COPERNICUS MARINE ENVIRONMENT MONITORING SERVICE

MED MFC

CMEMS ELEMENT

PRODUCT USER MANUAL

For Mediterranean Sea Physical Reanalysis Product MEDSEA_REANALYSIS_PHY_006_009

Reference: CMEMS-MED-PUM-006-009

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Contributors : Rita Lecci, Claudia Fratianni, Massimiliano Drudi, Alessandro Grandi		

CHANGE RECORD

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1.1	01.04.16	all	Revision after AR2 following CMEMS remarks reported into CMEMS-MED-PUM-006-009-V2-V1.0_RevCoD.docx	R. Lecci, C. Fratianni
1.2	18.01.17	all	General revision for CMEMS EIS V3.0	R. Lecci

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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. A long series of analyses is of great utility for studying the behavior of the ocean system.
CF	Climate Forecast (convention for NetCDF)
CLS	Collecte Localisation Satellites
CMAP	CPC Merged Analysis of Precipitation
CMCC	Centro Euro-Mediterraneo sui Cambiamenti Climatici
CMEMS	Copernicus Marine Environment Monitoring Service
CNR-ISAC	Istituto di Scienze dell'Atmosfera e del Clima
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
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
MDT	Mean Dynamic Topography
Med/MED	Mediterranean
Meridional Velocity	West to East component of the horizontal velocity vector
MFC	Monitoring and Forecasting Centre
MFS	Mediterranean Forecasting System
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
SL	Sea Level
SLA	Sea Level Anomaly
SSH	Sea Surface Height
SST	Sea Surface Temperature
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
XBT	eXpandable BathyThermograph
WW3	WaveWatch-III
Zonal Velocity	South to North component of the horizontal velocity vector
3DVAR	Three-Dimensional Variational

I INTRODUCTION

I.1 Summary

This guide describes the MED-MFC (Mediterranean Monitoring and Forecasting Centre) products giving details about the content and about the accessing services.

MEDSEA_REANALYSIS_006_009 is one of the two products for the reanalysis of the physical state of the Mediterranean Sea which includes 3D monthly mean fields of Temperature, Salinity, Zonal and Meridional Velocity, and 2D monthly mean fields of Sea Surface Height.

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 Web Portal 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 DGF Service.

III DESCRIPTION OF THE PRODUCT SPECIFICATION

III.1 General Information

Table 1 provides information about reanalysis products.

Table 1 MEDSEA_REANALYSIS_PHY_006_009 Product Specification

Product Specification	MEDSEA_REANALYSIS_PHY_006_009
Geographical coverage	6°W → 36.25°E ; 30.1875°N → 45.9375°N
Variables	Potential Temperature Salinity Sea Surface Height Horizontal Velocity (meridional and zonal component)
Available time series	61 years (1955-2015)
Temporal resolution	Monthly mean
Target delivery time	Once
Delivery mechanism	CMEMS Information System (Subsetter, CMEMS FTP, DirectGetFile)
Horizontal resolution	1/16°
Number of vertical levels	72
Format	Netcdf 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 60 years reanalysis has been produced by combining, every day, the output of the ocean model, forced by atmospheric surface fluxes and relaxed to SST, and quality controlled ocean observations.

The hydrodynamics are supplied by the Nucleos for European Modelling of the Ocean (NEMO) with a variational data assimilation schema (OceanVar) thanks to which salinity and temperature profiles and satellite Sea Level Anomaly along track data are jointly assimilated to estimate the initial conditions for numerical ocean model. The model horizontal grid resolution in 1/16˚ (ca. 6-7 km) and the unevenly spaced vertical levels are 72.

