MED MFC
CMEEMS ELEMENT

PRODUCT USER MANUAL

For Mediterranean Sea Physical Analysis and Forecasting Product
MEDSEA_ANALYSIS_FORECAST_PHYS_006_001

Reference: CMEMS-MED-PUM-006-001

Contributors: Rita Lecci, Massimiliano Drudi, Alessandro Grandi, Claudia Fratianni
## CHANGE RECORD

<table>
<thead>
<tr>
<th>Issue</th>
<th>Date</th>
<th>§§</th>
<th>Description of Change</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>26.01.16</td>
<td>all</td>
<td>First version of document</td>
<td>R. Lecci, M. Drudi, A. Grandi, C. Fratianni</td>
</tr>
<tr>
<td>1.1</td>
<td>26.09.16</td>
<td>all</td>
<td>Replacement of GLOBAL_ANALYSIS_FORECAST_PHYS_001_002 occurrences with GLOBAL_ANALYSIS_FORECAST_PHYS_001_024 (the new system)</td>
<td>R. Lecci</td>
</tr>
</tbody>
</table>
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## GLOSSARY AND ABBREVIATIONS

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analysis (Numerical)</td>
<td>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.</td>
</tr>
<tr>
<td>CF</td>
<td>Climate Forecast (convention for NetCDF)</td>
</tr>
<tr>
<td>CLS</td>
<td>Collecte Localisation Satellites</td>
</tr>
<tr>
<td>CMAP</td>
<td>CPC Merged Analysis of Precipitation</td>
</tr>
<tr>
<td>CMCC</td>
<td>Centro Euro-Mediterraneo sui Cambiamenti Climatici</td>
</tr>
<tr>
<td>CMEMS</td>
<td>Copernicus Marine Environment Monitoring Service</td>
</tr>
<tr>
<td>CNR-ISAC</td>
<td>Istituto di Scienze dell’Atmosfera e del Clima</td>
</tr>
<tr>
<td>CTD</td>
<td>Conductivity Temperature Depth</td>
</tr>
<tr>
<td>DAC</td>
<td>Dynamic Atmospheric Correction</td>
</tr>
<tr>
<td>DGF</td>
<td>DirectGetFile</td>
</tr>
<tr>
<td>DirectGetFile</td>
<td>CMEMS service tool (FTP like) to download a NetCDF file</td>
</tr>
<tr>
<td>ECMWF</td>
<td>European Centre for Medium-Range Weather Forecasts</td>
</tr>
<tr>
<td>EOF</td>
<td>Empirical Orthogonal Function</td>
</tr>
<tr>
<td>FAQ</td>
<td>Frequently Asked Question</td>
</tr>
<tr>
<td>Forecast (Numerical)</td>
<td>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).</td>
</tr>
<tr>
<td>FTP</td>
<td>File Transfer Protocol</td>
</tr>
<tr>
<td>MDT</td>
<td>Mean Dynamic Topography</td>
</tr>
<tr>
<td>Med/MED</td>
<td>Mediterranean</td>
</tr>
<tr>
<td>Meridional Velocity</td>
<td>West to East component of the horizontal velocity vector</td>
</tr>
<tr>
<td>MFC</td>
<td>Monitoring and Forecasting Centre</td>
</tr>
<tr>
<td>MFS</td>
<td>Mediterranean Forecasting System</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>NEMO</td>
<td>Nucleous for European Modelling of the Ocean</td>
</tr>
<tr>
<td>NetCDF</td>
<td>Network Common Data Form</td>
</tr>
<tr>
<td>NOAA</td>
<td>National Oceanic and Atmospheric Administration</td>
</tr>
<tr>
<td>OA</td>
<td>Objective Analyses</td>
</tr>
<tr>
<td>OCEANVAR</td>
<td>Oceanographic variational data assimilation scheme developed at INGV/CMCC.</td>
</tr>
<tr>
<td>OGCM</td>
<td>Ocean General Circulation Model</td>
</tr>
<tr>
<td>OpenDAP</td>
<td>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)</td>
</tr>
<tr>
<td>OSI</td>
<td>Ocean and Sea Ice</td>
</tr>
<tr>
<td>PU</td>
<td>Production Unit</td>
</tr>
<tr>
<td>SL</td>
<td>Sea Level</td>
</tr>
<tr>
<td>SLA</td>
<td>Sea Level Anomaly</td>
</tr>
<tr>
<td>SSH</td>
<td>Sea Surface Height</td>
</tr>
<tr>
<td>SST</td>
<td>Sea Surface Temperature</td>
</tr>
<tr>
<td>Subsetter</td>
<td>CMEMS service tool to download a NetCDF file of a selected geographical box using values of longitude and latitude, and time range</td>
</tr>
<tr>
<td>TAC</td>
<td>Thematic Assembly Centre</td>
</tr>
<tr>
<td>XBT</td>
<td>eXpandable BathyThermograph</td>
</tr>
<tr>
<td>WW3</td>
<td>WaveWatch-III</td>
</tr>
<tr>
<td>Zonal Velocity</td>
<td>South to North component of the horizontal velocity vector</td>
</tr>
<tr>
<td>3DVAR</td>
<td>Three-Dimensional Variational</td>
</tr>
</tbody>
</table>
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:

