COPERNICUS MARINE ENVIRONMENT MONITORING SERVICE

MED MFC

CMEMS ELEMENT

PRODUCT USER MANUAL

For Mediterranean Sea Physical Analysis and Forecasting Product MEDSEA_ANALYSIS_FORECAST_PHYS_006_001

Reference: CMEMS-MED-PUM-006-001

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CHANGE RECORD

Issue	Date	§	Description of Change	Author
1.0	26.01.16	all	First version of document	R. Lecci, M. Drudi, A. Grandi, C. Fratianni
1.1	26.09.16	all	Replacement of GLOBAL_ANALYSIS_FORECAST_PHYS_001_002 occurrences with GLOBAL_ANALYSIS_FORECAST_PHYS_001_024 (the new system)	R. Lecci
1.2	16.05.17	all	Update of IV.7 Section “Update Time”	R. Lecci
1.3	16.06.17	all	Update of link to access Mediterranean Sea bathymetry	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_ANALYSIS_FORECAST_PHYS_006_001 is the nominal product of the Mediterranean Sea Physical Forecasting system, composed by 3D, 24 hours mean fields and hourly mean fields of Potential Temperature, Salinity, Zonal and Meridional Velocity, and by 2D, 24 hours mean fields and hourly mean fields of Sea Surface Height, Zonal and Meridional Stokes drift velocity, wave number and Mixed Layer Depth.

I.2 History of changes

On April 2016, this product is improved with:

- implementation of ECMWF daily precipitations instead of CMAP monthly climatology to force the circulation model;
- use of grid point EOFs instead of regional EOFs for the background vertical error covariance matrix with the use of a vertical error z-dependent and monthly varying;
- correction in the DAC to be applied to the SLA assimilated data;
- use of 20 years based MDT in the SLA assimilated data.

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 Direct Get File Service.

III DESCRIPTION OF THE PRODUCT SPECIFICATION

III.1 General Information

Table 1 provides information about forecast/analysis products.

Table 1 MEDSEA_ANALYSIS_FORECAST_PHYS_006_001 Product Specification

Product Specification	MEDSEA_ANALYSIS_FORECAST_PHYS_006_001
Geographical coverage	15°W → 36.25°E ; 30.1875°N → 45.9375°N
Variables	Potential Temperature Salinity Sea Surface Height Mixed Layer Depth Horizontal Velocity (meridional and zonal component) Stokes drift velocity (meridional and zonal component) Potential Temperature at sea bed Wave Number
Analysis	Yes
Hindcast	Yes
Forecast	Yes
Available time series	Daily mean: from 1 January 2013 – on going Hourly mean: 1 month
Temporal resolution	24hr average field 1hr average field
Target delivery time	Forecast : daily, 01 UTC Analysis : on Wednesday, 01 UTC Simulation: daily, 01 UTC
Delivery mechanism	CMEMS Information System (Subsetter, CMEMS FTP, DGF)
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 physical component of the Mediterranean Forecasting System (Med-Currents) is a coupled hydrodynamic-wave model implemented over the whole Mediterranean Basin. The model horizontal grid resolution is 1/16° (ca. 6-7 km) and has 72 unevenly spaced vertical levels.

The hydrodynamics are supplied by the Nucleous for European Modelling of the Ocean (NEMO) while the wave component is provided by WaveWatch-III. The model solutions are corrected by the variational assimilation (based on a 3DVAR scheme) of temperature and salinity vertical profiles and along track satellite Sea Level Anomaly observations.

III.2.2 Detailed description

The Mediterranean Forecasting System, MFS, (Tonani et al 2014, Dombrowsky et al. 2009) is providing since 2000 short term forecast for the Mediterranean Sea and it is the component of the Med-Currents system.

The oceanic equations of motion of Med-Currents system are solved by two elements: an Ocean General Circulation Model (OGCM) and a Wave Model. The OGCM code is based on NEMO (Nucleus for European Modelling) version 3.4 (Madec et al 2008). The code is developed and maintained by the NEMO-consortium. The model solves the primitive equations in spherical coordinates. The Wave dynamic is solved by a Mediterranean implementation of the WaveWatch-III code (Tolman 2009).

NEMO has been implemented in the Mediterranean at 1/16° x 1/16° horizontal resolution and 72 unevenly spaced vertical levels (Oddo et al. 2014, Oddo et al., 2009, Tonani et al. 2008) with time step of 300sec, WaveWatch follows the same horizontal discretization and has a time step of 600 sec. The NEMO model provides every hour estimates of Sea Surface Temperature and Surface Currents to WaveWatch which returns back to NEMO the neutral component of the surface drag coefficient taking into account wave induced effect at the air-sea interface (Clementi et al. 2013). The two models cover the whole Mediterranean Sea and also extend into the Atlantic in order to better resolve the exchanges with the Atlantic Ocean at the Strait of Gibraltar.

