PRODUCT USER MANUAL

For Atlantic -Iberian Biscay Irish- Ocean Physics Reanalysis Product:

IBI_REANALYSIS_PHYS_005_002

Issue: 2.0

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CMEMS version scope : Version 2.0

Approval Date: March2016

CHANGE RECORD

Issue	Date	§	Description of Change	Author	Validated By
1.0	05/05/2014	All	Creation of the document.	Marcos García Sotillo, Arancha Amo, Sylvain Cailleau	Enrique Álvarez Fanjul L. Crosnier
1.1	01/05/2015	all	Change format to fit CMEMS graphical rules		L. Crosnier
2.0	15/12/2015	all	Change due to CMEMS V2	Marcos García Sotillo, Arancha Amo, Bruno Levier	

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GLOSSARY AND ABBREVIATIONS

ARC	Artic Monitoring and Forecasting Centre
AVHRR	Advanced Very High Resolution Radiometer – Optical instrument onboard NOAA satellites
BAL	Baltic Monitoring and Forecasting Centre
BOOS	Baltic Operational Oceanographic System
BS	BlackSea Monitoring and Forecasting Centre
Calval	Calibration Validation
CIS	Central Information System
CORIOLIS	In situ data system for operational oceanography
DGF	Direct Get File. It is a MyOcean download mean. "Direct download" directly transfers the file as stored on the server. It is able to deliver compressed data and should be used if you wish to download larger datasets.
DU	Dissemination Unit. A Dissemination Unit is a kind of Production Unit, with the ability to disseminate its own products or other Production Unit's products to the rest of MyOcean Production Centres and to external Users.
EC	European Commission
DT	Delayed Time
ECMWF	European Centre for Medium Range Weather Forecast
ECOOP	European Coastal Operational Oceanography Project
ECV	Essential Climate Variables
ENVISAT	ESA Environment Satellite
EO	Earth Observation
ERS	ESA Environment Remote Sensing satellite
ESA	European Space Agency
EU	European Union

EUMETSAT	European Meteorological Satellite agency
EuroGOOS	European Global Operational Oceanography System
FTP	File Transfer Protocol
GCOS	Global Climate Observing System
GDAC	Global Data Archiving Centre
GHRSST	GODAE High Resolution Sea Surface Temperature
GLO	Global Monitoring and Forecasting Centre
GMES	Global Monitoring for Environment and Security
GOOS	Global Ocean Observing System
GTS	Meteorological data exchange network
I/F	Interfaces
IBI	Iberia – Biscay – Ireland Monitoring and Forecasting Centre
IBIROOS	EuroGOOS system for East Atlantic domain
ICES	International Council for the Exploitation of the Sea
INS	Insitu Thematic Assembly Centre
IOC	Intergovernmental Oceanographic Commission
IPCC	Intergovernmental Panel on Climate Change
JCOMM	Joint Technical Commission for Oceanography and Marine Meteorology
L1	Level 1 data : Raw data (telemetry) from instruments
L2	Level 2 data : (A and B) ground segment geophysical measures, interpreted, calibrated
L3	Level 1 data : Multi sensor data
L4	Level 4 data : Analysed data
MCS	Marine Core Service
MED	Mediterranean Sea Monitoring and Forecasting Centre

MedSea	Mediterranean Sea
METOP	EUMETSAT Polar Satellite
MFC	Monitoring and Forecasting Centre
MIS	MyOcean Information System
MOON	Mediterranean Ocean Observing Network
MSSH	Mean Sea Surface Height
NetCDF	Network Common Data Form
NOAA	National Oceanic and Atmospheric Administration of the USA
NOOS	North East Atlantic Ocean Observing System
NRT	Near Real Time
NWP	Numerical Weather Prediction
NWS	North West Shelves Monitoring and Forecasting Centre
OC	Ocean Colour Thematic Assembly Centre
OSI	Ocean Sea Ice Thematic Assembly Centre (merge of MyOcean1 SST and SEAICE & WIND TACs)
PUM	Product User Manual
QUID	Quality Information Document
R&D	Research and Development
REA	Reanalysis (for Models)
REP	Reprocessing (for Observations)
ROOS	Regional Operational Oceanography System
SAF	EUMETSAT Satellite Application Facility
SAR	Synthetic Aperture Radar
SEVIRI	Spinning Enhanced Visible and Infrared Imager – optical instrument onboard EUMETSAT MeteoSat Second Generation satellites
SIW	Former SeaIce and Wind Thematic Assembly Centre merged into OSI TAC

SLA	Service Level Agreement
SL	Sea Level Thematic Assembly Centre
SSS	Sea Surface Salinity
SST	Sea Surface Temperature Thematic Assembly Centre
SUBS	Subsetter Download mechanism : MyOcean service tool to download a NetCDF file of a selected geographical box using values of longitude an latitude, and time range
TAC	Thematic Assembly Centres
WAM	Waves model
WMO	World Meteorological Organisation
WMS	Web Map Service

I EXECUTIVE SUMMARY

I.1 Description summary of Products covered by this document

This guide describes the ocean physic reanalysis product IBI_REANALYSIS_PHYS_005_002, covering the 2002-2014 period in the Atlantic -Iberian Biscay Irish- area (generated and provided by the CMEMS IBI-MFC; *Sotillo et al.* 2015). This guide comprises a description of data files and user interfaces to get access to this product, as well as a brief description of the reanalysis system used to generate the product.

The IBI_REANALYSIS_PHYS_005_002 product consists of 3D monthly and daily mean fields of Temperature, Salinity, Sea Surface Height, Zonal and Meridional Velocity components, mix layer depth and sea bottom temperature. Hourly means of surface fields such as Sea Surface Height, Surface Temperature and Currents, together with Barotropic Velocities are also provided.

II DESCRIPTION OF THE IBI-MFC REANALYSIS SYSTEM

II.1 System Description

II.1.1 Numerical Ocean Code

II.1.1.1 Description of Ocean code and version

The ocean model is based on the version 2.3 of NEMO (Madec, 2008) and the configuration is NEATL12.The horizontal grid is a subset of the global 1/12° ORCA tripolar grid (367 x 638 grid points).

The original bathymetry is derived from the 30 arc-second resolution GEBCO 08 dataset (Becker et al., 2009) merged with several local databases (F. Lyard, personal communication, 2010). At open boundaries within 10-point-wide relaxation areas, bathymetry is exactly set to the parent grid model bathymetry and progressively merged with the interpolated dataset described above.

A bi-harmonic viscosity and diffusivity for the lateral dissipation of momentum and tracer are used. The diffusion coefficients are respectively -1.25e10 and -1.25e9 m4s-1.

The advection scheme for the momentum is written in vector form and respects the energy–enstrophy conservation (Barnier et al. 2006). For the tracer advection (both physical and biogeochemical variables), a 3rd order QUICKEST scheme is used (Leonard, 1979) with the limiter of Zalezak (1979).

The vertical grid has 75 levels, with a resolution of 1 meter near the surface and 200 meters in the deep ocean. Partial bottom cell representation of the bathymetry allows an accurate representation of the steep slopes characteristic of the area.

Vertical mixing is parameterized according to a k-ε model implemented in the generic form proposed by Umlauf and Burchard (2003) including surface wave breaking induced mixing, while tracers and momentum subgrid lateral mixing is parameterized according to bilaplacian operators. Solar penetration is parameterized according to a two-band exponential scheme with monthly climatological attenuation coefficients built from Seawif satellite ocean colour imagery and IFREMER climatology.

The simulation started at rest, with initial temperature, salinity, velocity components and sea surface height provided by the MYO2 global reanalysis GLORYS2V3. The date of start is 2nd January 2002. . A first simulation was made in the framework of the MyOcean project, ending the 23rd December 2011. This simulation was extended to 2014. For the extension, the simulation restarted on August 31, 2011 and was extended up to December 27, 2014.

A baroclinic time step of 450s is used. No data were assimilated during the first four weeks.

NEMO version	**2.3**
Horizontal resolution	**1/12° (5-6 km)**
Vertical coord.	**z*=f(ssh)** **75 levels** **Partial bottom cells**
Bathymetry	**Composite (GEBCO_08 + different local databases)**
Free surface	**Explicit, non-linear, time-splitting**
Vertical mixing	**k-epsilon**
Tracer advection	**QUICKEST + Zalezak**
Rivers	**As lateral point sources** **Merge of daily SMHI & PREVIMER & Monthly climatology (GRDC), 35 rivers**
Atm. Forcing	**ERAinterim (3h and 1d)** **+ analytic diurnal cycle from daily short wave irradiance**
Surge capability	**Yes**
Tides	**Yes (11 tidal components, astro pot)**
Ocean color effects	**Merged SEAWIF/IFREMER kpar climatology**
IC & OBCs	**GLORYS2V3 ¼°**
Data Assimilation	**SAM2 (SEEK Filter) + IAU**

Table1: Main Characteristics of the system

II.1.1.2 Open Boundary Conditions

Lateral open boundary data (temperature, salinity, velocities and sea level) are interpolated from the daily outputs from the MyO2 global reanalysis GLORYS2V3. These are complemented by 11 tidal harmonics (M2, S2, N2, K1, O1, Q1, M4, K2, P1, Mf, Mm) built from FES2004 (Lyard et al., 2006) and TPXO7.1 (Egbert and Erofeeva, 2002) tidal models solutions. Atmospheric pressure component, missing in the large scale parent system sea level outputs, is added hypothesing pure isostatic response at open boundaries (inverse barometer approximation).

