PRODUCT USER MANUAL

For Black Sea Biogeochemical Analysis and Forecasting Product

BLKSEA_ANALYSIS_FORECAST_BIO_007_010

Issue: 1.0

Contributors: Rita Lecci, Luc Vandenbulcke, Marilaure Grégoire

Approval Date: July 2019

Issue	Date	§	Description of Change	Author	Validated By
1.0	19/04/2019	all	Initial version	R. Lecci, L. Vandenbulcke, M. Grégoire	C. Derval

TABLE OF CONTENTS

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. A long series of analyses is of great utility for studying the behavior of the ocean system.
BAMHBI	BiogeochemicAl Model for Hypoxic and Benthic Influenced areas (MAST / Université de Liège, Belgium)
BCs	Boundary Conditions
BS	Black Sea
BFM	Biogeochemical Flux Model
CF	Climate Forecast (convention for NetCDF)
CHL	Chlorophyll
CMEMS	Copernicus Marine Environment Monitoring Service
DGF	DirectGetFile
DIC	Dissolved Inorganic Carbon
DirectGetFile	CMEMS service tool (FTP like) to download a NetCDF file
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
GHER	Geo-Hydrodynamics Environmental Research laboratory of the Liege University(Belgium), and the synonym 3D circulation model
MFC	Monitoring and Forecasting Centre
NetCDF	Network Common Data Form
NOAA	National Oceanic and Atmospheric Administration

OCTAC	Ocean Color Thematic Assembly Centre
OpenDAP	Open-Source Project for a Network Data Access Protocol. Protocol to download subset of data from a n-dimensional gridded dataset (ie: 4 dimensions: lon-lat,depth,time)
pCO2	partial pressure of carbon dioxide
PFT	Plankton Functional Types
pH	potential of Hydrogen
PU	Production Unit
Subsetter	CMEMS service tool to download a NetCDF file of a selected geographical box using values of longitude and latitude, and time range
ULg MAST (ULg)	Université de Liège, Belgium Modelling for Aquatic SysTems research Unit
3DVAR	Three-Dimensional Variational

I INTRODUCTION

I.1 Summary

This document is the user manual for the CMEMS analysis and forecast product **BLKSEA_ANALYSIS_FORECAST_BIO_007_010**. An archive of analysis since 01/01/2017 up to real-time is available on the CMEMS server.

The product is composed by 3D daily and monthly mean concentration of chlorophyll, nitrate, phosphate, dissolved oxygen, phytoplankton carbon biomass, pH, dissolved inorganic carbon, net primary production and by 2D daily and monthly means of vertically integrated bottom oxygen concentration (for the shelf), surface partial pressure of CO2 and surface flux of CO2.

BLKSEA_ANALYSIS_FORECAST_BIO_007_010 product is organized in 11 datasets:

- 5 contain the 3D monthly mean fields for all the variables
  - **bs-ulg-bio-an-fc-m**
  - **bs-ulg-car-an-fc-m**
  - **bs-ulg-co2-an-fc-m**
  - **bs-ulg-nut-an-fc-m**
  - **bs-ulg-pft-an-fc-m**
- 5 contain the 3D daily mean fields for all the variables
  - **bs-ulg-bio-an-fc-d**
  - **bs-ulg-car-an-fc-d**
  - **bs-ulg-co2-an-fc-d**
  - **bs-ulg-nut-an-fc-d**
  - **bs-ulg-pft-an-fc-d**
- 1 contains the static fields for the system: coordinates, mask and bathymetry: **BLKSEA_ANALYSIS_FORECAST_BIO_007_010-statics**

The product is published on the CMEMS dissemination server after automatic and human quality controls. Product is available on-line and disseminated through the CMEMS Information System. Files downloaded are in NetCDF format.

The analysis and forecasting system is described in the Quality Information Document (QUID) CMEMS-BS-QUID-007-010 (http://cmems-resources.cls.fr/documents/QUID/CMEMS-BS-QUID-007-010.pdf).
More detailed information can be obtained from http://marine.copernicus.eu/services-portfolio/contact-us/.

See also News flash..