The NEMO code solves the primitive equations using the time-splitting technique that is the external gravity waves are explicitly resolved. Also the atmospheric pressure effect has been introduced in the model dynamic. The horizontal eddy diffusivity coefficient for tracers and the horizontal bilaplacian eddy viscosity have been set respectively equal to -6.e8 [m4/s] and -1.e9 [m4/s]. Moreover at the bottom, a quadratic bottom drag coefficient with a logarithmic formulation has been used according to Maraldi et al. (2013). The model uses vertical partial cells to fit the bottom depth shape.

The wave model takes into consideration the surface currents for wave refraction but assumes no interactions with the ocean bottom. The wave model uses 24 directional bins (15° directional resolution) and 30 frequency bins (ranging between 0.05 Hz and 0.7931 Hz) to represent the wave spectra distribution.

The hydrodynamic model is nested, in the Atlantic, within the daily products at 1/12° of horizontal resolution produced by the CMEMS Global Monitoring and Forecasting Centre, GLOBAL_ANALYSIS_FORECAST_PHYS_001_024. Details on the nesting technique and major impacts on the model results are in Oddo et al., 2009. The model is forced by momentum, water and heat fluxes interactively computed by bulk formulae using the 6-hours (for the first 3 days of forecast a 3-hours temporal resolution is used), 0.125° horizontal-resolution operational analysis and forecast fields from the European Centre for Medium-Range Weather Forecasts (ECMWF) and the model predicted surface temperatures (details of the air-sea physics are in Tonani et al., 2008). The water balance is computed as Evaporation minus Precipitation and Runoff. The evaporation is derived from

the latent heat flux, precipitation is provided by ECMWF as daily averages, while the runoff of the 7 rivers implemented is provided by monthly mean datasets: 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 Buna/Bojana ((UNEP: Implications of Climate Change for the Albanian Coast, Mediterranean Action Plan, MAP Technical Reports Series No.98., 1996). The Dardanelles inflow is parameterized as a river and the climatological net inflow rates are taken from Kourafalou and Barbopoulos (2003).

The data assimilation system is the OCEANVAR scheme developed by Dobricic and Pinardi (2008). The background error correlation matrix is estimated from the temporal variability of parameters in a Reanalysis. Background error correlation matrices vary monthly for each grid point in the discretized domain of the Mediterranean Sea.

The assimilated data include: Sea Level Anomaly (a satellite product accounting for atmospheric pressure effect is used) from CLS SL-TAC, and vertical temperature and salinity profiles from Argo, XBT (eXpandable BathyThermograph) and Gliders. Objective Analyses-Sea Surface Temperature (OA-SST) fields from CNR-ISAC OSI-TAC are used for the correction of surface heat fluxes with the relaxation constant of 40 W m-2 K-1.

III.2.3 Processing information

The analysis is done weekly, on Tuesday, for the previous 15 days. The assimilation cycle is daily (24hr) and is done in filter mode. 10-day forecast is produced every day. The forecast is initialized by a hindcast every day except Tuesday, when the analysis is used instead of the hindcast.