II.1.1.3 Atmospheric forcing/correction and runoffs

The surface boundary conditions are prescribed to the model using the CORE bulk formulation. Forcing fields are provided from ERA-Interim reanalysis products (Simons et al., 2007), interpolated on ORCA025 native grid using an Akima interpolation algorithm. The data set includes 4 turbulent variables (u10, v10, t2, q2) and the atmospheric pressure given every 3 hours and 3 fluxes: 2 downward radiative variables (radsw, radlw) and the precipitation rate given as daily average.

The ERAinterim radiative fluxes (both long and short waves) exhibit some unacceptable biases. Therefore a specific correction, based on GEWEX satellites fluxes products, has been implemented by Garric and Verbrugge (2010) in order to improve those fluxes. Basically, the idea is to apply a 2D scaling coefficient to the large scale features of the radiative fluxes. Original fields are band-pass filtered to separate large scale and small scale, using an iterative Shapiro filter. The correction is applied to the large scale and then the small scale is added to produce the radiative flux for the model.

Similar to the radiative fluxes, ERAInterim rainfall fluxes present large biases and a correction, based on GPCPV2.1 rainfalls flux, allows a more realistic SSS spatial distribution.

Due to the high vertical resolution near the surface, we implement a parameterization of the diurnal cycle on the solar flux. Input is the daily mean flux, which is spread over the day according to the time, and geographical position on the earth. This parameterization aims at better representing the night-time convection which takes place in the upper most layer of the ocean (Bernie, 2007).

Rivering inputs are implemented as lateral points sources with flow rates based on monthly climatological data taken from GRDC (http://www.bafg.de/GRDC), French “Banque Hydro” dataset (http://www.hydro.eaufrance.fr/) and simulations from SMHI.

II.1.2 Data Assimilation

II.1.2.1 Description of Data Assimilation Scheme

The data assimilation method relies on a reduced order Kalman filter based on the SEEK formulation introduced by Pham et al. (1998). This approach is used for several years at Mercator and has been implemented in different ocean model configurations (Lellouche et al, 2013). Here we present a short description of this system we then called SAM2 (Système d’Assimilation Mercator version 2) which includes the variant of the SEEK filter developed at Mercator and the model initialization procedure. For this IBI reanalysis (IBIRYS), we use the same version of the assimilation system used of GLORYS2V3 reanalysis with some differences. We use assimilation cycles of 5 days instead of 7 days usually used in Mercator systems. The objective is to use information in the past and in the future and provide the best estimate of the ocean centered in time. Using such an approach, the analysis has a smoother like feature. For technical reasons, this could not be done exactly at time=2.5 days so it has been slightly shifted at time=3days. We describe here the different aspects of the SAM2 configuration used in IBIRYS**.**

The forecast and observation error covariances are essential parameters of an assimilation system as they define the relative weight of the background and observation field with respect to the analysis increment. These covariances are also important as they define the multivariate property of the system. Here we will focus on the model forecast error covariance. The choice of the observation error will be detailed in the “assimilated observations” section.

The SEEK formulation requires knowledge of the forecast error covariance of the control vector. In our system (REAIBI12), this vector is composed of large-scale surface temperature, sea level, the 2D barotropic height, the 3D temperature, salinity, zonal and meridional velocity fields. The forecast error covariance is based on the statistics of a collection of 3D ocean state anomalies (typically a few hundred) and is seasonally variable (i.e. fixed basis, seasonally variable). This approach comes from the concept of statistical ensembles where an ensemble of anomalies is representative of the error covariances (ergodic theory). With this approach the truncation does not take place any more, thus it is only necessary to generate the appropriate number of anomalies. This approach is similar to the Ensemble optimal interpolation (EnOI) developed by Oke et al., (2008) which is an approximation to the EnKF that uses a stationary ensemble to define background error covariances. In our case, the anomalies are high pass filtered ocean states (Hanning filter, length cut-off frequency = 1/30 days-1) available over the 2002-2009 time period every 1 day. These ocean states come from a reference simulation (free simulation from 01/01/2002 to 31/12/2009) carried out with the same ocean model configuration and same atmospheric forcing. The details described in the “free simulation” section. The main characteristic of the anomaly calculations is to filter out temporal scales at low frequencies in order to keep high frequencies for which the period is lower than the assimilation cycle. The Figure 1 is a schematic representation of the anomalies calculation.

For an analysis at date T, a subset of anomalies corresponding to the current season (a given number of days before and after T) is selected. From one analysis cycle to the other, change only a small part of the subset of anomalies. This method implies that at each analysis step a different sub-set of anomalies is used that improves the dynamical dependency. The error covariance continuity is kept by connecting the ensemble of anomalies with a same part of anomalies at every analysis steps.

For an assimilation cycle centered on the N^{th} day of year YYYY, ocean state anomalies falling in the window [N-Δn; N+ Δn] of each year of reference run are gathered and define the covariance of the model forecast error. In REAIBI12, we tested several windows length, we chose Δn equal to 176 days with an anomaly of 8. The means use anomalies selected over all year length windows centred on the Nth day of each year of NEATL12 simulation. However, in order to decrease the number of ocean states, only one state each two is retained over the 2002-2009. For each analysis, we use 350 ocean state anomalies. It should also be noted that the analysis increment is a linear combination of these error modes and depends on the model innovation (observation-model misfit) and on the specified observation errors (see assimilated observations section). The analysis is performed on a reduced horizontal grid (1 point every 4 in both directions) in order to reduce the computational cost.

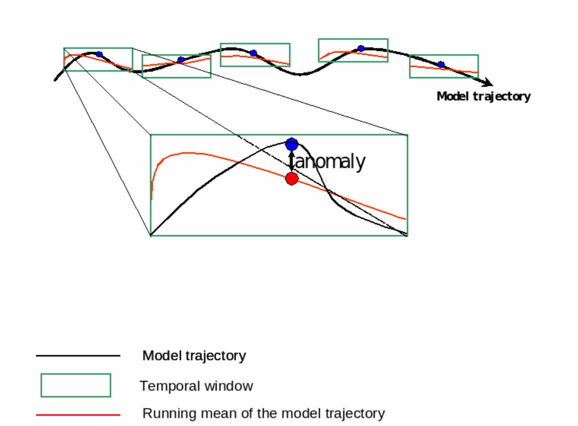

Figure 1: Schematic representation of the anomalies calculation along a model trajectory (these anomalies are used to build the model forecast covariance).

Last, the forecast error covariance used is "configuration dependent", i.e. it is closely linked to:

- The model bathymetry and vertical discretization.
- The physical parameterizations used.
- The surface forcing used.

A particular feature of the SEEK is that the error covariance only gives the direction of the model error, not its intensity. An adaptive scheme for the model error variance has been implemented which calculates an optimal variance of the model error based on a statistical test formulated by Talagrand (1998).

The last feature of the model forecast covariance employed is the use of a weighting function which sets the covariances to zero beyond a distance defined as twice the local spatial correlation scale. Because we use a finite number of ocean state anomalies to build the model forecast covariance, the latter is not significant any more away from a certain distance of the analysis point (from a statistical point of view). That is why it is preferable not to use this information and to set the covariance to zero. In our case the spatial (X and Y direction) and temporal (T) correlation scales used are spatially dependent and are calculated from the SST and SLA daily output free model (NEATL12). The figure 2 shows the correlation radius use in our system.

The correlation scales shown below are multiplied by 1.3 in order to use more data in the selection bubble.

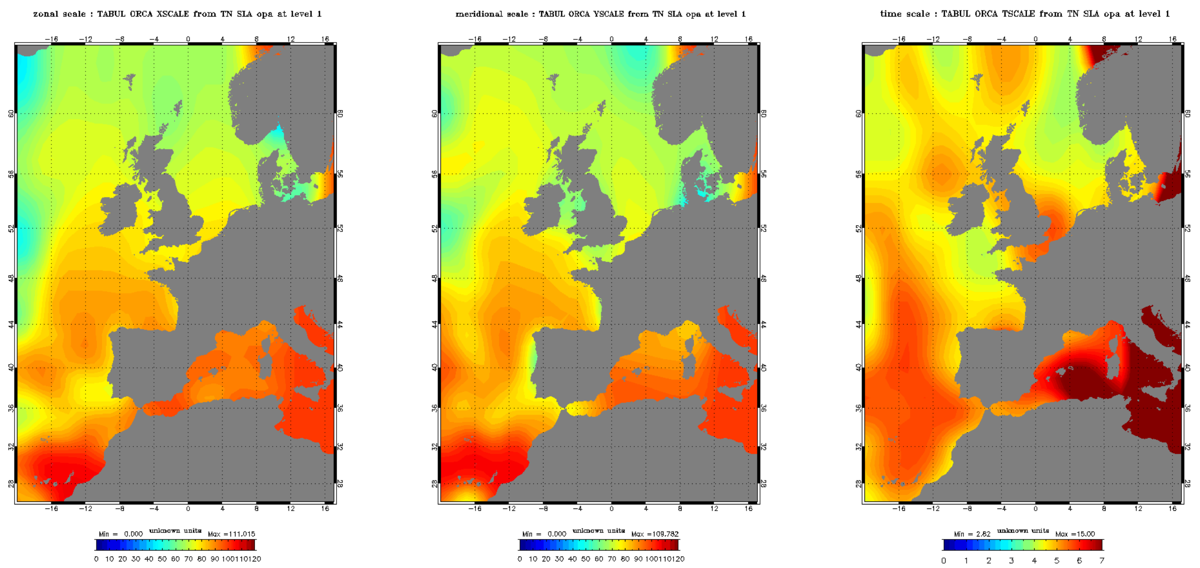

Figure 2: (a,b) Decorrelation radii (in km) along zonal and meridional direction (contours: 10km), (c) Time correlation scale used (days).

II.1.2.2 Which data is assimilated?