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

I.2 History of changes

II PRODUCT DESCRIPTION

II.1 General Information about products

Product name	BLKSEA_ANALYSIS_FORECAST_BIO_007_010		
Geographical coverage	27.37°E → 41.96°E; 40.86°N → 46.80°N		
Variables	Nitrate Phosphate Phytoplankton Carbon Biomass Chlorophyll Net Primary Production Dissolved Oxygen (3D field and bottom value on the shelf) Dissolved Inorganic Carbon Surface partial pressure of CO2 Surface CO2 flux Alkalinity pH		
	Analysis	**Forecast**	
Update frequency	Weekly	Daily	
Available time series	01/01/2017 up to real-time	10-days forecast	
Target delivery time	On Wednesdays at 05pm UTC	Daily at 05pm UTC	
Temporal resolution	• bs-ulg-bio-an-fc-d, bs-ulg-car-an-fc-d, bs-ulg-co2-an-fc-d, bs-ulg-nut-an-fc-d, bs-ulg-pft-an-fc-d: daily mean • bs-ulg-bio-an-fc-m, bs-ulg-car-an-fc-m, bs-ulg-co2-an-fc-m, bs-ulg-nut-an-fc-m, bs-ulg-pft-an-fc-m: monthly mean		
Delivery mechanisms	Subsetter	DGF	FTP
Horizontal resolution	3km		
Number of vertical levels	31		
Format	NetCDF CF1.0		

II.2 Details of the datasets

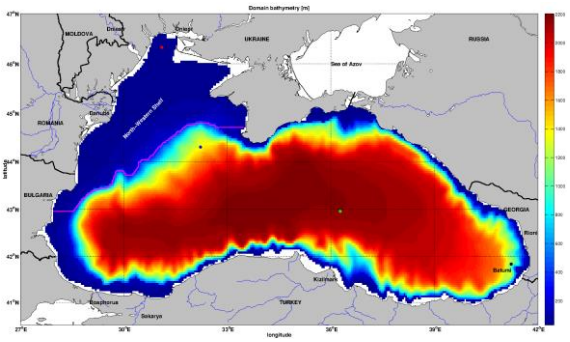
BLKSEA_ANALYSIS_FORECAST_BIO_007_010	
bs-ulg-nut-an-fc-m	contains the monthly mean fields: 3D mole concentration of Nitrate and Phosphate information from top to bottom
	no3 [mmol m-3] Nitrate mole_concentration_of_nitrate_in_sea_water
	po4 [mmol m-3] Phosphate mole_concentration_of_phosphate_in_sea_water
bs-ulg-pft-an-fc-m	contains the monthly mean fields: 3D mole concentration of Phytoplankton expressed as carbon and mass concentration of Chlorophyll information from top to bottom.
	phyc [mmol m-3] Phytoplankton Carbon Biomass mole_concentration_of_phytoplankton_expressed_as_carbon_in_sea_water
	chl [mg m-3] Chlorophyll mass_concentration_of_chlorophyll_a_in_sea_water
bs-ulg-bio-an-fc-m	contains the monthly mean fields: 3D mole concentration of Dissolved Oxygen information from top to bottom and Net Primary Production, and 2D Dissolved Oxygen on the shelf bottom
	nppv [mg m-3 day-1] Primary Production net_primary_production_of_biomass_expressed_as_carbon_per_unit_volume_in_sea_water
	o2 [mmol m-3] Oxygen mole_concentration_of_dissolved_molecular_oxygen_in_sea_water
	o2b [mmol m-3] Dissolved Oxygen on the shelf bottom mole_concentration_of_dissolved_molecular_oxygen_in_sea_water
bs-ulg-car-an-fc-m	contains the monthly mean fields: 3D ocean pH, dissolved inorganic carbon and alkalinity information from top to bottom.
	ph [1] pH sea_water_ph_reported_on_total_scale
	dissic [mol m-3] Dissolved Inorganic Carbon mole_concentration_of_dissolved_inorganic_carbon_in_sea_water
	talk [mol m-3] Alkalinity sea_water_alkalinity_expressed_as_mole_equivalent

