



# PRODUCT USER MANUAL

## For Mediterranean Sea Biogeochemical Analysis and Forecasting Product

MEDSEA\_ANALYSISFORECAST\_BGC\_006\_014

Issue: 2.3

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**RECORD TABLE**

| Issue | Date       | §   | Description of Change                      | Author                                      | Validated By                         |
|-------|------------|-----|--------------------------------------------|---------------------------------------------|--------------------------------------|
| 1.0   | 25/09/2017 | all | Initial version                            | R. Lecci, G. Bolzon, S. Salon, G. Cossarini |                                      |
| 1.1   | 30/04/2018 | all | Update after v4.1                          | R. Lecci, G. Bolzon, S. Salon, G. Cossarini |                                      |
| 1.2   | 31/05/2018 | all | Update of section III                      | R. Lecci                                    |                                      |
| 1.3   | 21/01/2019 | all | New template and inclusion of new datasets | R. Lecci, G. Bolzon, S. Salon, G. Cossarini |                                      |
| 1.4   | 06/12/2019 | all | New datasets                               | R. Lecci, G. Bolzon, S. Salon, G. Cossarini | C. Derval                            |
| 2.0   | 15/01/2021 | all | New product and new datasets               | R. Lecci, G. Bolzon, S. Salon, G. Cossarini | C. Derval                            |
| 2.1   | 10/09/2021 | all | Upgrade of forcing                         | R. Lecci, G. Bolzon, S. Salon               | C. Derval                            |
| 2.2   | 29/11/2022 | all | Quality improvement and additional dataset | R. Lecci, G. Bolzon, S. Salon               | Copernicus Marine Product Management |
| 2.3   | 30/11/2023 | all | Updated datasets                           | R. Lecci, G. Bolzon, S. Salon               |                                      |

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## GLOSSARY AND ABBREVIATIONS

|                      |                                                                                                                                                                                                                                                                                             |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Analysis (Numerical) | a detailed study of the state of the ocean done in Near real Time based on observations and numerical model. The operational prediction centre produces 3D time-space analysis systems.<br><br>A long series of analyses is of great utility for studying the behavior of the ocean system. |
| BFM                  | Biogeochemical Flux Model                                                                                                                                                                                                                                                                   |
| CF                   | Climate Forecast (convention for NetCDF)                                                                                                                                                                                                                                                    |
| CHL                  | Chlorophyll                                                                                                                                                                                                                                                                                 |
| CMEMS                | Copernicus Marine Environment Monitoring Service                                                                                                                                                                                                                                            |
| DIC                  | Dissolved Inorganic Carbon                                                                                                                                                                                                                                                                  |
| FAQ                  | Frequently Asked Question                                                                                                                                                                                                                                                                   |
| Forecast (Numerical) | a computer forecast or prediction based on equations governing the motions and the forces affecting motion of fluids. The equations are based, or initialized, on specified ocean conditions at a certain place and time (NOAA Glossary).                                                   |
| FTP                  | File Transfer Protocol                                                                                                                                                                                                                                                                      |
| ICNP                 | In situ Chlorophyll and Nitrate Profiles                                                                                                                                                                                                                                                    |
| Med/MED              | Mediterranean                                                                                                                                                                                                                                                                               |
| MFC                  | Monitoring and Forecasting Centre                                                                                                                                                                                                                                                           |
| NetCDF               | Network Common Data Form                                                                                                                                                                                                                                                                    |
| NOAA                 | National Oceanic and Atmospheric Administration                                                                                                                                                                                                                                             |
| OCTAC                | Ocean Color Thematic Assembly Centre                                                                                                                                                                                                                                                        |
| OGS                  | Istituto Nazionale di Oceanografia e di Geofisica Sperimentale                                                                                                                                                                                                                              |
| pCO <sub>2</sub>     | partial pressure of carbon dioxide                                                                                                                                                                                                                                                          |
| PFT                  | Plankton Functional Types                                                                                                                                                                                                                                                                   |
| pH                   | potential of Hydrogen                                                                                                                                                                                                                                                                       |
| PU                   | Production Unit                                                                                                                                                                                                                                                                             |

|           |                                                                                                                                                |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------|
| Subsetter | Copernicus Marine service tool to download a NetCDF file of a selected geographical box using values of longitude and latitude, and time range |
| 3DVAR     | Three-Dimensional Variational                                                                                                                  |

# I INTRODUCTION

## I.1 Summary

This document is the user manual for the Copernicus Marine analysis and forecast product **MEDSEA\_ANALYSISFORECAST\_BGC\_006\_014**. An archive of analysis over the last two years up to real-time is available on the Marine Data Store.