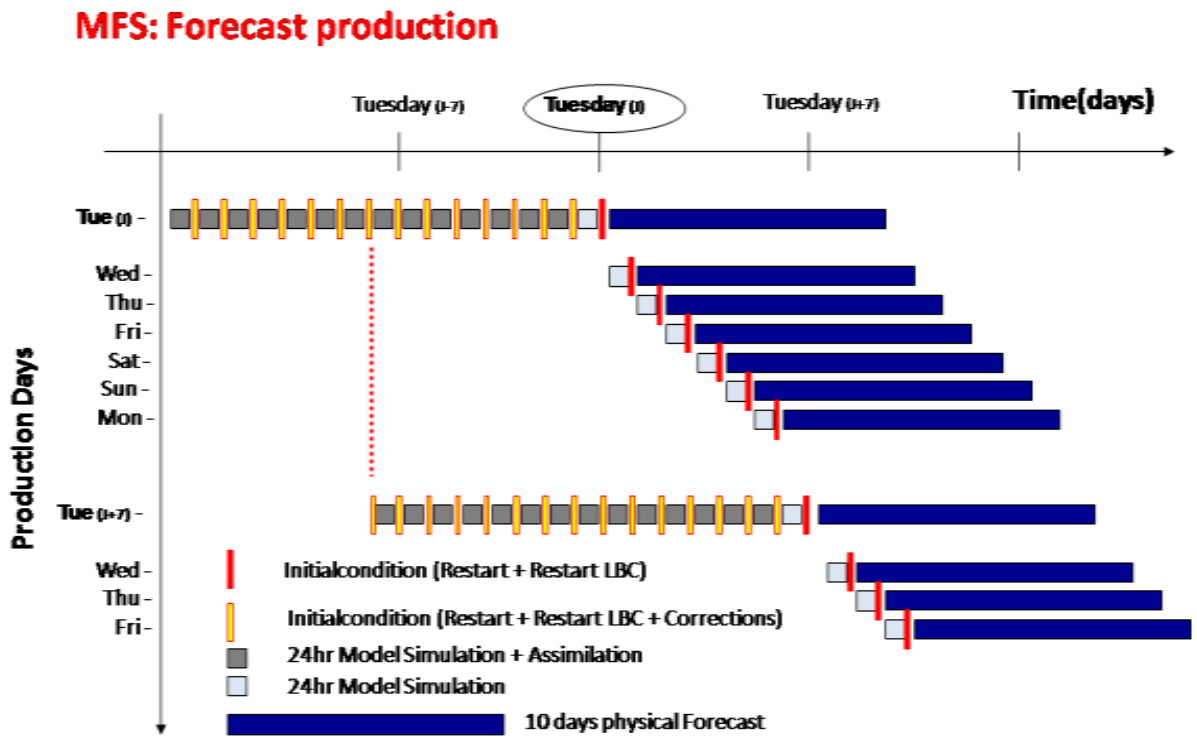

Figure 1 Scheme of the production chains of MEDSEA_ANALYSIS_FORECAST_PHYS_006_001

III.3 Details of datasets

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

MEDSEA_ANALYSIS_FORECAST_PHYS_006_001		
DATASETS	VARIABLES AND UNITS	NAME OF VARIABLES IN THE NETCDF FILE
CMEMSv02-MED-INGV-CUR-AN-FC-D	Zonal Velocity [m/s] Meridional Velocity [m/s] Wave Number U-Stokes drift velocity at surface [m/s] V-Stokes drift velocity at surface [m/s]	vozocrtx vomecrty sowavenu sozostdx somestdy
CMEMSv02-MED-INGV-SSH-AN-FC-D	Sea Surface Height [m]	sossheig
CMEMSv02-MED-INGV-TEM-AN-FC-D	Potential Temperature [K] Potential Temperature at sea bed [K]	votemper seabed_temp
CMEMSv02-MED-INGV-SAL-AN-FC-D	Salinity [PSU]	vosaline
CMEMSv02-MED-INGV-MLD-AN-FC-D	Mixed Layer Depth [m]	somxl010
CMEMSv02-MED-INGV-CUR-AN-FC-H	Zonal Velocity [m/s] Meridional Velocity [m/s] Wave Number U-Stokes drift velocity at surface [m/s] V-Stokes drift velocity at surface [m/s]	vozocrtx vomecrty sowavenu sozostdx somestdy
CMEMSv02-MED-INGV-SSH-AN-FC-H	Sea Surface Height [m]	sossheig
CMEMSv02-MED-INGV-TEM-AN-FC-H	Potential Temperature [K] Potential Temperature at sea bed [K]	votemper seabed_temp
CMEMSv02-MED-INGV-SAL-AN-FC-H	Salinity [PSU]	vosaline
CMEMSv02-MED-INGV-MLD-AN-FC-H	Mixed Layer Depth [m]	somxl010

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_ANALYSIS_FORECAST_PHYS_006_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 :

- cmemsv02-med-ingv-tem-an-fc-d
- cmemsv02-med-ingv-sal-an-fc-d
- cmemsv02-med-ingv-cur-an-fc-d
- cmemsv02-med-ingv-ssh-an-fc-d
- cmemsv02-med-ingv-mld-an-fc-d
- cmemsv02-med-ingv-tem-an-fc-h
- cmemsv02-med-ingv-sal-an-fc-h
- cmemsv02-med-ingv-cur-an-fc-h
- cmemsv02-med-ingv-ssh-an-fc-h
- cmemsv02-med-ingv-mld-an-fc-h

. nnnnnnnnnnnnn: 13 digit integer corresponding to the current time (download time) in millisecondssince 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**) and Potential Temperature at sea bed (**seabed_temp**), Salinity (**vosaline**), Sea Surface Height (**sossheig**), Velocity (**vozocrtx**, **vomecrty, sozostdx**, **somestdy** and **sowavenu)** and Mixed Layer Depth **(somxl010).**

Example for a file of Salinity:

```
cmemsv02-med-ingv-sal-an-fc-d_1303461772348.nc
```

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

MEDSEA_ANALYSIS_FORECAST_PHYS_006_001 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.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 (h = hourly, d = daily)
- **producer** is a short version of the CMEMS production unit
- **config** identifies the producing system and configuration
- **region** is a 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 (06, 07 or 08) and yy is an incremental version number

Table 3 shows the nomenclature for the MEDSEA_ANALYSIS_FORECAST_PHYS_006_001 products.

Table 3 Description of the nomenclature for MEDSEA_ANALYSIS_FORECAST_PHYS_006_001

valid date	YYYYMMDD
freq flag	d (daily) h (hourly)
producer	INGV
config	MFSeas1
region	MEDATL
parameter	TEMP PSAL ASLV RFVL AMXL
bul date	bYYYYYMMDD
product type	fc (forecast) an (analysis) sm (hindcast)
file version	06.00

Example for a forecast file of Salinity:

`20140309_d-INGV--PSAL-MFSeas1-MEDATL-b20140306_fc-fv06.00.nc.gz`

This is the mean field of salinity centered at 00:00 UTC of the 9thMarch 2014, and the time coverage is from noon (12:00 UTC) of the 8thMarch 2014 to noon (12:00 UTC) of the 9thMarch 2014 (see section IV.8).