bs-ulg-co2-an-fc-m	contains the monthly mean fields: 2D surface partial pressure of CO2 and surface flux of CO2 information.
	spco2 [Pa] Surface partial pressure of CO2 surface_partial_pressure_of_carbon_dioxide_in_sea_water
	fpco2 [kg m-2 s-1] Surface flux of CO2 surface_downward_mass_flux_of_carbon_dioxide_expressed_as_carbon
bs-ulg-nut-an-fc-d	contains the daily mean fields: 3D mole concentration of Nitrate and Phosphate information from top to bottom
	no3 [mmol m-3] Nitrate mole_concentration_of_nitrate_in_sea_water
	po4 [mmol m-3] Phosphate mole_concentration_of_phosphate_in_sea_water
bs-ulg-pft-an-fc-d	contains the daily mean fields: 3D mole concentration of Phytoplankton expressed as carbon and mass concentration of Chlorophyll information from top to bottom.
	phyc [mmol m-3] Phytoplankton Carbon Biomass mole_concentration_of_phytoplankton_expressed_as_carbon_in_sea_water
	chl [mg m-3] Chlorophyll mass_concentration_of_chlorophyll_a_in_sea_water
bs-ulg-bio-an-fc-d	contains the daily mean fields: 3D mole concentration of Dissolved Oxygen information from top to bottom and Net Primary Production, and 2D Dissolved Oxygen on the shelf bottom
	nppv [mg m-3 day-1] Primary Production net_primary_production_of_biomass_expressed_as_carbon_per_unit_volume_in_sea_water
	o2 [mmol m-3] Oxygen mole_concentration_of_dissolved_molecular_oxygen_in_sea_water
	o2b [mmol m-3] Dissolved Oxygen on the shelf bottom mole_concentration_of_dissolved_molecular_oxygen_in_sea_water
bs-ulg-car-an-fc-d	contains the daily mean fields: 3D ocean pH, dissolved inorganic carbon and alkalinity information from top to bottom.
	ph [1] pH sea_water_ph_reported_on_total_scale
	dissic [mol m-3] Dissolved Inorganic Carbon

	mole_concentration_of_dissolved_inorganic_carbon_in_sea_water
	talk [mol m-3] Alkalinity sea_water_alkalinity_expressed_as_mole_equivalent
bs-ulg-co2-an-fc-d	contains the monthly mean fields: 2D surface partial pressure of CO2 and surface flux of CO2 information.
	spco2 [Pa] Surface partial pressure of CO2 surface_partial_pressure_of_carbon_dioxide_in_sea_water
	fpco2 [kg m-2 s-1] Surface flux of CO2 surface_downward_mass_flux_of_carbon_dioxide_expressed_as_carbon
BLKSEA_ANALYSIS_FORECAST_BIO_007_010-statics	contains the static fields for the system: coordinates, mask and bathymetry.
	e1t [m] Cell dimension along X axis
	e2t [m] Cell dimension along Y axis
	e3t [m] Cell dimension along Z axis cell_thickness
	mask [1] Land-sea mask: 1 = sea ; 0 = land sea_binary_mask
	deptho [m] Bathymetry sea_floor_depth_below_geoid
	deptho_lev [1] Model level number at sea floor model_level_number_at_sea_floor

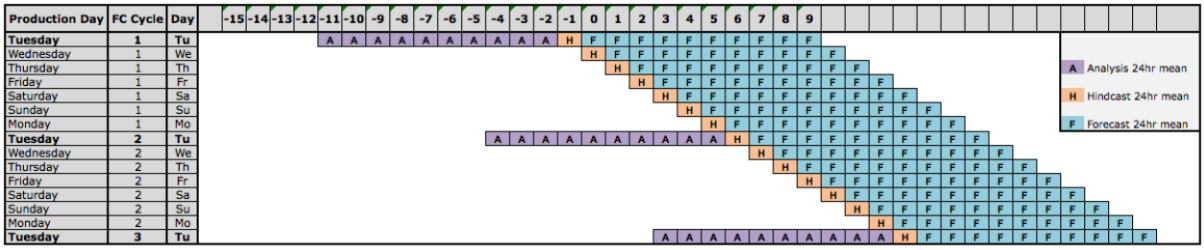
II.3 Product System Description

The biogeochemical hindcasts and forecasts for the Black Sea are produced by the MAST / ULg Production Unit by means of the NEMO 3.6 3D circulation model online coupled with the BAMHBI biogeochemical model. The workflow runs at the Cenaero (Belgium) Tier-1 supercomputing centre called Zenobe. Analysis is produced once a week, forecasts are produced daily.

