PRODUCT USER MANUAL

for the Black Sea Physics Reanalysis Product

BLKSEA_REANALYSIS_PHYS_007_004

Issue: 1.0

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CHANGE RECORD

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	09.08.16	all	Revision	A. Storto	
	05.09.16		Final check	S. Ciliberti	
1.1	02.10.16		Update version after PIT v1.2 acceptance:	S. Ciliberti, S. Creti'	
2.0	20.11.16	all	First version of document for V3 products	S. Ciliberti	
	17.01.16		Final version	S. Ciliberti, F. Macchia	
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	22.10.18	New §IV.7	Adding description of static files	S. Ciliberti	
2.2	21.01.19	all	General revision	R. Lecci, S. Ciliberti	C. Derval

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GLOSSARY AND ABBREVIATIONS

BS	Black Sea
CF	Climate Forecast (convention for NetCDF)
CLS	Collecte Localisation Satellites
CMAP	CPC Merged Analysis of *Precipitation*
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
FAQ	Frequently Asked Question
FTP	File Transfer Protocol
HZG	Helmholtz-Zentrum Geesthacht
Meridional Velocity	West to East component of the horizontal velocity vector
MFC	Monitoring and Forecasting Centre
NEMO	Nucleous 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)

OSI	Ocean and Sea Ice
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
WW3	WaveWatch-III
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 reanalysis product **BLKSEA_REANALYSIS_PHYS_007_004**. An archive of reanalysis since 01/01/1992 regularly updated (see product improvements pages http://marine.copernicus.eu/services-portfolio/product-improvements/).is available on the CMEMS server.

It contains the reanalysis product of the physical state of the Black Sea, composed by 3D, daily and monthly mean fields of Potential Temperature, Salinity, Zonal and Meridional Velocity, and by 2D, daily and monthly mean fields of Sea Surface Height and Mixed Layer Depth.

BLKSEA_REANALYSIS_PHYS_007_004 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.
    - **sv04-bs-cmcc-tem-rean-d**
    - **sv04-bs-cmcc-cur-rean-d**
    - **sv04-bs-cmcc-ssh-rean-d**
    - **sv04-bs-cmcc-mld-rean-d**
    - **sv04-bs-cmcc-sal-rean-d**
- 5 contain the 3D monthly 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.
    - **sv04-bs-cmcc-tem-rean-m**
    - **sv04-bs-cmcc-sal-rean-m**
    - **sv04-bs-cmcc-cur-rean-m**
    - **sv04-bs-cmcc-ssh-rean-m**
    - **sv04-bs-cmcc-mld-rean-m**
- **1** contains the static fields for the system: coordinates, mean sea surface level, mask and bathymetry: **BLKSEA_REANALYSIS_PHYS_007_004-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 reanalysis system is described in the Quality Information Document (QUID) CMEMS-BS-QUID-007-004 (http://marine.copernicus.eu/documents/QUID/CMEMS-BS-QUID-007-004.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

- Versions v1.1 and v1.0 of CMEMS-BS-PUM_007_004 are related to V2.2 products,
- Version v1.1, in particular, includes revision after the V2.2 acceptance,
- Version v2.0 is related to CMEMS-BS-PUM_007_004 for V3 products,
- Version v2.1 corresponds to update version for V4 acceptance
    - It has been updated in Oct 2018 to add the description of static files
- Version v2.2 corresponds to update version for Q2/2019 acceptance, which includes static datasets

II HOW TO DOWNLOAD A PRODUCT

II.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

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.

II.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

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 FTP Service.

II.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

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 (DGF) Service.

III DESCRIPTION OF THE PRODUCT SPECIFICATION

III.1 General Information

Table 1 provides information about reanalysis products.

Table 1 BLKSEA_REANALYSIS_PHYS_007_004 Product Specification

Product Specification	**BLKSEA_REANALYSIS_PHYS_007_004**
Geographical coverage	27.73°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)
Available time series	From 1992 Regularly updated (see product improvements pages (http://marine.copernicus.eu/services-portfolio/product-improvements/)
Temporal resolution	Daily means and monthly means
Target delivery time	Once
Delivery mechanism	CMEMS Information System (Subsetter, CMEMS FTP, DGF)
Horizontal resolution	About 3 km (1/36° zonal resolution, 1/27° meridional resolution)
Number of vertical levels	31
Format	Netcdf 3.0 CF1.0

Detailed information on the systems and products are on CMEMS web site: http://marine.copernicus.eu/ .

