COPERNICUS MARINE ENVIRONMENT MONITORING SERVICE

MED MFC

CMEMS ELEMENT

PRODUCT USER MANUAL

For Mediterranean Sea Physical Analysis and Forecasting Product MEDSEA_ANALYSIS_FORECAST_PHY_006_013

Reference: CMEMS-MED-PUM-006-013

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CHANGE RECORD

Issue	Date	§	Description of Change	Author
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1.1	25.01.18	all	Changes for product upgrade	R.Lecci, Alessandro Grandi, Claudia Fratianni, Emanuela Clementi, Massimiliano Drudi

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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_PHY_006_013 is the nominal product of the Mediterranean Sea Physical Forecasting system, composed by 3D, monthly mean fields, 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, Potential Temperature at sea bed and Mixed Layer Depth.

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_PHY_006_013 Product Specification

Product Specification	**MEDSEA_ANALYSIS_FORECAST_PHY_006_013**
Geographical coverage	17.29°W → 36.30°E; 30.18°N → 45.98°N
Variables	Temperature Salinity Sea Surface Height Ocean mixed layer thickness Horizontal Currents (meridional and zonal component) Sea floor Potential Temperature
Analysis	Yes
Hindcast	Yes
Forecast	Yes
Available time series	Daily mean: from 1 January 2016 – on going Hourly mean: 1 month (rolling archive) from 1 January 2016 – on going for 2D variables and 15 levels of 3D variables Monthly mean: from January 2016 – on going
Temporal resolution	24hr average field 1hr average field 1 month average field
Target delivery time	Forecast : daily, 03 UTC Analysis : on Wednesday, 03 UTC Simulation: daily, 03 UTC
Delivery mechanism	CMEMS Information System (Subsetter, CMEMS FTP, DGF)
Horizontal resolution	1/24°
Number of vertical levels	141
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 modeling system implemented over the whole Mediterranean Basin. The model horizontal grid resolution is 1/24˚ (ca. 4 km) and has 141 unevenly spaced vertical levels. The hydrodynamics are supplied by the Nucleous for European Modelling of the Ocean (NEMO v3.6) while the wave component is provided by WaveWatch-III; the model solutions are corrected by a variational data assimilation scheme (3DVAR) of temperature and salinity vertical profiles and along track satellite Sea Level Anomaly observations.

III.2.2 Detailed description

The Mediterranean Forecasting System, MFS, (Pinardi et al., 2003, Pinardi and Coppini 2010, Tonani et al 2014) is providing, since year 2000, analysis and short term forecast of the main physical parameters in the Mediterranean Sea and it is the component of the Med-Currents system.

The oceanic equations of motion are solved by an Ocean General Circulation Model (OGCM), based on the latest available NEMO model version 3.6, with non-linear free surface formulation and time-varying vertical z-star coordinates.

NEMO has been implemented in the Mediterranean at 1/24° x 1/24° horizontal resolution and 141 unevenly spaced vertical levels (more details in Clementi et al., 2017a), covering 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 topography is created starting from the GEBCO 30arc-second grid (http://www.gebco.net/data_and_products/gridded_bathymetry_data/gebco_30_second_grid/), filtered and manually modified in critical areas such as: islands along the Eastern Adriatic coasts, Gibraltar and Messina straits, Atlantic box edge.

The model has a non-linear explicit free surface and it is forced by surface pressure, interactive heat, momentum and water fluxes at the air-sea interface.

The vertical background viscosity and diffusivity values are set to 1.2e-6 [m2/s] and 1.0e-7 [m2/s] respectively, while the horizontal bilaplacian eddy diffusivity and viscosity are set respectively equal to -1.2e8 [m4/s] and -2.e8 [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 hydrodynamic model is nested, in the Atlantic, within the daily analysis and forecast CMEMS GLO-MFC product at 1/12° horizontal resolution, GLOBAL_ANALYSIS_FORECAST_PHY_001_024, by using a BDY (Unstructured Open Boundary Conditions) tool, since it allows to specify easier the location of the open boundaries.

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 39 rivers implemented is provided by monthly mean datasets: the Global Runoff Data Centre dataset (Fekete et al., 1999) for the Po, Ebro, Nile and Rhone rivers; the dataset from Raicich (1996) for: Vjosë, Seman rivers; the UNEP-MAP dataset (Implications of Climate Change for the Albanian Coast, Mediterranean Action Plan, MAP Technical

Reports Series No.98., 1996) for the Buna/Bojana river; the PERSEUS dataset for the following 32 rivers: Piave, Tagliamento, Soca/Isonzo, Livenza, Brenta-Bacchiglione, Adige, Lika, Reno, Krka, Arno, Nerveta, Aude, Trebisjnica, Tevere/Tiber, Mati, Volturno, Shkumbini, Struma/Strymonas, Meric/Evros, Maritsa, Axios/Vadar, Arachtos, Pinios, Acheloos, Gediz, Buyuk Menderes, Kopru, Manavgat, Seyhan, Ceyhan, Gosku, Medjerda, Asi/Orontes

The Dardanelles Starit is closed but considered as net volume input (Kourafalou and Barbopoulos ,2003) through a river-like parametrization.

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 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., 2017b).

The data assimilation system is the 3DVAR scheme developed by Dobricic and Pinardi (2008) and modified by Storto at al (2015). Background error correlation matrices vary monthly for each grid point in the discretized domain of the Mediterranean Sea. Observational error covariance matrix are evaluated with Desroziers's relationship (Desroziers et al, 2005)

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. Objective Analyses-Sea Surface Temperature (OA-SST) fields from CNR-ISA 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.

