on the physical/chemical Black Sea waters properties.
    - **Spatial accuracy:** data are highly accurate as they are acquired through GPS.
    - **Time extent**: the product is time limited because data are available only for the time period 1921-1984.
    - **Time resolution**: the targeted product based on monthly means data is suitable to describe and to evaluate the River Inputs trend and the impact on the physical/chemical Black Sea waters properties.
    - **Usability**: the product is easy to understand and use.
    - **Completeness**: due to the lack of spatial and temporal data from the north-eastern Black Sea, the level of missing data is low because the main river is covered, Danube River, which influence the physical and chemical properties of the Black Sea (located in the north-western part).
    - **Logical consistency**: the targeted product agrees with the format required.
    - **Thematic accuracy**: uniform.
4) The limitations of the product due to the data sets used are:
    - Missing of spatial and temporal data from the north-eastern Black Sea and of recent time series.
5) The characteristic monthly mean time series of Rivers Discharge into Black Sea basin from in-situ data (RIVDIS) used to generate this product does not fail to meet the scope of the Targeted Product. In-situ datasets are checked before dissemination, thus they are considered reliable for 20-year river discharge monitoring. In this product 6 main rivers monthly mean discharge datasets are used.
6) The most important gaps in these targeted products are related to the limited geographical and temporal coverage.

BLACKSEA_CH09_Product_2

1) The overall product quality score with respect to scope (fitness for purpose) is **excellent (1)**. The data covering all important river discharge in the Black Sea.
2) All characteristics are important because they have different spatial coverage.
3) The following aspects of quality have the greatest effect on the Targeted product quality:
    - **Spatial extent**: the product covers the important Black Sea river tributaries.
    - **Spatial resolution**: the targeted product is based on in-situ river discharge data collected in the same point more than a decade that is suitable to describe and to evaluate the River Inputs trend and the impact on the physical/chemical Black Sea waters properties.
    - **Spatial accuracy:** data are highly accurate as they are acquired through GPS.
    - **Time extent**: the product is time limited because data are available only for the time period 1921-1984.
    - **Time resolution**: the targeted product based on yearly means data is suitable to describe and to evaluate the River Inputs trend and the impact on the physical/chemical Black Sea waters properties.
    - **Usability**: the product is easy to understand and use.
    - **Completeness**: due to the lack of spatial and temporal data from the north-eastern Black Sea, the level of missing data is low because the main river is covered, Danube River, which influence the physical and chemical properties of the Black Sea (located in the north-western part).
    - **Logical consistency**: the targeted product agrees with the format required.
    - **Thematic accuracy**: uniform.
4) The limitations of the product due to the data sets used are:
    - Missing of spatial and temporal data from the north-eastern Black Sea and of recent time series.
5) The characteristic yearly mean time series of Rivers Discharge into Black Sea basin from in-situ data (RIVDIS) used to generate this product does not fail to meet the scope of the Targeted Product. In-situ datasets are checked before dissemination, thus they are considered reliable for 20-year river discharge monitoring. In this product 6 main rivers yearly mean discharge datasets are used.
6) The most important gaps in these targeted products are related to the limited geographical and temporal coverage.

BLACKSEA_CH09_Product_3

1) The overall product quality score with respect to scope (fitness for purpose) is **excellent (1)**. The data covering all important river basins those discharge into the Black Sea.
2) All characteristics are important because they have different spatial coverage.
3) The following aspects of quality have the greatest effect on the Targeted product quality:
    - **Spatial extent**: the product cover all the important Black Sea river tributaries.
    - **Spatial resolution**: the targeted product is based on E-HYPE model with geographical domain the Drainage basin of Europe; the E-HYPE model data are based on calculus of the hydrological variables on a daily time-step at a high sub-basin resolution (120 km2, median) simultaneously that is suitable to describe and to evaluate the Rivers discharge trend and the impact on the physical/chemical Black Sea waters properties.