In data assimilation, the computation of innovation (*d=y-Hxf*) requires to define an observation operator *H* such as *Hx* represents the model equivalent of the observation *y*. In the present system, prognostic variables are interpolated on a quadrilateral grid, i.e., on the four canvas grid points surrounding the observation. The four weights are calculated for a bilinear remapping interpolation. Data location and weights are calculated on canvas grid during the data loading, they are stored in binary data file.We provide here a short description of these operators.

- **Sea Level Anomaly**

The first assimilated observations are altimetric tracks from satellite with a radar altimeter on board (TOPEX, JASON, ERS, ENVISAT, GFO). Along each track, only one point over three is conserved to avoid redundant information which gives one observation of sea level height every 21 km. Moreover, observations along the satellite tracks are smoothed by several altimetric corrections (Le Traon et al., 2001) and there is no independent information in the non-conserved points.

In first approximation, an inconsistency exists between the sea level height computed by NEMO and altimeter data coming from SSALTO/DUACS (http://www.jason.oceanobs.com/html/donnees/duacs/welcome_uk.html). This difference comes from recent corrections applied to altimeter tracks. These corrections combine the high frequencies of a barotropic, non linear and time stepping model (MOG2D) forced by pressure and wind, to the low frequencies of the IB (Inverted Barometer) model. As our mode (IBI12) is forced by atmospheric pressure and tide, we must take this into account in our model equivalent.

- **Sea Surface Temperature**

The SST maps that are assimilated result from an objective analysis of various satellite data sets. Reynolds 1/4° product is distributed on a 0,25 x 0,25° geographical grid but the SST does not contain signals with spatial scales shorter than ~1°. As the model grid is 1/12°, we have to slightly "smooth" the model SST in order to get an appropriate model equivalent for the AVHRR-only SST field. The observation operator in that case is a horizontal smoother applied on the model first level temperature field. The smoother consists of an iterative (60 iterations) Shapiro filter α=1/2) applied to the model SST.

- **In situ Temperature and Salinity**

In this case, the observed profiles are interpolated on model levels by using a spline function. If the distance between two consecutive data depths is less than the model level thickness, the spline interpolation on the model level is not used. No extrapolation is performed at the top or at the bottom of the profile.

II.1.3 Temporal Extension of the IBI reanalysis

The reanalysis product provided at CMEMS V2 release includes a temporal extension of the reanalysis, originally performed in the framework of the MyOcean-2 project. The initial temporal coverage of this reanalysis was 2002-02-01 to 2011-12-23. The extension temporal coverage is 2011-08-31 to 2014-12-27. The initial and extended reanalysis use exactly the same ocean numerical code and the same data assimilation system described in the previous sections, but there are some differences to take into account:

- The extension of this reanalysis run has been performed onto a new HPC (High Performance Computing) facility at Météo-France (IBM instead of NEC).

- Instead of a 7 years (1993-1999) reference period, the Sea Level Anomaly is now estimated based on a 20 years (1993-2012) time period. A new processing is also applied in terms of filtering and sub-sampling. It follows an increase of the number of observations by 100% and a better extraction of the physical signal, notably at low latitudes.

- The in-situ product used for assimilation has been released (CORA4.1 ; extended to 2013 and including a denser dataset). For the year 2014, the data assimilation system uses the RT in-situ product.

- At open boundaries, the parent GLO system used at boundaries has been extended to 2014 using similar new SLA and in-situ products as previously mentioned.

- The number of satellites used by the data assimilation system has decreased from three in 2011 (Jason1, Jason 2 and Envisat) to one in 2012 (Jason 2) after the end of the Envisat and Jason 1 missions.

III PRODUCT DESCRIPTION

III.1 General Information

The Product IBI_REANALYSIS_PHYS_005_002 provides 3D monthly and daily ocean fields as well as hourly mean values for some surface variables. The time coverage starts in 01/02/2002 and ends the 28/12/2014. Monthly and daily averages of 3D Temperature, Salinity, Mix Layer Depth, Sea Bottom Temperature, Zonal and Meridional Velocity components and Sea Surface Height are provided. Hourly means of surface fields for variables such as Sea Surface Height, Surface Temperature and Currents, together with Barotropic Velocities are also provided. Outputs files are delivered in Netcdf format (using CF/COARDS 1.0 convention).

Next section is devoted to describe the different datasets from IBI_REANALYSIS_PHYS_005_002 product.

III.2 Details of datasets

Product IBI_REANALYSIS_PHYS_005_002 contains 4 different datasets:

1) **dataset-ibi-reanalysis-phys-005-002-hourly-regulargrid**

2) **dataset-ibi-reanalysis-phys-005-002-daily-regulargrid**

3) **dataset-ibi-reanalysis-phys-005-002-monthly-regulargrid**

4) **dataset-ibi-reanalysis-phys-005-002-monthly-nativegrid**

The three first datasets provide information on hourly, daily and monthly basis post-processed into a **regular lat/lon grid** (analogous to the one used for the daily IBI forecast product IBI_ANALYSIS_FORECAST_PHYS_005_001_b, but with a 1/12º horizontal resolution

The last dataset provides the monthly fields delivered in the original model **native grid**.

- **dataset-ibi-reanalysis-phys-005-002-hourly-regulargrid** contains **hourly averages** of the following variables **at the surface**:
    - Sea water potential temperature (K)
    - Eastward velocity (m/s)
    - Northward velocity (m/s)
    - Sea surface height above sea level (m)
    - Zonal barotropic velocity (m/s)
    - Meridional barotropic velocity (m/s)

  Data provided in a regular LON/LAT grid that goes from 26.0N to 56.0N in latitude and 19.0W to 5.0E. Latitude and longitude step is: 0.08333f. The resulting horizontal grid extends to 361 x 289 gridpoints. Information from all surface variables contained in this datasets is provided at same gridpoints.

- **dataset-ibi-reanalysis-phys-005-002-daily-regulargrid** contains **daily averages** of the following variables for the whole water column:
    - Sea water potential temperature (K)
    - Sea water Salinity (psu)
    - Eastward velocity (m/s),
    - Northward velocity (m/s)
    - Sea surface height above sea level (m)
    - Sea floor potential temperature (K)
    - Ocean mixed layer thickness defined by density (m)

  Data is provided in a regular LON/LAT grid that goes from 26.0N to 56.0N in latitude and 19.0W to 5.0E. The latitude and longitude step is: 0.08333f. Data is provided at 50 vertical levels (z-type) that goes from a surface level at 0.5m to the deepest level at 5698 m. The resulting grid extends to 361x289x50 gridpoints. Data from all the variables contained in the dataset is provided at same gridpoints.

- **dataset-ibi-reanalysis-phys-005-002-monthly-regulargrid** contains **monthly averages** of the following variables for the whole water column:
    - Sea water potential temperature (K)
    - Sea water Salinity (psu)
    - Eastward velocity (m/s),
    - Northward velocity (m/s)
    - Sea surface height above sea level (m)
    - Sea floor potential temperature (K)
    - Ocean mixed layer thickness defined by density (m)

  Data is provided in a regular LON/LAT grid that goes from 26.0N to 56.0N in latitude and 19.0W to 5.0E. The latitude and longitude step is: 0.08333f. Data is provided at 50 vertical levels (z-type) that goes from a surface level at 0.5 m to the deepest level at 5698 m. The resulting grid extends to 361x289x50 grid points. Data from all the variables contained in the dataset is provided at same grid points.

- **dataset-ibi-reanalysis-phys-005-002-monthly-nativegrid** contains **monthly averages** of the following variables for the whole water column:
    - Sea water potential temperature (K)
    - Sea water Salinity (psu)
    - Eastward velocity (m/s),
    - Northward velocity (m/s)
    - Sea surface height above sea level (m)

  In this specific dataset data is delivered in the original model native grid. The native model grid is a 1/12º ORCA tripolar grid. It is a staggered Arakawa-C grid, what means that U- and V-velocity components are provided at different positions (shifted) than the temperature, salinity and sea surface height variables. The "staggered" Arakawa C-grid further separates evaluation of vector quantities, evaluating both east-west (u) and north-south (v) velocity components, not at the grid center, but the u components at the centers of the left and right grid faces, and the v components at the centers of the upper and lower grid faces. The grid goes from 26.04056N to 57.67273N in latitude and from 19.6662W to 7.992964E in longitude. Data is provided at 75 vertical levels (z-type) that goes from a surface level at 0.5 m to the deepest level at 5902 m. The resulting grid (for the T/S/zet points) extends to 296x504x75 grid points and to 297x504x75 for U-component and to 296x503x75 for V-component.

III.3 Details of variables and units

- Sea water potential temperature (K)
- Sea water Salinity (psu)
- Eastward velocity (m/s),
- Northward velocity (m/s)
- Sea surface height above sea level (m)
- Zonal barotropic velocity (m/s)
- Meridional barotropic velocity (m/s)
- Sea floor potential temperature (K)
- Ocean mixed layer thickness defined by density (m)

III.4 Grid Characteristics and Geographical Projection

As it was stated in the dataset description, information from the IBI reanalysis is provided on hourly, daily and monthly basis already post-processed into a regular lat/lon grid (analogous to the one used for the daily IBI forecast products, but with 1/12º horizontal resolution). Additionally, the monthly averages are also served in the original model native grid (irregular staggered Arakawa-C grid).

III.5 Update Time and Production Cycle

The IBI reanalysis product is a static product and therefore no update time is applicable.

IV PRODUCT DISTRIBUTION

IV.1 Which Download mechanism is available for this product?

The CMEMS download mechanisms available for this product are:

- DirectGetFile (for all datasets)
- FTP (for all datasets)
- Subsetter (note that Subsetter is available for all datasets except the "dataset-ibi-reanalysis-phys-005-002-monthly-nativegrid")

IV.2 How to Download this product?