`20140309_h-INGV--PSAL-MFSeas1-MEDATL-b20140306_fc-fv06.00.nc.gz`

This file contains the 24 hourly mean fields of salinity, each one centered at 30' of every hour from noon (12:00 UTC) of the 8th March 2014 to noon (12:00 UTC) of the 9th March 2014 (see section IV.9).

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

MEDSEA_ANALYSIS_FORECAST_PHYS_006_001 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 :

- cmemsv02-med-ingv-tem-an-fc-d
- cmemsv02-med-ingv-sal-an-fc-d
- cmemsv02-med-ingv-cur-an-fc-d
- cmemsv02-med-ingv-ssh-an-fc-d
- cmemsv02-med-ingv-mld-an-fc-d
- cmemsv02-med-ingv-tem-an-fc-h
- cmemsv02-med-ingv-sal-an-fc-h
- cmemsv02-med-ingv-cur-an-fc-h
- cmemsv02-med-ingv-ssh-an-fc-h
- cmemsv02-med-ingv-mld-an-fc-h

.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**) and Potential Temperature at sea bed (**seabed_temp**), Salinity (**vosaline**), Sea Surface Height (**sossheig**), Velocity (**vozocrtx**, **vomecrty, sozostdx**, **somestdy** and **sowavenu)** and Mixed Layer Depth **(somxl010).**

Example:

```
http---purl.org-myocean-ontology-product-database-cmemsv02-med-ingv-tem-an-fc-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.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 (d = daily, h= hourly)
- **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 sm for hindcast.
- **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 MEDSEA_ANALYSIS_FORECAST_PHYS_006_001 products.

Table 4 Description of the nomenclature for MEDSEA_ANALYSIS_FORECAST_PHYS_006_001

valid date	YYYYMMDD
freq flag	d (daily) h (hourly)
producer	INGV
config	MFSeas1
region	MEDATL
parameter	TEMP PSAL ASLV RFVL AMXL
bul date	bYYYYMMDD
product type	fc (forecast) an (analysis) sm (hindcast)
file version	06.00

Example for a forecast file of Salinity:

`20140309_d-INGV--PSAL-MFSeas1-MEDATL-b20140306_fc-fv06.00.nc`

This is the mean field of salinity centered at 00:00 UTC of the 9th March 2014, and the time coverage is from noon (12:00 UTC) of the 8th March 2014 to noon (12:00 UTC) of the 9th March 2014 (see section IV.8).

`20140309_h-INGV--PSAL-MFSeas1-MEDATL-b20140306_fc-fv06.00.nc`

This file contains the 24 hourly mean fields of salinity, each one centered at 30' of every hour from noon (12:00 UTC) of the 8th March 2014 to noon (12:00 UTC) of the 9th March 2014 (see section IV.9).

IV.4 Grid

The horizontal grid step is regular in latitude and longitude with a resolution of 1/16° x 1/16° of degree (~6.5 Km). The vertical grid is composed of 72 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 MEDSEA_ANALYSIS_FORECAST_PHYS_006_001 products.

Table 5 Description of grid and spatial coverage

MEDSEA_ANALYSIS_FORECAST_PHYS_006_001_a *							
VARIABLE	LON MIN	LON MAX	LAT MIN	LAT MAX	XPOINT	YPOINT	ZPOINT
Potential Temperature	15°W	36.25°E	30.1875°N	45.9375°N	821	253	72
Salinity	15°W	36.25°E	30.1875°N	45.9375°N	821	253	72
Sea Surface Height	15°W	36.25°E	30.1875°N	45.9375°N	821	253	1
Horizontal Current	15°W	36.25°E	30.1875°N	45.9375°N	821	253	72
Mixed Layer Depth	15°W	36.25°E	30.1875°N	45.9375°N	821	253	1
Potential Temperature at sea bed	15°W	36.25°E	30.1875°N	45.9375°N	821	253	1
Stokes drift velocity at surface	15°W	36.25°E	30.1875°N	45.9375°N	821	253	1

* The Gulf of Biscay is excluded.

IV.5 Domain coverage

The blue area in Fig.2 represents the spatial coverage of the MEDSEA_ANALYSIS_FORECAST_PHYS_006_001 products.

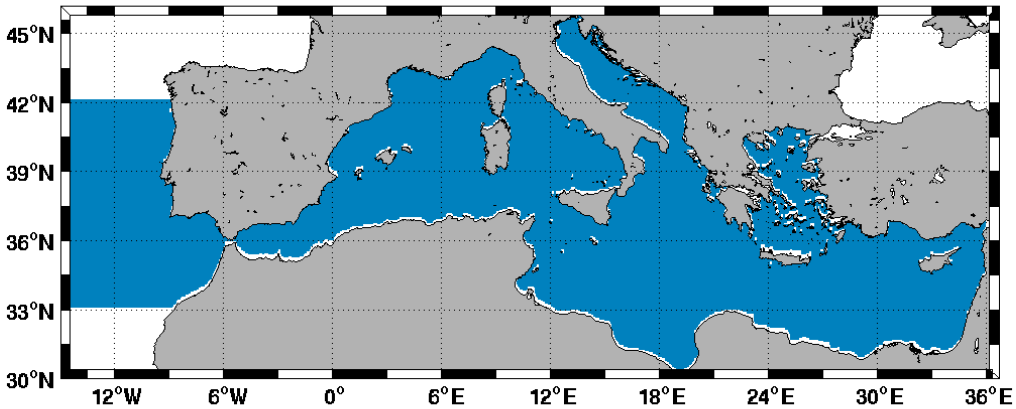

Figure 2 Spatial coverage of the MEDSEA_ANALYSIS_FORECAST_PHYS_006_001 products (blue zone).

Grid type is the following standard projection:

Regular projection: longitude and latitude step is constant	

IV.6 Vertical Levels

MEDSEA_ANALYSIS_FORECAST_PHYS_006_001 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_ANALYSIS_FORECAST_PHYS_006_001 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_SYS4e_T.nc. This file is freely available via HTTP at this link http://cmems-med-mfc.eu/masks/MEDmeshmask_SYS4e_T.nc.gz. The relevant variables described in MEDmeshmask_SYS4e_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_SYS4e_T {

dimensions:

x = 821 ;

y = 253 ;

z = 72 ;

t = UNLIMITED ; // (1 currently)

variables:

floatnav_lon(y, x) ;

floatnav_lat(y, x) ;

floatnav_lev(z) ;

doubletime_counter(t) ;

bytetmask(t, z, y, x) ;