The product is composed by 3D daily and monthly mean concentration of chlorophyll, nitrate, phosphate, ammonium, silicate, primary production, oxygen, phytoplankton carbon biomass and relative four functional types (PFT), zooplankton carbon biomass, pH, dissolved inorganic carbon, alkalinity, and 2D daily and monthly mean of surface partial pressure of CO<sub>2</sub>, surface flux of CO<sub>2</sub>, and light attenuation coefficient.

**MEDSEA\_ANALYSISFORECAST\_BGC\_006\_014** product is organised in 13 datasets:

- 6 contain the monthly mean fields for all the variables
  - **cmems\_mod\_med\_bgc-bio\_anfc\_4.2km\_P1M-m**
  - **cmems\_mod\_med\_bgc-car\_anfc\_4.2km\_P1M-m**
  - **cmems\_mod\_med\_bgc-co2\_anfc\_4.2km\_P1M-m**
  - **cmems\_mod\_med\_bgc-nut\_anfc\_4.2km\_P1M-m**
  - **cmems\_mod\_med\_bgc-pft\_anfc\_4.2km\_P1M-m**
  - **cmems\_mod\_med\_bgc-optics\_anfc\_4.2km\_P1M-m**
- 6 contain the daily mean fields for all the variables
  - **cmems\_mod\_med\_bgc-bio\_anfc\_4.2km\_P1D-m**
  - **cmems\_mod\_med\_bgc-car\_anfc\_4.2km\_P1D-m**
  - **cmems\_mod\_med\_bgc-co2\_anfc\_4.2km\_P1D-m**
  - **cmems\_mod\_med\_bgc-nut\_anfc\_4.2km\_P1D-m**
  - **cmems\_mod\_med\_bgc-pft\_anfc\_4.2km\_P1D-m**
  - **cmems\_mod\_med\_bgc-optics\_anfc\_4.2km\_P1D-m**
- 1 contains the static fields for the system (coordinates, mask and bathymetry):  
**cmems\_mod\_med\_bgc\_anfc\_4.2km\_static**

The product is published on the Copernicus Marine dissemination server after automatic and human quality controls. Files downloaded are in NetCDF format.

The analysis and forecasting system is described in the Quality Information Document (see in Annex).

Disclaimer: The quality of the product may vary during the proposed time series depending on the possible update of the system.

Information on operational issues on products and services can be found on our [User Notification Service](#). If you have any questions, please [contact us](#).

## I.2 History of changes

| Date       | Description                                           |
|------------|-------------------------------------------------------|
| 21.01.2019 | New template and inclusion of new datasets            |
| 06.12.2019 | New datasets                                          |
| 15.01.2021 | New product and new datasets                          |
| 10.09.2021 | Upgrade of forcing                                    |
| 29.11.2022 | Quality improvement and additional dataset            |
| 30.11.2023 | Updated datasets including 8 additional new variables |

## II DESCRIPTION OF THE PRODUCT SPECIFICATION

### II.1 General Information

|                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                  |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>Product Lines</b>         | MEDSEA_ANALYSISFORECAST_BGC_006_014                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                  |
| <b>Geographical coverage</b> | 5.541667°W → 36.29167°E; 30.1875°N → 45.97917°N                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                  |
| <b>Variables</b>             | Nitrate<br>Phosphate<br>Ammonium<br>Silicate<br>Phytoplankton Carbon Biomass<br>Zooplankton Carbon Biomass<br>Chlorophyll<br>Primary Production<br>Oxygen<br>pH<br>Dissolved Inorganic Carbon<br>Alkalinity<br>Surface partial pressure of CO <sub>2</sub><br>Surface CO <sub>2</sub> flux<br>Light attenuation coefficient<br>Diatoms carbon biomass<br>Diatoms chlorophyll concentration<br>Nanoflagellates carbon biomass<br>Nanoflagellates chlorophyll concentration<br>Picophytoplankton carbon biomass<br>Picophytoplankton chlorophyll concentration<br>Dinoflagellates carbon biomass<br>Dinoflagellates chlorophyll concentration |                  |
| <b>Product Type</b>          | <b>Analysis</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>Forecast</b>  |
| <b>Update frequency</b>      | Weekly                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Daily            |
| <b>Available time series</b> | last two years up to real-time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 10-days forecast |