III.2.2 Detailed description

The system is based upon the operational configuration of the prototype Copernicus Marine Service (MyOcean) models. The Ocean General Circulation Model (OGCM) codes are NEMO-OPA version 3.2 and 3.4, developed and maintained by the NEMO consortium. The model is primitive equation in spherical coordinates implemented in the Mediterranean at 1/16° x 1/16° horizontal resolution and 72 unelevely spaced vertical levels (Oddo et al, 2009). It is nested in the Atlantic within the monthly mean climatological fields computed from ten years of daily output of the 1/4° x 1/4° degrees global model (Drevillon et al. 2008). The model uses vertical partial cells in order to have better representation of the flow over steep topography.

The model is forced by momentum, heat and water fluxes computed by bulk formulae adapted to the Mediterranean case, using AMIP data (Cherchi and Navarra, 2007). Heat flux is corrected proportionally to the difference between the model and observed SST (Pinardi et al.2003) with a relaxation coefficient equal to -60 Wm-2 K-1, corresponding to about 2.5 day time-scale over a depth of 3 m. The choise of use Met Office Hadley Centre SST dataset (HadSST1) for the production of 60 years reanalysis is consistent with the idea to use AMIP-type experiments since AMIP were obtained from ECHAM4 model forced by HadSST1. The dataset consists of monthly SST on regular grid of 1°x1° starting from 1870 (Rayner et al, 2003).

Water balance is computed as evaporation minus precipitation and runoff. The evaporation is derived from the latent heat flux while the precipitation and the runoff are provided by monthly mean datasets. Precipitation is taken from the Climate Prediction Centre Merged Analysis of Precipitation (CMAP) Data (Xie and Arkin, 1997).

Runoff is taken instead from the Global Runoff Data Centre dataset (Fekete et al., 1999) for the Ebro, Nile and Rhone and the dataset from Raicich (Raicich, 1996) for the Adriatic rivers (Po, Vjosë, Seman and Bojana). The Dardanelles inflow is parameterized as a river, and the climatological net inflow rates are taken from Kourafalou and Barbopoulos (2003).

The model is combined with a three-dimensional variational assimilation scheme called OceanVar (Dobricic and Pinardi, 2008). The evolving part of temperature and salinity background error covariances is represented by seasonal varying Empirical Orthogonal Functions (EOFs), divided in 13 subregions of the Mediterranean Sea (Dobricic et al, 2006), calculated from the temporal variability of parameters in a historical model simulation. The mean dynamic topography used to assimilate sea surface height measurements by altimeter satellites has been computed by Dobricic et al, 2005.

Altimeter data and insitu temperature and salinity vertical profiles are jointly assimilated to estimate the initial conditions for numerical ocean model.

The SLA data consist of sea level anomalies referred to a 7-year average (1993-1999) and combine information from different missions (Topex/Poseidon, ERS-1 and ERS-2, Envisat, Jason1 and

Jason2), intercalibrated with respect to a reference mission, which is currently Jason2. The temporal coverage depends on the duration of the mission starting from 1992.

The insitu temperature and salinity vertical profiles are collected from different instrumental data types, such as CTDs, XBTs, MBTs, bottles, ARGO, and sources: MFSPP (Mediterranean ocean Forecasting System Pilot Project), MFSTEP (Mediterranean ocean Forecasting System Toward Environmental Prediction), SeaDataNet, MEDAR-MEDATLAS and CMEMS In situ TAC (Thematic Assembly Centre).

III.2.3 Processing information

The Mediterranean Sea Physical reanalysis has been initialized by a temperature and salinity monthly climatology on the 1st of January 1953 and run till the 31st of December 2015. The first two years are considered the period of model spin up

III.3 Details of datasets

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

MEDSEA_REANALYSIS_PHY_006_009		
DATASETS	VARIABLES AND UNITS	NAME OF VARIABLES IN THE NETCDF FILE
sv03-med-ingv-cur-rean2-m	Zonal Velocity [m/s] Meridional Velocity [m/s]	vozocrtx vomecrty
sv03-med-ingv-ssh-rean2-m	Sea Surface Height [m]	sossheig
sv03-med-ingv-tem-rean2-m	Potential Temperature [degC]	votemper
sv03-med-ingv-sal-rean2-m	Salinity [PSU]	vosaline