```
        floatglamt(t, y, x) ;
        floatgphit(t, y, x) ;
        double e1t(t, y, x) ;
        double e2t(t, y, x) ;
        doubleff(t, y, x) ;
        shortmbathy(t, y, x) ;
        doublehdept(t, y, x) ;
        double e3t(t, z, y, x) ;
        double gdept_0(t, z) ;
        double e3t_0(t, z) ;
        doubleDepthlevt(t, z, y, x) ;

    // global attributes:
                :DOMAIN_number_total = 1 ;
                :DOMAIN_number = 0 ;
                :DOMAIN_dimensions_ids = 1, 2 ;
                :DOMAIN_size_global = 821, 253 ;
                :DOMAIN_size_local = 821, 253 ;
                :DOMAIN_position_first = 1, 1 ;
                :DOMAIN_position_last = 821, 253 ;
                :DOMAIN_halo_size_start = 0, 0 ;
                :DOMAIN_halo_size_end = 0, 0 ;
                :DOMAIN_type = "BOX" ;
    }
```

IV.7 Update Time

MEDSEA_ANALYSIS_FORECAST_PHYS_006_001 products: the daily update of forecast and simulation fields is available within 01:00 am UTC of the following day. This applies also to the analyses weekly update that is available on Wednesday within 01:00 am UTC.

IV.8 Temporal extend of analysis and forecast stored on delivery mechanism

MEDSEA_ANALYSIS_FORECAST_PHYS_006_001 products temporal coverage: for the daily mean fields, every day J is available a time series starting from 1/1/2013 to the dayJ+9. The last ten days of the time series are forecast fields, the fields relating to the days that go from the last Tuesday to the day J-1 are simulations, while the remaining days are analyses. Every day, the time series is updated with a day of simulation and ten days of forecast, every Wednesday this archive is upgraded with the analyses from day J-15 to day J-2.

For the hourly mean fields, every day J is available a time series starting from D-21, where D is the previous Tuesday before J, to the day J+5, so the length of this time series is about one month. Every Wednesday the oldest seven days of analyses are delayed and this archive is upgraded with the analyses from day J-15 to day J-2.

An example of aggregated product is shown in Fig. 3

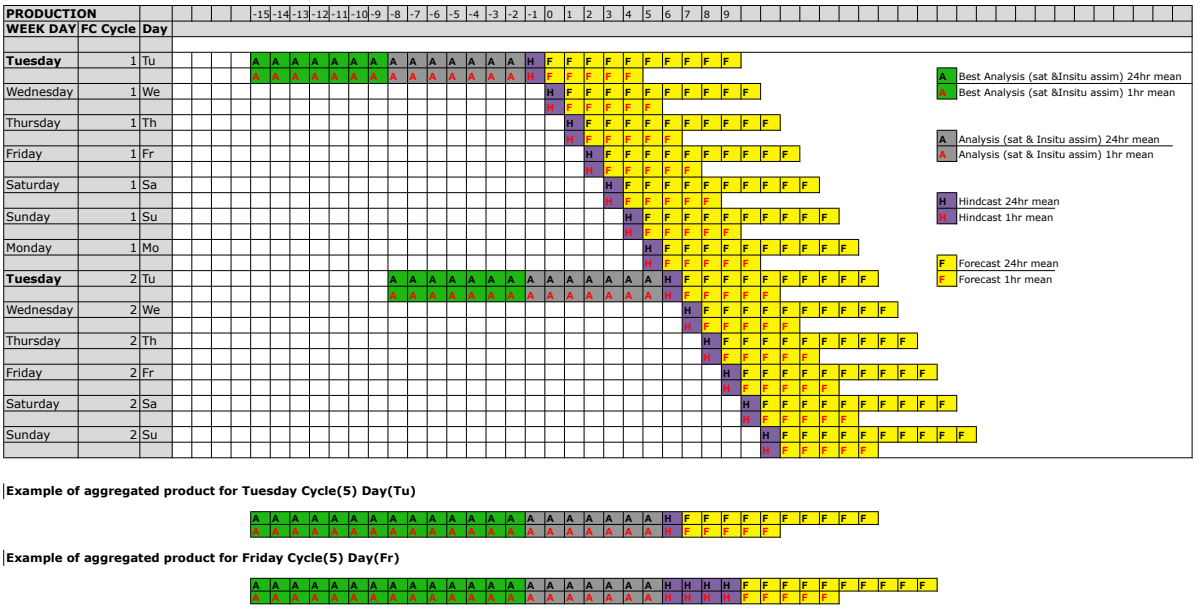

Figure 3 Example of aggregated product

IV.9 Other information: mean centre of Products, missing value, production chain and file dimension

IV.9.1 Mean Centre of Products

MEDSEA_ANALYSIS_FORECAST_PHYS_006_001 products: the 24hr mean fields of the forecast, analysis and hindcast are centered at midnight, 00:00 UTC (Fig.4).

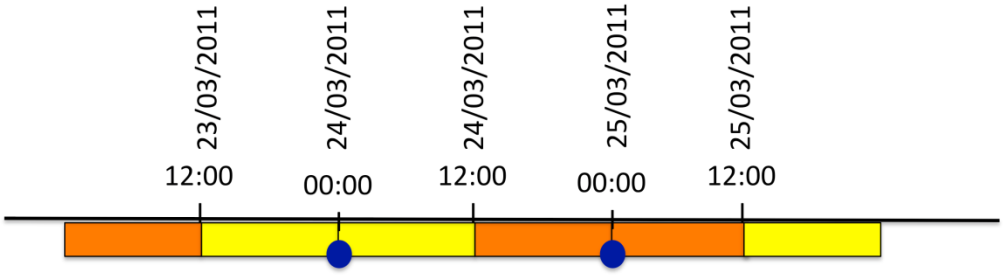

Figure 4 Example of time coverage of the products for MEDSEA_ANALYSIS_FORECAST_PHYS_006_001. The products are 24hr mean centered at midnight

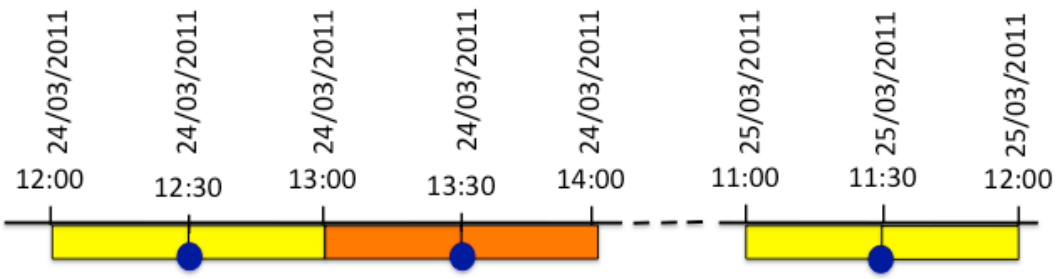