|                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                    |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| <b>Target delivery time</b>      | On Tuesday at 22:00 UTC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Daily at 22:00 UTC |
| <b>Temporal resolution</b>       | <ul style="list-style-type: none"> <li>cmems_mod_med_bgc-bio_anfc_4.2km_P1D-m,<br/>cmems_mod_med_bgc-car_anfc_4.2km_P1D-m,<br/>cmems_mod_med_bgc-co2_anfc_4.2km_P1D-m,<br/>cmems_mod_med_bgc-nut_anfc_4.2km_P1D-m,<br/>cmems_mod_med_bgc-pft_anfc_4.2km_P1D-m,<br/>cmems_mod_med_bgc-optics_anfc_4.2km_P1D-m:<br/>daily mean</li> <li>cmems_mod_med_bgc-bio_anfc_4.2km_P1M-m,<br/>cmems_mod_med_bgc-car_anfc_4.2km_P1M-m,<br/>cmems_mod_med_bgc-co2_anfc_4.2km_P1M-m,<br/>cmems_mod_med_bgc-nut_anfc_4.2km_P1M-m,<br/>cmems_mod_med_bgc-pft_anfc_4.2km_P1M-m,<br/>cmems_mod_med_bgc-optics_anfc_4.2km_P1M-m: monthly mean</li> </ul> |                    |
| <b>Horizontal resolution</b>     | 1/24 °                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                    |
| <b>Number of vertical levels</b> | 125                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                    |
| <b>Format</b>                    | NetCDF CF1.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                    |
| <b>Delivery mechanisms</b>       | Subsetter FTP                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |

Table 1: MED-MFC Real Time products

#### The runtime schedule:

MEDSEA\_ANALYSISFORECAST\_BGC\_006\_014

The MedBFM Production follows a split temporal scheme: a weekly assimilation/analysis and a daily forecast.

The system produces seven days of analysis (weekly on Tuesday) with the assimilation of surface chlorophyll and of vertical profiles of chlorophyll, nitrate, and oxygen. One day of hindcast and ten days of forecast are produced daily.

## II.2 Details of datasets

### MEDSEA\_ANALYSISFORECAST\_BGC\_006\_014

Datasets:

- **cmems\_mod\_med\_bgc-bio\_anfc\_4.2km\_P1M-m**
- **cmems\_mod\_med\_bgc-car\_anfc\_4.2km\_P1M-m**
- **cmems\_mod\_med\_bgc-co2\_anfc\_4.2km\_P1M-m**
- **cmems\_mod\_med\_bgc-nut\_anfc\_4.2km\_P1M-m**
- **cmems\_mod\_med\_bgc-pft\_anfc\_4.2km\_P1M-m**
- **cmems\_mod\_med\_bgc-optics\_anfc\_4.2km\_P1M-m**

contain the monthly mean fields for all the variables

- **cmems\_mod\_med\_bgc-bio\_anfc\_4.2km\_P1D-m**
- **cmems\_mod\_med\_bgc-car\_anfc\_4.2km\_P1D-m**
- **cmems\_mod\_med\_bgc-co2\_anfc\_4.2km\_P1D-m**
- **cmems\_mod\_med\_bgc-nut\_anfc\_4.2km\_P1D-m**
- **cmems\_mod\_med\_bgc-pft\_anfc\_4.2km\_P1D-m**
- **cmems\_mod\_med\_bgc-optics\_anfc\_4.2km\_P1D-m**

contain the daily mean fields for all the variables

- **cmems\_mod\_med\_bgc\_anfc\_4.2km\_static**

contains the static fields for the system: coordinates, mean sea surface level, mask, and bathymetry