- **Spatial accuracy:** data are highly accurate. The model uses global databases and GMES satellite products as input data. Forcing data is obtained from ECMWF and SMHI. The model produces high resolution information.
- **Time extent**: the product is time limited because data are available only for the period 2000 – 2010 years.
- **Time resolution**: the targeted product based on monthly means data is suitable to describe and to evaluate the River discharge trend and the impact on the physical/chemical Black Sea waters properties.
- **Usability**: the product is easy to understand and use.
- **Completeness**: the product is EXCELLENT covered.
- **Logical consistency**: the targeted product agrees with the format required.
- **Thematic accuracy**: uniform.

4) The limitations of the product due to the data sets used are:
   - There are no limitations on spatial and temporal data for the Black Sea Rivers and covers recent data time series.
5) The characteristic daily time series of Rivers Discharge into Black Sea basin from modelled data (E-HYPE model) used to generate this product does not fail to meet the scope of the Targeted Product. Modelled datasets are checked before dissemination, thus they are considered reliable for 10-year river discharge monitoring. In this product 11 main rivers daily discharge datasets are used.
6) There are no important gaps and these targeted products fitness for use.

BLACKSEA_CH09_Product_4

1) The overall product quality score with respect to scope (fitness for purpose) is **excellent (1)**. The data covering all important river basins those discharge into the Black Sea.
2) All characteristics are important because they have different spatial coverage.
3) The following aspects of quality have the greatest effect on the Targeted product quality:
   - **Spatial extent**: the product covers all the important Black Sea river tributaries.
   - **Spatial resolution**: the targeted product is based on E-HYPE model with geographical domain the Drainage basin of Europe; the E-HYPE model data are based on calculus of the hydrological variables on a daily time-step at a high sub basin resolution (120 km2, median) simultaneously that is suitable to describe and to evaluate the Rivers temperature (°C) trend and the impact on the physical/chemical Black Sea waters properties.
   - **Spatial accuracy:** data are highly accurate. The model uses global databases and GMES satellite products as input data. Forcing data is obtained from ECMWF and SMHI. The model produces high resolution information.
   - **Time extent**: the product is time limited because data are available only for the period 2000 – 2010 years.
   - **Time resolution**: the targeted product based on monthly means data is suitable to describe and to evaluate the River Temperature trend and the impact on the physical/chemical Black Sea waters properties.
   - **Usability**: the product is easy to understand and use.
   - **Completeness**: the product is EXCELLENT covered.
   - **Logical consistency**: the targeted product agrees with the format required.
   - **Thematic accuracy**: uniform.

4) The limitations of the product due to the data sets used are:
    - There are no limitations on spatial and temporal data for the Black Sea Rivers and covers recent data time series.
5) The characteristic time series of monthly mean river temperature at the discharge point into the Black Sea from modelled data (E-HYPE model) used to generate this product does not fail to meet the scope of the Targeted Product. Modelled datasets are checked before dissemination, thus they are considered reliable for 10-year river temperature monitoring. In this product 11 main rivers monthly mean temperature datasets are used.
6) There are no important gaps and these targeted products fitness for use.