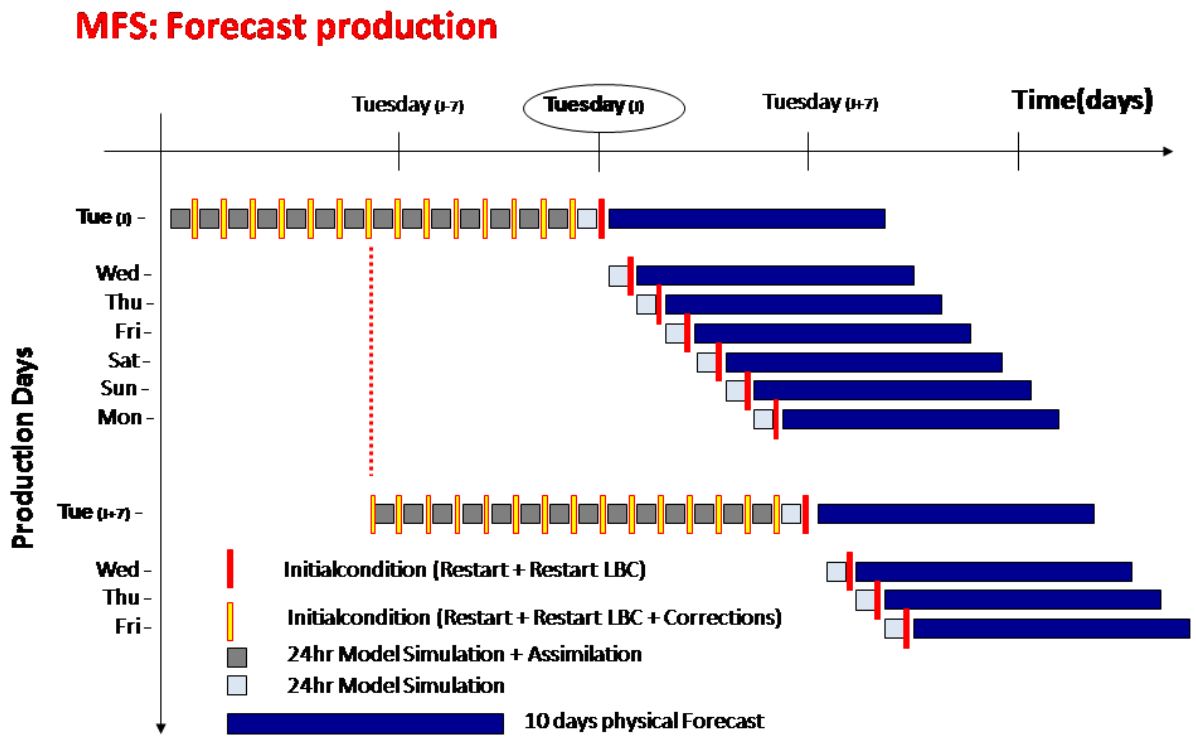

Figure 1 Scheme of the production chains of MEDSEA_ANALYSIS_FORECAST_PHY_006_013

III.3 Details of datasets

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

MEDSEA_ANALYSIS_FORECAST_PHY_006_013		
DATASETS	VARIABLES AND UNITS	NAME OF VARIABLES IN THE NETCDF FILE
sv04-med-ingv-cur-an-fc-d	Zonal Current [m/s] Meridional Current [m/s]	uo vo
sv04-med-ingv-ssh-an-fc-d	Sea Surface Height [m]	zos

sv04-med-ingv-tem-an-fc-d	Temperature [degrees C] Sea floor Potential Temperature [degrees C]	tethao bottomT
sv04-med-ingv-sal-an-fc-d	Salinity [PSU]	so
sv04-med-ingv-mld-an-fc-d	Ocean mixed layer thickness [m]	mlotst
sv04-med-ingv-cur-an-fc-h	Zonal Current [m/s] Meridional Current [m/s]	uo vo
sv04-med-ingv-ssh-an-fc-h	Sea Surface Height [m]	zos
sv04-med-ingv-tem-an-fc-h	Temperature [degrees_C] Sea floor potential temperature [degrees_C]	thetao bottomT
sv04-med-ingv-sal-an-fc-h	Salinity [PSU]	so
sv04-med-ingv-mld-an-fc-h	Ocean mixed layer thickness [m]	mlotst
sv04-med-ingv-cur-an-fc-hts	Zonal Current [m/s] Meridional Current [m/s]	uo vo
sv04-med-ingv-ssh-an-fc-hts	Sea Surface Height [m]	zos
sv04-med-ingv-tem-an-fc-hts	Temperature [degrees_C] Sea floor potential temperature [degrees_C]	thetao bottomT
sv04-med-ingv-sal-an-fc-hts	Salinity [PSU]	so
sv04-med-ingv-mld-an-fc-hts	Ocean mixed layer thickness [m]	mlotst
sv04-med-ingv-cur-an-fc-m	Zonal Current [m/s] Meridional Current [m/s]	uo vo
sv04-med-ingv-ssh-an-fc-m	Sea Surface Height [m]	zos
sv04-med-ingv-tem-an-fc-m	Temperature [degrees C] Sea floor Potential Temperature [degrees C]	tethao bottomT
sv04-med-ingv-sal-an-fc-m	Salinity [PSU]	so
sv04-med-ingv-mld-an-fc-m	Ocean mixed layer thickness [m]	mlotst

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_PHY_006_013 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-med-ingv-tem-an-fc-d
- sv04-med-ingv-sal-an-fc-d
- sv04-med-ingv-cur-an-fc-d
- sv04-med-ingv-ssh-an-fc-d
- sv04-med-ingv-mld-an-fc-d
- sv04-med-ingv-tem-an-fc-h
- sv04-med-ingv-sal-an-fc-h
- sv04-med-ingv-cur-an-fc-h
- sv04-med-ingv-ssh-an-fc-h
- sv04-med-ingv-mld-an-fc-h
- sv04-med-ingv-cur-an-fc-hts
- sv04-med-ingv-sal-an-fc-hts
- sv04-med-ingv-tem-an-fc-hts
- sv04-med-ingv-mld-an-fc-hts
- sv04-med-ingv-ssh-an-fc-hts
- sv04-med-ingv-tem-an-fc-m
- sv04-med-ingv-sal-an-fc-m
- sv04-med-ingv-cur-an-fc-m
- sv04-med-ingv-ssh-an-fc-m
- sv04-med-ingv-mld-an-fc-m

. 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 Temperature (**thetao**) and Sea Floor Potential Temperature (**bottomT**), Salinity (**so**), Sea Surface Height (**zos**), Velocity (**uo, vo**) and Ocean Mixed Layer Thickness (**mlotst**).

Example for a file of Salinity:

`sv04-med-ingv-sal-an-fc-d_1303461772348.nc`

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

MEDSEA_ANALYSIS_FORECAST_PHY_006_013 files nomenclature when downloaded through CMEMS FTP is based as follows:

{valid date}_{freq flag}-{producer}--{parameter}-{config}-{region}-{bul date}_{product type}-sv{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, hts = hourly time series, d = daily, m=monthly)
- **producer** is a short version of the CMEMS production unit
- **config** identifies the producing system and configuration
- **region** is a 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 (03, 04 or 05) and yy is an incremental version number

Table 3 shows the nomenclature for the MEDSEA_ANALYSIS_FORECAST_PHY_006_013 products.