III.2 Production subsystem description

III.2.1 Brief overview

The physical component of the Black Sea Reanalysis System (BS-Currents) is a hydrodynamic model implemented over the whole Black Sea basin. The model horizontal grid resolution is 1/36° in zonal resolution, 1/27° 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 the U.K. MetOffice Hadley Center and the Copernicus TACs.

III.2.2 Detailed description

The numerical ocean model for the BS-Currents covers the entire Black Sea area and the hydrodynamic code is based on NEMO (Nucleus for European Modeling of the Ocean, Madec et al., 2012). The primitive equations are discretized on a horizontal grid with 1/27° resolution in zonal direction and 1/36° resolution in meridional direction and a vertical grid of 31 levels with partial-steps, integrated in time using a linear free-surface formulation. The horizontal spatial resolution of 1/27°x1/36° is chosen in order to have the same Cartesian resolution in latitude and longitude, approximately 3 km at the model domain latitudes, which is conforming to the mesoscale eddy-resolving scale (Rossby radius of deformation in the Black Sea ~20 km). The Turbulent Kinetic Energy vertical mixing is used as turbulent closure scheme. Bathymetry is based on GEBCO dataset (www.gebco.net). The spatial domain implemented in NEMO is shown in Figure 1.

The BS-Currents model for reanalysis uses the ECMWF ERA-Interim atmospheric reanalysis (about 0.75° of spatial resolution). The atmospheric fields are provided 3-hourly. In particular, the atmospheric fields used are: zonal and meridional components of 10 m wind (ms^{-1}), total cloud cover (%), 2 m air temperature (K), 2 m dew point temperature (K) and mean sea level pressure (Pa). Precipitation fields over the basin are from GPCP rainfall monthly data (Adler et al., 2003; Huffman et al., 2009). The atmospheric fields are used for computing the momentum, heat and water fluxes at the air-sea interface based on the Black Sea bulk formulae (Grayek et al., 2010).

Concerning the land forcing, in particular the river runoff contribution, an estimate of the inflow using monthly mean dataset provided by SESAME project (Ludwig et al., 2009) is used. The impact of the Bosporus Strait on the Black Sea dynamics is accounted for in terms of a surface boundary condition, taking into account the barotropic transport, which has been computed to balance the freshwater fluxes on monthly basis (Stanev and Beckers, 1999, Peneva et al., 2001).

The data assimilation system of BS-Currents is based on a three-dimensional variational (3DVAR) assimilation scheme, originally developed for the Mediterranean Sea (Dobricic and Pinardi, 2008) and later extended for the global ocean (Storto et al., 2011; Storto et al., 2015). The system is called OceanVar.