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

MEDSEA_REANALYSIS_PHY_006_009 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 :

- sv03-med-ingv-tem-rean2-m
- sv03-med-ingv-sal-rean2-m
- sv03-med-ingv-cur-rean2-m
- sv03-med-ingv-ssh-rean2-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** are respectively for the variable of Potential Temperature (**votemper**), Salinity (**vosaline**), Sea Surface Height (**sossheig**), and Velocity (**vozocrtx**, **vomecrty).**

Example for a file of Salinity:

`sv03-med-ingv-sal-rean2-m_1303461772348.nc`

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

MEDSEA_REANALYSIS_PHY_006_009 files nomenclature when downloaded through CMEMS FTP is based as follows:

{valid date}_{freq flag}{average flag}-{producer}--{parameter}-{config}-{region}-{bul date}_{product type}-fv{file version}.nc.gz

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 (m = monthly)
- **average flag** is m=mean
- **producer** is a short version of the CMEMS production unit
- **config** identifies the producing system and configuration.
- **region** is a three 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 re for reanalysis.

- **file version** is xx.yy where xx is the CMEMS version and yy is an incremental version number

Table 3 shows the nomenclature for the MEDSEA_REANALYSIS_PHY_006_009 products.

Table 3 Description of the nomenclature for MEDSEA_REANALYSIS_PHY_006_009

valid date	YYYYMMDD
freq flag	m (monthly)
average flag	m (mean)
producer	INGV
config	MFSe2r1
region	MED
parameter	TEMP PSAL ASLV RFVL
bul date	bYYYYYMMDD
product type	re (reanalysis)
file version	06.00 (1955 - 2014) 07.00 (2015)

Example for a reanalysis file of Salinity:

`20000401_mm-INGV--PSAL-MFSe2r1-MED-b20130712_re-fv06.00.nc.gz`

This is the monthly mean field of salinity for the month of April 2000. The mean is computed from noon (12:00 UTC) of the 31st March 2000 to noon (12:00 UTC) of the 30th April 2000 (see section IV.8).

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

MEDSEA_REANALYSIS_PHY_006_009 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:

http---purl.org-myocean-ontology-product-database-**datasetname_nnnnnnnnnnnn.zip**

where :

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

- sv03-med-ingv-tem-rean2-m
- sv03-med-ingv-sal-rean2-m

- sv03-med-ingv-cur-rean2-m
- sv03-med-ingv-ssh-rean2-m

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

The fields **tem/sal/ssh/cur** are respectively for the variable of Potential Temperature (**votemper**), Salinity (**vosaline**), Sea Surface Height (**sossheig**), and Velocity (**vozocrtx**, **vomecrty).**

Example:

```
http---purl.org-myocean-ontology-product-database-sv03-med-ingv-tem-rean2-m
_1303461772348.zip
```

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

{valid date}_{freq flag}{average flag}-{producer}--{parameter}-{config}-{region}-{bul date}_{product type}-fv{file version}.nc.gz

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 (m = monthly)
- **average flag** is m=mean
- **producer** is a short version of the CMEMS production unit
- **config** identifies the producing system and configuration.
- **region** is a three 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 re for reanalysis.
- **file version** is xx.yy where xx is the CMEMS version and yy is an incremental version number

Table 4 shows the nomenclature for the MEDSEA_REANALYSIS_PHYS_006_009 products.

Table 4 Description of the nomenclature for MEDSEA_REANALYSIS_PHYS_006_009

valid date	YYYYMMDD
freq flag	m (monthly)
average flag	m (mean)
producer	INGV
config	MFSe2r1
region	MED
parameter	TEMP PSAL ASLV RFVL
bul date	bYYYYYMMDD
product type	re (reanalysis)

file version	06.00 (1955-2014) 07.00 (2015)

Example for a reanalysis file of Salinity:

`20000401_mm-INGV--PSAL-MFSe2r1-MED-b20130712_re-fv06.00.nc.gz`

This is the monthly mean field of salinity for the month of April 2000. The mean is computed from noon (12:00 UTC) of the 31st March 2000 to noon (12:00 UTC) of the 30th April 2000 (see section IV.8).