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:

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:

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

<table>
<thead>
<tr>
<th>Product Specification</th>
<th>MEDSEA_ANALYSIS_FORECAST_PHYS_006_001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographical coverage</td>
<td>15°W → 36.25°E ; 30.1875°N → 45.9375°N</td>
</tr>
<tr>
<td>Variables</td>
<td>Potential Temperature</td>
</tr>
<tr>
<td></td>
<td>Salinity</td>
</tr>
<tr>
<td></td>
<td>Sea Surface Height</td>
</tr>
<tr>
<td></td>
<td>Mixed Layer Depth</td>
</tr>
<tr>
<td></td>
<td>Horizontal Velocity (meridional and zonal component)</td>
</tr>
<tr>
<td></td>
<td>Stokes drift velocity (meridional and zonal component)</td>
</tr>
<tr>
<td></td>
<td>Potential Temperature at sea bed</td>
</tr>
<tr>
<td></td>
<td>Wave Number</td>
</tr>
<tr>
<td>Analysis</td>
<td>Yes</td>
</tr>
<tr>
<td>Hindcast</td>
<td>Yes</td>
</tr>
<tr>
<td>Forecast</td>
<td>Yes</td>
</tr>
<tr>
<td>Available time series</td>
<td>Daily mean: from 1 January 2013 – on going</td>
</tr>
<tr>
<td></td>
<td>Hourly mean: 1 month</td>
</tr>
<tr>
<td>Temporal resolution</td>
<td>24hr average field</td>
</tr>
<tr>
<td></td>
<td>1hr average field</td>
</tr>
<tr>
<td>Target delivery time</td>
<td>Forecast: daily, 01 UTC</td>
</tr>
<tr>
<td></td>
<td>Analysis: on Wednesday, 01 UTC</td>
</tr>
<tr>
<td></td>
<td>Simulation: daily, 01 UTC</td>
</tr>
<tr>
<td>Delivery mechanism</td>
<td>CMEMS Information System (Subsetter, CMEMS FTP, DGF)</td>
</tr>
<tr>
<td>Horizontal resolution</td>
<td>1/16°</td>
</tr>
<tr>
<td>Number of vertical levels</td>
<td>72</td>
</tr>
<tr>
<td>Format</td>
<td>Netcdf CF1.0</td>
</tr>
</tbody>
</table>
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 300 sec, 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](image-url)
### III.3 Details of datasets

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

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

- nnnnnnnnnnnn: 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/shh/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}-{bull 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>
<thead>
<tr>
<th>valid date</th>
<th>YYYYMMDD</th>
</tr>
</thead>
<tbody>
<tr>
<td>freq flag</td>
<td>d (daily)</td>
</tr>
<tr>
<td></td>
<td>h (hourly)</td>
</tr>
<tr>
<td>producer</td>
<td>INGV</td>
</tr>
<tr>
<td>config</td>
<td>MFSes1</td>
</tr>
<tr>
<td>region</td>
<td>MEDATL</td>
</tr>
<tr>
<td>parameter</td>
<td>TEMP</td>
</tr>
<tr>
<td></td>
<td>PSAL</td>
</tr>
<tr>
<td></td>
<td>ASLV</td>
</tr>
<tr>
<td></td>
<td>RFVL</td>
</tr>
<tr>
<td></td>
<td>AMXL</td>
</tr>
<tr>
<td>bul date</td>
<td>bYYYYYMMDD</td>
</tr>
<tr>
<td>product type</td>
<td>fc (forecast)</td>
</tr>
<tr>
<td></td>
<td>an (analysis)</td>
</tr>
<tr>
<td></td>
<td>sm (hindcast)</td>
</tr>
<tr>
<td>file version</td>
<td>06.00</td>
</tr>
</tbody>
</table>