You first need to register. Please find the registration steps on our website:

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, DirectGetfile and FTP Services.

IV.3 How to write and run a script to download this product?

FAQ#4 (http://marine.copernicus.eu/web/34-products-and-services-faq.php) will guide you on how to proceed.

V FILES NOMENCLATURE AND FORMAT

The file naming of the downloaded files differs on the basis of the chosen download mechanism (i.e. FTP, Subsetter or Directgetfile services).

V.1 Nomenclature of files when downloaded through the Subsetter Service

IBI-PUERTOS IBI_REANALYSIS_PHYS_005_002 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 MIS.

The scheme is: {**datasetname}_nnnnnnnnnnnnn.nc**

where:

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

· dataset-ibi-reanalysis-phys-005-002**-hourly-regulargrid**

· dataset-ibi-reanalysis-phys-005-002**-daily-regulargrid**

· dataset-ibi-reanalysis-phys-005-002**-monthly-regulargrid**

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

.nc: standard NetCDF filename extension.

Example:

dataset-ibi-reanalysis-phys-005-002-hourly-regulargrid_1399460336380.nc

V.2 Nomenclature of files when downloaded through the Directgetfile Service

IBI-PUERTOS IBI_REANALYSIS_PHYS_005_002 files nomenclature when downloaded through the CMEMS Web Portal Directgetfile (DGF) is based as follows:

When downloading a request of different days through DGF, one obtains the following zip file:

http---purl.org-myocean-ontology-product-database-{datasetname}_{nnnnnnnnnnnnn}.zip

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

· dataset-ibi-reanalysis-phys-005-002**-hourly-regulargrid**

· dataset-ibi-reanalysis-phys-005-002**-daily-regulargrid**

· dataset-ibi-reanalysis-phys-005-002**-monthly-regulargrid**

· dataset-ibi-reanalysis-phys-005-002**-monthly-nativegrid**

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

.zip: standard compressed zip filename extension.

Example for one downloading of files (corresponding to two days of data) from IBI reanalysis daily and hourly datasets:

http---purl.org-myocean-ontology-product-database-dataset-ibi-reanalysis-phys-005-002-daily-regulargrid_1452591804634.zip

http---purl.org-myocean-ontology-product-database-dataset-ibi-reanalysis-phys-005-002-hourly-regulargrid_1452591614944.zip

The zip file contains a netCDF files for every day requested:

{region}re{fileVersion}_PHY${grdtype}_{freqFlag}_{validDate}_{valiDate}_R{bulletinDate}_{productType}.nc

E.g.: From the daily dataset request, in the zip file we have the following two files:

IBIreV2r1_PHYRE_01dav_20110101_20110101_R20110103_RE01.nc

IBIreV2r1_PHYRE_01dav_20110102_20110102_R20110103_RE01.nc

E.g.: From the hourly dataset request, in the zip file we have the following two files:

IBIreV2r1_PHYRE_01hav_20110801_20110801_R20110806_RE01.nc

IBIreV2r1_PHYRE_01hav_20110802_20110802_R20110806_RE01.nc

Where:

- **region** is a three letter code for the region, IBI in this case.
- **fileVersion** is Vxry, where x, y are the version and release number, respectively
- **grdType** is RE for regular lon/lat grid and NA for native grid.
- **freqFlag** is the frequency of data values in the file (01hav = hourly averaged, 01dav = daily averaged)
- **validDate** YYYYMMDD is the valid date of the fields contained in the file
- **bulletinDate** RYYYYMMDD is the bulletin date, when data were product
- **productType** is a two letter code for the product type, in this case, RE01 for reanalysis.

V.3 Nomenclature of files when downloaded through the FTP Service

IBI-PUERTOS IBI_REANALYSIS_PHYS_005_002 files nomenclature when downloaded through the CMEMS Web Portal FTP is based as follows:

When downloading a request of a file through FTP, one obtains the following file name:

{region}re{fileVersion}_PHY{grdType}_{freqFlag}_{validDate}_{valiDate}_R{bulletinDate}_{productType}.nc

E.g.:

IBIreV2r1_PHYRE_01hav_20110831_20110831_R20110905_RE01.nc for hourly product

IBIreV2r1_PHYRE_01dav_20110131_20110131_R20110202_RE01.nc for daily product

IBIreV2r1_PHYRE_01mav_20110801_20110831_R20131106_RE01.nc for monthly product in regular grid

IBIreV2r1_PHYNA_01mav_20110801_20110831_R20131106_RE01.nc for monthly product in native grid.

Where:

• **region** is a three letter code for the region, IBI in this case.

• **fileVersion** is Vxry, where x, y are the version and release number, respectively

• **grdType** is RE for regular lon/lat grid and NA for native grid.

• **freqFlag** is the frequency of data values in the file (01hav = hourly averaged, 01dav = daily averaged, 01mav = monthly averaged)

• **validDate** YYYYMMDD is the valid date of the fields contained in the file

• **bulletinDate** RYYYYMMDD is the bulletin date, when data product were product

• **productType** is a two letter code for the product type, in this case, RE01 for reanalysis.

V.4 Land mask and missing values

Land values are treated as missing value.

V.5 File Format: Netcdf

The products are stored using the NetCDF-CF format version 3.0.

NetCDF (network Common Data Form) is an interface for array-oriented data access and a library that provides an implementation of the interface. The netCDF library also defines a machine-independent format for representing scientific data. Together, the interface, library, and format support the creation, access, and sharing of scientific data. The netCDF software was developed at the Unidata Program Center in Boulder, Colorado. The netCDF libraries define a machine-independent format for representing scientific data.

Please see Unidata netCDF pages for more information, and to retrieve netCDF software package.

NetCDF data is:

* Self-Describing. A netCDF file includes information about the data it contains.

* Architecture-independent. A netCDF file is represented in a form that can be accessed by computers with different ways of storing integers, characters, and floating-point numbers.

* Direct-access. A small subset of a large dataset may be accessed efficiently, without first reading through all the preceding data.

* Appendable. Data can be appended to a netCDF dataset along one dimension without copying the dataset or redefining its structure. The structure of a netCDF dataset can be changed, though this sometimes causes the dataset to be copied.

* Sharable. One writer and multiple readers may simultaneously access the same netCDF file.

V.6 Structure and semantic of NetCDF maps files

Examples of structure and header of **IBI-PUERTOS IBI_REANALYSIS_PHYS_005_002** file downloaded through **DGF or FTP User interfaces**.

- **HOURLY** data from **dataset-ibi-reanalysis-phys-005-002-hourly-regulargrid:**

  Through FTP users gets directly the files. For instance, a file of hourly data to be download would be:

  IBIreV2r1_PHYRE_01hav_20110831_20110831_R20110905_RE01.nc

  However, when a user request for instance 4 days of hourly data to be downloaded, the user gets a zip file with four netCDF inside, each one corresponding to each specific day requested.

  http---purl.org-myocean-ontology-product-database-dataset-ibi-reanalysis-phys-005-002-hourly-regulargrid_1399967277557.zip:

  IBIreV1r1_PHYRE_01hav_20111220_20111220_R20111224_RE01.nc

  IBIreV1r1_PHYRE_01hav_20111221_20111221_R20111224_RE01.nc

  IBIreV1r1_PHYRE_01hav_20111222_20111222_R20111224_RE01.nc

  IBIreV1r1_PHYRE_01hav_20111223_20111223_R20111224_RE01.nc

Example of netcdf map file for hourly product (download through DGF or FTP):

```
ncdump -h IBIreV2r1_PHYRE_01hav_20110831_20110831_R20110905_RE01.nc
netcdf IBIreV2r1_PHYRE_01hav_20110831_20110831_R20110905_RE01 {
dimensions:
	latitude = 361 ;
	longitude = 289 ;
	time = 24 ;
variables:
	float latitude(latitude) ;
		latitude:long_name = "Latitude" ;
		latitude:units = "degrees_north" ;
		latitude:standard_name = "latitude" ;
		latitude:axis = "Y" ;
		latitude:unit_long = "Degrees North" ;
		latitude:step = "0.08333f" ;
		latitude:valid_max = 56.f ;
		latitude:valid_min = 26.f ;
		latitude:_CoordinateAxisType = "Lat" ;
	float longitude(longitude) ;
		longitude:long_name = "Longitude" ;
		longitude:units = "degrees_east" ;
		longitude:standard_name = "longitude" ;
		longitude:axis = "X" ;
		longitude:unit_long = "Degrees East" ;
		longitude:step = "0.08333f" ;
		longitude:valid_max = 5.f ;
		longitude:valid_min = -19.f ;
		longitude:_CoordinateAxisType = "Lon" ;
	short ssh(time, latitude, longitude) ;
		ssh:long_name = "Sea surface height" ;
		ssh:standard_name = "sea_surface_height_above_sea_level" ;
		ssh:units = "m" ;
		ssh:add_offset = 0.f ;
		ssh:scale_factor = 0.001f ;
		ssh:_FillValue = -32767s ;
		ssh:valid_min = -10.f ;
		ssh:valid_max = 10.f ;
		ssh:unit_long = "Meters" ;
	short temperature(time, latitude, longitude) ;
		temperature:long_name = "Temperature" ;
		temperature:standard_name = "sea_water_potential_temperature" ;
		temperature:units = "K" ;
		temperature:add_offset = 294.15f ;
		temperature:scale_factor = 0.001f ;
		temperature:_FillValue = -32767s ;
		temperature:valid_max = 305.f ;
		temperature:valid_min = 271.f ;
		temperature:unit_long = "Kelvin" ;
	float time(time) ;
		time:calendar = "gregorian" ;
		time:units = "hours since 2002-01-02 00:00:00" ;
		time:standard_name = "time" ;
		time:long_name = "Time (hours since 2002-01-02 00:00:00)" ;
		time:valid_min = 84672.f ;
		time:valid_max = 84695.f ;
		time:_CoordinateAxisType = "Time" ;
		time:axis = "T" ;
	short u(time, latitude, longitude) ;
		u:long_name = "Eastward velocity" ;
```

```
                u:standard_name = "eastward_sea_water_velocity" ;
                u:units = "m s-1" ;
                u:add_offset = 0.f ;
                u:scale_factor = 0.001f ;
                u:_FillValue = -32767s ;
                u:valid_min = -3.f ;
                u:valid_max = 3.f ;
                u:unit_long = "Meters per second" ;
        short ubar(time, latitude, longitude) ;
                ubar:long_name = "zonal barotropic velocity" ;
                ubar:standard_name = "eastward_sea_barotropic_velocity" ;
                ubar:units = "m s-1" ;
                ubar:add_offset = 0.f ;
                ubar:scale_factor = 0.001f ;
                ubar:_FillValue = -32767s ;
                ubar:valid_min = -3.f ;
                ubar:valid_max = 3.f ;
                ubar:unit_long = "Meters per second" ;
        short v(time, latitude, longitude) ;
                v:long_name = "Northward velocity" ;
                v:standard_name = "northward_sea_water_velocity" ;
                v:units = "m s-1" ;
                v:add_offset = 0.f ;
                v:scale_factor = 0.001f ;
                v:_FillValue = -32767s ;
                v:valid_min = -3.f ;
                v:valid_max = 3.f ;
                v:unit_long = "Meters per second" ;
        short vbar(time, latitude, longitude) ;
                vbar:long_name = "meridional barotropic velocity" ;
                vbar:standard_name = "northward_sea_barotropic_velocity" ;
                vbar:units = "m s-1" ;
                vbar:add_offset = 0.f ;
                vbar:scale_factor = 0.001f ;
                vbar:_FillValue = -32767s ;
                vbar:valid_min = -3.f ;
                vbar:valid_max = 3.f ;
                vbar:unit_long = "Meters per second" ;

// global attributes:
                :CDI = "Climate Data Interface version 1.4.6 (http://code.zmaw.de/projects/cdi)" ;
                :Conventions = "CF-1.0" ;
                :institution = "Puertos del Estado (PdE) - Mercator-Ocean (MO) " ;
                :references = "http://marine.copernicus.eu" ;
                :nco_openmp_thread_number = 1 ;
                :title = "CMEMS IBI REANALYSIS: HOURLY PHYSICAL PRODUCTS (REGULAR GRID) " ;
                :easting = "longitude" ;
                :northing = "latitude" ;
                :domain_name = "IBI12" ;
                :field_type = "mean" ;
                :field_date = "20110831" ;
                :field_julian_date = "3528.f" ;
                :comment = "Class1 metrics" ;
                :julian_day_unit = "Hours since 2002-01-02 00:00:00" ;
                :longitude_min = "-19.f" ;
                :longitude_max = "5.f" ;
                :latitude_min = "26.f" ;
                :latitude_max = "56.f" ;
```

```
        :z_min = "0.50576f" ;
        :z_max = "0.50576f" ;
        :contact = "mailto: servicedesk.cmems@mercator-ocean.eu" ;
        :netcdf_version_id = "4.0.1" ;
        :CDO = "Climate Data Operators version 1.4.6 (http://code.zmaw.de/projects/cdo)" ;
        :NCO = "4.0.1" ;
        :source = "CMEMS IBI-MFC" ;
}
```

- **DAILY** data from **dataset-ibi-reanalysis-phys-005-002-daily-regulargrid**:

  Through FTP users gets directly the files. For instance, a file of daily data to be download would be:

  IBIreV2r1_PHYRE_01dav_20110131_20110131_R20110202_RE01.nc

  However, when a user request for instance 4 days of daily data to be downloaded, the user gets a zip file with four netCDF inside, each one corresponding to each specific day requested.

  4 days downloaded provides a zip file with four netCDF inside, each one corresponding to one of the days requested.

  http---purl.org-myocean-ontology-product-database-dataset-ibi-reanalysis-phys-005-002-daily-regulargrid_1399967371003.zip

  IBIreV1r1_PHYRE_01dav_20111220_20111220_R20111224_RE01.nc

  IBIreV1r1_PHYRE_01dav_20111221_20111221_R20111224_RE01.nc

  IBIreV1r1_PHYRE_01dav_20111222_20111222_R20111224_RE01.nc

  IBIreV1r1_PHYRE_01dav_20111223_20111223_R20111224_RE01.nc

Example of netcdf map file for daily product (download through DGF or FTP):

```
ncdump -h IBIreV2r1_PHYRE_01dav_20110131_20110131_R20110202_RE01.nc
netcdf IBIreV2r1_PHYRE_01dav_20110131_20110131_R20110202_RE01 {
dimensions:
    time = 1 ;
    latitude = 361 ;
    longitude = 289 ;
    depth = 50 ;
variables:
    short bottomtemperature(time, latitude, longitude) ;
        bottomtemperature:long_name = "Sea floor potential temperature" ;
        bottomtemperature:standard_name = "Sea_water_potential_temperature_at_sea_floor" ;
        bottomtemperature:units = "K" ;
        bottomtemperature:add_offset = 294.15f ;
        bottomtemperature:scale_factor = 0.001f ;
        bottomtemperature:_FillValue = -32767s ;
```

```
        bottomtemperature:valid_max = 305.f ;
        bottomtemperature:valid_min = 271.f ;
        bottomtemperature:unit_long = "Kelvin" ;
float depth(depth) ;
        depth:long_name = "Depth" ;
        depth:units = "m" ;
        depth:axis = "Z" ;
        depth:valid_min = 0.50576f ;
        depth:valid_max = 5698.061f ;
        depth:positive = "down" ;
        depth:unit_long = "Meters" ;
        depth:standard_name = "depth" ;
        depth:_CoordinateAxisType = "Height" ;
        depth:_CoordinateZisPositive = "down" ;
float latitude(latitude) ;
        latitude:long_name = "Latitude" ;
        latitude:units = "degrees_north" ;
        latitude:standard_name = "latitude" ;
        latitude:axis = "Y" ;
        latitude:unit_long = "Degrees North" ;
        latitude:step = "0.08333f" ;
        latitude:valid_max = 56.f ;
        latitude:valid_min = 26.f ;
        latitude:_CoordinateAxisType = "Lat" ;
float longitude(longitude) ;
        longitude:long_name = "Longitude" ;
        longitude:units = "degrees_east" ;
        longitude:standard_name = "longitude" ;
        longitude:axis = "X" ;
        longitude:unit_long = "Degrees East" ;
        longitude:step = "0.08333f" ;
        longitude:valid_max = 5.f ;
        longitude:valid_min = -19.f ;
        longitude:_CoordinateAxisType = "Lon" ;
short mixlayerdepth(time, latitude, longitude) ;
        mixlayerdepth:long_name = "Ocean mixed layer thickness defined by density" ;
        mixlayerdepth:standard_name = "ocean_mixed_layer_thickness_defined_by_sigma_theta" ;
        mixlayerdepth:units = "m" ;
        mixlayerdepth:add_offset = 500.f ;
        mixlayerdepth:scale_factor = 0.1f ;
        mixlayerdepth:_FillValue = -32767s ;
        mixlayerdepth:valid_max = 4000.f ;
        mixlayerdepth:valid_min = 0.f ;
        mixlayerdepth:unit_long = "Meters" ;
short salinity(time, depth, latitude, longitude) ;
        salinity:long_name = "Salinity" ;
        salinity:standard_name = "sea_water_salinity" ;
        salinity:units = "1e-3" ;
        salinity:add_offset = 20.f ;
        salinity:scale_factor = 0.001f ;
        salinity:_FillValue = -32767s ;
        salinity:valid_min = 0.f ;
        salinity:valid_max = 40.f ;
        salinity:unit_long = "Practical Salinity Unit" ;
short ssh(time, latitude, longitude) ;
        ssh:long_name = "Sea surface height" ;
        ssh:standard_name = "sea_surface_height_above_sea_level" ;
        ssh:units = "m" ;
```

```
        ssh:add_offset = 0.f ;
        ssh:scale_factor = 0.001f ;
        ssh:_FillValue = -32767s ;
        ssh:valid_min = -10.f ;
        ssh:valid_max = 10.f ;
        ssh:unit_long = "Meters" ;
    short temperature(time, depth, latitude, longitude) ;
        temperature:long_name = "Temperature" ;
        temperature:standard_name = "sea_water_potential_temperature" ;
        temperature:units = "K" ;
        temperature:add_offset = 294.15f ;
        temperature:scale_factor = 0.001f ;
        temperature:_FillValue = -32767s ;
        temperature:valid_max = 305.f ;
        temperature:valid_min = 271.f ;
        temperature:unit_long = "Kelvin" ;
    float time(time) ;
        time:calendar = "gregorian" ;
        time:units = "hours since 2002-01-02 00:00:00" ;
        time:standard_name = "time" ;
        time:long_name = "time" ;
        time:valid_min = 79596.f ;
        time:valid_max = 79596.f ;
        time:_CoordinateAxisType = "Time" ;
        time:axis = "T" ;
    short u(time, depth, latitude, longitude) ;
        u:long_name = "Eastward velocity" ;
        u:standard_name = "eastward_sea_water_velocity" ;
        u:units = "m s-1" ;
        u:add_offset = 0.f ;
        u:scale_factor = 0.001f ;
        u:_FillValue = -32767s ;
        u:valid_min = -3.f ;
        u:valid_max = 3.f ;
        u:unit_long = "Meters per second" ;
    short v(time, depth, latitude, longitude) ;
        v:long_name = "Northward velocity" ;
        v:standard_name = "northward_sea_water_velocity" ;
        v:units = "m s-1" ;
        v:add_offset = 0.f ;
        v:scale_factor = 0.001f ;
        v:_FillValue = -32767s ;
        v:valid_min = -3.f ;
        v:valid_max = 3.f ;
        v:unit_long = "Meters per second" ;

// global attributes:
        :CDI = "Climate Data Interface version 1.4.6 (http://code.zmaw.de/projects/cdi)" ;
        :Conventions = "CF-1.0" ;
        :institution = "Puertos del Estado (PdE) - Mercator-Ocean (MO) " ;
        :references = "http://marine.copernicus.eu" ;
        :nco_openmp_thread_number = 1 ;
        :title = "CMEMS IBI REANALYSIS: DAILY PHYSICAL PRODUCTS (REGULAR GRID) " ;
        :easting = "longitude" ;
        :northing = "latitude" ;
        :domain_name = "IBI12" ;
        :field_type = "mean" ;
        :field_date = "20110131" ;
```

```
        :field_julian_date = "3316.f" ;
        :comment = "Class1 metrics" ;
        :julian_day_unit = "Hours since 2002-01-02 00:00:00" ;
        :longitude_min = "-19.f" ;
        :longitude_max = "5.f" ;
        :latitude_min = "26.f" ;
        :latitude_max = "56.f" ;
        :z_min = "0.50576f" ;
        :z_max = "5698.061f" ;
        :contact = "mailto: servicedesk.cmems@mercator-ocean.eu" ;
        :netcdf_version_id = "4.0.1" ;
        :CDO = "Climate Data Operators version 1.4.6 (http://code.zmaw.de/projects/cdo)" ;
        :NCO = "4.0.1" ;
        :source = "CMEMS IBI-MFC" ;
}
```

