

PRODUCT USER MANUAL

for the Black Sea Physical Analysis and Forecast Product BLKSEA_ANALYSIS_FORECAST_PHYS_007_001

Issue: 2.3

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CHANGE RECORD

Issue	Date	§	Description of Change	Author	Validated By
1.0	01.07.16	all	First version for CMEMS V2.2	S. Ciliberti, A. Storto, S. Creti', F. Macchia	
	05.09.16	all	Final version for CMEMS V2.2	S. Ciliberti	
1.1	02.10.16		Update version after PIT v1.2 acceptance: correction in §IV.1	S. Ciliberti, S. Creti'	
2.0	20.11.16	all	First version for CMEMS V3	S. Ciliberti	
	17.01.17		Final version	S. Ciliberti, F. Macchia	
2.1	22.10.18	all	Preparing for the new template and adding the static files description	S. Ciliberti	
2.2	21.01.19	all	General revision	R. Lecci, S. Ciliberti	C. Derval
2.3	10.09.19	all	Inclusion of new dataset centered at 12Z	R. Lecci, S. Ciliberti, S. Creti	C. Derval

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GLOSSARY AND ABBREVIATIONS

BS	Black Sea
CF	Climate Forecast (convention for NetCDF)
CMEMS	Copernicus Marine Environment Monitoring Service
CTD	Conductivity Temperature Depth
DAC	Dynamic Atmospheric Correction
DGF	DirectGetFile
DirectGetFile	CMEMS service tool (FTP like) to download a NetCDF file
ECMWF	European Centre for Medium-Range Weather Forecasts
EOF	Empirical Orthogonal Function
FTP	File Transfer Protocol
Meridional Velocity	West to East component of the horizontal velocity vector
MFC	Monitoring and Forecasting Centre
NEMO	Nucleus for European Modelling of the Ocean
NetCDF	Network Common Data Form
NOAA	National Oceanic and Atmospheric Administration
OA	Objective Analyses
OCEANVAR	Oceanographic variational data assimilation scheme developed at INGV/CMCC.
OGCM	Ocean General Circulation Model
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)
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

TAC	Thematic Assembly Centre
Zonal Velocity	South to North component of the horizontal velocity vector

I INTRODUCTION

I.1 Summary

This document is the user manual for the CMEMS analysis and forecast product **BLKSEA_ANALYSIS_FORECAST_PHYS_007_001**. An archive of analysis since 01/01/2017 up to real-time is available on the CMEMS server.

It contains 3D, 24 hours mean fields and hourly mean fields of Potential Temperature, Bottom Temperature, Salinity, Zonal and Meridional Velocity, and by 2D, 24 hours mean fields and hourly mean fields of Sea Surface Height and Mixed Layer Depth.

BLKSEA_ANALYSIS_FORECAST_PHYS_007_001 product is organised in 11 datasets:

- 5 contain the 3D daily mean fields: 3D potential temperature, salinity and currents information from top to bottom and 2D sea surface level, bottom potential temperature, mixed layer thickness information.
 - **bs-cmcc-tem-an-fc-d**
 - **bs-cmcc-cur-an-fc-d**
 - **bs-cmcc-ssh-an-fc-d**
 - **bs-cmcc-mld-an-fc-d**
 - **bs-cmcc-sal-an-fc-d**
- 5 contain the 3D hourly mean fields: 3D potential temperature, salinity and currents information from top to bottom and 2D sea surface level, bottom potential temperature, mixed layer thickness information.
 - **bs-cmcc-tem-an-fc-h**
 - **bs-cmcc-sal-an-fc-h**
 - **bs-cmcc-cur-an-fc-h**
 - **bs-cmcc-ssh-an-fc-h**
 - **bs-cmcc-mld-an-fc-h**
- **1** contains the static fields for the system: coordinates, mean sea surface level, mask and bathymetry: **BLKSEA_ANALYSIS_FORECAST_PHYS_007_001-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-007-001 (<http://marine.copernicus.eu/documents/QUID/CMEMS-BS-QUID-007-001.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.1 History of changes

- V1.1 related to BS-PHY V2.2 products, including revisions after V2.2 acceptance,
- V2.0 is related to BS-PHY V3, considering system evolution issues as described in the AAP 2017-2018
- V2.1 is moved to new CMEMS template and the description of static files is added
- V2.2 general revision
- V2.3 related to nominal start of BS-PHY products from 12:00 of J to 00:00 of J, change from NetCDF3 to NetCDF4, revision of the semantic of files to account CMEMS recommendations, new PUM template