IV.4 Grid

The horizontal grid step is regular in latitude and longitude with a resolution of 1/16°x1/16° of degree (~6.5 Km). The vertical grid is composed of 72 unevenly spaced vertical levels (see §IV.5).

In Table 5 there is the description of the grid and the spatial coverage for each variable for the MEDSEA_REANALYSIS_PHY_006_009 products.

Table 5 Description of grid and spatial coverage

MEDSEA_REANALYSIS_PHY_006_009 *							
VARIABLE	LON MIN	LON MAX	LAT MIN	LAT MAX	XPOINT	YPOINT	ZPOINT
Potential Temperature	6°W	36.25°E	30.1875°N	45.9375°N	677	253	72
Salinity	6°W	36.25°E	30.1875°N	45.9375°N	677	253	72
Sea Surface Height	6°W	36.25°E	30.1875°N	45.9375°N	677	253	1
Horizontal Current	6°W	36.25°E	30.1875°N	45.9375°N	677	253	72

* The Gulf of Biscay is excluded.

IV.5 Domain coverage

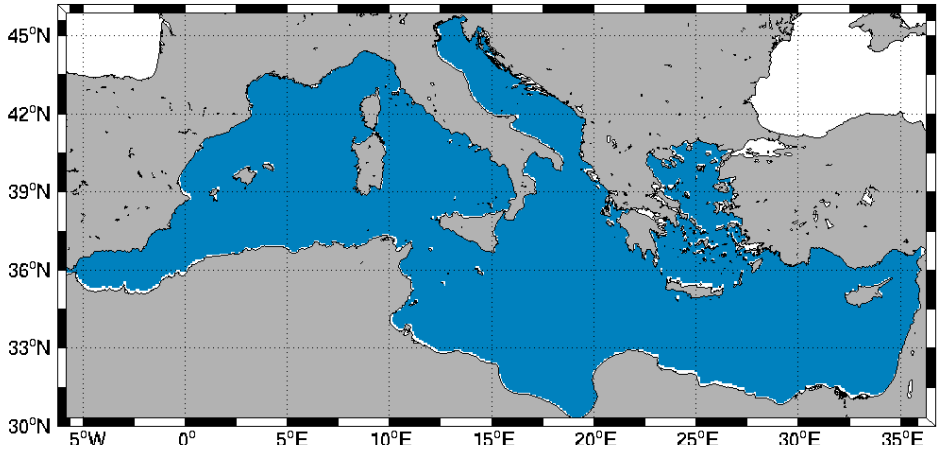

Figure 1 Spatial coverage of the MEDSEA_REANALYSIS_PHY_006_009 products (blue zone).

The blue area in Figure 1 represents the spatial coverage of the MEDSEA_REANALYSIS_PHY_006_009 products.

Grid type is the following standard projection:

Regular projection: longitude and latitude step is constant	

IV.6 Vertical Levels

MEDSEA_REANALYSIS_PHY_006_009 product is computed on 72 unevenly spaced vertical levels: the thickness of the layer at the surface is about 3 meters, and increases up to 300 meters at the bottom. All the 72 levels are released. The depths are (in meters): 1.5, 4.6, 7.9, 11.6, 15.4, 19.6333, 24.1, 28.9, 34.1, 39.7, 45.7, 52.1, 59.0, 66.4, 74.3, 82.8, 92, 101.7, 112.2, 123.4, 135.4, 148.3, 162.1, 176.8, 192.6, 209.4, 227.5, 246.8, 267.5, 289.6, 313.3, 338.6, 365.6, 394.5, 425.4, 458.5, 493.8, 531.6, 571.9, 615.1, 661.1, 710.3, 762.8, 818.9, 878.9, 942.8, 1011.2, 1084.1, 1161.9, 1245, 1333.6, 1428.2, 1529.1, 1636.6, 1751.3, 1873.5, 2003.8, 2142.7, 2290.6, 2448.2, 2615.9, 2794.6, 2984.7, 3186.9, 3402.1, 3630.7, 3873.8, 4132.1, 4406.5, 4697.7, 5006.8, 5334.648.