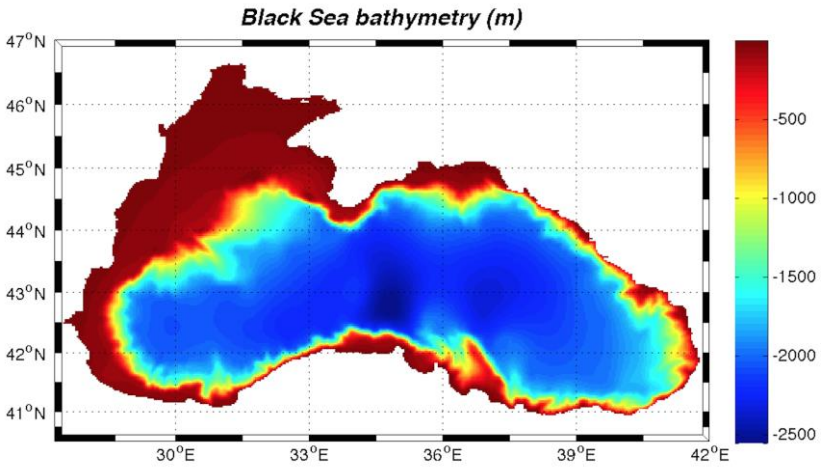

Figure 1: The BS-Currents model domain

The variational cost function is solved with the incremental formulation (Courtier et al. 1994). The pre-conditioning of the cost function minimization is achieved through a change-of-variable transformation. In the BS-Currents implementation of the OceanVar, the control vector in physical space is formed by the three-dimensional fields of temperature and salinity. The assimilation frequency is 3-daily, with a 6-day assimilation time-window. Background-error covariances are decomposed in vertical covariances and horizontal correlations. The former are modelled through 15-mode multi-variate Empirical Orthogonal Functions (EOFs). EOFs were calculated from a dataset of anomalies with respect to the long-term mean of a model simulation without data assimilation, using the full model resolution. Horizontal correlations are modelled through a third-order recursive filter (Farina et al., 2015), with spatially inhomogeneous correlation length-scales (Storto et al., 2014) specified as a function of the distance from coast, ranging approximately from 9 to 27 km. The assimilation of sea level anomaly (SLA) is performed by imposing local hydrostatic adjustments as multi-variate balance between the sea level innovation and vertical profiles of temperature and salinity (Storto et al., 2011). The observations assimilated in the BS-Currents include: i) in-situ hydrographic profiles (mostly Argo floats) from the UK MetOffice Hadley Center EN4 dataset; ii) along-track sea level anomalies, currently from AltiKa, Cryosat-2 and Jason-2, pre-processed and distributed by the CMEMS Sea level TAC. The mean dynamic topography for the assimilation of SLA is computed from a 4-year (2011-2014) model mean sea surface height, rescaled through gridded sea level products from the CMEMS Sea level TAC to match the reference period for altimetry (1993-2012); iii) gridded sea surface temperature (SST) observations provided by the CMEMS Ocean and sea ice TAC The assimilation of SST assumes that satellite observations are co-located with the first model level. In the BS-MFC the observation pre-processing includes a background quality-check, which rejects observations whose square departure from the background exceeds the sum of background and observation error variances by a certain threshold. The threshold is currently set to 3.3. For satellite observations (SLA, SST), a horizontal thinning is also applied, approximately to retain one observation only every 6 km. The observational error specification is vertically varying for the in-situ and horizontally varying for the satellite observations, and is based on a prior analysis of the assimilation output statistics.

III.2.3 Processing information

The Black Sea physical reanalysis has been initialized by a temperature and salinity state calculated as the mean state over the first week of January during 2012-2016 from a previous assimilation experiment.

III.3 Details of datasets

Table 2 List of the variables for each dataset and their names in the NetCDF

BLKSEA_REANALYSIS_PHYS_007_004		
DATASETS	VARIABLES AND UNITS	NAME OF VARIABLES IN THE NETCDF FILE
sv04-bs-cmcc-cur-rean-d	Zonal Velocity [m/s] Meridional Velocity [m/s]	vozocrtx vomecrty
sv04-bs-cmcc-ssh-rean-d	Sea Surface Height [m]	sossheig
sv04-bs-cmcc-tem-rean-d	Potential Temperature [degrees_C] Bottom Temperature [degrees_C]	votemper seabed_temp
sv04-bs-cmcc-sal-rean-d	Salinity [PSU]	vosaline
sv04-bs-cmcc-mld-rean-d	Mixed Layer Depth [m]	somxl010
sv04-bs-cmcc-cur-rean-m	Zonal Velocity [m/s] Meridional Velocity [m/s]	vozocrtx vomecrty
sv04-bs-cmcc-ssh-rean-m	Sea Surface Height [m]	sossheig
sv04-bs-cmcc-tem-rean-m	Potential Temperature [degrees_C] Bottom Temperature [degrees_C]	votemper seabed_temp
sv04-bs-cmcc-sal-rean-m	Salinity [PSU]	vosaline
sv04-bs-cmcc-mld-rean-m	Mixed Layer Depth [m]	somxl010

BLKSEA_REANALYSIS_PHYS_007_004-statics	Cell dimension along X axis [m]	e1t
	Cell dimension along Y axis [m]	e2t
	Cell dimension along Z axis [m]	e3t
	Land-sea mask: 1 = sea ; 0 = land [1]	mask
	Bathymetry [m]	deptho
	Model level number at sea floor [1]	deptho_lev
	Mean dynamic topography [m]	mdt

IV NOMENCLATURE OF FILES

The nomenclature of the downloaded files differs on the basis of the chosen download mechanism **Subsetter**,**MFTP** or **DGF** service.