This is the table Datasets/Variables

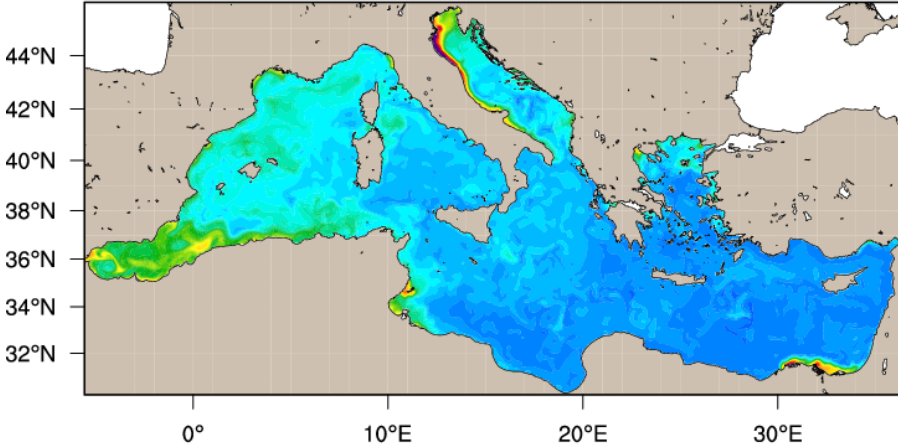
| Datasets                                                                                       | Variables                                     |
|------------------------------------------------------------------------------------------------|-----------------------------------------------|
| <u>cmems_mod_med_bgc-bio_anfc_4.2km_P1M-m</u><br><u>cmems_mod_med_bgc-bio_anfc_4.2km_P1D-m</u> | o2, nppv                                      |
| <u>cmems_mod_med_bgc-car_anfc_4.2km_P1M-m</u><br><u>cmems_mod_med_bgc-car_anfc_4.2km_P1D-m</u> | ph, dissic, talk                              |
| <u>cmems_mod_med_bgc-co2_anfc_4.2km_P1M-m</u><br><u>cmems_mod_med_bgc-co2_anfc_4.2km_P1D-m</u> | fgco2, spco2                                  |
| <u>cmems_mod_med_bgc-nut_anfc_4.2km_P1M-m</u><br><u>cmems_mod_med_bgc-nut_anfc_4.2km_P1D-m</u> | no3, po4, nh4, si                             |
| <u>cmems_mod_med_bgc-pft_anfc_4.2km_P1M-m</u><br><u>cmems_mod_med_bgc-pft_anfc_4.2km_P1D-m</u> | phyc, chl, zooc, diatoC, nanoC, picoC, dinoC, |

|                                                                                                                                                                                |                                         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
|                                                                                                                                                                                | diatoChla, nanoChla, picoChla, dinoChla |
| <u>cmems_mod_med_bgc-optics_anfc_4.2km_P1M-m</u><br><u>cmems_mod_med_bgc-optics_anfc_4.2km_P1D-m</u>                                                                           | kd490                                   |
| <b>Variables name in the NetCDF file and Unit: Long_name &amp; Standard_name</b>                                                                                               |                                         |
| <b>no3</b> [mmol m-3]<br>Nitrate<br>mole_concentration_of_nitrate_in_sea_water                                                                                                 |                                         |
| <b>po4</b> [mmol m-3]<br>Phosphate<br>mole_concentration_of_phosphate_in_sea_water                                                                                             |                                         |
| <b>nh4</b> [mmol m-3]<br>Ammonium<br>mole_concentration_of_ammonium_in_sea_water                                                                                               |                                         |
| <b>si</b> [mmol m-3]<br>Silicate<br>mole_concentration_of_silicate_in_sea_water                                                                                                |                                         |
| <b>phyc</b> [mmol m-3]<br>Phytoplankton Carbon Biomass<br>mole_concentration_of_phytoplankton_expressed_as_carbon_in_sea_water                                                 |                                         |
| <b>zooc</b> [mmol m-3]<br>Zooplankton Carbon Biomass<br>mole_concentration_of_zooplankton_expressed_as_carbon_in_sea_water                                                     |                                         |
| <b>chl</b> [mg m-3]<br>Chlorophyll<br>mass_concentration_of_chlorophyll_a_in_sea_water                                                                                         |                                         |
| <b>nppv</b> [mg m-3 day-1]<br>Net Primary Production<br>net_primary_production_of_biomass_expressed_as_carbon_per_unit_volume_in_sea_water                                     |                                         |
| <b>o2</b> [mmol m-3]<br>Dissolved oxygen<br>mole_concentration_of_dissolved_molecular_oxygen_in_sea_water                                                                      |                                         |
| <b>ph</b> [1]<br>Ocean pH<br>sea_water_ph_reported_on_total_scale                                                                                                              |                                         |
| <b>dissic</b> [mol m-3]<br>Dissolved Inorganic Carbon<br>mole_concentration_of_dissolved_inorganic_carbon_in_sea_water                                                         |                                         |
| <b>talk</b> [mol m-3]<br>Alkalinity<br>sea_water_alkalinity_expressed_as_mole_equivalent                                                                                       |                                         |
| <b>sppo2</b> [Pa]<br>Surface partial pressure of CO2<br>surface_partial_pressure_of_carbon_dioxide_in_sea_water                                                                |                                         |
| <b>fgco2</b> [kg m-2 s-1]<br>Surface CO2 flux<br>surface_downward_mass_flux_of_carbon_dioxide_expressed_as_carbon                                                              |                                         |
| <b>kd490</b> [m-1]<br>Diffuse attenuation coefficient of the downwelling irradiance at 490 nm<br>volume_attenuation_coefficient_of_downwelling_radiative_flux_in_sea_water_490 |                                         |