Domain Resolution and grid Geographic coverage	BLKSEA (27.37°E → 41.96°E; 40.86°N → 46.80°N) ~3km ; regular grid ; 395 x 215 This product covers the Black Sea Area, the horizontal resolution is approx 3 km, the vertical grid is composed of 31 unevenly spaced vertical z-levels. 
Algorithm	nemo_bamhbi
Atmospheric forcings	ECMWF atmospheric forcings at 1/8 degree: 6-hourly analysis and 3-hourly for the first 3 days of forecast
Assimilation scheme	fixed-base SEEK
Assimilated observations	temperature, oxygen
Initial conditions	Physical fields: GHER model outputs (CMEMS product BLKSEA_ANALYSIS_FORECAST_BIO_007_009) Biogeochemistry: GHER-BAMHBI model outputs (CMEMS product BLKSEA_ANALYSIS_FORECAST_BIO_007_009) Carbonate component: Proprietary climatology built from observations
Bathymetry	GEBCO 30sec interpolated on the model grid

II.4 Processing information

BLKSEA_ANALYSIS_FORECAST_BIO_007_010 analysis and forecast products are updated daily within 17 UTC. The production is composed by: 1 day of hindcast (also referred to as simulation, S) and 10 days of forecast (F). An example of aggregated product is shown in the Figure below.



II.4.1 Update Time

Daily datasets are updated daily at 17:00 UTC.

The monthly dataset is updated monthly on the 20th (addition of the monthly mean of the previous month).

II.4.2 Time coverage

An archive of analysis since 01/01/2017 up to real-time is available.

II.4.3 Time averaging

For the monthly dataset, the fields are monthly means over the calendar month (first to last day of the month). For the daily dataset, the fields are daily means over a day (midnight to midnight, centred at noon).

III HOW TO DOWNLOAD A PRODUCT

III.1 Download a product through the CMEMS Web Portal Subsetter Service

You first need to register. Please find below the registration steps: http://marine.copernicus.eu/web/34-products-and-services-faq.php#1

Once registered, the CMEMS FAQ http://marine.copernicus.eu/web/34-products-and-services-faq.php will guide you on how to download a product through the CMEMS Web Portal Subsetter Service.

III.2 Download a product through the CMEMS Web Portal Ftp Service

You first need to register. Please find below the registration steps: http://marine.copernicus.eu/web/34-products-and-services-faq.php#1

Once registered, the CMEMS FAQ http://marine.copernicus.eu/web/34-products-and-services-faq.php will guide you on how to download a product through the CMEMS Web Portal FTP Service.

III.3 Download a product through the CMEMS Web Portal Direct Get File Service

You first need to register. Please find below the registration steps: http://marine.copernicus.eu/web/34-products-and-services-faq.php#1

Once registered, the CMEMS FAQ http://marine.copernicus.eu/web/34-products-and-services-faq.php will guide you on how to download a product through the CMEMS Web Portal Direct Get File Service.

IV FILES NOMENCLATURE AND FORMAT

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

BLKSEA_ANALYSIS_FORECAST_BIO_007_010 files nomenclature when downloaded through the CMEMS 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
- **nnnnnnnnnnnnn**: 13 digit integer corresponding to the current time (download time) in milliseconds since January 1, 1970 midnight UTC.
- **.nc**: standard NetCDF filename extension.

Example: bs-ulg-bio-an-fc-d_1303461772348.nc

IV.2 Nomenclature of files when downloaded through the DGF and CMEMS FTP Services

BLKSEA_ANALYSIS_FORECAST_BIO_007_010 files nomenclature when downloaded through the CMEMS Web Portal DGF or 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 CMEMS 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 CMEMS version (07, 08 or 09) and yy is an incremental version number

Table 1 shows the nomenclature for the BLKSEA_ANALYSIS_FORECAST_BIO_007_010 products.

Table 1 Description of the nomenclature for BLKSEA_ANALYSIS_FORECAST_BIO_007_010

valid date	YYYYMMDD
freq flag	m (monthly) d (daily)
producer	ULg
config	nemo_bamhbi
region	BS
parameter	NUTR PFTC BIOL CARB CO2F
bul date	bYYYYYMMDD
product type	fc (forecast) an (analysis) sm (hindcast)
file version	08.00

Example for a forecast file:

`20170410_d-ULg--NUTR-nemo_bamhbi-BS-b20170405_fc-sv08.00.nc`

This is the mean field of biogeochemistry centered at 12:00 UTC of the 10th April 2017, and the time coverage is from midnight (00:00 UTC) of the 10th April 2017 to midnight (00:00 UTC) of the 11th April 2017 (see section IV.8).

IV.3 File Format: format name

The products are stored using the NetCDF format.

NetCDF (network Common Data Form) is an interface for array-oriented data access and a library that provides an implementation of the interface. The NetCDF library also defines a machine-independent format for representing scientific data. Together, the interface, library, and format support the creation, access, and sharing of scientific data. The NetCDF software was developed at the Unidata Program Center in Boulder, Colorado. The NetCDF libraries define a machine-independent format for representing scientific data.