Table 3 Description of the nomenclature for MEDSEA_ANALYSIS_FORECAST_PHY_006_013

valid date	YYYYMMDD
freq flag	m (monthly) d (daily) h (hourly) hts (hourly time series)
producer	INGV
config	MFSeas3
region	MEDATL

parameter	TEMP PSAL ASLV RFVL AMXL
bul date	bYYYYYMMDD
product type	fc (forecast) an (analysis) sm (hindcast)
file version	04.00

Example for a forecast file of Salinity:

`20150309_d-INGV--PSAL-MFSeas3-MEDATL-b20150306_fc-sv04.00.nc`

This is the mean field of salinity centered at 00:00 UTC of the 9th March 2015, and the time coverage is from noon (12:00 UTC) of the 8th March 2015 to noon (12:00 UTC) of the 9th March 2015 (see section IV.8).

`20150309_h-INGV--PSAL-MFSeas3-MEDATL-b20150306_fc-sv04.00.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 2015 to noon (12:00 UTC) of the 9th March 2015 (see section IV.9).

`20150309_hts-INGV--PSAL-MFSeas3-MEDATL-b20150306_fc-sv04.00.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 2015 to noon (12:00 UTC) of the 9th March 2015 (see section IV.9).

`20150301_m-INGV--PSAL-MFSeas3-MEDATL-b20150306_fc-sv04.00.nc`

This is the monthly mean field of salinity for the month of March 2015. The mean is computed from noon (12:00 UTC) of the 28th February 2015 to noon (12:00 UTC) of the 31st March 2015 (see section IV.9).

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

MEDSEA_ANALYSIS_FORECAST_PHY_006_013 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 :

- sv04-med-ingv-tem-an-fc-d

- sv04-med-ingv-sal-an-fc-d
- sv04-med-ingv-cur-an-fc-d
- sv04-med-ingv-ssh-an-fc-d
- sv04-med-ingv-mld-an-fc-d
- sv04-med-ingv-tem-an-fc-h
- sv04-med-ingv-sal-an-fc-h
- sv04-med-ingv-cur-an-fc-h
- sv04-med-ingv-ssh-an-fc-h
- sv04-med-ingv-mld-an-fc-h
- sv04-med-ingv-cur-an-fc-hts
- sv04-med-ingv-sal-an-fc-hts
- sv04-med-ingv-tem-an-fc-hts
- sv04-med-ingv-mld-an-fc-hts
- sv04-med-ingv-ssh-an-fc-hts
- sv04-med-ingv-tem-an-fc-m
- sv04-med-ingv-sal-an-fc-m
- sv04-med-ingv-cur-an-fc-m
- sv04-med-ingv-ssh-an-fc-m
- sv04-med-ingv-mld-an-fc-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 (**thetao**) and Potential Temperature at sea bed (**bottomT**), Salinity (**so**), Sea Surface Height (**zos**), Velocity (**uo,vo)** and Mixed Layer Depth **(mlotst).**