MEDSEA_REANALYSIS_PHY_006_009 has a vertical grid with partial steps (See NEMO_book_v3_3.pdf, pag 90). The depth of the last level depends therefore from point to point from the bathymetry depth. The vertical grids are described in the file: MEDmeshmask_SYS4b3_T.nc. This file is freely available via HTTP at this link http://cmems-med-mfc.eu/masks/MEDmeshmask_SYS4b3_T.nc.gz. The relevant variables described in MEDmeshmask_SYS4b3_T.nc file are:

- tmask (3D land/sea mask);
- Depthlevt (3D matrix with the depth of each grid point taking into account the partial steps)
- e3t (3D matrix with the Δz of each grid point, taking into account the partial steps)

netcdf MEDmeshmask_SYS4b3_T {

dimensions:

x = 677 ;

y = 253 ;

z = 72 ;

t = UNLIMITED ; // (1 currently)

variables:

float nav_lon(y, x) ;

float nav_lat(y, x) ;

```
        float nav_lev(z) ;
        double time_counter(t) ;
        byte tmask(t, z, y, x) ;
        float glamt(t, y, x) ;
        float gphit(t, y, x) ;
        double e1t(t, y, x) ;
        double e2t(t, y, x) ;
        double ff(t, y, x) ;
        short mbathy(t, y, x) ;
        double hdept(t, y, x) ;
        double e3t(t, z, y, x) ;
        double gdept_0(t, z) ;
        double e3t_0(t, z) ;
        double Depthlevt(t, z, y, x) ;

    // global attributes:
                :DOMAIN_number_total = 1 ;
                :DOMAIN_number = 0 ;
                :DOMAIN_dimensions_ids = 1, 2 ;
                :DOMAIN_size_global = 677, 253 ;
                :DOMAIN_size_local = 677, 253 ;
                :DOMAIN_position_first = 1, 1 ;
                :DOMAIN_position_last = 677, 253 ;
                :DOMAIN_halo_size_start = 0, 0 ;
                :DOMAIN_halo_size_end = 0, 0 ;
                :DOMAIN_type = "BOX" ;
    }
```

IV.7 Temporal extend of analysis and forecast stored on delivery mechanism

MEDSEA_REANALYSIS_PHY_006_009 temporal coverage is 60 years, from 1955 to 2015. The reanalysis has been produced using the syse2r1.

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

IV.8.1 Mean Centre of Products

MEDSEA_REANALYSIS_PHY_006_009 product reanalysis is available as monthly mean fields.

IV.8.2 ***Missing Value***

The **missing value** for the MEDSEA_REANALYSIS_PHY_006_009 products is 1e+20.

IV.8.3 ***Production Chain***

MEDSEA_REANALYSIS_PHY_006_009 production chain is as follows:

In the V6 products, the model is forced to the surface by 1.125° horizontal-resolution AMIP data. Model solution is correct every 24hr by the OCEANVAR assimilation scheme of the available satellite (SLA) and in situ data (XBT, CTD and ARGO). 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 and for one month.

Table 6 Names and dimensions of the files

DATASET NAME	NAME OF FILE	DIMENSION [MB]*	
		Compressed	Uncompressed
sv03-med-ingv-ssh-rean2-m	{date1}_mm-INGV--ASLV-MFSe2r1-MED-b{date2}_re-fv{06|7.00}.nc	0.24	0.7
sv03-med-ingv-sal-rean2-m	{date1}_mm-INGV--PSAL-MFSe2r1-MED-b{date2}_re-fv{06|7.00}.nc	9	50
sv03-med-ingv-tem-rean2-m	{date1}_mm-INGV--TEMP-MFSe2r1-MED-b{date2}_re-fv{06|7.00}.nc	10	50
sv03-med-ingv-cur-rean2-m	{date1}_mm-INGV--RFVL-MFSe2r1-MED-b{date2}_re-fv{06|7.00}.nc	23	101