II PRODUCT DESCRIPTION

General Information about products

Product name	BLKSEA_ANALYSIS_FORECAST_PHYS_007_001		
Geographical coverage	27.37°E → 41.96°E; 40.86°N → 46.80°N		
Variables	Potential Temperature Bottom Temperature Salinity Sea Surface Height Mixed Layer Depth Horizontal Velocity (zonal and meridional components)		
	Analysis		Forecast
Update frequency	Daily		Daily
Available time series	01/01/2017 up to real-time		10-days forecast
Target delivery time	Daily at 12 UTC		Daily at 12 UTC
Temporal resolution	<ul style="list-style-type: none">bs-cmcc-tem-an-fc-h, bs-cmcc-sal-an-fc-h, bs-cmcc-cur-an-fc-h, bs-cmcc-ssh-an-fc-h, bs-cmcc-mld-an-fc-h: hourly meanbs-cmcc-tem-an-fc-d, bs-cmcc-sal-an-fc-d, bs-cmcc-cur-an-fc-d, bs-cmcc-ssh-an-fc-d, bs-cmcc-mld-an-fc-d: daily mean		
Delivery mechanisms	Subsetter	DGF	FTP
Horizontal resolution	~3km		
Number of vertical levels	31		
Format	NetCDF CF1.0		

II.1 Details of the datasets

BLKSEA_ANALYSIS_FORECAST_PHYS_007_001	
bs-cmcc-tem-an-fc-d	contains the 3D <u>daily mean fields</u> : 3D potential temperature information from top to bottom and 2D bottom potential temperature information.
	thetao [°C] Potential temperature sea_water_potential_temperature
	bottomT [°C] Sea floor potential temperature sea_water_potential_temperature_at_sea_floor
bs-cmcc-sal-an-fc-d	contains the 3D <u>daily mean fields</u> : 3D salinity information from top to bottom.
	so [psu] Salinity sea_water_salinity
bs-cmcc-cur-an-fc-d	contains the 3D <u>daily mean fields</u> : 3D currents information from top to bottom.
	uo [m/s] Eastward ocean current velocity eastward_sea_water_velocity
	vo [m/s] Northward ocean current velocity northward_sea_water_velocity
bs-cmcc-ssh-an-fc-d	contains the 2D <u>daily mean fields</u> : 2D sea surface level information.
	zos [m] Sea surface height sea_surface_height_above_geoid
bs-cmcc-mld-an-fc-d	contains the 2D <u>daily mean fields</u> : 2D mixed layer thickness information.
	mld [m] Mixed layer thickness ocean_mixed_layer_thickness_defined_by_sigma_theta

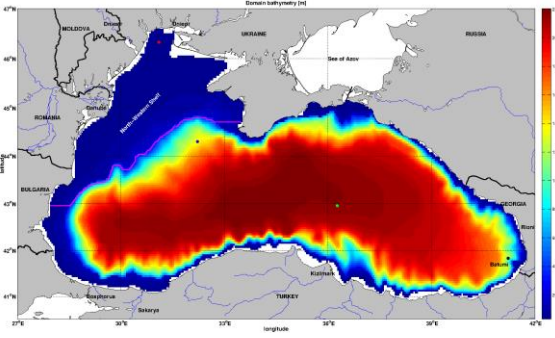
bs-cmcc-tem-an-fc-h	contains the 3D <u>hourly mean fields</u> : 3D potential temperature information from top to bottom and 2D bottom potential temperature information.
	thetao [°C] Potential temperature sea_water_potential_temperature
	bottomT [°C] Sea floor potential temperature sea_water_potential_temperature_at_sea_floor
bs-cmcc-sal-an-fc-h	contains the 3D <u>hourly mean fields</u> : 3D salinity information from top to bottom.
	so [psu] Salinity sea_water_salinity
bs-cmcc-cur-an-fc-h	contains the 3D <u>hourly mean fields</u> : 3D currents information from top to bottom.
	uo [m/s] Eastward ocean current velocity eastward_sea_water_velocity
	vo [m/s] Northward ocean current velocity northward_sea_water_velocity
bs-cmcc-tem-an-fc-h	contains the 3D <u>hourly mean fields</u> : 3D potential temperature information from top to 400m and 2D bottom potential temperature information.
	thetao [°C] Potential temperature sea_water_potential_temperature
	bottomT [°C] Sea floor potential temperature sea_water_potential_temperature_at_sea_floor
bs-cmcc-ssh-an-fc-h	contains the 2D <u>hourly mean fields</u> : 2D sea surface level information.
	zos [m] Sea surface height sea_surface_height_above_geoid
bs-cmcc-mld-an-fc-h	contains the 2D <u>hourly mean fields</u> : 2D mixed layer thickness information.
	mlotst [m]