|                                                                                                                                                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>diatoC</b> [mmol m-3]<br>Diatoms Carbon Biomass<br>mole_concentration_of_diatoms_expressed_as_carbon_in_sea_water                                     |
| <b>diatoChla</b> [mg m-3]<br>Diatoms Chlorophyll concentration<br>mass_concentration_of_diatoms_expressed_as_chlorophyll_in_sea_water                    |
| <b>nanoC</b> [mmol m-3]<br>Nanoflagellates Carbon Biomass<br>mole_concentration_of_nanoflagellates_expressed_as_carbon_in_sea_water                      |
| <b>nanoChla</b> [mg m-3]<br>Nanoflagellates Chlorophyll concentration<br>mass_concentration_of_nanoflagellates_expressed_as_chlorophyll_in_sea_water     |
| <b>picoC</b> [mmol m-3]<br>Picophytoplankton Carbon Biomass<br>mole_concentration_of_picophytoplankton_expressed_as_carbon_in_sea_water                  |
| <b>picoChla</b> [mg m-3]<br>Picophytoplankton Chlorophyll concentration<br>mass_concentration_of_picophytoplankton_expressed_as_chlorophyll_in_sea_water |
| <b>dinoC</b> [mmol m-3]<br>Dinoflagellates Carbon Biomass<br>mole_concentration_of_dinoflagellates_expressed_as_carbon_in_sea_water                      |
| <b>dinoChla</b> [mg m-3]<br>Dinoflagellates Chlorophyll concentration<br>mass_concentration_of_dinoflagellates_expressed_as_chlorophyll_in_sea_water     |
| <b>e1t</b> [m]<br>Cell dimension along X axis                                                                                                            |
| <b>e2t</b> [m]<br>Cell dimension along Y axis                                                                                                            |
| <b>e3t</b> [m]<br>Cell dimension along Z axis<br>cell_thickness                                                                                          |
| <b>mask</b> [1]<br>Land-sea mask: 1 = sea ; 0 = land<br>sea_binary_mask                                                                                  |
| <b>deptho</b> [m]<br>Bathymetry<br>sea_floor_depth_below_geoid                                                                                           |
| <b>deptho_lev</b> [1]<br>Model level number at sea floor<br>model_level_number_at_sea_floor                                                              |

Table 2: list of the datasets and variable names and unit for the MEDSEA\_ANALYSISFORECAST\_BGC\_006\_014 product

## II.3 Production System Description

|                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Domain</b><br><br><b>Resolution and grid</b><br><br><b>Geographic coverage</b> | <p>MEDSEA (5.54°W – 36.30°E; 30.18°N – 45.98°N)</p> <p>1/24°; regular grid; 1005 x 380</p> <p>This product is over the Mediterranean Area, the horizontal resolution is 1/24 (approx 4 km), the vertical grid is composed of 125 unevenly spaced levels.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Model Version</b><br><b>Production unit</b><br><b>Period of validation</b>     | <ul style="list-style-type: none"> <li>▪ MedBFM4.0</li> <li>▪ OGS, Italy</li> <li>▪ 01.01.2019–31.12.2019</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Vertical grid</b>                                                              | <p>The product is delivered at the model's native grid, with up to 125 vertical levels:</p> <ul style="list-style-type: none"> <li>▪ levels [m]: 1.018237, 3.165747, 5.464963, 7.920377, 10.5366, 13.31838, 16.27059, 19.39821, 22.70639, 26.2004, 29.88564, 33.76767, 37.85219, 42.14504, 46.65221, 51.37986, 56.33429, 61.52196, 66.94949, 72.62369, 78.5515, 84.74004, 91.19663, 97.92873, 104.944, 112.2502, 119.8554, 127.7678, 135.9958, 144.5479, 153.4328, 162.6596, 172.2374, 182.1754, 192.4831, 203.1704, 214.2472, 225.7234, 237.6095, 249.9158, 262.6532, 275.8325, 289.4648, 303.5613, 318.1335, 333.1931, 348.752, 364.822, 381.4154, 398.5447, 416.2223, 434.4611, 453.2738, 472.6735, 492.6735, 513.287, 534.5276, 556.4089, 578.9446, 602.1486, 626.0349, 650.6176, 675.9107, 701.9286, 728.6856, 756.196, 784.4743, 813.5349, 843.3922, 874.0607, 905.5548, 937.8891, 971.0779, 1005.135, 1040.076, 1075.914, 1112.664, 1150.338, 1188.952, 1228.519, 1269.052, 1310.564, 1353.069, 1396.58, 1441.109, 1486.668, 1533.269, 1580.925, 1629.647, 1679.445, 1730.33, 1782.314, 1835.405, 1889.613, 1944.947, 2001.417, 2059.029, 2117.792, 2177.714, 2238.8, 2301.058, 2364.492, 2429.108, 2494.91, 2561.903, 2630.09, 2699.474, 2770.057, 2841.841, 2914.827, 2989.016, 3064.407, 3141.001, 3218.796, 3297.79, 3377.981, 3459.366, 3541.942, 3625.704, 3710.647, 3796.768, 3884.06, 3972.516, 4062.13, 4152.896</li> </ul> |