Figure 5 Example of time coverage of the hourly products for MEDSEA_ANALYSIS_FORECAST_PHYS_006_001. The products are 1hr means centered at 30' of every hour.

The hourly mean fields of the forecast, analysis and hindcast are centered at 30' of every hour (Fig.5)

IV.9.2 Missing Value

The **missing value** for theMEDSEA_ANALYSIS_FORECAST_PHYS_006_001 products is 1e+20.

IV.9.3 Production Chain

MEDSEA_ANALYSIS_FORECAST_PHYS_006_001 production chain:

Each Tuesday (D) a simulation is done with the model for the period from D-15 to D-1. The model is forced to the surface by atmospheric data of analysis produced by the European Center Middle Range Weather Forecast (ECMWF), and every 24hr its solutions are corrected by the assimilation, via OCEAN3DVAR scheme, of the satellite data (SLA) and the available in situ data (XBT, CTD and ARGO). Satellite OA-SST data are used for the correction of surface heat fluxes. In this way we obtain the initial conditions for the forecast production at 12:00 UTC of day D. The forecast for the next 240hr (D +9) is computed forcing the numerical model with ECMWF forecast fields.

Every day but Tuesday the initial condition for the forecast cycle are generated by a model simulation for the previous 24hr hours. The model hindcast is forced by ECMWF analysis fields (Fig.1).

IV.9.4 File Dimension

Table 6 describes the dimensions of the files for analysis and forecast for one day.

Table 6 Names and dimensions of the files

DATASET NAME	NAME OF FILE	DIMENSION [MB]*	
		Compressed	Uncompressed
CMEMSv02-MED-INGV-SSH-AN-FC-D	{date1}_d-INGV--ASLV-MFSeas1-MEDATL-b{date2}_fc-fv06.00.nc {date1}_d-INGV--ASLV-MFSeas1-MEDATL-b{date2}_sm-fv06.00.nc {date1}_d-INGV--ASLV-MFSeas1-MEDATL-b{date2}_an-fv06.00.nc	0.28	0.8

CMEMSv02-MED-INGV-SAL-AN-FC-D	{date1}_d-INGV--PSAL-MFSeas1-MEDATL-b{date2}_fc- fv06.00.nc {date1}_d-INGV--PSAL-MFSeas1-MEDATL-b{date2}_sm- fv06.00.nc {date1}_d-INGV--PSAL-MFSeas1-MEDATL-b{date2}_an- fv06.00.nc	11	58
CMEMSv02-MED-INGV-TEM-AN-FC-D	{date1}_d-INGV--TEMP-MFSeas1-MEDATL-b{date2}_fc- fv06.00.nc {date1}_d-INGV--TEMP-MFSeas1-MEDATL-b{date2}_sm- fv06.00.nc {date1}_d-INGV--TEMP-MFSeas1-MEDATL-b{date2}_an- fv06.00.nc	13	58
CMEMSv02-MED-INGV-CUR-AN-FC-D	{date1}_d-INGV--RFVL-MFSeas1-MEDATL-b{date2}_fc- fv06.00.nc {date1}_d-INGV--RFVL-MFSeas1-MEDATL-b{date2}_sm- fv06.00.nc {date1}_d-INGV--RFVL-MFSeas1-MEDATL-b{date2}_an- fv06.00.nc	30	117
CMEMSv02-MED-INGV-MLD-AN-FC-D	{date1}_d-INGV--AMXL – MFSeas1-MEDATL-b{date2}_fc- fv06.00.nc {date1}_d-INGV--AMXL – MFSeas1-MEDATL-b{date2}_sm- fv06.00.nc {date1}_d-INGV--AMXL – MFSeas1-MEDATL-b{date2}_an- fv06.00.nc	0.2	0.8