Example for a forecast file of Salinity:

20140309_d-INGV--PSAL-MFSes1-MEDATL-b20140306_fc-fv06.00.nc.gz

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-MFSes1-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_nnnnnnnnnnnnn.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:


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>
<thead>
<tr>
<th>valid date</th>
<th>YYYYMMDD</th>
</tr>
</thead>
<tbody>
<tr>
<td>freq flag</td>
<td>d (daily)</td>
</tr>
<tr>
<td></td>
<td>h (hourly)</td>
</tr>
<tr>
<td>producer</td>
<td>INGV</td>
</tr>
<tr>
<td>config</td>
<td>MFSeas1</td>
</tr>
<tr>
<td>region</td>
<td>MEDATL</td>
</tr>
<tr>
<td>parameter</td>
<td>TEMP</td>
</tr>
<tr>
<td></td>
<td>PSAL</td>
</tr>
<tr>
<td></td>
<td>ASLV</td>
</tr>
<tr>
<td></td>
<td>RFVL</td>
</tr>
<tr>
<td></td>
<td>AMXL</td>
</tr>
<tr>
<td>bul date</td>
<td>bYYYYYMMD</td>
</tr>
<tr>
<td>product type</td>
<td>fc (forecast)</td>
</tr>
<tr>
<td></td>
<td>an (analysis)</td>
</tr>
<tr>
<td></td>
<td>sm (hindcast)</td>
</tr>
<tr>
<td>file version</td>
<td>06.00</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>LON MIN</th>
<th>LON MAX</th>
<th>LAT MIN</th>
<th>LAT MAX</th>
<th>XPOINT</th>
<th>YPOINT</th>
<th>ZPOINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential Temperature</td>
<td>15°W</td>
<td>36.25°E</td>
<td>30.1875°N</td>
<td>45.9375°N</td>
<td>821</td>
<td>253</td>
<td>72</td>
</tr>
<tr>
<td>Salinity</td>
<td>15°W</td>
<td>36.25°E</td>
<td>30.1875°N</td>
<td>45.9375°N</td>
<td>821</td>
<td>253</td>
<td>72</td>
</tr>
<tr>
<td>Sea Surface Height</td>
<td>15°W</td>
<td>36.25°E</td>
<td>30.1875°N</td>
<td>45.9375°N</td>
<td>821</td>
<td>253</td>
<td>1</td>
</tr>
<tr>
<td>Horizontal Current</td>
<td>15°W</td>
<td>36.25°E</td>
<td>30.1875°N</td>
<td>45.9375°N</td>
<td>821</td>
<td>253</td>
<td>72</td>
</tr>
<tr>
<td>Mixed Layer Depth</td>
<td>15°W</td>
<td>36.25°E</td>
<td>30.1875°N</td>
<td>45.9375°N</td>
<td>821</td>
<td>253</td>
<td>1</td>
</tr>
<tr>
<td>Potential Temperature at sea bed</td>
<td>15°W</td>
<td>36.25°E</td>
<td>30.1875°N</td>
<td>45.9375°N</td>
<td>821</td>
<td>253</td>
<td>1</td>
</tr>
<tr>
<td>Stokes drift velocity at surface</td>
<td>15°W</td>
<td>36.25°E</td>
<td>30.1875°N</td>
<td>45.9375°N</td>
<td>821</td>
<td>253</td>
<td>1</td>
</tr>
</tbody>
</table>