BLACKSEA_CH09_Product_5

1) The overall product quality score with respect to scope (fitness for purpose) is **excellent (1).** The data covering all important river basins those discharge into the Black Sea.
2) All characteristics are important because they have different spatial coverage.
3) The following aspects of quality have the greatest effect on the Targeted product quality:
    - **Spatial extent**: The products cover all the important Black Sea river tributaries.
    - **Spatial resolution**: the targeted product is based on E-HYPE model with geographical domain the Drainage basin of Europe; the E-HYPE model data are based on calculus of the hydrological variables on a daily time-step at a high sub basin resolution (120 km2, median) simultaneously that is suitable to describe and to evaluate the Rivers Inorganic nitrogen (µg/L), Organic nitrogen (µg/L),Total nitrogen (µg/L) and Nitrogen load (kg/month) trends and the impact on the physical/chemical Black Sea waters properties.
    - **Spatial accuracy:** data are highly accurate. The model uses global databases and GMES satellite products as input data. Forcing data is obtained from ECMWF and SMHI. The model produces high resolution information
    - **Time extent**: the product is time limited because data are available only for the period 2000 – 2010 years.
    - **Time resolution**: the targeted product based on monthly means data is suitable to describe and to evaluate the River Inorganic nitrogen (µg/L), Organic nitrogen (µg/L), Total nitrogen (µg/L) and Nitrogen load (kg/month) trends and the impact on the physical/chemical Black Sea waters properties.
    - **Usability**: the product is easy to understand and use.
    - **Completeness**: the product is EXCELLENT covered.
    - **Logical consistency**: the targeted product agrees with the format required.
    - **Thematic accuracy**: uniform.
4) The limitations of the product due to the data sets used are:
    - There are no limitations on spatial and temporal data for the Black Sea Rivers and covers recent data time series.
5) The characteristic time series of monthly mean river nutrients at the discharge point into the Black Sea from modelled data (E-HYPE model) used to generate this product does not fail to meet the scope of the Targeted Product. Modelled datasets are checked before dissemination, thus they are considered reliable for 10-year Rivers Inorganic nitrogen (µg/L), Organic nitrogen (µg/L), Total nitrogen (µg/L) and Nitrogen load (kg/month) monitoring. In this product 11 main rivers monthly mean nitrogen datasets are used.
6) There are no important gaps and these targeted products fitness for use.

BLACKSEA_CH09_Product_6

1) The overall product quality score with respect to scope (fitness for purpose) is **excellent (1).** The data covering all important river basins those discharge into the Black Sea.
2) All characteristics are important because they have different spatial coverage.
3) The following aspects of quality have the greatest effect on the Targeted product quality:
    - **Spatial extent**: the product cover all the important Black Sea river tributaries.
    - **Spatial resolution**: the targeted product is based on E-HYPE model with geographical domain the Drainage basin of Europe; the E-HYPE model data are based on calculus of the hydrological variables on a daily time-step at a high subbasin resolution (120 km2, median) simultaneously that is suitable to describe and to evaluate the Rivers Soluble phosphorus (µg/L), Particulate phosphorus (µg/L), Total phosphorus (µg/L) and Phosphorus load (kg/month) trends and the impact on the physical/chemical Black Sea waters properties.
    - **Spatial accuracy:** data are highly accurate. The model uses global databases and GMES satellite products as input data. Forcing data is obtained from ECMWF and SMHI. The model produces high resolution information.
    - **Time extent**: the product is time limited because data are available only for the period 2000 – 2010 years.
        - **Time resolution**: the targeted product based on monthly means data is suitable to describe and to evaluate the River Soluble phosphorus (µg/L), Particulate phosphorus (µg/L), Total phosphorus (µg/L) and Phosphorus load (kg/month) trends and the impact on the physical/chemical Black Sea waters properties.
        - **Usability**: the product is easy to understand and use.
        - **Completeness**: the product is EXCELLENT covered.
        - **Logical consistency**: the targeted product agrees with the format required.
        - **Thematic accuracy**: uniform.
4) The limitations of the product due to the data sets used are:
    - There are no limitations on spatial and temporal data for the Black Sea Rivers and covers recent data time series.
5) The characteristic time series of monthly mean river phosphorus at the discharge point into the Black Sea from modelled data (E-HYPE model) used to generate this product does not fail to meet the scope of the Targeted Product. Modelled datasets are checked before dissemination, thus they are considered reliable for 10-year Rivers Soluble phosphorus (µg/L), Particulate phosphorus (µg/L), Total phosphorus (µg/L) and Phosphorus load (kg/month) monitoring. In this product 11 main rivers monthly mean phosphorus datasets are used.
6) There are no important gaps and these targeted products fitness for use.