CMEMSv02-MED-INGV-SSH-AN-FC-H	{date1}_h-INGV--ASLV-MFSeas1-MEDATL-b{date2}_fc- fv06.00.nc {date1}_h-INGV--ASLV-MFSeas1-MEDATL-b{date2}_sm- fv06.00.nc {date1}_h-INGV--ASLV-MFSeas1-MEDATL-b{date2}_an- fv06.00.nc	6.5	20
CMEMSv02-MED-INGV-SAL-AN-FC-H	{date1}_h-INGV--PSAL-MFSeas1-MEDATL-b{date2}_fc-fv06.00.nc {date1}_h-INGV--PSAL-MFSeas1-MEDATL-b{date2}_sm- fv06.00.nc {date1}_h-INGV--PSAL-MFSeas1-MEDATL-b{date2}_an- fv06.00.nc	264	1400
CMEMSv02-MED-INGV-TEM-AN-FC-H	{date1}_h-INGV--TEMP-MFSeas1-MEDATL-b{date2}_fc- fv06.00.nc {date1}_h-INGV--TEMP-MFSeas1-MEDATL-b{date2}_sm- fv06.00.nc {date1}_h-INGV--TEMP-MFSeas1-MEDATL-b{date2}_an- fv06.00.nc	301	1400
CMEMSv02-MED-INGV-CUR-AN-FC-H	{date1}_h-INGV--RFVL-MFSeas1-MEDATL-b{date2}_fc- fv06.00.nc {date1}_h-INGV--RFVL-MFSeas1-MEDATL-b{date2}_sm- fv06.00.nc {date1}_h-INGV--RFVL-MFSeas1-MEDATL-b{date2}_an- fv06.00.nc	708	2800

CMEMSv02-MED-INGV-MLD-AN-FC-H	{date1}_h-INGV--AMXL-MFSeas1-MEDATL-b{date2}_fc-fv06.00.nc {date1}_h-INGV--AMXL–MFSeas1-MEDATL-b{date2}_sm-fv06.00.nc {date1}_h-INGV--AMXL –MFSeas1-MEDATL-b{date2}_an-fv06.00.nc	1.5	20

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

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
CMEMSv02-MED-INGV-SSH-AN-FC-D	438	1281
CMEMSv02-MED-INGV-SAL-AN-FC-D	17204	90712
CMEMSv02-MED-INGV-TEM-AN-FC-D	17204	90712
CMEMSv02-MED-INGV-CUR-AN-FC-D	46920	182988
CMEMSv02-MED-INGV-MLD-AN-FC-D	438	1281
CMEMSv02-MED-INGV-SSH-AN-FC-H	234	720
CMEMSv02-MED-INGV-SAL-AN-FC-H	9504	50400
CMEMSv02-MED-INGV-TEM-AN-FC-H	10836	50400
CMEMSv02-MED-INGV-CUR-AN-FC-H	25488	100800
CMEMSv02-MED-INGV-MLD-AN-FC-H	234	720

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 MEDSEA_ANALYSIS_FORECAST_PHYS_006_001.

DIMENSIONS	VARIABLES		
	NAME	DIMENSIONS	TYPE
lon=821 lat=253 depth=72 time=1	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
	sozostdx	time,lat,lon	float
	somestdy	time,lat,lon	float
	sowavenu	time,lat,lon	float
	somxl010	time,lat,lon	float
	seabed_temp	time,lat,lon	float

For 20121205_d-INGV--TEMP-MFSeas1-MEDATL-b20121231_an-fv06.00.nc

netcdf \20121205_d-INGV--TEMP-MFSeas1-MEDATL-b20121231_an-fv06.00 {

dimensions:

depth = 72 ;

lat = 253 ;

lon = 821 ;

time = UNLIMITED ; // (1 currently)

variables:

float depth(depth) ;

depth:axis = "Z" ;

depth:units = "m" ;

depth:positive = "down" ;

depth:valid_min = 1.472102f ;

depth:valid_max = 5334.648f ;

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 = 45.9375f ;

lat:valid_min = 30.1875f ;

float lon(lon) ;

lon:units = "degrees_east" ;

lon:long_name = "longitude" ;

lon:standard_name = "longitude" ;

lon:axis = "X" ;

lon:valid_max = 36.25f ;

lon:valid_min = -15.f ;

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 = "degC" ;

votemper:coordinates = "time depth lat lon" ;

votemper:standard_name = "sea_water_potential_temperature" ;