	Mixed layer thickness ocean_mixed_layer_thickness_defined_by_sigma_theta
BLKSEA_ANALYSIS_FORECAST_PHYS_007_001-statics	contains the static fields for the system: coordinates, mean sea surface level, 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
	mdt [m] Mean dynamic topography sea_surface_height_above_geoid

II.2 Product System Description

The physical component of the Black Sea Forecasting System (BS-Currents) is a hydrodynamic model implemented over the whole Black Sea basin. The model horizontal grid resolution is $1/36^\circ$ in zonal resolution, $1/27^\circ$ in meridional resolution (ca. 3 km) and has 31 unevenly spaced vertical levels.

The hydrodynamics are supplied by the Nucleus for European Modeling of the Ocean (NEMO, v3.4). The model solutions are corrected by the variational assimilation (based on a 3DVAR scheme), originally developed for the Mediterranean Sea and later extended for the global ocean. The observations assimilated in the BS-Currents includes in-situ profiles, along-track sea level anomalies (SLA) and gridded sea surface temperature (SST) provided by Copernicus TACs.

Domain	BLKSEA (27.37°E → 41.96°E; 40.86°N → 46.80°N)
Resolution and grid	~3km ; regular grid ; 395 x 215
Geographic coverage	<p>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.</p> 
Algorithm	NEMO
Atmospheric forcings	ECMWF atmospheric forcing at 1/8 degree: 6-hourly analysis and 3-hourly for the first 3 days of forecast
Assimilation scheme	OceanVar (3DVAR)
Assimilated observations	Insitu vertical profiles of Temperature and Salinity from ARGO, XBT, CTD; Sea Level Anomaly (SLA) from available satellites Jason 2 & 3, Saral-Altika, Cryosat; Sentinel-3A, and Sentinel-3B; Sea Surface Temperature (SST)
Initial conditions	Simonov & Altman (1991) January Climatology (initial date: 2014/01/01)
Bathymetry	GEBCO 1min interpolated on the model grid

II.3 Processing information

BS-Currents Analysis and Forecast are produced using two different cycles. One cycle is daily, in which the system produces 3-day analysis, 1-day hindcast and 10-days forecast every day. The second cycle is weekly, in which on Tuesday the system produces 14-day analysis, 1-day hindcast and 10-days of forecast in order to incorporate a large number of in-situ and satellite observations into the data assimilation. Irrespective of the cycle the starting fields for the initialization of each forecast are taken as the instantaneous field at 12:00:00 UTC of day J resulting from the chain of daily analyses done for the previous 3 (or 14) days and 1-day hindcast.

II.3.1 Update Time

The product is updated daily at 12:00 UTC for the daily and hourly datasets.

II.3.2 Time coverage

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

II.3.3 Time averaging

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_PHYS_007_001 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 CIS.

The scheme is: **datasetname_nnnnnnnnnnnnn.nc**

where :

.datasetname is a character string within one of the following :

- bs-cmcc-tem-an-fc-d
- bs-cmcc-sal-an-fc-d
- bs-cmcc-cur-an-fc-d
- bs-cmcc-ssh-an-fc-d
- bs-cmcc-mld-an-fc-d
- bs-cmcc-tem-an-fc-h
- bs-cmcc-sal-an-fc-h
- bs-cmcc-cur-an-fc-h
- bs-cmcc-ssh-an-fc-h
- bs-cmcc-mld-an-fc-h

. nnnnnnnnnnnnnnn: 13 digit integer corresponding to the current time (download time) in milliseconds since January 1, 1970 midnight UTC.

.nc: standard NetCDF filename extension.

The fields **tem/sal/ssh/cur/mld** are respectively for the variable of Potential Temperature (**tethao**), Bottom Temperature (**bottomT**) Salinity (**so**), Sea Surface Height (**zos**), Velocity (**uo, vo**) and Mixed Layer Depth (**mldst**).