BLACKSEA_CH09_Product_7

1) The overall product quality score with respect to scope (fitness for purpose) is **inadequate** (5). No eel available data in the Black Sea. No data / information to produce the salmon biomass on the Black Sea Rivers.
2) All characteristics are important but there are no available data / information to produce the products.
3) The following aspects of quality have the greatest effect on the Targeted product quality:

- **Spatial extent**: The products not cover the Black Sea river tributaries.
- **Spatial resolution**: no available data / information to produce trends.
- **Spatial accuracy:** No eel available data in the Black Sea. No data / information to produce the salmon biomass on the Black Sea Rivers.
- **Time extent**: the product is time limited because there are no available data.
- **Time resolution**: No eel available data in the Black Sea. No data / information to produce the salmon biomass on the Black Sea Rivers.
- **Usability**: Inadequate: Impossible to produce or fails to meet all the objectives (not usable).
- **Completeness**: the product is INADEQUATE covered.
- **Logical consistency**: no available data / information to produce products.
- **Thematic accuracy**: no available data / information.

4) The limitations of the product due to the data sets used are:
   - There are no eel data available in the Black Sea Rivers.
   - No data / information to produce the salmon biomass on the Black Sea Rivers.
5) The characteristic time series of monthly mean river phosphorus at the discharge point into the Black Sea from modelled data (E-HYPE model) used to generate this product does not fail to meet the scope of the Targeted Product. Modelled datasets are checked before dissemination, thus they are considered reliable for 10-year Rivers Soluble phosphorus (µg/L), Particulate phosphorus (µg/L), Total phosphorus (µg/L) and Phosphorus load (kg/month) monitoring. In this product 11 main rivers monthly mean phosphorus datasets are used.
6) There are important gaps and these targeted products are not fitness for use. Component is not covered because existing data are not available.

CHALLENGE 10

BLACKSEA_CH10_Product_1

1) The product quality score is **very good** (2). The GIS layer in ESRI shapefile format was produced based on Landsat 7 Enhanced Thematic Mapper Plus (ETM+) images, pixel size 14.25-meter, panchromatic, Band 8. The product covers Black Sea and the Sea of Azov. It is expected, to obtain a more precise coastline in case VHR satellite images (e.g. 0.6-4.00 m) are used.
2) Using a single data source (Landsat 7 ETM+images) to digitalise the coastline is the most important characteristic of this product.
3) The product's quality is limited by the horizontal (14.25 meter) spatial resolution of the Landsat 7 ETM+ images.
4) All characteristics contribute to the quality of the analysis. One of the weakest places is that the data source is from the 1999-2002 periods, suggesting that there are no reflections on the shoreline changes resulting from natural processes and human activity.
5) The characteristic used to generate this product does not fail to meet the scope of the Targeted Product.
6) The biggest data gap is the large resolution (14.25 m) of the Landsat 7 images. Other important gaps of the input data sets are that, the used satellite images were acquired in the interval 1999-2002.

BLACKSEA_CH10_Product_2

1) The result for product quality is **very good (2).** The ESRI shapefile GIS layer is based on Landsat 7 Enhanced Thematic Mapper Plus (ETM +) images, and EMODNET bathymetry DTM with a grid size of .125 minute * .125 minute. The main drawback of the product is the coarse resolution of the EMODNet's bathymetry dataset used to draw contour bathymetric map with intervals of 100 meters. The product covers the Black Sea and the Sea of Azov.
2) All characteristics are important. The coastline positions from the EMODnet database portal is very rough, so the use of LANDSAT 7 somewhat corrects this omission. EMODNET bathymetry DTM, because of the large pixel size, on the places where the sea depth is rapidly changing, and the biggest errors are shown. This applies mostly to the shallow waters and continental slope.
3) The product, contour bathymetric map with intervals of 100 meters, covers the whole Black Sea and the Sea of Azov.
4) The product's quality is limited by the (horizontal) spatial resolution of the EMODNET bathymetry DTM, with a grid size of .125 minute * .125 minute.
5) All of the characteristics contribute to the quality of the analysis, but the properties of the EMODNet's bathymetry dataset represent the weakest among all upstream data sets used for producing this particular product.
6) There are no serious gaps in the input data sets. The coarse resolution of the basin-scale bathymetry data set used (i.e., the EMODNet bathymetry dataset) remains the weakest component of the Product 2 (contour bathymetric map for the Black sea basin with intervals of 100 meters).