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

BLKSEA_REANALYSIS_PHYS_007_004 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 :

- sv04-bs-cmcc-tem-rean-d
- sv04-bs-cmcc-sal-rean-d
- sv04-bs-cmcc-cur-rean-d
- sv04-bs-cmcc-ssh-rean-d
- sv04-bs-cmcc-mld-rean-d
- sv04-bs-cmcc-tem-rean-m
- sv04-bs-cmcc-sal-rean-m
- sv04-bs-cmcc-cur-rean-m
- sv04-bs-cmcc-ssh-rean-m
- sv04-bs-cmcc-mld-rean-m

. nnnnnnnnnnnnn: 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 (**votemper**), Bottom Temperature (**seabed_temp**), Salinity (**vosaline**), Sea Surface Height (**sossheig**), Velocity (**vozocrtx**, **vomecrty)** and Mixed Layer Depth **(somxl010).**

Example for a file of Salinity:

`sv04-bs-cmcc-sal-rean-d_1303461772348.nc`

IV.2 Nomenclature of files when downloaded through the CMEMS FTP Service

BLKSEA_REANALYSIS_PHYS_007_004 files nomenclature when downloaded through CMEMS FTP is based as follows:

{valid date}_{freq flag}-{producer}--{parameter}-{config}-{region}-{bul date}_{producttype}-fv{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, re for reanalysis.
- **file version** is xx.yy where xx is the CMEMS version (06, 07 or 08) and yy is an incremental version number

Table 3 shows the nomenclature for the BLKSEA_REANALYSIS_PHYS_007_004 products.

Table 3 Description of the nomenclature for BLKSEA_REANALYSIS_PHYS_007_004

valid date	YYYYMMDD
freq flag	d (daily) m (monthly)
producer	CMCC
config	BSe2r2
region	BS
parameter	TEMP PSAL ASLV RFVL AMXL
bul date	bYYYYMMDD
product type	re (reanalysis)
file version	08.00

Example for a reanalysis file of Salinity:

`20050101_d-CMCC--PSAL-BSe2r2-BS-b20180101_re-fv08.00.nc`

This is the daily mean at 00:00 UTC of the 1st October 2005, and the time coverage is from noon (12:00 UTC) of the 31h December 2004 to noon (12:00 UTC) of the 1st January 2005 (see section IV.8).

`20050101_m-CMCC--PSAL-BSe2r2-BS-b20180101_re-fv08.00.nc`

This is the monthly mean of October 2005, computed from noon (12:00 UTC) of 31st December 2004 to noon (12:00 UTC) of the 31st January 2005 (see section IV.8).

IV.3 Nomenclature of files when downloaded through the CMEMS DGF Service

BLKSEA_REANALYSIS_PHYS_007_004 files nomenclature when downloaded through the CMEMS Web Portal DGF is based on product dataset name and a numerical reference related to the request date on the CIS.

The scheme is:

datasetname_nnnnnnnnnnnn.zip

where :

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

- sv04-bs-cmcc-tem-rean-d
- sv04-bs-cmcc-sal-rean-d
- sv04-bs-cmcc-cur-rean-d
- sv04-bs-cmcc-ssh-rean-d
- sv04-bs-cmcc-mld-rean-d
- sv04-bs-cmcc-tem-rean-m
- sv04-bs-cmcc-sal-rean-m
- sv04-bs-cmcc-cur-rean-m
- sv04-bs-cmcc-ssh-rean-m
- sv04-bs-cmcc-mld-rean-m