- **MONTHLY** data from **dataset-ibi-reanalysis-phys-005-002-monthly-regulargrid**:

  Through FTP users gets directly the files. For instance, a file of monthly data (in regular grid) to be download would be:

  IBIreV2r1_PHYRE_01mav_20110801_20110831_R20131106_RE01.nc

  However, when a user requests through DGF for instance 2 months of monthly data to be downloaded, the user gets a zip file with four netCDF inside, each one corresponding to each specific month requested.

  http---purl.org-myocean-ontology-product-database-dataset-ibi-reanalysis-phys-005-002-monthly-regulargrid_1399967371003.zip

    IBIreV1r1_PHYRE_01mav_20110901_20110930_R20131106_RE01.nc

    IBIreV1r1_PHYRE_01mav_20111001_20111031_R20131106_RE01.nc

Example of netcdf map file for monthly product in regular lonlat grid (download through DGF or FTP):

```
ncdump -h IBIreV2r1_PHYRE_01mav_20110801_20110831_R20131106_RE01.nc
netcdf IBIreV2r1_PHYRE_01mav_20110801_20110831_R20131106_RE01 {
dimensions:
    time = 1 ;
    latitude = 361 ;
    longitude = 289 ;
    depth = 50 ;
variables:
    short bottomtemperature(time, latitude, longitude) ;
        bottomtemperature:long_name = "Sea floor potential temperature" ;
        bottomtemperature:standard_name = "Sea_water_potential_temperature_at_sea_floor" ;
        bottomtemperature:units = "K" ;
        bottomtemperature:add_offset = 294.15f ;
        bottomtemperature:scale_factor = 0.001f ;
        bottomtemperature:_FillValue = -32768s ;
```

```
        bottomtemperature:valid_max = 305.f ;
        bottomtemperature:valid_min = 271.f ;
        bottomtemperature:unit_long = "Kelvin" ;
float depth(depth) ;
        depth:long_name = "Depth" ;
        depth:units = "m" ;
        depth:axis = "Z" ;
        depth:valid_min = 0.50576f ;
        depth:valid_max = 5698.061f ;
        depth:positive = "down" ;
        depth:unit_long = "Meters" ;
        depth:standard_name = "depth" ;
        depth:_CoordinateAxisType = "Height" ;
        depth:_CoordinateZisPositive = "down" ;
float latitude(latitude) ;
        latitude:long_name = "Latitude" ;
        latitude:units = "degrees_north" ;
        latitude:standard_name = "latitude" ;
        latitude:axis = "Y" ;
        latitude:unit_long = "Degrees North" ;
        latitude:step = "0.08333f" ;
        latitude:valid_max = 56.f ;
        latitude:valid_min = 26.f ;
        latitude:_CoordinateAxisType = "Lat" ;
float longitude(longitude) ;
        longitude:long_name = "Longitude" ;
        longitude:units = "degrees_east" ;
        longitude:standard_name = "longitude" ;
        longitude:axis = "X" ;
        longitude:unit_long = "Degrees East" ;
        longitude:step = "0.08333f" ;
        longitude:valid_max = 5.f ;
        longitude:valid_min = -19.f ;
        longitude:_CoordinateAxisType = "Lon" ;
short mixlayerdepth(time, latitude, longitude) ;
        mixlayerdepth:long_name = "Ocean mixed layer thickness defined by density" ;
        mixlayerdepth:standard_name = "ocean_mixed_layer_thickness_defined_by_sigma_theta" ;
        mixlayerdepth:units = "m" ;
        mixlayerdepth:add_offset = 500.f ;
        mixlayerdepth:scale_factor = 0.1f ;
        mixlayerdepth:_FillValue = -32767s ;
        mixlayerdepth:unit_long = "Meters" ;
        mixlayerdepth:valid_max = 4000. ;
        mixlayerdepth:valid_min = 0. ;
short salinity(time, depth, latitude, longitude) ;
        salinity:long_name = "Salinity" ;
        salinity:standard_name = "sea_water_salinity" ;
        salinity:units = "1e-3" ;
        salinity:add_offset = 20.f ;
        salinity:scale_factor = 0.001f ;
        salinity:_FillValue = -32767s ;
        salinity:valid_max = 40.f ;
        salinity:valid_min = 0.f ;
        salinity:unit_long = "Practical Salinity Unit" ;
short ssh(time, latitude, longitude) ;
        ssh:long_name = "Sea surface height" ;
        ssh:standard_name = "sea_surface_height_above_sea_level" ;
        ssh:units = "m" ;
```

```
        ssh:add_offset = 0.f ;
        ssh:scale_factor = 0.001f ;
        ssh:_FillValue = -32767s ;
        ssh:unit_long = "Meters" ;
        ssh:valid_max = 10.f ;
        ssh:valid_min = -10.f ;
    short temperature(time, depth, latitude, longitude) ;
        temperature:long_name = "Temperature" ;
        temperature:standard_name = "sea_water_potential_temperature" ;
        temperature:units = "K" ;
        temperature:add_offset = 294.15f ;
        temperature:scale_factor = 0.001f ;
        temperature:_FillValue = -32767s ;
        temperature:valid_max = 305.f ;
        temperature:valid_min = 271.f ;
        temperature:unit_long = "Kelvin" ;
    float time(time) ;
        time:calendar = "gregorian" ;
        time:units = "hours since 2002-01-02 00:00:00" ;
        time:standard_name = "time" ;
        time:long_name = "time" ;
        time:valid_min = 84324.f ;
        time:valid_max = 84324.f ;
        time:_CoordinateAxisType = "Time" ;
        time:axis = "T" ;
    short u(time, depth, latitude, longitude) ;
        u:long_name = "Eastward velocity" ;
        u:standard_name = "eastward_sea_water_velocity" ;
        u:units = "m s-1" ;
        u:add_offset = 0.f ;
        u:scale_factor = 0.001f ;
        u:_FillValue = -32767s ;
        u:valid_max = 3.f ;
        u:valid_min = -3.f ;
        u:unit_long = "Meters per second" ;
    short v(time, depth, latitude, longitude) ;
        v:long_name = "Northward velocity" ;
        v:standard_name = "northward_sea_water_velocity" ;
        v:units = "m s-1" ;
        v:add_offset = 0.f ;
        v:scale_factor = 0.001f ;
        v:_FillValue = -32767s ;
        v:valid_max = 3.f ;
        v:valid_min = -3.f ;
        v:unit_long = "Meters per second" ;

// global attributes:
        :CDI = "Climate Data Interface version 1.4.6 (http://code.zmaw.de/projects/cdi)" ;
        :Conventions = "CF-1.0" ;
        :institution = "Puertos del Estado (PdE) - Mercator-Ocean (MO) " ;
        :references = "http://marine.copernicus.eu" ;
        :nco_openmp_thread_number = 1 ;
        :title = "CMEMS IBI REANALYSIS: MONTHLY PHYSICAL PRODUCTS (REGULAR GRID) " ;
        :easting = "longitude" ;
        :northing = "latitude" ;
        :domain_name = "IBI12" ;
        :field_type = "mean" ;
        :field_date = "201108" ;
```

```
        :comment = "Class1 metrics" ;
        :julian_day_unit = "Hours since 2002-01-02 00:00:00" ;
        :longitude_min = "-19.f" ;
        :longitude_max = "5.f" ;
        :latitude_min = "26.f" ;
        :latitude_max = "56.f" ;
        :z_min = "0.50576f" ;
        :z_max = "5698.061f" ;
        :contact = "mailto: servicedesk.cmems@mercator-ocean.eu" ;
        :netcdf_version_id = "4.0.1" ;
        :CDO = "Climate Data Operators version 1.4.6 (http://code.zmaw.de/projects/cdo)" ;
        :NCO = "4.0.1" ;
        :source = "CMEMS IBI-MFC" ;
}
```

- **MONTHLY** data from **dataset-ibi-reanalysis-phys-005-002-monthly-nativegrid**: :