Example:

```
http---purl.org-myocean-ontology-product-database-sv04-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}-sv{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, hts = hourly time series, m= monthly)
- **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 (03, 04 and 05) and yy is an incremental version number

Table 4 shows the nomenclature for the MEDSEA_ANALYSIS_FORECAST_PHY_006_013 products.

Table 4 Description of the nomenclature for MEDSEA_ANALYSIS_FORECAST_PHY_006_013

valid date	YYYYMMDD
freq flag	m (monthly) d (daily) h (hourly) hts (hourly time series)
producer	INGV
config	MFSeas3
region	MEDATL
parameter	TEMP PSAL ASLV RFVL AMXL
bul date	bYYYYYMMDD
product type	fc (forecast) an (analysis) sm (hindcast)
file version	04.00

Example for a forecast file of Salinity:

`20150309_d-INGV--PSAL-MFSeas3-MEDATL-b20150306_fc-sv04.00.nc`

This is the mean field of salinity centered at 00:00 UTC of the 9thMarch 2015, and the time coverage is from noon (12:00 UTC) of the 8thMarch 2015 to noon (12:00 UTC) of the 9thMarch 2015 (see section IV.8).

`20150309_h-INGV--PSAL-MFSeas3-MEDATL-b20150306_fc-sv04.00.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 8thMarch 2015 to noon (12:00 UTC) of the 9thMarch 2015 (see section IV.9).

`20150309_hts-INGV--PSAL-MFSeas3-MEDATL-b20150306_fc-sv04.00.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 8thMarch 2015 to noon (12:00 UTC) of the 9thMarch 2015 (see section IV.9).

`20150301_m-INGV--PSAL-MFSeas3-MEDATL-b20150306_fc-sv04.00.nc`

This is the monthly mean field of salinity for the month of March 2015. The mean is computed from noon (12:00 UTC) of the 28th February 2015 to noon (12:00 UTC) of the 31st March 2015 (see section IV.9).

IV.4 Grid

The horizontal grid step is regular in latitude and longitude with a resolution of 1/24° x 1/24° of degree (~4 Km). The vertical grid is composed of 141 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_PHY_006_013 products.

Table 5 Description of grid and spatial coverage

MEDSEA_ANALYSIS_FORECAST_PHY_006_013							
VARIABLE	LON MIN	LON MAX	LAT MIN	LAT MAX	XPOINT	YPOINT	ZPOINT
Potential Temperature	-17.2917°W	36.29167°E	30.1875°N	45.97917°N	1287	380	141
Salinity	-17.2917°W	36.29167°E	30.1875°N	45.97917°N	1287	380	141
Sea Surface Height	-17.2917°W	36.29167°E	30.1875°N	45.97917°N	1287	380	1
Horizontal Current	-17.2917°W	36.29167°E	30.1875°N	45.97917°N	1287	380	141
Mixed Layer Depth	-17.2917°W	36.29167°E	30.1875°N	45.97917°N	1287	380	141
Potential Temperature at sea bed	-17.2917°W	36.29167°E	30.1875°N	45.97917°N	1287	380	1

IV.5 Domain coverage

The blue area in Fig.2 represents the spatial coverage of the MEDSEA_ANALYSIS_FORECAST_PHY_006_013 products.

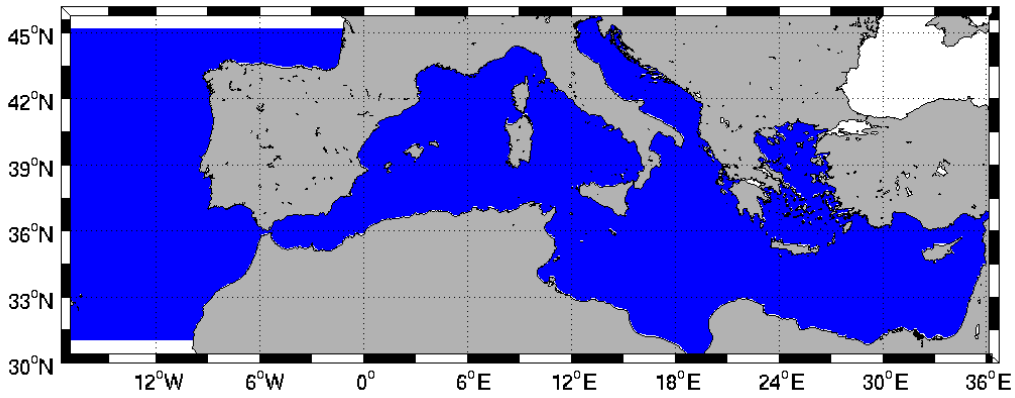

Figure 2 Spatial coverage of the MEDSEA_ANALYSIS_FORECAST_PHY_006_013 products (blue zone).

Grid type is the following standard projection:

Regular projection: longitude and latitude step is constant	

IV.6 Vertical Levels

MEDSEA_ANALYSIS_FORECAST_PHY_006_013 product is computed on 141 unevenly spaced vertical levels: the thickness of the layer at the surface is about 2 meters, and increases up to 100 meters at the bottom. All the 72 levels are released. The depths are (in meters): 1.018237, 3.165747, 5.464963, 7.920377, 10.5366, 13.31838, 16.27059, 19.39821, 22.70639, 26.2004, 29.88564, 33.76767, 37.85219, 42.14504, 46.65221, 51.37986, 56.33429, 61.52196, 66.94949, 72.62369, 78.5515, 84.74004, 91.19663, 97.92873, 104.944, 112.2502, 119.8554, 127.7678, 135.9958, 144.5479, 153.4328, 162.6596, 172.2374, 182.1754, 192.4831, 203.1704, 214.2472, 225.7234, 237.6095, 249.9158, 262.6532, 275.8325, 289.4648, 303.5613, 318.1335, 333.1931, 348.752, 364.822, 381.4154, 398.5447, 416.2223, 434.4611, 453.2738, 472.6735, 492.6735, 513.287, 534.5276, 556.4089, 578.9446, 602.1486, 626.0349, 650.6176, 675.9107, 701.9286, 728.6856, 756.196, 784.4743, 813.5349, 843.3922, 874.0607, 905.5548, 937.8891, 971.0779, 1005.135, 1040.076, 1075.914, 1112.664, 1150.338, 1188.952, 1228.519, 1269.052, 1310.564, 1353.069, 1396.58, 1441.109, 1486.668, 1533.269, 1580.925, 1629.647, 1679.445, 1730.33, 1782.314, 1835.405, 1889.613, 1944.947, 2001.417, 2059.029, 2117.792, 2177.714, 2238.8, 2301.058, 2364.492, 2429.108, 2494.91, 2561.903, 2630.09, 2699.474, 2770.057, 2841.841, 2914.827, 2989.016, 3064.407, 3141.001, 3218.796, 3297.79, 3377.981, 3459.366, 3541.942, 3625.704, 3710.647, 3796.768, 3884.06, 3972.516, 4062.13, 4152.896, 4244.804, 4337.848, 4432.018, 4527.304, 4623.699, 4721.191, 4819.771, 4919.427, 5020.149, 5121.926, 5224.745, 5328.594, 5433.461, 5539.333, 5646.199, 5754.044.

In Table 6 there is the description of the 15 levels at which are released the hourly time series.

Level n.	Corresponding model level	Model Depth [m]
1	1	1.018237
2	2	3.165747
3	3	5.464963
4	4	7.920377
5	5	10.5366
6	8	19.39821
7	11	29.88564
8	16	51.37986
9	20	72.62369
10	24	97.92873
11	31	153.4328
12	36	203.1704
13	40	249.9158
14	44	303.5613
15	50	398.5447

Table 6 Details of 15 levels for hourly time series.

MEDSEA_ANALYSIS_FORECAST_PHY_006_013 has a vertical grid with partial steps (See NEMO_book.pdf, pag 59). 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_EAS2_T.nc. This file is freely available via HTTP at this link http://cmems-med-mfc.eu/masks/MEDmeshmask_EAS2_T.nc.gz . The relevant variables described in MEDmeshmask_SYS4e_T.nc file are:

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

```
netcdf MEDmeshmask_EAS2_T {
dimensions:
        t = UNLIMITED ; // (1 currently)
        y = 380 ;
        x = 1307 ;
        z = 141 ;
variables:
        double e1t(t, y, x) ;
        double e2t(t, y, x) ;
```

```
        double e3t(t, z, y, x) ;
        double e3t_0(t, z) ;
        double ff(t, y, x) ;
        double gdept_0(t, z) ;
        double glamt(t, y, x) ;
        double gphit(t, y, x) ;
        short mbathy(t, y, x) ;
        float nav_lat(y, x) ;
        float nav_lev(z) ;
        float nav_lon(y, x) ;
        double time_counter(t) ;
        byte tmask(t, z, y, x) ;