Example for a file of Salinity:

bs-cmcc-sal-an-fc-d_1303461772348.nc

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

BLKSEA_ANALYSIS_FORECAST_PHYS_007_001 files nomenclature when downloaded through CMEMS FTP is based as follows:

{valid date}_{freq flag}-{producer}-{parameter}-{config}-{region}-{bul date}_{producttype}-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, d = daily)
- **producer** is a short version of the CMEMS production unit
- **config** identifies the producing system and configuration
- **region** is a two 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 (06, 07, 08 or 09) and yy is an incremental version number

Table 1 shows the nomenclature for the BLKSEA_ANALYSIS_FORECAST_PHYS_007_001 products.

Table 1 Description of the nomenclature for BLKSEA_ANALYSIS_FORECAST_PHYS_007_001

valid date	YYYYMMDD
freq flag	d (daily) h (hourly)
producer	CMCC
config	BSeas3
region	BS
parameter	TEMP PSAL ASLV RFVL AMXL
bul date	bYYYYYMMDD
product type	fc (forecast) an (analysis) sm (hindcast)
file version	09.00

Example for a forecast file of Salinity:

20161001_d-CMCC--PSAL-BSeas3-BS-b20161002_fc-sv09.00.nc

This is the mean field of salinity centered at 12:00 UTC of the 1st October 2016, and the time coverage is from 00:00 UTC to 23:59 UTC of the 1st October 2016 (see section IV.8).

20161001_h-CMCC--PSAL-BSeas3-BS-b20161002_fc-fv09.00.nc

This file contains the 24 hourly mean fields of salinity, each one centered at 30' of every hour from from 00:00 UTC to 23:59 UTC of the 1st October 2016 (see section IV.9).

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.3.1 File Size

DATASET NAME	FILE NAME	DIMENSION [MB]
bs-cmcc-ssh-an-fc-d	{date1}_d-CMCC--ASLV-BSeas3-BS-b{date2}_fc-sv09.00.nc {date1}_d-CMCC--ASLV- BSeas3-BS-b{date2}_sm-sv09.00.nc {date1}_d-CMCC--ASLV- BSeas3-BS-b{date2}_an-sv09.00.nc	0.151
bs-cmcc-sal-an-fc-d	{date1}_d-CMCC--PSAL- BSeas3-BS-b{date2}_fc-sv09.00.nc {date1}_d-CMCC--PSAL- BSeas3-BS-b{date2}_sm-sv09.00.nc {date1}_d-CMCC--PSAL- BSeas3-BS-b{date2}_an-sv09.00.nc	3.1
bs-cmcc-tem-an-fc-d	{date1}_d-CMCC--TEMP- BSeas3-BS-b{date2}_fc-sv09.00.nc {date1}_d-CMCC--TEMP- BSeas3-BS-b{date2}_sm-sv09.00.nc {date1}_d-CMCC--TEMP- BSeas3-BS-b{date2}_an-sv09.00.nc	3.4
bs-cmcc-cur-an-fc-d	{date1}_d-CMCC--RFVL- BSeas3-BS-b{date2}_fc-sv09.00.nc {date1}_d-CMCC--RFVL- BSeas3-BS-b{date2}_sm-sv09.00.nc {date1}_d-CMCC--RFVL- BSeas3-BS-b{date2}_an-sv09.00.nc	7.7
bs-cmcc-mld-an-fc-d	{date1}_d-CMCC--AMXL – BSeas3-BS-b{date2}_fc-sv09.00.nc {date1}_d-CMCC--AMXL – BSeas3-BS-b{date2}_sm-sv09.00.nc {date1}_d-CMCC--AMXL – BSeas3-BS-b{date2}_an-sv09.00.nc	0.151