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

The fields **tem/sal/ssh/cur/mld** are respectively for the variable of Potential Temperature (**votemper**), Bottom Temperature (**seabed_temp**), Salinity (**vosaline**), Horizontal Velocity (**vozocrtx**, **vomecrty**), Sea Surface Height (**sossheig**) and Mixed Layer Depth **(somxl010).**

Example:

`sv04-bs-cmcc-tem-rean-d_1303461772348.zip`

The zip file contains one or more files, depending on the number of selected days, whose name is

{valid date}_{freq flag}-{producer}--{parameter}-{config}-{region}-{bul date}_{product type}-fv{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 (d = daily, h= hourly)
- **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, re for reanalysis.
- **file version** is xx.yy where xx is the CMEMS version (06, 07 and 08) and yy is an incremental version number

Table 4 shows the nomenclature for the BLKSEA_REANALYSIS_PHYS_007_004 products.

Table 4 Description of the nomenclature for BLKSEA_REANALYSIS_PHYS_007_004

valid date	YYYYMMDD
freq flag	d (daily) m (monthly)
producer	CMCC
config	BSe2r2
region	BS
parameter	TEMP PSAL ASLV RFVL AMXL
bul date	bYYYYYMMDD
product type	re (reanalysis)
file version	08.00

Example for a reanalysis file of Salinity:

`20050101_d-CMCC--PSAL-BSe2r2-BS-b20180101_re-fv08.00.nc`

This is the daily mean at 00:00 UTC of the 1st October 2005, and the time coverage is from noon (12:00 UTC) of the 31h December 2004 to noon (12:00 UTC) of the 1st January 2005 (see section IV.8).

20050101_m-CMCC--PSAL-BSe2r2-BS-b20180101_re-fv08.00.nc

This is the monthly mean of October 2005, computed from noon (12:00 UTC) of 31st December 2004 to noon (12:00 UTC) of the 31st January 2005 (see section IV.8).

IV.4 Grid

The horizontal grid step is regular in latitude and longitude with a resolution of 1/36° x 1/27° of degree (~3 Km). The vertical grid is composed of 31 unevenly spaced vertical levels (see §IV.6).

In Table 5 there is the description of the grid and the spatial coverage for each variable for the BLKSEA_REANALYSIS_PHYS_007_004 products.

Table 5: Description of grid and spatial coverage

BLKSEA_REANALYSIS_PHYS_007_004							
VARIABLE	LON MIN	LON MAX	LAT MIN	LAT MAX	XPOINT	YPOINT	ZPOINT
Potential Temperature	27.32°E	41.96°E	40.86°N	46.80°N	215	395	31
Bottom Temperature	27.32°E	41.96°E	40.86°N	46.80°N	215	395	1
Salinity	27.32°E	41.96°E	40.86°N	46.80°N	215	395	31
Sea Surface Height	27.32°E	41.96°E	40.86°N	46.80°N	215	395	1
Horizontal Velocity	27.32°E	41.96°E	40.86°N	46.80°N	215	395	31
Mixed Layer Depth	27.32°W	41.96°E	40.86°N	46.80°N	215	395	1

IV.5 Domain coverage

The blue area in Figure 2 represents the spatial coverage of the BLKSEA_REANALYSIS_PHYS_007_004 products.

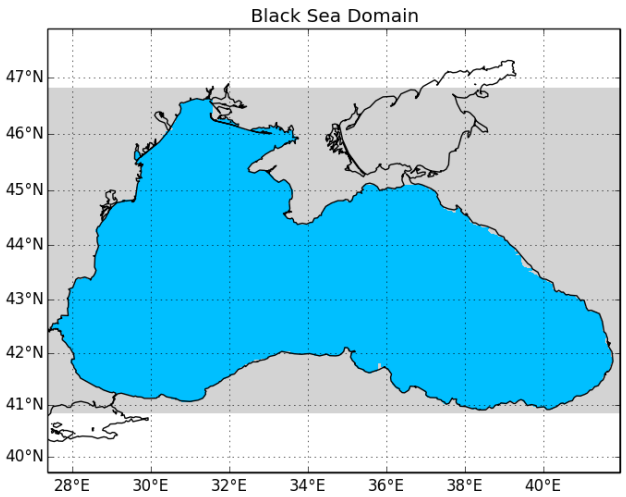

Figure 2: Spatial coverage of the BLKSEA_REANALYSIS_PHYS_007_004 products (blue zone)