|                                             |                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Atmospheric forcing</b>                  | ECMWF atmospheric forcing at 1/10 degrees: 6-hourly analysis; 1 hour for the first 3 days of forecast, 3 hours for the following 3 days of forecast and 6 hours for the last 4 days of forecast                                                                                                                                                                                                                            |
| <b>Boundary forcing</b>                     | The Mediterranean modeling system is forced at the Atlantic side by climatological profiles based on World Ocean Atlas 2018 and GLODAPv2 datasets. The open boundary conditions at the Dardanelles Strait for nitrate, phosphate, silicate, DIC, alkalinity are set to constant values using literature information after a tuning procedure; a radiative condition at the open boundary is set for the other BFM tracers. |
| <b>Assimilation scheme</b>                  | 3DVarBio (3DVAR)                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Assimilated observations</b>             | Surface chlorophyll from multi-sensor satellite (MODIS-AQUA, NOAA20-VIIRS, NPP-VIIRS and Sentinel3A-OLCI sensors) data provided by CMEMS OCTAC; in-situ chlorophyll, nitrate, and oxygen profiles (ICNOP) from Biogeochemical Argo floats (provided by CORIOLIS data repository).                                                                                                                                          |
| <b>Initial conditions (spin-up process)</b> | Sub-basin climatological profiles from EMODnet2018_int dataset that integrates in-situ aggregated EMODnet data collections (Buga et al., 2018) and datasets listed in Lazzari et al. (2016) and Cossarini et al. (2015).                                                                                                                                                                                                   |
| <b>Bathymetry</b>                           | GEBCO 30sec interpolated on the model grid                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>River run-off</b>                        | Runoff Rivers input from Perseus dataset<br>High-resolution data of Po River runoff                                                                                                                                                                                                                                                                                                                                        |

The biogeochemical analysis and forecasts for the Mediterranean Sea at 1/24 degree are produced by means of the MedBFM model system (i.e., the physical-biogeochemical OGSTM-BFM model, integrated with the OASIM optics model and coupled with the 3DVarBio assimilation scheme). MedBFM model is run by OGS and uses as physical forcing the outputs of the Med-PHY products. Seven days of analysis are weekly produced on Tuesday, with the assimilation of surface chlorophyll concentration from satellite observations (provided by the Copernicus Marine-OCTAC) and chlorophyll, nitrate, and oxygen from Biogeochemical Argo floats (provided by CORIOLIS). One day of hindcast and ten days of forecast are produced daily.

### II.3.1.1 [Production Cycle](#)

**MEDSEA\_ANALYSISFORECAST\_BGC\_006\_014** analysis and forecast products are updated daily within 22 UTC. The production is composed by: 7 days of analysis (A, with data assimilation), 1 day of hindcasts (H) and 10 days of forecast (F) for the Tuesday run; 1 day of hindcast (H) and 10 days of forecast (F) daily. An example of aggregated product is shown in the Figure below.



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### III DOWNLOAD A PRODUCT

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After registration, you will be able to download our data. To assist you, our [HelpCenter](#) is available, and more specifically its [section about download](#).

Information on operational issues on products and services can be found on our [User Notification Service](#). If you have any questions, please [contact us](#).

## IV FILES NOMENCLATURE

### IV.1 Nomenclature of files when downloaded through the Web Portal Subsetter Service

MEDSEA\_ANALYSISFORECAST\_BGC\_006\_014 files nomenclature when downloaded through the Copernicus Marine Web Portal Subsetter is based on product dataset name and a numerical reference related to the request date on the portal.

The scheme is: **datasetname\_nnnnnnnnnnnnn.nc**

where:

- **datasetname**: as described previously
- **nnnnnnnnnnnnnn**: 13-digit integer corresponding to the current time (download time) in milliseconds since January 1, 1970 midnight UTC.
- **.nc**: standard NetCDF filename extension.