Please see Unidata NetCDF pages for more information, and to retrieve NetCDF software package.

NetCDF data is:

* Self-Describing. A netCDF file includes information about the data it contains.

* Architecture-independent. A NetCDF file is represented in a form that can be accessed by computers with different ways of storing integers, characters, and floating-point numbers.

* Direct-access. A small subset of a large dataset may be accessed efficiently, without first reading through all the preceding data.

* Appendable. Data can be appended to a NetCDF dataset along one dimension without copying the dataset or redefining its structure. The structure of a NetCDF dataset can be changed, though this sometimes causes the dataset to be copied.

* Sharable. One writer and multiple readers may simultaneously access the same NetCDF file.

IV.4 File size

DATASET NAME	FILE NAME	DIMENSION [MB]
bs-ulg-nut-an-fc-d	{date1}_d-ULg--NUTR-nemo_bamhbi-BS-b{date2}_fc-sv08.00.nc {date1}_d-ULg--NUTR-nemo_bamhbi-BS-b{date2}_sm-sv08.00.nc {date1}_d-ULg--NUTR-nemo_bamhbi-BS-b{date2}_an-sv08.00.nc	5.0 – 7.0
bs-ulg-pft-an-fc-d	{date1}_d-ULg--PFTC-nemo_bamhbi-BS-b{date2}_fc-sv08.00.nc {date1}_d-ULg-- PFTC-nemo_bamhbi-BS-b{date2}_sm-sv08.00.nc {date1}_d-ULg--PFTC-nemo_bamhbi-BS-b{date2}_an-sv08.00.nc	5.0 – 7.0
bs-ulg-bio-an-fc-d	{date1}_d-ULg--BIOL-nemo_bamhbi-BS-b{date2}_fc-sv08.00.nc {date1}_d-ULg--BIOL-nemo_bamhbi-BS-b{date2}_sm-sv08.00.nc {date1}_d-ULg--BIOL-nemo_bamhbi-BS-b{date2}_an-sv08.00.nc	5.5 – 7.5
bs-ulg-car-an-fc-d	{date1}_d-ULg--CARB-nemo_bamhbi-BS-b{date2}_fc-sv08.00.nc {date1}_d-ULg--CARB-nemo_bamhbi-BS-b{date2}_sm-sv08.00.nc {date1}_d-ULg--CARB-nemo_bamhbi-BS-b{date2}_an-sv08.00.nc	6.0 – 8.0

bs-ulg-co2-an-fc-d	{date1}_d-ULg--CO2F-nemo_bamhbi-BS-b{date2}_fc-sv08.00.nc {date1}_d-ULg--CO2F-nemo_bamhbi-BS-b{date2}_sm-sv08.00.nc {date1}_d-ULg--CO2F-nemo_bamhbi-BS-b{date2}_an-sv08.00.nc	0.2 – 1.0
bs-ulg-nut-an-fc-m	{date1}_m-ULg--NUTR-nemo_bamhbi-BS-b{date2}_an-sv08.00.nc	5.0 – 7.0
bs-ulg-pft-an-fc-m	{date1}_m-ULg--PFTC-nemo_bamhbi-BS-b{date2}_an-sv08.00.nc	5.0 – 7.0
bs-ulg-bio-an-fc-m	{date1}_m-ULg--BIOL-nemo_bamhbi-BS-b{date2}_an-sv08.00.nc	5.5 – 7.5
bs-ulg-car-an-fc-m	{date1}_m-ULg--CARB-nemo_bamhbi-BS-b{date2}_an-sv08.00.nc	6.0 – 8.0
bs-ulg-co2-an-fc-m	{date1}_m-ULg--CO2F-nemo_bamhbi-BS-b{date2}_an-sv08.00.nc	0.2 – 1.0
BLKSEA_ANALYSIS_FORECAST_BIO_007_010-statics	BS-MFC_007_010_${field}.nc	14.5

IV.5 Remember: scale_factor & add_offset / missing_value / land mask

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

Land mask is equal to "_FillValue" (see variable attribute on NetCDF file).