BLACKSEA_CH10_Product_3

1) The product quality score is **very good (2).** The GIS layer in ESRI shapefile format is produced based on real-time data on heavy-traffic marine areas in the Black Sea and the Sea of Azov, provided by the AIS Marine Traffic (www.marinetraffic.com) online system. However, a main drawback represents the coarse resolution of the EMODNet's bathymetry dataset used to delineate the shallow-water priority areas for surveying outside the Bulgarian coastal waters.
2) All characteristics are important, both in the positive (i.e. quality and regular update of the real-time data on heavy-traffic marine areas) and negative (i.e. coarse resolution of the EMODNet's bathymetry dataset used) aspect.
3) The (horizontal) spatial resolution combined with the accuracy of the EMODNet's bathymetry dataset are the crucial elements that influence the quality of the GIS-based spatial analysis performed in order to identify (and subsequently produce the ESRI shapefile of) the priority areas for surveying for safer navigation. The statement is particularly valid for the shallow marine parts outside the Bulgarian coastal waters.
4) The product's quality is limited by the (horizontal) spatial resolution of the bathymetry data set used.
5) All of the characteristics contribute to the quality of the analysis, but the properties of the EMODNet's bathymetry dataset represent the weakest among all three upstream data sets used for producing this particular product.
6) There are no serious gaps in the input data sets, but as already mentioned above, the coarse resolution of the basin-scale bathymetry data set used (i.e., the EMODNet bathymetry dataset) to delineate the priority shallow-water areas for surveying for safer

navigation remains the weakest component of the GIS-based spatial analysis carried out.

BLACKSEA_CH10_Product_4

1) The product quality score is **sufficient (4).** The GIS layer as ESRI GRID format is produced based on four upstream data sets: Bathymetry and Elevation/Sea-floor depth (below mean sea level) {bathymetric depth}/Global Land Cover Facility; Bathymetry and Elevation/Sea-floor depth/BATHDPTH/Bulgarian Oceanographic Data Centre, Institute of Oceanology - Bulgarian Academy of Sciences/2012_MN-GeoHazard; Bathymetry and Elevation/Sea-floor depth (below mean sea level) {bathymetric depth}/EMODnet Secretariat/EMODNET Bathymetry; Bathymetry and Elevation/Sea-floor depth/BATHDPTH/Bulgarian Oceanographic Data Centre, Institute of Oceanology - Bulgarian Academy of Sciences/2013_MOSW. The main reasons for this score are that the bathymetric survey data sets cover less than 5% of the sea basin area.
2) All characteristics are important. That includes the bathymetric survey data sets, EMODNet's bathymetry dataset and positions of the coastline.
3) Data from the bathymetric surveys are critical for this product. The horizontal spatial resolution combined with the accuracy of the EMODNet's bathymetry dataset is the crucial elements that influence the quality of the GIS-based spatial analysis. The statement is particularly valid for the shallow waters.
4) Data from the bathymetric surveys are critical for this product, but they cover only 5% of the sea basin area.
5) All of the characteristics contribute to the quality of the analysis, but the properties of the EMODNet's bathymetry dataset represent the weakest among all four upstream data sets used for producing this particular product.
6) The most important gaps in the input data sets are related to geographical coverage, as the data from the bathymetric surveys cover only 5% of the sea basin area.