Grid type is the following standard projection:

Regular projection: longitude and latitude step is constant	

IV.6 Vertical Levels

BLKSEA_REANALYSIS_PHYS_007_004 product is computed on 31 unevenly spaced vertical levels: the thickness of the layer at the surface is about 5 meters, and increases up to 300 meters at the bottom. All the 31 levels are released. The depths are (in meters): 2.501079, 7.511193, 12.5362, 17.5834, 22.66374, 27.79346, 32.99686, 38.31007, 43.78698, 49.50773, 55.59151, 62.21519, 69.64064, 78.25402, 88.6217, 101.5674, 118.2747, 140.4134, 170.2776, 210.8995, 266.0667, 340.1394, 437.566, 562.0992, 715.9152, 899.0139, 1109.219, 1342.778, 1595.243, 1862.253, 2140.021.

IV.7 Temporal extend of reanalysis stored on delivery mechanism

BLKSEA_REANALYSIS_PHYS_007_004 temporal coverage is 26 years, from 1992 to 2017. The reanalysis has been produced using the e2r1.

IV.8 Other information: mean centre of products, missing value, production chain and file dimension

IV.8.1 Mean Centre of Products

BLKSEA_REANALYSIS_PHYS_007_004 products are available as daily mean and monthly mean fields.

IV.8.2 Missing Value

The **missing value** for the BLKSEA_REANALYSIS_PHYS_007_004 products is 1e+20.

IV.8.3 Production Chain

The reanalysis processing chain is run once. The model is forced to the surface by 0.75° horizontal-resolution ERA-Interim atmospheric reanalysis. Model solution is corrected every 3 days by the OceanVar assimilation scheme of the available satellite (SLA), in situ data (XBT, CTD and ARGO) and satellite SST (SST). Satellite OA-SST data are used for the surface heat fluxes correction.

IV.8.4 File Dimension

Table 6 describes the dimensions of the files for reanalysis for one day.

DATASET NAME	NAME OF FILE	DIMENSION [MB]
sv04-bs-cmcc-sal-rean-d	{date1}_d-CMCC--PSAL-BSe2r2-BS-b{date2}_re-fv08.00.nc	11
sv04-bs-cmcc-tem-rean-d	{date1}_d-CMCC--TEMP-BSe2r2-BS-b{date2}_re-fv08.00.nc	11
sv04-bs-cmcc-cur-rean-d	{date1}_d-CMCC--RFVL-BSe2r2-BS-b{date2}_re-fv08.00.nc	21
sv04-bs-cmcc-ssh-rean-d	{date1}_d-CMCC--ASLV-BSe2r2-BS-b{date2}_re-fv08.00.nc	0.336
sv04-bs-cmcc-mld-rean-d	{date1}_d-CMCC--AMXL-BSe2r2-BS-b{date2}_re-fv08.00.nc	0.336
sv04-bs-cmcc-ssh-rean-m	{date1}_m-CMCC--ASLV-BSe2r2-BS-b{date2}_re-fv08.00.nc	0.336
sv04-bs-cmcc-sal-rean-m	{date1}_m-CMCC--PSAL-BSe2r2-BS-b{date2}_re-fv08.00.nc	11
sv04-bs-cmcc-tem-rean-m	{date1}_m-CMCC--TEMP-BSe2r2-BS-b{date2}_re-fv08.00.nc	11
sv04-bs-cmcc-cur-rean-m	{date1}_m-CMCC--RFVL-BSe2r2-BS-b{date2}_re-fv08.00.nc	21
sv04-bs-cmcc-mld-rean-m	{date1}_m-CMCC--AMXL-BSe2r2-BS-b{date2}_re-fv08.00.nc	0.336
BLKSEA_REANALYSIS _PHYS_007_004-statics	BS-MFC_007_004_${field}.nc	0.713

Table 6: Names and dimensions of the files

Table 7 describes the dimensions of the entire time series for each dataset.