// global attributes:
                :DOMAIN_number_total = 1 ;
                :DOMAIN_number = 0 ;
                :DOMAIN_dimensions_ids = 1, 2 ;
                :DOMAIN_size_global = 1287, 380 ;
                :DOMAIN_size_local = 1287, 380 ;
                :DOMAIN_position_first = 1, 1 ;
                :DOMAIN_position_last = 1287, 380 ;
                :DOMAIN_halo_size_start = 0, 0 ;
                :DOMAIN_halo_size_end = 0, 0 ;
                :DOMAIN_type = "BOX" ;
```

IV.7 Update Time

MEDSEA_ANALYSIS_FORECAST_PHY_006_013 product contains: the daily update of forecast and simulation fields is available within 03:00 am UTC of the following day. This applies also to the analyses weekly update that is available on Wednesday within 03:00 am UTC.

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

MEDSEA_ANALYSIS_FORECAST_PHY_006_013 products temporal coverage: for the daily mean fields, every day J is available a time series starting from 1/1/2016 to the day J+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 J-21, where J 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

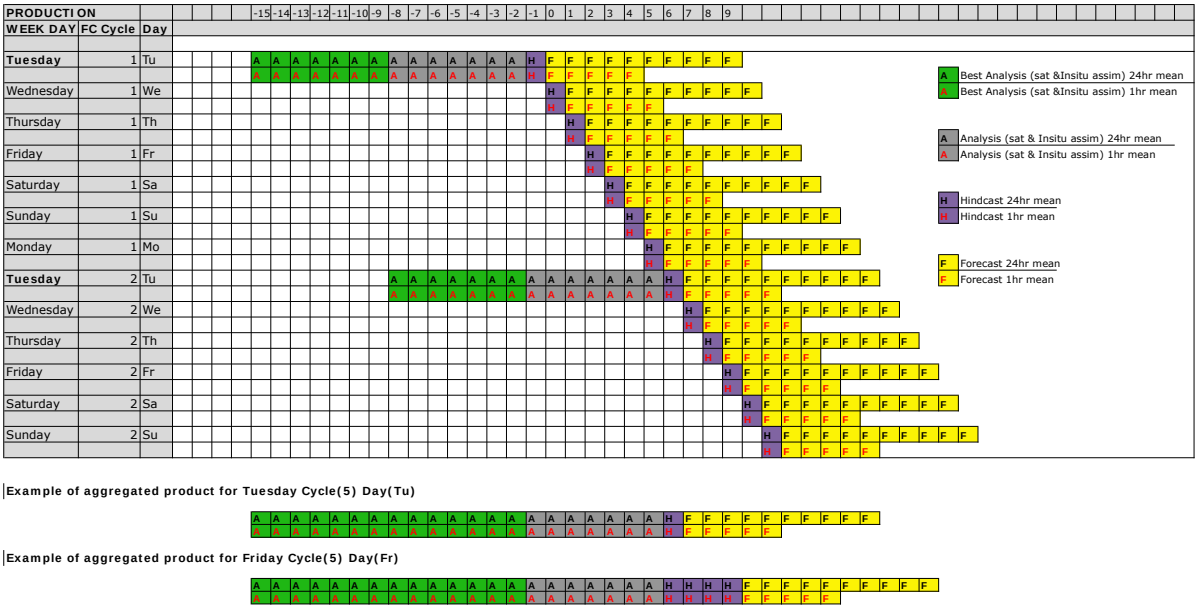

Figure 3 Example of aggregated product

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_PHY_006_013 products: the 24hr mean fields of the forecast, analysis and hindcast are centered at midnight, 00:00 UTC (Fig.4).

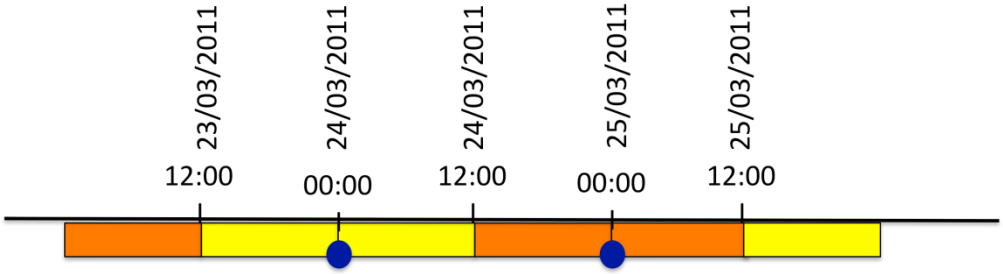

Figure 4 Example of time coverage of the products for MEDSEA_ANALYSIS_FORECAST_PHY_006_013. The products are 24hr mean centered at midnight

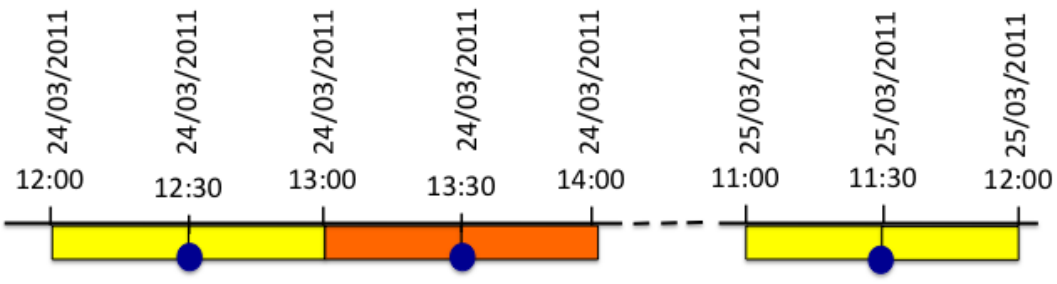

Figure 5 Example of time coverage of the hourly products for MEDSEA_ANALYSIS_FORECAST_PHY_006_013. The products are 1hr means centered at 30' of every hour.

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

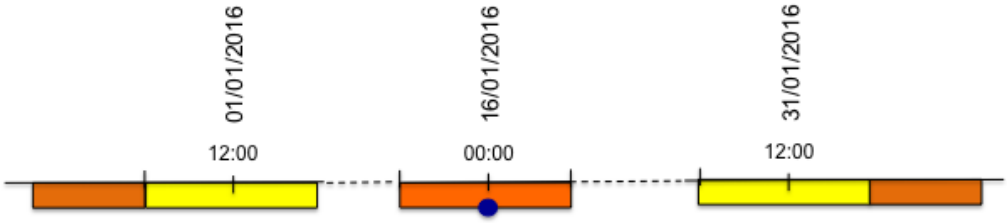

Figure 6 Example of time coverage of the product for MEDSEA_ANALYSIS_FORECAST_PHY_006_013. The products are monthly mean centered at midnight.

The monthly mean fields of the analysis are centered at midnight, 00:00 UTC (Fig.6).

IV.9.2 Missing Value

The **missing value** for theMEDSEA_ANALYSIS_FORECAST_PHY_006_013 products is 1e+20.

IV.9.3 Production Chain

MEDSEA_ANALYSIS_FORECAST_PHY_006_013 production chain:

Each Tuesday (J) a simulation is done with the model for the period from J-15 to J-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 J. The forecast for the next 240hr (J +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]*
sv04-med-ingv-ssh-an-fc-d	{date1}_d-INGV--ASLV-MFSeas3-MEDATL-b{date2}_fc-sv04.00.nc {date1}_d-INGV--ASLV-MFSeas3-MEDATL-b{date2}_sm-sv04.00.nc {date1}_d-INGV--ASLV-MFSeas3-MEDATL-b{date2}_an-sv04.00.nc	0.83
sv04-med-ingv-sal-an-fc-d	{date1}_d-INGV--PSAL-MFSeas3-MEDATL-b{date2}_fc-sv03.00.nc {date1}_d-INGV--PSAL-MFSeas3-MEDATL-b{date2}_sm-sv04.00.nc {date1}_d-INGV--PSAL-MFSeas3-MEDATL-b{date2}_an-sv04.00.nc	54
sv04-med-ingv-tem-an-fc-d	{date1}_d-INGV--TEMP-MFSeas3-MEDATL-b{date2}_fc-sv04.00.nc {date1}_d-INGV--TEMP-MFSeas3-MEDATL-b{date2}_sm-sv04.00.nc {date1}_d-INGV--TEMP-MFSeas3-MEDATL-b{date2}_an-sv04.00.nc	67
sv04-med-ingv-cur-an-fc-d	{date1}_d-INGV--RFVL-MFSeas3-MEDATL-b{date2}_fc-sv04.nc {date1}_d-INGV--RFVL-MFSeas3-MEDATL-b{date2}_sm-sv04.00.nc {date1}_d-INGV--RFVL-MFSeas3-MEDATL-b{date2}_an-sv04.00.nc	154
sv04-med-ingv-mld-an-fc-d	{date1}_d-INGV--AMXL –MFSeas3-MEDATL-b{date2}_fc-sv04.00.nc {date1}_d-INGV--AMXL –MFSeas3-MEDATL-b{date2}_sm-sv04.00.nc {date1}_d-INGV--AMXL –MFSeas3-MEDATL-b{date2}_an-sv04.00.nc	0.73