votemper:long_name = "temperature" ;

float seabed_temp(lat, lon) ;

seabed_temp:long_name = "sea_water_potential_temperature_at_sea_bed" ;

seabed_temp:standard_name = "seabed_temperature" ;

seabed_temp:missing_value = "1.e+20" ;

seabed_temp:valid_max = "35." ;

seabed_temp:units = "degC" ;

seabed_temp:coordinates = "time lat lon" ;

// global attributes:

:bulletin_type = "analysis" ;

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

:source = "MFS EAS1" ;

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

:references = "Please check in CMEMS catalogue the INFO section for product MEDSEA_ANALYSIS_FORECAST_PHYS_006_001 - http://marine.copernicus.eu" ;

:comment = "Please check in CMEMS catalogue the INFO section for product MEDSEA_ANALYSIS_FORECAST_PHYS_006_001 - http://marine.copernicus.eu" ;

:Conventions = "CF-1.0" ;

:bulletin_date = "2012-12-04" ;

:field_type = "daily_mean_centered_at_time_field" ;

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

}

For 20121205_h-INGV--TEMP-MFSeas1-MEDATL-b20121231_an-fv06.00.nc

netcdf \20121205_h-INGV--TEMP-MFSeas1-MEDATL-b20121231_an-fv06.00 {

dimensions:

depth = 72 ;

lat = 253 ;

lon = 821 ;

time = UNLIMITED ; // (24 currently)

variables:

float depth(depth) ;

depth:axis = "Z" ;

depth:units = "m" ;

depth:positive = "down" ;

depth:valid_min = 1.472102f ;

depth:valid_max = 5334.648f ;

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 = 45.9375f ;

lat:valid_min = 30.1875f ;

float lon(lon) ;

lon:units = "degrees_east" ;

lon:long_name = "longitude" ;

lon:standard_name = "longitude" ;

lon:axis = "X" ;

lon:valid_max = 36.25f ;

lon:valid_min = -15.f ;

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 = "degC" ;

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:long_name = "sea_water_potential_temperature_at_sea_bed" ;

seabed_temp:standard_name = "seabed_temperature" ;

seabed_temp:missing_value = "1.e+20" ;

seabed_temp:valid_max = "35." ;

seabed_temp:units = "degC" ;

seabed_temp:coordinates = "time lat lon" ;

// global attributes:

:bulletin_type = "analysis" ;

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

:source = "MFS EAS1" ;

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

:references = "Please check in CMEMS catalogue the INFO section for product MEDSEA_ANALYSIS_FORECAST_PHYS_006_001 - http://marine.copernicus.eu" ;

:comment = "Please check in CMEMS catalogue the INFO section for product MEDSEA_ANALYSIS_FORECAST_PHYS_006_001 - http://marine.copernicus.eu" ;

:Conventions = "CF-1.0" ;

:bulletin_date = "2012-12-04" ;

:field_type = "hourly_mean_centered_at_time_field" ;

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