Table 7: Names and dimensions of the entire datasets (1992/01/01-2017/12/31)

DATASET NAME	DIMENSION [MB]
sv04-bc-cmcc-ssh-rean-d	3100
sv04-bc-cmcc-sal-rean-d	93200
sv04-bc-cmcc-tem-rean-d	96200
sv04-bc-cmcc-cur-rean-d	186400
sv04-bc-cmcc-mld-rean-d	3100
sv04-bc-cmcc-ssh-rean-m	102.3
sv04-bc-cmcc-sal-rean-m	3100
sv04-bc-cmcc-tem-rean-m	3200
sv04-bc-cmcc-cur-rean-m	6200
sv04-bc-cmcc-mld-rean-m	102.3
BLKSEA_REANALYSIS_PHYS_007_004-statics	0.713

V FILE FORMAT

V.1 Netcdf

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 UnidataNetCDF 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.

V.2 Structure and semantic of NetCDF maps files

Table 8: Dimensions and variables included in the files NetCDF of BLKSEA_REANALYSIS_PHYS_007_004

DIMENSIONS	VARIABLES		
	NAME	DIMENSIONS	TYPE
lon=395	Lon	lon	float
	Lat	lat	float
	Depth	depth	float
	Time	time	int

lat=215 depth=31 time=1	sossheig	time,lat,lon	float
	votemper	time,depth,lat,lon	float
	seabed_temp	time, lat, lon	float
	vosaline	time,depth,lat,lon	float
	vozocrtx	time,depth,lat,lon	float
	vomecrty	time,depth,lat,lon	float
	somxl010	time,lat,lon	float

For 20050101_d-CMCC--TEMP-BSe2r2-BS-b20180101_re-fv08.00.nc

netcdf \20050101_d-CMCC--TEMP-BSe2r2-BS-b20180101_re-fv08.00 {

dimensions:

depth = 31 ;

lat = 215 ;

lon = 395 ;

time = UNLIMITED ; // (1 currently)

variables:

float depth(depth) ;

depth:axis = "Z" ;

depth:units = "m" ;

depth:positive = "down" ;

depth:valid_min = 2.5010792f ;

depth:valid_max = 2140.021f ;

depth:standard_name = "depth" ;

depth:long_name = "depth" ;

float lat(lat) ;

lat:units = "degrees_north" ;

lat:long_name = "latitude" ;

lat:standard_name = "latitude" ;

lat:axis = "Y" ;

lat:valid_max = 46.80f;

lat:valid_min = 40.86f ;

float lon(lon) ;

lon:units = "degrees_east" ;

lon:long_name = "longitude" ;

lon:standard_name = "longitude" ;

lon:axis = "X" ;

lon:valid_max = 41.96f ;

lon:valid_min = 27.32f ;

int time(time) ;

time:units = "seconds since 1970-01-01 00:00:00" ;

time:calendar = "standard" ;

time:long_name = "time" ;

time:standard_name = "time" ;

time:axis = "T" ;

float votemper(time, depth, lat, lon) ;

votemper:_FillValue = 1.e+20f ;

votemper:missing_value = 1.e+20f ;

votemper:valid_min = 4.f ;

votemper:valid_max = 35.f ;

votemper:units = "degrees_C" ;

votemper:coordinates = "time depth lat lon" ;

votemper:standard_name = "sea_water_potential_temperature" ;

votemper:long_name = "temperature" ;

float seabed_temp(time, lat, lon) ;

seabed_temp:_FillValue = 1.e+20f ;

seabed_temp:missing_value = 1.e+20f ;

seabed_temp:valid_min = 4.f ;

seabed_temp:valid_max = 35.f ;

seabed_temp:units = "degrees_C" ;

seabed_temp:coordinates = "time lat lon" ;

seabed_temp:standard_name = "sea_water_potential_temperature_at_sea_floor" ;

seabed_temp:long_name = " sea floor potential temperature" ;

// global attributes:

:bulletin_type = "reanalysis" ;