sv04-med-ingv-ssh-an-fc-h	{date1}_h-INGV--ASLV-MFSeas3-MEDATL-b{date2}_fc-sv04.00.nc {date1}_h-INGV--ASLV-MFSeas3-MEDATL-b{date2}_sm-sv04.00.nc {date1}_h-INGV--ASLV-MFSeas3-MEDATL-b{date2}_an-sv04.00.nc	19
sv04-med-ingv-sal-an-fc-h	{date1}_h-INGV--PSAL-MFS eas3-MEDATL-b{date2}_fc-sv04.00.nc {date1}_h-INGV--PSAL-MFSeas3-MEDATL-b{date2}_sm-sv04.00.nc {date1}_h-INGV--PSAL-MFSeas3-MEDATL-b{date2}_an-sv04.00.nc	1288
sv04-med-ingv-tem-an-fc-h	{date1}_h-INGV--TEMP-MFSeas3-MEDATL-b{date2}_fc-sv04.00.nc {date1}_h-INGV--TEMP-MFSeas3-MEDATL-b{date2}_sm-sv04.00.nc {date1}_h-INGV--TEMP-MFSeas3-MEDATL-b{date2}_an-sv04.00.nc	1596
sv04-med-ingv-cur-an-fc-h	{date1}_h-INGV--RFVL-MFSeas3-MEDATL-b{date2}_fc-sv04.00.nc {date1}_h-INGV--RFVL-MFSeas3-MEDATL-b{date2}_sm-sv04.00.nc {date1}_h-INGV--RFVL-MFSeas3-MEDATL-b{date2}_an-sv04.00.nc	3696
sv04-med-ingv-mld-an-fc-h	{date1}_h-INGV--AMXL-MFSeas3-MEDATL-b{date2}_fc-sv04.00.nc {date1}_h-INGV--AMXL–MFSeas3-MEDATL-b{date2}_sm-sv04.00.nc {date1}_h-INGV--AMXL –MFSeas3-MEDATL-b{date2}_an-sv04.00.nc	14
sv04-med-ingv-ssh-an-fc-hts	{date1}_hts-INGV--ASLV-MFSeas3-MEDATL-b{date2}_fc-sv04.00.nc {date1}_hts-INGV--ASLV-MFSeas3-MEDATL-b{date2}_sm-sv04.00.nc {date1}_hts-INGV--ASLV-MFSeas3-MEDATL-b{date2}_an-sv04.00.nc	19

sv04-med-ingv-sal-an-fc-hts	{date1}_hts-INGV--PSAL-MFS eas3-MEDATL-b{date2}_fc-sv04.00.nc {date1}_hts-INGV--PSAL-MFSeas3-MEDATL-b{date2}_sm-sv04.00.nc {date1}_hts-INGV--PSAL-MFSeas3-MEDATL-b{date2}_an-sv04.00.nc	217
sv04-med-ingv-tem-an-fc-hts	{date1}_hts-INGV--TEMP-MFSeas3-MEDATL-b{date2}_fc-sv04.00.nc {date1}_hts-INGV--TEMP-MFSeas3-MEDATL-b{date2}_sm-sv04.00.nc {date1}_hts-INGV--TEMP-MFSeas3-MEDATL-b{date2}_an-sv04.00.nc	268
sv04-med-ingv-cur-an-fc-hts	{date1}_hts-INGV--RFVL-MFSeas3-MEDATL-b{date2}_fc-sv04.00.nc {date1}_hts-INGV--RFVL-MFSeas3-MEDATL-b{date2}_sm-sv04.00.nc {date1}_hts-INGV--RFVL-MFSeas3-MEDATL-b{date2}_an-sv04.00.nc	575
sv04-med-ingv-mld-an-fc-hts	{date1}_hts-INGV--AMXL-MFSeas3-MEDATL-b{date2}_fc-sv04.00.nc {date1}_hts-INGV--AMXL–MFSeas3-MEDATL-b{date2}_sm-sv04.00.nc {date1}_hts-INGV--AMXL –MFSeas3-MEDATL-b{date2}_an-sv04.00.nc	14
sv04-med-ingv-ssh-an-fc-m	{date1}_m-INGV--ASLV-MFSeas3-MEDATL-b{date2}_an-sv04.00.nc	0.83
sv04-med-ingv-sal-an-fc-m	{date1}_m-INGV--PSAL-MFSeas3-MEDATL-b{date2}_an-sv04.00.nc	54
sv04-med-ingv-tem-an-fc-m	{date1}_m-INGV--TEMP-MFSeas3-MEDATL-b{date2}_an-sv04.00.nc	67
sv04-med-ingv-cur-an-fc-m	{date1}_m-INGV--RFVL-MFSeas3-MEDATL-b{date2}_an-sv04.00.nc	154
sv04-med-ingv-mld-an-fc-m	{date1}_m-INGV--AMXL –MFSeas3-MEDATL-b{date2}_an-sv04.00.nc	0.73

* 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]
sv04-med-ingv-ssh-an-fc-d	1212
sv04-med-ingv-sal-an-fc-d	78894
sv04-med-ingv-tem-an-fc-d	97887
sv04-med-ingv-cur-an-fc-d	224994
sv04-med-ingv-mld-an-fc-d	1067
sv04-med-ingv-ssh-an-fc-h	589
sv04-med-ingv-sal-an-fc-h	39928
sv04-med-ingv-tem-an-fc-h	49476
sv04-med-ingv-cur-an-fc-h	114576
sv04-med-ingv-mld-an-fc-h	434
sv04-med-ingv-ssh-an-fc-hts	10431
sv04-med-ingv-sal-an-fc-hts	75224
sv04-med-ingv-tem-an-fc-hts	93213
sv04-med-ingv-cur-an-fc-hts	215862
sv04-med-ingv-mld-an-fc-hts	7686
sv04-med-ingv-ssh-an-fc-m	1212
sv04-med-ingv-sal-an-fc-m	78894
sv04-med-ingv-tem-an-fc-m	97887
sv04-med-ingv-cur-an-fc-m	224994

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_PHY_006_013.

DIMENSIONS	VARIABLES		
	NAME	DIMENSIONS	TYPE
lon=1287 lat=380 depth=141 time=1	lon	lon	float
	lat	lat	float
	depth	depth	float
	time	time	int
	zos	time,lat,lon	float
	thetao	time,depth,lat,lon	float
	so	time,depth,lat,lon	float

	uo	time,depth,lat,lon	float
	vo	time,depth,lat,lon	float
	mlotst	time,lat,lon	float
	bottomT	time,lat,lon	float

For 20161205_d-INGV--TEMP-MFSeas3-MEDATL-b20161231_an-sv04.00.nc