  Through FTP users gets directly the files. For instance, a file of monthly data (in native grid) to be download would be:

  IBIreV2r1_PHYNA_01mav_20110801_20110831_R20131106_RE01.nc

  However, when a user requests through DGF for instance 2 months of monthly data to be downloaded, the user gets a zip file with four netCDF inside, each one corresponding to each specific month requested.

  http---purl.org-myocean-ontology-product-database-dataset-ibi-reanalysis-phys-005-002-monthly-regulargrid_1399967371003.zip

  IBIreV1r1_PHYRE_01mav_20110901_20110930_R20131106_RE01.nc

  IBIreV1r1_PHYRE_01mav_20111001_20111031_R20131106_RE01.nc

  Example of netcdf map file for monthly product in native model grid (download through DGF or FTP):

```
ncdump -h IBIreV2r1_PHYNA_01mav_20110801_20110831_R20131106_RE01.nc
netcdf IBIreV2r1_PHYNA_01mav_20110801_20110831_R20131106_RE01 {
dimensions:
        depth = 75 ;
        latitude = 504 ;
        longitude = 296 ;
        longitude_U = 297 ;
        latitude_V = 503 ;
        time = 1 ;
variables:
        float depth(depth) ;
                depth:long_name = "Depth" ;
                depth:units = "m" ;
                depth:axis = "Z" ;
```

```
        depth:valid_min = 0.50576f ;
        depth:valid_max = 5902.058f ;
        depth:positive = "down" ;
        depth:unit_long = "Meters" ;
        depth:standard_name = "depth" ;
        depth:_CoordinateAxisType = "Height" ;
        depth:_CoordinateZisPositive = "down" ;
    float latitude(latitude, longitude) ;
        latitude:long_name = "Latitude" ;
        latitude:standard_name = "latitude" ;
        latitude:units = "degrees_north" ;
        latitude:_CoordinateAxisType = "Lat" ;
        latitude:unit_long = "Degrees North" ;
        latitude:step = "0.08333f" ;
        latitude:valid_max = 57.67273f ;
        latitude:valid_min = 26.04056f ;
        latitude:axis = "Y" ;
    float latitude_U(latitude, longitude_U) ;
        latitude_U:long_name = "Latitude" ;
        latitude_U:standard_name = "latitude" ;
        latitude_U:units = "degrees_north" ;
        latitude_U:_CoordinateAxisType = "Lat" ;
    float latitude_V(latitude_V, longitude) ;
        latitude_V:long_name = "Latitude" ;
        latitude_V:standard_name = "latitude" ;
        latitude_V:units = "degrees_north" ;
        latitude_V:_CoordinateAxisType = "Lat" ;
    float longitude(latitude, longitude) ;
        longitude:long_name = "Longitude" ;
        longitude:standard_name = "longitude" ;
        longitude:units = "degrees_east" ;
        longitude:_CoordinateAxisType = "Lon" ;
        longitude:unit_long = "Degrees East" ;
        longitude:step = "0.08333f" ;
        longitude:valid_max = 7.992964f ;
        longitude:valid_min = -19.6662f ;
        longitude:axis = "X" ;
    float longitude_U(latitude, longitude_U) ;
        longitude_U:long_name = "Longitude" ;
        longitude_U:standard_name = "longitude" ;
        longitude_U:units = "degrees_east" ;
        longitude_U:_CoordinateAxisType = "Lon" ;
    float longitude_V(latitude_V, longitude) ;
        longitude_V:long_name = "Longitude" ;
        longitude_V:standard_name = "longitude" ;
        longitude_V:units = "degrees_east" ;
        longitude_V:_CoordinateAxisType = "Lon" ;
    short salinity(time, depth, latitude, longitude) ;
        salinity:long_name = "Salinity" ;
        salinity:standard_name = "sea_water_salinity" ;
        salinity:units = "1e-3" ;
        salinity:add_offset = 20.f ;
        salinity:scale_factor = 0.001f ;
        salinity:_FillValue = -32767s ;
        salinity:unit_long = "Practical Salinity Unit" ;
        salinity:valid_max = 40.f ;
        salinity:valid_min = 0.f ;
    short ssh(time, latitude, longitude) ;
```

```
                ssh:long_name = "Sea surface height" ;
                ssh:standard_name = "sea_surface_height_above_geoid" ;
                ssh:units = "m" ;
                ssh:add_offset = 0.f ;
                ssh:scale_factor = 0.001f ;
                ssh:_FillValue = -32767s ;
                ssh:unit_long = "Meters" ;
                ssh:valid_max = 5.f ;
                ssh:valid_min = -5.f ;
        short temperature(time, depth, latitude, longitude) ;
                temperature:long_name = "Temperature" ;
                temperature:standard_name = "sea_water_potential_temperature" ;
                temperature:units = "K" ;
                temperature:add_offset = 294.15f ;
                temperature:scale_factor = 0.001f ;
                temperature:_FillValue = -32767s ;
                temperature:unit_long = "Kelvin" ;
                temperature:valid_max = 305.f ;
                temperature:valid_min = 271.f ;
        float time(time) ;
                time:calendar = "gregorian" ;
                time:units = "hours since 2002-01-02 00:00:00" ;
                time:standard_name = "time" ;
                time:long_name = "time" ;
                time:valid_min = 84324.f ;
                time:valid_max = 84324.f ;
                time:_CoordinateAxisType = "Time" ;
                time:axis = "T" ;
        short u(time, depth, latitude, longitude_U) ;
                u:long_name = "Eastward velocity" ;
                u:standard_name = "sea_water_x_velocity" ;
                u:units = "m s-1" ;
                u:add_offset = 0.f ;
                u:scale_factor = 0.001f ;
                u:_FillValue = -32767s ;
                u:unit_long = "Meters per second" ;
                u:valid_max = 3.f ;
                u:valid_min = -3.f ;
        short v(time, depth, latitude_V, longitude) ;
                v:long_name = "Northward velocity" ;
                v:standard_name = "sea_water_y_velocity" ;
                v:units = "m s-1" ;
                v:add_offset = 0.f ;
                v:scale_factor = 0.001f ;
                v:_FillValue = -32767s ;
                v:unit_long = "Meters per second" ;
                v:valid_max = 3.f ;
                v:valid_min = -3.f ;

// global attributes:
                :CDI = "Climate Data Interface version 1.4.6 (http://code.zmaw.de/projects/cdi)" ;
                :Conventions = "CF-1.0" ;
                :institution = "Puertos del Estado (PdE) - Mercator-Ocean (MO) " ;
                :references = "http://marine.copernicus.eu" ;
                :nco_openmp_thread_number = 1 ;
                :title = "CMEMS IBI REANALYSIS: MONTHLY PHYSICAL PRODUCTS (NATIVE GRID) " ;
                :easting = "longitude" ;
                :northing = "latitude" ;
```

```
                :domain_name = "IBI12" ;
                :field_type = "mean" ;
                :field_date = "201108" ;
                :comment = "Class1 metrics" ;
                :julian_day_unit = "Hours since 2002-01-02 00:00:00" ;
                :longitude_min = "-19.6662.f" ;
                :longitude_max = "7.992964.f" ;
                :latitude_min = "26.04056.f" ;
                :latitude_max = "57.67273.f" ;
                :z_min = "0.50576f" ;
                :z_max = "5902.058f" ;
                :contact = "mailto: servicedesk.cmems@mercator-ocean.eu" ;
                :netcdf_version_id = "4.0.1" ;
                :CDO = "Climate Data Operators version 1.4.6 (http://code.zmaw.de/projects/cdo)" ;
                :NCO = "4.0.1" ;
                :source = "CMEMS IBI-MFC" ;
}
```

The previous file structures shown as example correspond to the complete IBI files, which are downloaded through DGF or FTP. However, when data from the IBI reanalysis product are downloaded through **the MIS-GW SUBSETTER interface** the file map and structure change slightly, and it is dependent on the parameter selection made by the user in the specific data request. Following, as example, the file structure of a file downloaded through Subsetter for every dataset is provided.

- HOURLY SST data extracted for selected region (10W-1E; 30N-40N) with a 4 days -96h- of time coverage from **dataset-ibi-reanalysis-phys-005-002-hourly-regulargrid:**

```
ncdump -h dataset-ibi-reanalysis-phys-005-002-hourly-regulargrid_1452592911312.nc
netcdf dataset-ibi-reanalysis-phys-005-002-hourly-regulargrid_1452592911312 {
dimensions:
    time = 97 ;
    latitude = 121 ;
    longitude = 133 ;
variables:
    int time(time) ;
        time:calendar = "gregorian" ;
        time:units = "Hours since 2011-08-01" ;
        time:standard_name = "time" ;
        time:long_name = "Time" ;
        time:valid_min = 0 ;
        time:valid_max = 96 ;
        time:_CoordinateAxisType = "Time" ;
        time:axis = "T" ;
    float longitude(longitude) ;
        longitude:long_name = "Longitude" ;
        longitude:units = "degrees_east" ;
        longitude:standard_name = "longitude" ;
        longitude:axis = "X" ;
        longitude:unit_long = "Degrees East" ;
        longitude:step = "0.08333f" ;
        longitude:valid_max = 0.9999992f ;
        longitude:valid_min = -10.f ;
        longitude:_CoordinateAxisType = "Lon" ;
    float latitude(latitude) ;
```

```
        latitude:long_name = "Latitude" ;
        latitude:units = "degrees_north" ;
        latitude:standard_name = "latitude" ;
        latitude:axis = "Y" ;
        latitude:unit_long = "Degrees North" ;
        latitude:step = "0.08333f" ;
        latitude:valid_max = 40.f ;
        latitude:valid_min = 30.f ;
        latitude:_CoordinateAxisType = "Lat" ;
    short temperature(time, latitude, longitude) ;
        temperature:_CoordinateAxes = "time latitude longitude " ;
        temperature:long_name = "Temperature" ;
        temperature:standard_name = "sea_water_potential_temperature" ;
        temperature:units = "K" ;
        temperature:add_offset = 294.15f ;
        temperature:scale_factor = 0.001f ;
        temperature:_FillValue = -32767s ;
        temperature:unit_long = "Kelvin" ;

// global attributes:
        :title = "CMEMS IBI REANALYSIS: HOURLY PHYSICAL PRODUCTS (REGULAR GRID) " ;
        :institution = "Puertos del Estado (PdE) - Mercator-Ocean (MO) " ;
        :references = "http://marine.copernicus.eu" ;
        :source = "CMEMS IBI-MFC" ;
        :Conventions = "CF-1.0" ;
        :history = "Data extracted from dataset http://test-puertos.cesga.es:8080/thredds/dodsC/dataset-ibi-reanalysis-phys-005-002-hourly-regulargrid" ;
        :time_min = 0. ;
        :time_max = 96. ;
        :julian_day_unit = "Hours since 2011-08-01" ;
        :latitude_min = 30. ;
        :latitude_max = 40. ;
        :longitude_min = -10. ;
        :longitude_max = 0.999999225139618 ;
}
```