* 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, 19.633, 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://gnoodap.bo.ingv.it/myocean/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:
  float nav_lon(y, x);
  float nav_lat(y, x);
  float nav_lev(z);
  double time_counter(t);
  byte tmask(t, z, y, x);
```
floatglamt(t, y, x);  
floatgphit(t, y, x);  
double e1t(t, y, x);  
double e2t(t, y, x);  
doubleeff(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 forecast fields and the simulation fields are updated daily at 01 UTC, while the analysis fields are updated weekly, on Wednesday at 01 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 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 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 the MEDSEA_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>
<thead>
<tr>
<th>DATASET NAME</th>
<th>NAME OF FILE</th>
<th>DIMENSION [MB]*</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMEMSv02-MED-INGV-SSH-AN-FC-D</td>
<td>{date1}_d-INGV--ASLV-MFSes1-MEDATL-b(date2)_fc-fv06.00.nc</td>
<td>0.28</td>
</tr>
<tr>
<td></td>
<td>{date1}_d-INGV--ASLV-MFSes1-MEDATL-b(date2)_sm-fv06.00.nc</td>
<td>0.28</td>
</tr>
<tr>
<td></td>
<td>{date1}_d-INGV--ASLV-MFSes1-MEDATL-b(date2)_an-fv06.00.nc</td>
<td>0.28</td>
</tr>
<tr>
<td></td>
<td>{date1}_d-INGV--ASLV-MFSes1-MEDATL-b(date2)_fc-fv06.00.nc</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>{date1}_d-INGV--ASLV-MFSes1-MEDATL-b(date2)_sm-fv06.00.nc</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>{date1}_d-INGV--ASLV-MFSes1-MEDATL-b(date2)_an-fv06.00.nc</td>
<td>0.8</td>
</tr>
<tr>
<td>Dataset</td>
<td>Files</td>
<td>Issues</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------------------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>CMEMSv02-MED-INGV-SAL-AN-FC-D</td>
<td>(date1)_d-INGV--PSAL-MFSeas1-MEDATL-b(date2)_fc- fv06.00.nc</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>(date1)_d-INGV--PSAL-MFSeas1-MEDATL-b(date2)_sm- fv06.00.nc</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(date1)_d-INGV--PSAL-MFSeas1-MEDATL-b(date2)_an- fv06.00.nc</td>
<td></td>
</tr>
<tr>
<td>CMEMSv02-MED-INGV-TEM-AN-FC-D</td>
<td>(date1)_d-INGV--TEMP-MFSeas1-MEDATL-b(date2)_fc- fv06.00.nc</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>(date1)_d-INGV--TEMP-MFSeas1-MEDATL-b(date2)_sm- fv06.00.nc</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(date1)_d-INGV--TEMP-MFSeas1-MEDATL-b(date2)_an- fv06.00.nc</td>
<td></td>
</tr>
<tr>
<td>CMEMSv02-MED-INGV-CUR-AN-FC-D</td>
<td>(date1)_d-INGV--RFVL-MFSeas1-MEDATL-b(date2)_fc- fv06.00.nc</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>(date1)_d-INGV--RFVL-MFSeas1-MEDATL-b(date2)_sm- fv06.00.nc</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(date1)_d-INGV--RFVL-MFSeas1-MEDATL-b(date2)_an- fv06.00.nc</td>
<td></td>
</tr>
<tr>
<td>CMEMSv02-MED-INGV-MLD-AN-FC-D</td>
<td>(date1)_d-INGV--AMXL–MFSeas1-MEDATL-b(date2)_fc- fv06.00.nc</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>(date1)_d-INGV--AMXL–MFSeas1-MEDATL-b(date2)_sm- fv06.00.nc</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(date1)_d-INGV--AMXL–MFSeas1-MEDATL-b(date2)_an- fv06.00.nc</td>
<td></td>
</tr>
<tr>
<td>Dataset ID</td>
<td>Dataset Description</td>
<td>Ref</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-----------------------------------------------------------</td>
<td>-----</td>
</tr>
<tr>
<td>CMEMSv02-MED-INGV-SSH-AN-FC-H</td>
<td>{date1}_h-INGV--ASLV-MFSeas1-MEDATL-b(date2)_fc- fv06.00.nc</td>
<td>6.5</td>
</tr>
<tr>
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<td>{date1}_h-INGV--ASLV-MFSeas1-MEDATL-b(date2)_sm- fv06.00.nc</td>