CHALLENGE 11

BLACKSEA_CH11_Product_1

1. The quality score of the product is **sufficient (4).** The developed table of *Mnemiopsis leidyi* alien species abundance and biomass includes 23 available datasets from the Black Sea Database created in framework of the NATO SfP-971818 ODBMS Black Sea Project http://sfp1.ims.metu.edu.tr/ODBMSDB/ and Bulgarian National Monitoring Programme http://bgodc.io-bas.bg/documents/. The data are submitted on Quality assurance (detection of stations with different names but the same geographic location; detection of stations with the same name but with different geographic locations). Afterward the values of stations with different names and the same geographic location are averaged; stations with the same name but in different geographic locations are renamed; the units are recalculated from ind/m^3 and g/m^3 to ind/m^2 and g/m^2 for more representative spatial surface performance). The data modification doesn't allow reliable assessing of the biological and ecological parameters of the *Mnemiopsis leidyi* population. Nevertheless the data are not evenly distributed in space and time the product is useful for visualization of the alien species distribution in the Black Sea.

2. The product includes two characteristics, abundance and biomass of the species, both of them are equally important for the Targeted Product quality.
3. The quality elements which affect the product quality are:
    - **Horizontal Spatial Coverage and Horizontal Resolution.** The data are insufficient in the North part of the basin;
    - **Temporal Coverage and Temporal Resolution.** The data doesn't cover the whole period from the species settlement in 1982 till now. The databases would be more complete if they contain seasonal and annual data.
4. The limitations on the quality of the product due to the input dataset used (fitness for use) are:
    - **Horizontal Spatial Coverage and Horizontal Resolution.** Each of used 23 UDs has different horizontal coverage and resolution which are not enough to present the species distribution on the entire Black sea.
    - **Temporal Coverage and Temporal Resolution.** The datasets cover relatively short time span related to monitoring campaigns.
5. There is not a separate dataset which "fails the most" to meet the scope of the Targeted Product (fitness for use). All of them are with limited space and time coverage.
6. The most important gaps in the input data sets are:
    - Lack of long-term annual and seasonal data for the period from the species introduction till now.
    - Sparse and unevenly distributed sampling stations affect the reliability of the product.

    The species population is a dynamic system with annual, seasonal and spatial variations. Our recommendations to the *Mnemiopsis leidyi* databases are in term of the completeness. The data should be in regular time intervals (seasonally) and with representative density of the stations net.
    Other disadvantages are the unavailability and restrictions on the data created in the frameworks of some projects.

BLACKSEA_CH11_Product_2

1. The quality score of the product is **SUFFICIENT** (4). The digital map of *Mnemiopsis leidyi* alien species abundance distribution includes 21 available datasets (lack of abundance data of two datasets - "Vityaz", cruise 21; "Vityaz", cruise 26) from the Black Sea Database created in framework of the NATO SfP-971818 ODBMS Black Sea Project http://sfp1.ims.metu.edu.tr/ODBMSDB/ and Bulgarian National Monitoring Programme http://bgodc.io-bas.bg/documents/. The map with special resolution of 13.6 km is created base on Product 1 data. The product is useful for assessing the species distribution in the Black Sea but the data are not evenly distributed in space and time.
2. Product 2 includes one characteristic, abundance of the *Mnemiopsis leidyi* alien species.
3. The quality elements which affects the product quality are:
    - **Horizontal Spatial Coverage and Horizontal Resolution.** The data are insufficient in the North part of the basin;
    - **Temporal Coverage and Temporal Resolution.** The data doesn't cover the whole period from the species settlement in 1982 till now. The databases would be more complete if they contain seasonal and annual data.
4. The limitations on the quality of the product due to the input dataset used (fitness for use) are:

- **Horizontal Spatial Coverage and Horizontal Resolution.** Each of used 21 UDs has different horizontal coverage and resolution which are not enough to present the species distribution on the entire Black sea.
- **Temporal Coverage and Temporal Resolution.** The datasets cover relatively short time span related to monitoring campaigns.