```
netcdf \20161205_d-INGV--TEMP-MFSeas3-MEDATL-b20161231_an-sv04.00 {
dimensions:
        depth = 141 ;
        lat = 380 ;
        lon = 1287 ;
        time = UNLIMITED ; // (1 currently)
variables:
        float depth(depth) ;
                depth:units = "m" ;
                depth:axis = "Z" ;
                depth:valid_min = 1.020676f ;
                depth:valid_max = 6486.14f ;
                depth:standard_name = "depth" ;
                depth:long_name = "depth" ;
                depth:positive = "down" ;
        float lat(lat) ;
                lat:units = "degrees_north" ;
                lat:long_name = "latitude" ;
                lat:standard_name = "latitude" ;
                lat:axis = "Y" ;
                lat:valid_min = 30.1875f ;
                lat:valid_max = 45.97917f ;
        float lon(lon) ;
                lon:units = "degrees_east" ;
                lon:valid_min = -17.2917.f ;
                lon:valid_max = 36.29167f ;
                lon:long_name = "longitude" ;
                lon:standard_name = "longitude" ;
                lon:axis = "X" ;
        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 thetao(time, depth, lat, lon) ;

thetao:_FillValue = 1.e+20f ;

thetao:missing_value = 1.e+20f ;

thetao:valid_min = 4.f ;

thetao:valid_max = 35.f ;

thetao:units = "degC" ;

thetao:coordinates = "time depth lat lon" ;

thetao:standard_name = "sea_water_potential_temperature" ;

thetao:long_name = "temperature" ;

float bottomT(time, lat, lon) ;

bottomT:_FillValue = 1.e+20f ;

bottomT:missing_value = 1.e+20f ;

bottomT:valid_min = 4.f ;

bottomT:valid_max = 35.f ;

bottomT:units = "degC" ;

bottomT:coordinates = "time lat lon" ;

bottomT:standard_name = "sea_water_potential_temperature_at_sea_floor" ;

bottomT:long_name = "Sea floor potential temperature" ;

// global attributes:

:bulletin_type = " analysis " ;

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

:source = "MFS EAS3" ;

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

:references = "Please check in CMEMS catalogue the INFO section for product MEDSEA_ANALYSIS_FORECAST_PHY_006_013 - http://marine.copernicus.eu" ;

:comment = "Please check in CMEMS catalogue the INFO section for product MEDSEA_ANALYSIS_FORECAST_PHY_006_013 - http://marine.copernicus.eu" ;

:Conventions = "CF-1.0" ;

:bulletin_date = "2016-12-31" ;

:field_type = "daily_mean_centered_at_time_field" ;

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

}

For 20161205_h-INGV--TEMP-MFSeas3-MEDATL-b20161231_an-sv04.00.nc

```
netcdf \20161205_h-INGV--TEMP-MFSeas3-MEDATL-b20161231_an-sv04.00 {
dimensions:
        depth = 141 ;
        lat = 380 ;
        lon = 1287 ;
        time = UNLIMITED ; // (24 currently)
variables:
        float depth(depth) ;
                depth:units = "m" ;
                depth:axis = "Z" ;
                depth:valid_min = 1.020676f ;
                depth:valid_max = 6486.14f ;
                depth:standard_name = "depth" ;
                depth:long_name = "depth" ;
                depth:positive = "down" ;
        float lat(lat) ;
                lat:units = "degrees_north" ;
                lat:long_name = "latitude" ;
                lat:standard_name = "latitude" ;
                lat:axis = "Y" ;
                lat:valid_min = 30.1875f ;
                lat:valid_max = 45.97917f ;
        float lon(lon) ;
                lon:units = "degrees_east" ;
                lon:valid_min = -17.2917.f ;
                lon:valid_max = 36.29167f ;
                lon:long_name = "longitude" ;
                lon:standard_name = "longitude" ;
                lon:axis = "X" ;
        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 thetao(time, depth, lat, lon) ;
                thetao:_FillValue = 1.e+20f ;
                thetao:missing_value = 1.e+20f ;
                thetao:valid_min = 4.f ;
```

thetao:valid_max = 35.f ;

thetao:units = "degC" ;

thetao:coordinates = "time depth lat lon" ;

thetao:standard_name = "sea_water_potential_temperature" ;

thetao:long_name = "temperature" ;

float bottomT(time, lat, lon) ;

bottomT:_FillValue = 1.e+20f ;

bottomT:missing_value = 1.e+20f ;

bottomT:valid_min = 4.f ;

bottomT:valid_max = 35.f ;

bottomT:units = "degC" ;

bottomT:coordinates = "time lat lon" ;

bottomT:standard_name = "sea_water_potential_temperature_at_sea_floor" ;

bottomT:long_name = "Sea floor potential temperature" ;