<td></td>
</tr>
<tr>
<td></td>
<td>{date1}_h-INGV--ASLV-MFSeas1-MEDATL-b(date2)_an- fv06.00.nc</td>
<td></td>
</tr>
<tr>
<td>CMEMSv02-MED-INGV-SAL-AN-FC-H</td>
<td>{date1}_h-INGV--PSAL-MFSeas1-MEDATL-b(date2)_fc- fv06.00.nc</td>
<td>264</td>
</tr>
<tr>
<td></td>
<td>{date1}_h-INGV--PSAL-MFSeas1-MEDATL-b(date2)_sm- fv06.00.nc</td>
<td></td>
</tr>
<tr>
<td></td>
<td>{date1}_h-INGV--PSAL-MFSeas1-MEDATL-b(date2)_an- fv06.00.nc</td>
<td></td>
</tr>
<tr>
<td>CMEMSv02-MED-INGV-TEM-AN-FC-H</td>
<td>{date1}_h-INGV--TEMP-MFSeas1-MEDATL-b(date2)_fc- fv06.00.nc</td>
<td>301</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>{date1}_h-INGV--TEMP-MFSeas1-MEDATL-b(date2)_an- fv06.00.nc</td>
<td></td>
</tr>
<tr>
<td>CMEMSv02-MED-INGV-CUR-AN-FC-H</td>
<td>{date1}_h-INGV--RFVL-MFSeas1-MEDATL-b(date2)_fc- fv06.00.nc</td>
<td>708</td>
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<tr>
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<td></td>
</tr>
<tr>
<td></td>
<td>{date1}_h-INGV--RFVL-MFSeas1-MEDATL-b(date2)_an- fv06.00.nc</td>
<td></td>
</tr>
</tbody>
</table>
* 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

<table>
<thead>
<tr>
<th>DATASET NAME</th>
<th>DIMENSION [MB]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Compressed</td>
</tr>
<tr>
<td>CMEMSv02-MED-INGV-SSH-AN-FC-D</td>
<td>438</td>
</tr>
<tr>
<td>CMEMSv02-MED-INGV-SAL-AN-FC-D</td>
<td>17204</td>
</tr>
<tr>
<td>CMEMSv02-MED-INGV-TEM-AN-FC-D</td>
<td>17204</td>
</tr>
<tr>
<td>CMEMSv02-MED-INGV-CUR-AN-FC-D</td>
<td>46920</td>
</tr>
<tr>
<td>CMEMSv02-MED-INGV-MLD-AN-FC-D</td>
<td>438</td>
</tr>
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<td>CMEMSv02-MED-INGV-SSH-AN-FC-H</td>
<td>234</td>
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<tr>
<td>CMEMSv02-MED-INGV-SAL-AN-FC-H</td>
<td>9504</td>
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<td>CMEMSv02-MED-INGV-TEM-AN-FC-H</td>
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<td>CMEMSv02-MED-INGV-CUR-AN-FC-H</td>
<td>25488</td>
</tr>
<tr>
<td>CMEMSv02-MED-INGV-MLD-AN-FC-H</td>
<td>234</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>DIMENSIONS</th>
<th>VARIABLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>DIMENSIONS</td>
</tr>
<tr>
<td>lon</td>
<td>lon</td>
</tr>
<tr>
<td>lat</td>
<td>lat</td>
</tr>
<tr>
<td>depth</td>
<td>depth</td>
</tr>
<tr>
<td>time</td>
<td>time</td>
</tr>
<tr>
<td>sossheig</td>
<td>time,lat,lon</td>
</tr>
<tr>
<td>votemper</td>
<td>time,depth,lat,lon</td>
</tr>
<tr>
<td>vosaline</td>
<td>time,depth,lat,lon</td>
</tr>
</tbody>
</table>

lon=821  
lat=253  
depth=72  
time=1
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<thead>
<tr>
<th>Variable</th>
<th>Attributes</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>vozocrtx</td>
<td>time,depth,lat,lon</td>
<td>float</td>
</tr>
<tr>
<td>vomecrty</td>
<td>time,depth,lat,lon</td>
<td>float</td>
</tr>
<tr>
<td>sozostdx</td>
<td>time,lat,lon</td>
<td>float</td>
</tr>
<tr>
<td>somestdy</td>
<td>time,lat,lon</td>
<td>float</td>
</tr>
<tr>
<td>sowavenu</td>
<td>time,lat,lon</td>
<td>float</td>
</tr>
<tr>
<td>somxl010</td>
<td>time,lat,lon</td>
<td>float</td>
</tr>
<tr>
<td>seabed_temp</td>
<td>time,lat,lon</td>
<td>float</td>
</tr>
</tbody>
</table>

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

```plaintext
def dimensions:
    depth = 72 ;
    lat = 253 ;
    lon = 821 ;
    time = UNLIMITED ; // (1 currently)

def 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" ;
```


```plaintext
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/
- NetCDF Climata Data Operators (CDO): https://code.zmaw.de/projects/cdo
- IDL, Matlab, GMT…