* Dimensions for one day and for one month of reanalysis

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

Table 7 Names and dimensions of the entire datasets

DATASET NAME	DIMENSION [MB]**	
	Compressed	Uncompressed
sv03-med-ingv-ssh-rean2-m	77.76	226.8
sv03-med-ingv-sal-rean2-m	2916	16200
sv03-med-ingv-tem-rean2-m	3240	16200
sv03-med-ingv-cur-rean2-m	7452	32724

**Dimension for daily dataset and for monthly dataset of reanalysis

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 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.

V.2 Structure and semantic of NetCDF maps files

Table 8 Dimensions and variables included in the files NetCDF of MEDSEA_REANALYSIS_PHY_006_009.

DIMENSIONS	VARIABLES		
lon=677 lat=253 depth=72 time=1	NAME	DIMENSIONS	TYPE
	lon	lon	float
	lat	lat	float
	depth	depth	float
	time	time	int
	sossheig	time,lat,lon	float
	votemper	time,depth,lat,lon	float
	vosaline	time,depth,lat,lon	float
	vozocrtx	time,depth,lat,lon	float
	vomecrty	time,depth,lat,lon	float

For 20130101_mm-INGV--PSAL-MFSe2r1-MED-b20160116_re-fv06.00.nc

```
netcdf \20130101_mm-INGV--PSAL-MFSe2r1-MED-b20160116_re-fv06.00 {
dimensions:
        depth = 72 ;
        lat = 253 ;
        lon = 677 ;
        time = UNLIMITED ; // (1 currently)
variables:
        float depth(depth) ;
                depth:units = "m" ;
                depth:positive = "down" ;
                depth:valid_min = 1.472102f ;
                depth:valid_max = 5334.648f ;
                depth:long_name = "depth" ;
                depth:axis = "Z" ;
                depth:standard_name = "depth" ;
        float lat(lat) ;
                lat:units = "degrees_north" ;
                lat:valid_min = 30.1875f ;
                lat:valid_max = 45.9375f ;
                lat:long_name = "latitude" ;
                lat:standard_name = "latitude" ;
                lat:axis = "Y" ;
        float lon(lon) ;
                lon:units = "degrees_east" ;
                lon:valid_min = -6.f ;
                lon:valid_max = 36.25f ;
                lon:long_name = "longitude" ;
                lon:standard_name = "longitude" ;
                lon:axis = "X" ;
        int time(time) ;
                time:units = "seconds since 1950-01-01 00:00:00" ;
                time:calendar = "standard" ;
                time:long_name = "time" ;
                time:standard_name = "time" ;
                time:axis = "T" ;
        float vosaline(time, depth, lat, lon) ;
                vosaline:units = "1e-3" ;
```

vosaline:missing_value = 1.e+20f ;

vosaline:valid_min = 15.f ;

vosaline:valid_max = 42.f ;

vosaline:long_name = "Salinity" ;

vosaline:_FillValue = 1.e+20f ;

vosaline:coordinates = "time depth lat lon" ;

vosaline:standard_name = "sea_water_salinity" ;

// global attributes:

:bulletin_type = " reanalysis " ;

:institution = "Istituto Nazionale di Geofisica e Vulcanologia - Bologna, Italy" ;

:source = " MFS e2r1" ;

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

:references = "Please check in CMEMS catalogue the INFO section for product MEDSEA_REANALYSIS_PHY_006_009 - http://marine.copernicus.eu/" ;

:comment = "Please check in CMEMS catalogue the INFO section for product MEDSEA_REANALYSIS_PHY_006_009 - http://marine.copernicus.eu/" ;

:Conventions = "CF-1.0" ;

:field_type = "monthly_mean_centered_at_time_field" ;

:title = "Potential Temperature (3D) - 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…