5. There is not a separate dataset which "fails the most" to meet the scope of the Targeted Product (fitness for use). All of them are with limited space and time coverage.
6. The most important gaps in the input data sets are:
   - Lack of long-term annual and seasonal data for the period from the species introduction till now.
   - Sparse and unevenly distributed sampling stations affect the reliability of the product.
   - The data should be in regular time intervals (seasonally) and with representative density of the stations net.

BLACKSEA_CH11_Product_3

1. The quality score of the product is **SUFFICIENT** (4). The digital map of *Mnemiopsis leidyi* alien species biomass distribution includes 23 available datasets from the Black Sea Database created in framework of the NATO SfP-971818 ODBMS Black Sea Project http://sfp1.ims.metu.edu.tr/ODBMSDB/ and Bulgarian National Monitoring Programme http://bgodc.io-bas.bg/documents/. The map with special resolution of 13.6 km is created base on Product 1 data. The product is useful for assessing the species distribution in the Black Sea but the data are not evenly distributed in space and time.
2. The product includes one characteristic, biomass of the *Mnemiopsis leidyi* alien species.
3. The quality elements which affects the product quality are:
   - **Horizontal Spatial Coverage and Horizontal Resolution.** The data are insufficient in the North part of the basin;
   - **Temporal Coverage and Temporal Resolution.** The data doesn't cover the whole period from the species settlement in 1982 till now. The databases would be more complete if they contain seasonal and annual data.
4. The limitations on the quality of the product due to the input dataset used (fitness for use) are:
   - **Horizontal Spatial Coverage and Horizontal Resolution.** Each of used 23 UDs has different horizontal coverage and resolution which are not enough to present the species distribution on the entire Black sea.
   - **Temporal Coverage and Temporal Resolution.** The datasets cover relatively short time span related to monitoring campaigns.
5. There is not a separate dataset which "fails the most" to meet the scope of the Targeted Product (fitness for use). All of them are with limited space and time coverage.
6. The most important gaps in the input data sets are:
   - Lack of long-term annual and seasonal data for the period from the species introduction till now.
   - Sparse and unevenly distributed sampling stations affect the reliability of the product.

The data should be in regular time intervals (seasonally) and with representative density of the stations net.

BLACKSEA_CH11_Product_4

1. The quality score of the product is **SUFFICIENT** (4). The table of *Beroe ovata* alien species abundance and biomass distribution includes 15 available datasets from the Bulgarian National Monitoring Programme http://bgodc.io-bas.bg/documents/. The data are submitted on Quality assurance. The units are recalculated from ind/m^3 and g/m^3 to ind/m^2 and g/m^2 and averaged for more representative spatial surface performance. The data are not evenly distributed in space and time. The product does not adequately meet the scope to assess the species distribution on the entire Black Sea but is a starting point.
2. The product includes two characteristics, abundance and biomass of the species.
3. The quality elements which affects the product quality are:
    - **Horizontal Spatial Coverage and Horizontal Resolution.** The data covers only the Western part of the sea basin;
    - **Temporal Coverage and Temporal Resolution.** The data doesn't cover the whole period from the species settlement in 1997 till now. The databases would be more complete if they contain seasonal and annual data.
4. The limitations on the quality of the product due to the input dataset used (fitness for use) are:
    - **Horizontal Spatial Coverage and Horizontal Resolution.** Each of used 15 UDs has different horizontal coverage and resolution which are not enough to present the species distribution on the entire Black sea.
    - **Temporal Coverage and Temporal Resolution.** The datasets cover relatively short time span related to monitoring campaigns.
5. There is not a separate dataset which "fails the most" to meet the scope of the Targeted Product (fitness for use). All of them are with limited space and time coverage.
6. The most important gaps in the input data sets are:
    - Lack of long-term annual and seasonal data for the period from the species introduction till now.
    - Sparse and unevenly distributed sampling stations affect the reliability of the product.