IV.6 Reading Software

NetCDF data can be browsed and used through a number of software, like:

- ✓ ncBrowse: http://www.epic.noaa.gov/java/ncBrowse/,
- ✓ NetCDF Operator (NCO): http://nco.sourceforge.net/
- ✓ IDL, Matlab, GMT…

Useful information on UNIDATA: http://www.unidata.ucar.edu/software/netcdf/

IV.7 Structure and semantic of netCDF maps files

Table 8 Dimensions and variables included in the files NetCDF of BLKSEA_ANALYSIS_FORECAST_BIO_007_010.

DIMENSIONS	VARIABLES		
	NAME	DIMENSIONS	TYPE
longitude=395 latitude=215 depth=31 time=1	longitude	longitude	float
	latitude	latitude	float
	depth	depth	float
	time	time	double
	no3	time,depth,latitude,longitude	float
	po4	time,depth,latitude,longitude	float
	phyc	time,depth,latitude,longitude	float
	chl	time,depth,latitude,longitude	float
	nppv	time,depth,latitude,longitude	float
	o2	time,depth,latitude,longitude	float
	o2b	time, latitude,longitude	float
	ph	time,depth,latitude,longitude	float
	dissic	time,depth,latitude,longitude	float
	talk	time,depth,latitude,longitude	float
	spco2	time, latitude,longitude	float
	fpco2	time, latitude,longitude	float

For 20170101_d-ULg--PFTC-nemo_bamhbi-BS-b20190115_sm-sv08.00.nc:

```
netcdf \20170101_d-ULg--PFTC-nemo_bamhbi-BS-b20191015_sm-sv08.00 {
dimensions:
        longitude = 215 ;
        latitude = 395 ;
        depth = 31 ;
        time = UNLIMITED ; // (1 currently) ;
variables:
        double time(time) ;
                time:units = "seconds since 1900-01-01 00:00:00" ;
                time:long_name = "time" ;
                time:standard_name = "time" ;
                time:axis = "T" ;
                time:calendar = "standard" ;
        float depth(depth) ;
                depth:units = "m" ;
                depth:long_name = "depth" ;
                depth:standard_name = "depth" ;
                depth:positive = "down" ;
                depth:axis = "Z" ;
                depth:valid_min 0.f ;
```

```
            depth:valid_max = 2000.f ;
      float latitude(latitude) ;
            latitude:units = "degrees_north" ;
            latitude:long_name = "latitude" ;
            latitude:standard_name = "latitude" ;
            latitude:axis = "Y" ;
            latitude:valid_min = 40.86f ;
            latitude:valid_max = 46.80f ;
      float longitude(longitude) ;
            longitude:units = "degrees_east" ;
            longitude:long_name = "longitude" ;
            longitude:standard_name = "longitude" ;
            longitude:axis = "X" ;
            longitude:valid_min = 27.37f ;
            longitude:valid_max = 41.96f ;
      float phyc(time, depth, latitude, longitude) ;
            phyc:_FillValue = 1.e+20f ;
            phyc:missing_value = 1.e+20f ;
            phyc:units = "mmol m-3" ;
            phyc:long_name = "Concentration of Phytoplankton Biomass in sea water"
;
            phyc:standard_name                                                    =
"mole_concentration_of_phytoplankton_expressed_as_carbon_in_sea_water" ;
            phyc:coordinates = "time depth latitude longitude" ;
      float chl(time, depth, latitude, longitude) ;
            chl:_FillValue = 1.e+20f ;
            chl:missing_value = 1.e+20f ;
            chl:units = "mg m-3" ;
            chl:long_name = "Concentration of Chlorophyll in sea water" ;
            chl:standard_name  =  "mass_concentration_of_chlorophyll_a_in_sea_water
" ;
            chl:coordinates = "time depth latitude longitude" ;


// global attributes:
            :Conventions = "CF-1.0" ;
            :references = "Please check in CMEMS catalogue the INFO section for
product BLKSEA_ANALYSIS_FORECAST_BIO_007_010 - http://marine.copernicus.eu/" ;
            :institution = "MAST, ULg (Universite de Liege), Belgium" ;
            :source = "NEMO-BAMHBI" ;
            :comment = "Please check in CMEMS catalogue the INFO section for
product BLKSEA_ANALYSIS_FORECAST_BIO_007_010 - http://marine.copernicus.eu/" ;
            :contact = "servicedesk.cmems@mercator-ocean.eu" ;
            :bulletin_date = "20191015" ;
            :bulletin_type = "simulation" ;
            :field_type = "daily_mean_centered_at_time_field" ;
```

```
            :title = "Carbon and Chlorophyll content of phytoplankton functional
type (3D) - Daily Mean" ;
}
```