SEA BASIN CHECKPOINT
LOT4: BLACK SEA

CHALLENGE 4 – Climate
Expert evaluation of Targeted Products

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Please use your own judgement to describe for each Targeted product of the assessment of the "fitness for purpose and use". For each Targeted product please comment on the following points:

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) 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 1. Targeted Products quality scores and their meaning.

Expert evaluation of Target Product quality

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.
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, temporal extent, temporal resolution, as well as the accuracy of the SST dataset used. These parameters are not suitable for this product.
4) The limitations of the product are related to insufficient temporal and spatial coverage of observation in order to produce adequate average value.
5) The product is based on one characteristic (PSST) which fails the scope of the Targeted product
6) Important gaps are identified, especially in the period 1966-1980;

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.
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: horizontal coverage (Black Sea surface), horizontal resolution, temporal extent, temporal resolution, as well as the accuracy of the SST dataset used. These parameters are not suitable for this product.
4) The limitations of the product are related to insufficient temporal and spatial coverage of observation in order to produce adequate average value.
5) The product is based on one characteristic (TEMP) which fails the scope of the Targeted product
6) Important gaps are identified, especially in the period 1966-1980;

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 1500 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.
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: horizontal coverage (Black Sea surface), horizontal resolution, temporal extent, temporal resolution, as well as the accuracy of the SST dataset used. These parameters are not suitable for this product.
4) The limitations of the product are related to insufficient temporal and spatial coverage of observation in order to produce adequate average value.
5) The product is based on one characteristic (TEMP) which fails the scope of the Targeted product
6) Important gaps are identified, especially in the period 1966-1980;

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.
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, temporal extent, temporal resolution, as well as the accuracy of the SST dataset used. These parameters are not suitable for this product.
4) The limitations of the product are related to insufficient temporal and spatial coverage of observation in order to produce adequate average value.
5) The product is based on one characteristic (PSST) which fails the scope of the Targeted product
6) Important gaps are identified, especially in the period 1916-1980;

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.
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: horizontal coverage (Black Sea surface), horizontal resolution, temporal extent, temporal resolution, as well as the accuracy of the SST dataset used. These parameters are not suitable for this product.
4) The limitations of the product are related to insufficient temporal and spatial coverage of observation in order to produce adequate average value.
5) The product is based on one characteristic (TEMP) which fails the scope of the Targeted product
6) Important gaps are identified, especially in the period 1916-1980;

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.
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: horizontal coverage (Black Sea surface), horizontal resolution, temporal extent, temporal resolution, as well as the accuracy of the SST dataset used. These parameters are not suitable for this product.
4) The limitations of the product are related to insufficient temporal and spatial coverage of observation in order to produce adequate average value.
5) The product is based on one characteristic (TEMP) which fails the scope of the Targeted product
6) Important gaps are identified, especially in the period 1916-1980;

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) 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 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.
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, temporal extent, and temporal resolution. These parameters are not suitable for this product.
4) The limitations of the product are related to insufficient temporal and spatial coverage of observation in order to produce adequate average value.
5) The product is based on one characteristic (CRYS) which fails the scope of the Targeted product.
6) Important gaps are identified, especially in the period 1966-1980.

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.
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, temporal extent, and temporal resolution. These parameters are not suitable for this product.
4) The limitations of the product are related to insufficient temporal and spatial coverage of observation in order to produce adequate average value.
5) The product is based on one characteristic (CRYS) which fails the scope of the Targeted product.
6) Important gaps are identified, especially in the period 1966-1980.

BLACKSEA_CH4_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_CH4_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_CH4_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_CH4_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_CH4_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_CH4_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.