Example: cmems\_mod\_med\_bgc-bio\_anfc\_4.2km\_PID-m\_1303461772348.nc

### IV.2 Nomenclature of files when downloaded through the CMS Web Portal [DirectGetFile](#) or [CMS FTP Service](#)

MEDSEA\_ANALYSISFORECAST\_BGC\_006\_014 files nomenclature when downloaded through the Copernicus Marine FTP service is based as follows:

**{valid date}\_{freq flag}-{producer}--{parameter}-{config}-{region}-{bul date}\_{product type}-sv{file version}.nc**

where

- **valid date** YYYYMMDD is the validity day of the data in the file
- **freq flag** is the frequency of data values in the file (h = hourly, hts = hourly time series, d = daily, m=monthly)
- **producer** is a short version of the CMS production unit
- **config** identifies the producing system and configuration
- **region** is a maximum six letter code for the region
- **parameter** is a four-letter code for the parameter or parameter set from Standard BODC.
- **bul date** bYYYYMMDD is the bulletin date the product was produced
- **product type** is a two-letter code for the product type, for example fc for forecast, an for analysis and sm for hindcast.
- **file version** is xx.yy where xx is the CMS version and yy is an incremental version number

Table 1 shows the nomenclature for the MEDSEA\_ANALYSISFORECAST\_BGC\_006\_014 products.

Table 1 Description of the nomenclature for MEDSEA\_ANALYSISFORECAST\_BGC\_006\_014

|                     |                                                 |
|---------------------|-------------------------------------------------|
| <b>valid date</b>   | YYYYMMDD                                        |
| <b>freq flag</b>    | m (monthly)<br>d (daily)                        |
| <b>producer</b>     | OGS                                             |
| <b>config</b>       | MedBFM4                                         |
| <b>region</b>       | MED                                             |
| <b>parameter</b>    | NUTR<br>PFTC<br>BIOL<br>CARB<br>CO2F<br>EXCO    |
| <b>bul date</b>     | bYYYYMMDD                                       |
| <b>product type</b> | fc (forecast)<br>an (analysis)<br>sm (hindcast) |
| <b>file version</b> | 08.00                                           |

Example for an analysis file:

20190501\_d-OGS--PFTC-MedBFM4-MED-b20210112\_an-sv08.00.nc

This is the mean field of biogeochemistry centered at 12:00 UTC of the 1<sup>st</sup> May 2019, and the time coverage is from midnight (00:00 UTC) of the 1<sup>st</sup> May 2019 to midnight (00:00 UTC) of the 2<sup>nd</sup> May 2019.

### IV.3 Other information: mean centre of Products, land mask value, missing value

The missing value for this product is: 1.e+20

Land mask is equal to “\_FillValue” (see variable attribute on NetCDF file).

Real\_Value = (Display\_Value X scale\_factor) + add\_offset

The BGC forecasts are using the NetCDF4 format without offset nor scale factors.

In the CMEMS online system data from the latest 2 years (running window) are available via these download interfaces: Subsetter and FTP download

## IV.4 File size

| DATASET NAME                           | FILE NAME                                                                                                                                                                      | DIMENSION [MB] |
|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| cmems_mod_med_bgc-nut_anfc_4.2km_P1D-m | {date1}_d-OGS--NUTR-MedBFM4-MED-b{date2}_fc-sv08.00.nc<br>{date1}_d-OGS--NUTR-MedBFM4-MED-b{date2}_sm-sv08.00.nc<br>{date1}_d-OGS--NUTR-MedBFM4-MED-b{date2}_an-sv08.00.nc     | 120            |
| cmems_mod_med_bgc-pft_anfc_4.2km_P1D-m | {date1}_d-OGS--PFTC-MedBFM4-MED-b{date2}_fc- sv08.00.nc<br>{date1}_d-OGS-- PFTC-MedBFM4-MED-b{date2}_sm- sv08.00.nc<br>{date1}_d-OGS--PFTC-MedBFM4-MED-b{date2}_an- sv08.00.nc | 335            |
| cmems_mod_med_bgc-bio_anfc_4.2km_P1D-m | {date1}_d-OGS--BIOL-MedBFM4-MED-b{date2}_fc- sv08.00.nc<br>{date1}_d-OGS--BIOL-MedBFM4-MED-b{date2}_sm- sv08.00.nc<br>{date1}_d-OGS--BIOL-MedBFM4-MED-b{date2}_an- sv08.00.nc  | 61             |
| cmems_mod_med_bgc-car_anfc_4.2km_P1D-m | {date1}_d-OGS--CARB-MedBFM4-MED-b{date2}_fc- sv08.00.nc<br>{date1}_d-OGS--CARB-MedBFM4-MED-b{date2}_sm- sv08.00.nc<br>{date1}_d-OGS--CARB-MedBFM4-MED-b{date2}_an- sv08.00.nc  | 64             |
| cmems_mod_med_bgc-co2_anfc_4.2km_P1D-m | {date1}_d-OGS--CO2F-MedBFM4-MED-b{date2}_fc- sv08.00.nc<br>{date1}_d-OGS--CO2F-MedBFM4-MED-b{date2}_sm- sv08.00.nc<br>{date1}_d-OGS--CO2F-MedBFM4-MED-b{date2}_an- sv08.00.nc  | 1              |