bs-cmcc-ssh-an-fc-h	{date1}_h-CMCC--ASLV- BSeas3-BS-b{date2}_fc- sv09.00.nc {date1}_h-CMCC--ASLV- BSeas3-BS-b{date2}_sm- sv09.00.nc {date1}_h-CMCC--ASLV- BSeas3-BS-b{date2}_an- sv09.00.nc	3.6
bs-cmcc-sal-an-fc-h	{date1}_h-CMCC--PSAL- BSeas3-BS-b{date2}_fc- sv09.00.nc {date1}_h-CMCC--PSAL- BSeas3-BS-b{date2}_sm- sv09.00.nc {date1}_h-CMCC--PSAL- BSeas3-BS-b{date2}_an- sv09.00.nc	74
bs-cmcc-tem-an-fc-h	{date1}_h-CMCC--TEMP- BSeas3-BS-b{date2}_fc- sv09.00.nc {date1}_h-CMCC--TEMP- BSeas3-BS-b{date2}_sm- sv09.00.nc {date1}_h-CMCC--TEMP- BSeas3-BS-b{date2}_an- sv09.00.nc	80
bs-cmcc-cur-an-fc-h	{date1}_h-CMCC--RFVL- BSeas3-BS-b{date2}_fc- sv09.00.nc {date1}_h-CMCC--RFVL- BSeas3-BS-b{date2}_sm- sv09.00.nc {date1}_h-CMCC--RFVL- BSeas3-BS-b{date2}_an- sv09.00.nc	184
bs-cmcc-mld-an-fc-h	{date1}_h-CMCC--AMXL- BSeas3-BS-b{date2}_fc- sv09.00.nc {date1}_h-CMCC--AMXL- BSeas3-BS-b{date2}_sm- sv09.00.nc {date1}_h-CMCC--AMXL- BSeas3-BS-b{date2}_an- sv09.00.nc	0.361
BLKSEA_ANALYSIS_FORECAST_PHYS_007_001-statics	BS-MFC_007_001_\${field}.nc	0.713

* Dimensions for **one day** of forecast, hindcast or analysis.

IV.4 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.5 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.6 Structure and semantic of netCDF maps files

Table 8 Dimensions and variables included in the files NetCDF of BLKSEA_ANALYSIS_FORECAST_PHY_007_008.

DIMENSIONS	VARIABLES		
	NAME	DIMENSIONS	TYPE
lon=395 lat=215 depth=31 time=1	lon	lon	float
	lat	lat	float
	depth	depth	float
	time	time	int
	zos	time,lat,lon	float
	thetao	time,depth,lat,lon	float
	so	time,depth,lat,lon	float
	uo	time,depth,lat,lon	float
	vo	time,depth,lat,lon	float
	m1otst	time,lat,lon	float
	bottomT	time,lat,lon	float

For 20170101_d-CMCC--TEMP-BSeas3-BS-b20190115_sm-sv09.00.nc:

```
netcdf \20170101_d-CMCC--TEMP-BSeas3-BS-b20190115_sm-sv09.00 {
dimensions:
    lon = 215 ;
    lat = 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 lat (lat) ;  
        lat:units = "degrees_north" ;  
        lat:long_name = "latitude" ;  
        lat:standard_name = "latitude" ;  
        lat:axis = "Y" ;  
        lat:valid_min = 40.86f ;  
        lat:valid_max = 46.80f ;  
    float lon (lon) ;  
        lon:units = "degrees_east" ;  
        lon:long_name = "longitude" ;  
        lon:standard_name = "longitude" ;  
        lon:axis = "X" ;  
        lon:valid_min = 27.37f ;  
        lon:valid_max = 41.96f ;  
    float tethao(time, depth, lat, lon) ;  
        tethao:_FillValue = 1.e+20f ;  
        tethao:missing_value = 1.e+20f ;  
        tethao:units = "degC" ;  
        tethao:long_name = "temperature" ;  
        tethao:standard_name = "sea_water_potential_temperature" ;  
        phyc:coordinates = "time depth lat lon" ;  
    float bottomT(time,lat, lon) ;  
        bottomT:_FillValue = 1.e+20f ;  
        bottomT:missing_value = 1.e+20f ;
```

```
        bottomT:units = "degC" ;
        bottomT:long_name = "sea floor potential temperature" ;
        bottomT:standard_name = "sea_water_potential_temperature_at_sea_floor"
;

        bottomT:coordinates = "time lat lon" ;

// global attributes:
        :Conventions = "CF-1.0" ;
        :references = "Please check in CMEMS catalogue the INFO section for
product BLKSEA_ANALYSIS_FORECAST_PHYS_007_001 - http://marine.copernicus.eu/" ;
        :institution = "Centro Euro-Mediterraneo sui Cambiamenti Climatici -
CMCC, Italy" ;
        :source = " BS EAS3" ;S
        :comment = "Please check in CMEMS catalogue the INFO section for
product BLKSEA_ANALYSIS_FORECAST_PHYS_007_001 - 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 = "Potential Temperature (3D) - Daily Mean" ;
}
```