- DAILY Salinity data extracted for selected region (10W-1E; 30N-40N) with a 10 days of time coverage from **dataset-ibi-reanalysis-phys-005-002-daily-regulargrid**:

```
ncdump -h dataset-ibi-reanalysis-phys-005-002-daily-regulargrid_1452594063241.nc
netcdf dataset-ibi-reanalysis-phys-005-002-daily-regulargrid_1452594063241 {
dimensions:
    time = 10 ;
    depth = 50 ;
    latitude = 121 ;
    longitude = 133 ;
variables:
    int time(time) ;
        time:calendar = "gregorian" ;
        time:units = "Days since 2011-01-01" ;
        time:standard_name = "time" ;
        time:long_name = "time" ;
        time:valid_min = 0 ;
        time:valid_max = 9 ;
        time:_CoordinateAxisType = "Time" ;
```

```
        time:axis = "T" ;
    float longitude(longitude) ;
        longitude:long_name = "Longitude" ;
        longitude:units = "degrees_east" ;
        longitude:standard_name = "longitude" ;
        longitude:axis = "X" ;
        longitude:unit_long = "Degrees East" ;
        longitude:step = "0.08333f" ;
        longitude:valid_max = 0.9999992f ;
        longitude:valid_min = -10.f ;
        longitude:_CoordinateAxisType = "Lon" ;
    float latitude(latitude) ;
        latitude:long_name = "Latitude" ;
        latitude:units = "degrees_north" ;
        latitude:standard_name = "latitude" ;
        latitude:axis = "Y" ;
        latitude:unit_long = "Degrees North" ;
        latitude:step = "0.08333f" ;
        latitude:valid_max = 40.f ;
        latitude:valid_min = 30.f ;
        latitude:_CoordinateAxisType = "Lat" ;
    short salinity(time, depth, latitude, longitude) ;
        salinity:_CoordinateAxes = "time depth latitude longitude " ;
        salinity:long_name = "Salinity" ;
        salinity:standard_name = "sea_water_salinity" ;
        salinity:units = "1e-3" ;
        salinity:add_offset = 20.f ;
        salinity:scale_factor = 0.001f ;
        salinity:_FillValue = -32767s ;
        salinity:unit_long = "Practical Salinity Unit" ;
    float depth(depth) ;
        depth:long_name = "Depth" ;
        depth:units = "m" ;
        depth:axis = "Z" ;
        depth:valid_min = 0.50576f ;
        depth:valid_max = 5698.061f ;
        depth:positive = "down" ;
        depth:unit_long = "Meters" ;
        depth:standard_name = "depth" ;
        depth:_CoordinateAxisType = "Height" ;
        depth:_CoordinateZisPositive = "down" ;

// global attributes:
        :title = "CMEMS IBI REANALYSIS: DAILY PHYSICAL PRODUCTS (REGULAR GRID) " ;
        :institution = "Puertos del Estado (PdE) - Mercator-Ocean (MO) " ;
        :references = "http://marine.copernicus.eu" ;
        :source = "CMEMS IBI-MFC" ;
        :Conventions = "CF-1.0" ;
        :history = "Data extracted from dataset http://test-puertos.cesga.es:8080/thredds/dodsC/dataset-ibi-
reanalysis-phys-005-002-daily-regulargrid" ;
        :time_min = 0. ;
        :time_max = 9. ;
        :julian_day_unit = "Days since 2011-01-01" ;
        :z_min = 0.505760014057159 ;
        :z_max = 5698.060546875 ;
        :latitude_min = 30. ;
        :latitude_max = 40. ;
        :longitude_min = -10. ;
```

```
        :longitude_max = 0.999999225139618 ;
}
```

• MONTHLY means of mixlayer depth, bottom temperature and temperature for the whole water column extracted for selected region (10W-1E; 30N-40N) from **dataset-ibi-reanalysis-phys-005-002-daily-regulargrid**:

```
ncdump -h dataset-ibi-reanalysis-phys-005-002-monthly-regulargrid_1452595192310.nc
netcdf dataset-ibi-reanalysis-phys-005-002-monthly-regulargrid_1452595192310 {
dimensions:
    time = 1 ;
    latitude = 121 ;
    longitude = 133 ;
    depth = 50 ;
variables:
    int time(time) ;
        time:calendar = "gregorian" ;
        time:units = "Hours since 2002-02-15" ;
        time:standard_name = "time" ;
        time:long_name = "time" ;
        time:valid_min = 83232 ;
        time:valid_max = 83232 ;
        time:_CoordinateAxisType = "Time" ;
        time:axis = "T" ;
    short mixlayerdepth(time, latitude, longitude) ;
        mixlayerdepth:_CoordinateAxes = "time latitude longitude " ;
        mixlayerdepth:long_name = "Ocean mixed layer thickness defined by density" ;
        mixlayerdepth:standard_name = "ocean_mixed_layer_thickness_defined_by_sigma_theta" ;
        mixlayerdepth:units = "m" ;
        mixlayerdepth:add_offset = 500.f ;
        mixlayerdepth:scale_factor = 0.1f ;
        mixlayerdepth:_FillValue = -32767s ;
        mixlayerdepth:unit_long = "Meters" ;
    short bottomtemperature(time, latitude, longitude) ;
        bottomtemperature:_CoordinateAxes = "time latitude longitude " ;
        bottomtemperature:long_name = "Sea floor potential temperature" ;
        bottomtemperature:standard_name = "Sea_water_potential_temperature_at_sea_floor" ;
        bottomtemperature:units = "K" ;
        bottomtemperature:add_offset = 294.15f ;
        bottomtemperature:scale_factor = 0.001f ;
        bottomtemperature:_FillValue = -32768s ;
        bottomtemperature:unit_long = "Kelvin" ;
    float longitude(longitude) ;
        longitude:long_name = "Longitude" ;
        longitude:units = "degrees_east" ;
        longitude:standard_name = "longitude" ;
        longitude:axis = "X" ;
        longitude:unit_long = "Degrees East" ;
        longitude:step = "0.08333f" ;
        longitude:valid_max = 0.9999992f ;
        longitude:valid_min = -10.f ;
        longitude:_CoordinateAxisType = "Lon" ;
    float latitude(latitude) ;
        latitude:long_name = "Latitude" ;
```

```
            latitude:units = "degrees_north" ;
            latitude:standard_name = "latitude" ;
            latitude:axis = "Y" ;
            latitude:unit_long = "Degrees North" ;
            latitude:step = "0.08333f" ;
            latitude:valid_max = 40.f ;
            latitude:valid_min = 30.f ;
            latitude:_CoordinateAxisType = "Lat" ;
        float depth(depth) ;
            depth:long_name = "Depth" ;
            depth:units = "m" ;
            depth:axis = "Z" ;
            depth:valid_min = 0.50576f ;
            depth:valid_max = 5698.061f ;
            depth:positive = "down" ;
            depth:unit_long = "Meters" ;
            depth:standard_name = "depth" ;
            depth:_CoordinateAxisType = "Height" ;
            depth:_CoordinateZisPositive = "down" ;
        short temperature(time, depth, latitude, longitude) ;
            temperature:_CoordinateAxes = "time depth latitude longitude " ;
            temperature:long_name = "Temperature" ;
            temperature:standard_name = "sea_water_potential_temperature" ;
            temperature:units = "K" ;
            temperature:add_offset = 294.15f ;
            temperature:scale_factor = 0.001f ;
            temperature:_FillValue = -32767s ;
            temperature:unit_long = "Kelvin" ;

// global attributes:
            :title = "CMEMS IBI REANALYSIS: MONTHLY PHYSICAL PRODUCTS (REGULAR GRID) " ;
            :institution = "Puertos del Estado (PdE) - Mercator-Ocean (MO) " ;
            :references = "http://marine.copernicus.eu" ;
            :source = "CMEMS IBI-MFC" ;
            :Conventions = "CF-1.0" ;
            :history = "Data extracted from dataset http://test-puertos.cesga.es:8080/thredds/dodsC/dataset-ibi-reanalysis-phys-005-002-monthly-regulargrid" ;
            :time_min = 83232. ;
            :time_max = 83232. ;
            :julian_day_unit = "Hours since 2002-02-15" ;
            :z_min = 0.505760014057159 ;
            :z_max = 5698.060546875 ;
            :latitude_min = 30. ;
            :latitude_max = 40. ;
            :longitude_min = -10. ;
            :longitude_max = 0.999999225139618 ;
}
```

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