:institution = "Centro Euro-Mediterraneo sui Cambiamenti Climatici - Lecce, Italy" ;

:source = "BS e2r2" ;

:contact = "servicedesk.cmems@mercator-ocean.eu" ;

:references = "Please check in CMEMS catalogue the INFO section for product BLKSEA_REANLYSIS_PHYS_007_004 - http://marine.copernicus.eu" ;

:comment = "Please check in CMEMS catalogue the INFO section for product BLKSEA_REANALYSIS_PHYS_007_004 - http://marine.copernicus.eu" ;

:Conventions = "CF-1.0" ;

:bulletin_date = 20180101" ;

:field_type = "daily_mean_centered_at_time_field" ;

:title = "Potential Temperature (3D), Bottom Temperature (2D) - Daily Mean " ;

}

For 20050101_m-CMCC--TEMP-BSe2r2-BS-b20180101_re-fv08.00.nc

netcdf \20050101_m-CMCC--TEMP-BSe2r2-BS-b20180101_re-fv08.00 {

dimensions:

depth = 31 ;

lat = 215 ;

lon = 395 ;

time = UNLIMITED ; // (1 currently)

variables:

float depth(depth) ;

depth:axis = "Z" ;

depth:units = "m" ;

depth:positive = "down" ;

depth:valid_min = 2.5010792f ;

depth:valid_max = 2140.021f ;

depth:standard_name = "depth" ;

depth:long_name = "depth" ;

float lat(lat) ;

lat:units = "degrees_north" ;

lat:long_name = "latitude" ;

lat:standard_name = "latitude" ;

lat:axis = "Y" ;

lat:valid_max = 46.80f;

lat:valid_min = 40.86f ;

float lon(lon) ;

lon:units = "degrees_east" ;

lon:long_name = "longitude" ;

lon:standard_name = "longitude" ;

lon:axis = "X" ;

lon:valid_max = 41.96f ;

lon:valid_min = 27.32f ;

int time(time) ;

time:units = "seconds since 1970-01-01 00:00:00" ;

time:calendar = "standard" ;

time:long_name = "time" ;

time:standard_name = "time" ;

time:axis = "T" ;

float votemper(time, depth, lat, lon) ;

votemper:_FillValue = 1.e+20f ;

votemper:missing_value = 1.e+20f ;

votemper:valid_min = 4.f ;

votemper:valid_max = 35.f ;

votemper:units = "degrees_C" ;

votemper:coordinates = "time depth lat lon" ;

votemper:standard_name = "sea_water_potential_temperature" ;

votemper:long_name = "temperature" ;

float seabed_temp(time, lat, lon) ;

seabed_temp:_FillValue = 1.e+20f ;

seabed_temp:missing_value = 1.e+20f ;

seabed_temp:valid_min = 4.f ;

seabed_temp:valid_max = 35.f ;

seabed_temp:units = "degrees_C" ;

seabed_temp:coordinates = "time lat lon" ;

seabed_temp:standard_name = "sea_water_potential_temperature_at_sea_floor" ;

seabed_temp:long_name = " sea floor potential temperature" ;

// global attributes:

:bulletin_type = "reanalysis" ;

:institution = "Centro Euro-Mediterraneo sui Cambiamenti Climatici - Lecce, Italy" ;

:source = "BS e2r2" ;

:contact = "servicedesk.cmems@mercator-ocean.eu" ;

:references = "Please check in CMEMS catalogue the INFO section for product BLKSEA_REANLYSIS_PHYS_007_004 - http://marine.copernicus.eu" ;

:comment = "Please check in CMEMS catalogue the INFO section for product BLKSEA_REANALYSIS_PHYS_007_004 - http://marine.copernicus.eu" ;

:Conventions = "CF-1.0" ;

:bulletin_date = "20180101" ;

:field_type = "monthly_mean_centered_at_time_field" ;

:title = "Potential Temperature (3D), Bottom Temperature (2D) - Monthly Mean " ;

}

V.3 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/
- ✓ Net CDF Climata Data Operators (CDO): https://code.zmaw.de/projects/cdo
- ✓ IDL, Matlab, GMT…

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