    The species population is a dynamic system with annual, seasonal and spatial variations. Our recommendations to the *Beroe ovata* databases are in term of the completeness. The data should be in regular time intervals (seasonally) and with representative density of the stations net.
    Other disadvantages are the unavailability and restrictions on the data created in the frameworks of some projects.

BLACKSEA_CH11_Product_5

1. The quality score of the product is **SUFFICIENT** (4). The table of *Mnemiopsis leidyi* alien species abundance and biomass includes 24 available datasets with the original values (g/m^3; ind/m^3) from the Black Sea Database created in framework of the NATO SfP-971818 ODBMS Black Sea Project http://sfp1.ims.metu.edu.tr/ODBMSDB/ and Bulgarian National Monitoring Programme http://bgodc.io-bas.bg/documents/. Being an invasive species but not only alien Mnemiopsis affects the ecosystem even with its presence in the environment. The publications of Vinogradov *et al.,* 2005 and Shiganova *et al.,* 2014 took thresholds for Good Environmental Status (GES) < 4g/m^3 (120 g/m^2) and <5 ind/m^3 respectively. In concentration above these thresholds the species affects the ecosystem.

The data modifications of Product 1 do not allow reliable assessment of this impact on the ecosystem.

2. The product includes two characteristics, abundance and biomass of the species, both of which are equally important for the Targeted Product quality.
3. The quality elements which affects the product quality are:
    - **Horizontal Spatial Coverage and Horizontal Resolution.** The data are insufficient in the North part of the basin;
    - **Temporal Coverage and Temporal Resolution.** The data doesn't cover the whole period from the species settlement in 1982 till now. The databases would be more complete if they contain seasonal and annual data.
4. The limitations on the quality of the product due to the input dataset used (fitness for use) are:
    - **Horizontal Spatial Coverage and Horizontal Resolution.** Each of used 24 UDs has different horizontal coverage and resolution which are not enough to present the species distribution on the entire Black sea.
    - **Temporal Coverage and Temporal Resolution.** The datasets cover relatively short time span related to monitoring campaigns.
5. There is not a separate dataset which "fails the most" to meet the scope of the Targeted Product (fitness for use). All of them are with limited space and time coverage.
6. The most important gaps in the input data sets are:
    - Lack of long-term annual and seasonal data for the period from the species introduction till now.
    - Sparse and unevenly distributed sampling stations affect the reliability of the product.
    - Proposal and testing of new indicators.

Conclusions

Table A5.2 summarizes the quality scores assigned by the Black Sea challenges experts to the Targeted Products developed within the project in order to evaluate the adequacy of the observational system at the Black 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.

1. Challenge 4 (climate) products encounter the largest problem since of the temperature measurements at surface, 500 m and bottom depth over past 50 years and 100 years are non-uniform in time and space and do not permit to create the consistent maps of temperature trends over the Black Sea. The same problem was reported for the observations of the Black Sea ice coverage for the 50-year period (1966-2015) and the 100-year period (1916-2015).
2. Challenge 5 (coast) reported gaps on the sea level and sediment mass balance data for the past 10, 50 and 100 years periods.
3. Challenge 9 (river inputs) reported a lack of information on the eel and salmon biomass in the Black Sea Rivers.
4. Challenge 11 (alien species) produce a low accuracy products since the data is non-uniform in time and space.

TP	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8	CH9	CH10	CH11
1	1	2	3	1	1	1	3	2	1	2	4
2	1	2	2	2	3	3	3	2	1	2	4
3	1	3		2	3	2			1	2	4
4		1		5	3				1	4	4
5		1		5	4				1		4
6				5	5				1		
7				5	5				5		
8				5	5						
9				5	5						
10				1	5						
11				5							
12				5							
13				1							
14				2							
15				2							
16				2							
17				4							
18				3							

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.