// global attributes:

:bulletin_type = "analysis" ;

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

:source = "MFS EAS3" ;

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

:references = "Please check in CMEMS catalogue the INFO section for product MEDSEA_ANALYSIS_FORECAST_PHY_006_013 - http://marine.copernicus.eu" ;

:comment = "Please check in CMEMS catalogue the INFO section for product MEDSEA_ANALYSIS_FORECAST_PHY_006_013 - http://marine.copernicus.eu" ;

:Conventions = "CF-1.0" ;

:bulletin_date = "2016-12-31" ;

:field_type = "hourly_mean_centered_at_time_field" ;

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

}

For 20170701_hts-INGV--TEMP-MFSeas3-MEDATL-b20170627_an-sv04.00.nc

netcdf \20170701_hts-INGV--TEMP-MFSeas3-MEDATL-b20170627_fc-sv04.00 {

dimensions:

time = UNLIMITED ; // (24 currently)

lat = 380 ;

lon = 1287 ;

depth = 15 ;

variables:

float bottomT(time, lat, lon) ;

bottomT:_FillValue = 1.e+20f ;

bottomT:missing_value = 1.e+20f ;
bottomT:valid_min = 4.f ;
bottomT:valid_max = 35.f ;
bottomT:units = "degC" ;
bottomT:coordinates = "time lat lon" ;
bottomT:standard_name = "sea_water_potential_temperature_at_sea_floor" ;
bottomT:long_name = "Sea floor potential temperature" ;
float depth(depth) ;
depth:units = "m" ;
depth:nav_model = "Grid T" ;
depth:positive = "down" ;
depth:standard_name = "depth" ;
depth:long_name = "depth" ;
depth:axis = "Z" ;
depth:valid_min = 1.018237f ;
depth:valid_max = 398.5447f ;
float lat(lat) ;
lat:valid_min = 30.1875f ;
lat:valid_max = 45.9792f ;
lat:units = "degrees_north" ;
lat:nav_model = "Grid T" ;
lat:standard_name = "latitude" ;
lat:long_name = "latitude" ;
lat:axis = "Y" ;
float lon(lon) ;
lon:valid_min = -17.2917f ;
lon:valid_max = 36.2917f ;
lon:units = "degrees_east" ;
lon:nav_model = "Grid T" ;
lon:standard_name = "longitude" ;
lon:long_name = "longitude" ;
lon:axis = "X" ;
float thetao(time, depth, lat, lon) ;
thetao:_FillValue = 1.e+20f ;
thetao:missing_value = 1.e+20f ;
thetao:valid_min = 4.f ;
thetao:valid_max = 35.f ;
thetao:units = "degC" ;
thetao:coordinates = "time depth lat lon" ;

thetao:standard_name = "sea_water_potential_temperature" ;

thetao:long_name = "temperature" ;

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" ;

// global attributes:

:bulletin_type = "forecast" ;

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

:source = "MFS EAS3" ;

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

:references = "Please check in CMEMS catalogue the INFO section for product MEDSEA_ANALYSIS_FORECAST_PHY_006_013 - http://marine.copernicus.eu" ;

:comment = "Please check in CMEMS catalogue the INFO section for product MEDSEA_ANALYSIS_FORECAST_PHY_006_013 - http://marine.copernicus.eu" ;

:Conventions = "CF-1.0" ;

:bulletin_date = "2017-06-27" ;

:field_type = "hourly_mean_centered_at_time_field" ;

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

}

For 20161201_m-INGV--TEMP-MFSeas3-MEDATL-b20161231_an-sv04.00.nc

netcdf \20161201_m-INGV--TEMP-MFSeas3-MEDATL-b20161231_an-sv04.00 {

dimensions:

depth = 141 ;

lat = 380 ;

lon = 1287 ;

time = UNLIMITED ; // (1 currently)

variables:

float depth(depth) ;

depth:units = "m" ;

depth:axis = "Z" ;

depth:valid_min = 1.020676f ;

depth:valid_max = 6486.14f ;

depth:standard_name = "depth" ;

depth:long_name = "depth" ;

depth:positive = "down" ;

float lat(lat) ;
lat:units = "degrees_north" ;
lat:long_name = "latitude" ;
lat:standard_name = "latitude" ;
lat:axis = "Y" ;
lat:valid_min = 30.1875f ;
lat:valid_max = 45.97917f ;
float lon(lon) ;
lon:units = "degrees_east" ;
lon:valid_min = -17.2917.f ;
lon:valid_max = 36.29167f ;
lon:long_name = "longitude" ;
lon:standard_name = "longitude" ;
lon:axis = "X" ;
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 thetao(time, depth, lat, lon) ;
thetao:_FillValue = 1.e+20f ;
thetao:missing_value = 1.e+20f ;
thetao:valid_min = 4.f ;
thetao:valid_max = 35.f ;
thetao:units = "degC" ;
thetao:coordinates = "time depth lat lon" ;
thetao:standard_name = "sea_water_potential_temperature" ;
thetao:long_name = "temperature" ;
float bottomT(time, lat, lon) ;
bottomT:_FillValue = 1.e+20f ;
bottomT:missing_value = 1.e+20f ;
bottomT:valid_min = 4.f ;
bottomT:valid_max = 35.f ;
bottomT:units = "degC" ;
bottomT:coordinates = "time lat lon" ;
bottomT:standard_name = "sea_water_potential_temperature_at_sea_floor" ;
bottomT:long_name = "Sea floor potential temperature" ;

// global attributes:

:bulletin_type = " analysis " ;

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

:source = "MFS EAS3" ;

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

:references = "Please check in CMEMS catalogue the INFO section for product MEDSEA_ANALYSIS_FORECAST_PHY_006_013 - http://marine.copernicus.eu" ;

:comment = "Please check in CMEMS catalogue the INFO section for product MEDSEA_ANALYSIS_FORECAST_PHY_006_013 - http://marine.copernicus.eu" ;

:Conventions = "CF-1.0" ;

:bulletin_date = "2016-12-31" ;

: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…