|                                           |                                                                                                                                                                               |     |
|-------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| cmems_mod_med_bgc-optics_anfc_4.2km_PID-m | {date1}_d-OGS--EXCO-MedBFM4-MED-b{date2}_fc- sv08.00.nc<br>{date1}_d-OGS--EXCO-MedBFM4-MED-b{date2}_sm- sv08.00.nc<br>{date1}_d-OGS--EXCO-MedBFM4-MED-b{date2}_an- sv08.00.nc | 1   |
| cmems_mod_med_bgc-nut_anfc_4.2km_P1M-m    | {date1}_m-OGS--NUTR-MedBFM4-MED-b{date2}_an- sv08.00.nc                                                                                                                       | 120 |
| cmems_mod_med_bgc-pft_anfc_4.2km_P1M-m    | {date1}_m-OGS--PFTC-MedBFM4-MED-b{date2}_an- sv08.00.nc                                                                                                                       | 335 |
| cmems_mod_med_bgc-bio_anfc_4.2km_P1M-m    | {date1}_m-OGS--BIOL-MedBFM4-MED-b{date2}_an- sv08.00.nc                                                                                                                       | 61  |
| cmems_mod_med_bgc-car_anfc_4.2km_P1M-m    | {date1}_m-OGS--CARB-MedBFM4-MED-b{date2}_an- sv08.00.nc                                                                                                                       | 64  |
| cmems_mod_med_bgc-co2_anfc_4.2km_P1M-m    | {date1}_m-OGS--CO2F-MedBFM4-MED-b{date2}_an- sv08.00.nc                                                                                                                       | 1   |
| cmems_mod_med_bgc-optics_anfc_4.2km_P1M-m | {date1}_m-OGS--EXCO-MedBFM4-MED-b{date2}_an- sv08.00.nc                                                                                                                       | 1   |
| cmems_mod_med_bgc_anfc_4.2km_static       | MED-MFC_006_014_{\$field}.nc                                                                                                                                                  | 5   |

## V FILE FORMAT

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### V.1 NetCDF

The products are compliant with the NetCDF Climate and Forecast Convention CF-1.4 (see <http://cf-pcmdi.llnl.gov/>).

The MEDSEA\_ANALYSISFORECAST\_BGC\_006\_014 product is distributed in netCDF4 format.

To know more about the NetCDF format, please follow this link: [What is the format of Copernicus Marine products ? NetCDF](#)

### V.2 Structure and semantic of netCDF maps files

The model output files contain some additional fields in addition to the variables mentioned earlier. An example output NetCDF file header for cmems\_mod\_med\_bgc-pft\_anfc\_4.2km\_PID-m is inserted below, with the additional fields in italic fonts.

```
netcdf \20190501_d-OGS--PFTC-MedBFM4-MED-b20220608_an-sv08.00 {
```

dimensions:

*longitude = 1005;*

*latitude = 380;*

*depth = 125;*

*time = UNLIMITED; // (1 currently)*

variables:

## VI REFERENCES

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Feudale, L., Bolzon, G., Lazzari, P., Salon, S., Teruzzi, A., Di Biagio, V., Coidessa, G., Alvarez, E., Amadio, C., & Cossarini, G. (2023). Mediterranean Sea Biogeochemical Analysis and Forecast (Copernicus Marine Service MED-Biogeochemistry, MedBFM4 system) (Version 2) [Data set]. Copernicus Marine Service.  
[https://doi.org/10.25423/CMCC/MEDSEA\\_ANALYSISFORECAST\\_BGC\\_006\\_014\\_MEDBFM4](https://doi.org/10.25423/CMCC/MEDSEA_ANALYSISFORECAST_BGC_006_014_MEDBFM4)

Quality Information Document (QUID) CMEMS-MED-QUID-006\_014  
[catalogue.marine.copernicus.eu/documents/QUID/CMEMS-MED-QUID-006-014.pdf](https://catalogue.marine.copernicus.eu/documents/QUID/CMEMS-MED-QUID-006-014.pdf)