PRODUCT USER MANUAL

For Atlantic -Iberian Biscay Irish- Biogeochemistry Non Assimilative Hindcast Product:

IBI_REANALYSIS_BIO_005_003

Issue: 2.0

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CHANGE RECORD

Issue	Date	§	Description of Change	Author	Validated By
0.0	05/05/2014	All	Creation of the document.	Marcos García Sotillo	
1.0	13/5/2014	All	Inclusion of information on model and product download interfaces	Sylvain Caillau, Marcos G Sotillo, Arancha Amo	Enrique Álvarez L. Crosnier
1.1	01/05/2015	all	Change format to fit CMEMS graphical rules		L. Crosnier
2.0	14/12/2015	all	Update for CMEMS V2	Marcos García Sotillo, 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 biogeochemistry non assimilative hindcast product IBI_REANALYSIS_BIO_005_003 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 provides with 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_BIO_005_003 product consists of 3D monthly fields of concentration of: chlorophyll, iron, nitrate, ammonium, oxygen, phosphate, silicate, phytoplankton Net Primary Productivity of Carbon and the euphotic zone depth.

II DESCRIPTION OF THE IBI-MFC REANALYSIS SYSTEM

II.1 System Description

II.1.1 Numerical Ocean Biogeochemistry Code

The biogeochemical model PISCES is coupled online with the ocean physics code NEMO used to generate the IBI ocean physic reanalysis (described in the PUM of IBI physical reanalysis product IBI_REANALYSIS_PHYS_005_002). The time scheme of the BGQ model is eulerian contrary to the leap-frog scheme applied for the physical part. Thus, for numerical conservation aspects, PISCES model is called every two time-step of the ocean physic model. The time step is then 900 s for the bio model. The advection scheme is the same than those used for the physical part.

II.1.1.1 Description of Ocean Biogeochemistry code and version

The biogeochemical model used is PISCES (*Aumont and Bopp, 2006*) in its version NEMO3.2. It is a model of intermediate complexity designed for global ocean applications (*Aumont and Bopp, 2006*) and is part of NEMO modeling platform. It has 24 prognostic variables and simulates biogeochemical cycles of oxygen, carbon and the main nutrients controlling phytoplankton growth (nitrate, ammonium, phosphate, silicate and iron). The model distinguishes four plankton functional types based on size: two phytoplankton groups (small = nanophytoplankton and large = diatoms) and two zooplankton groups (small = microzooplankton and large = mesozooplankton). Prognostic variables of phytoplankton are total biomass in C, Fe, Si (for diatoms) and chlorophyll and hence the Fe/C, Si/C, Chl/C ratios are variable. For zooplankton, all these ratios are constant and total biomass in C is the only prognostic variable. The bacterial pool is not modeled explicitly. PISCES distinguishes three non-living pools for organic carbon: small particulate organic carbon, big particulate organic carbon and semi-labile dissolved organic carbon. While the C/N/P composition of dissolved and particulate matter is tied to Redfield stoichiometry, the iron, silicon and carbonate contents of the particles are computed prognostically. Next to the three organic detrital pools, carbonate and biogenic siliceous particles are modeled. Besides, the model simulates dissolved inorganic carbon and total alkalinity. In PISCES, phosphate and nitrate + ammonium are linked by constant Redfield ratio (C/N/P = 122/16/1). However, nitrogen fixation, denitrification as well as external sources can modify this ratio.

The distinction of two phytoplankton size classes, along with the description of multiple nutrient co-limitations allows the model to represent ocean productivity and biogeochemical cycles across major biogeographic ocean provinces (*Longhurst, 1998*). PISCES has been successfully used in a variety of biogeochemical studies (e.g. *Bopp et al. 2005; Gehlen et al. 2006; 2007; Schneider et al. 2008; Steinacher et al. 2010; Tagliabue et al. 2010, Séférian et al, 2012*).

II.1.1.2 Forcings, Initial and Boundary Conditions

The simulation started on January 30, 2002 and was initially run up to December 23, 2011. For the temporal extension delivered at the CMEMS V2 release, the simulation was restarted on August 31, 2011 and was extended up to December 27, 2014. Some modifications between the original physical ocean reanalysis and its later temporal extension for the physical component are described in the CMEMS Product User Manual Document associated to it (CMEMS-IBI-PUM-005-002 doc, Sotillo et al. 2016). There are no changes in the biogeochemical component used in the original hindcast run and in the extension of the BIO products.

The biogeochemical model is initialized with a previous IBI simulation at the same resolution. This previous simulation was initialized by World Ocean Atlas 2001 for nitrate, phosphate, oxygen and silicate (Conkright et al. 2002), with GLODAP climatology including anthropogenic CO2 for Dissolved Inorganic Carbon and Alkalinity (Key et al. 2004) and, in the absence of corresponding data products, with model climatological fields for dissolved iron and dissolved organic carbon the others variables. These same climatologies are also used to force the open boundaries.

Boundary fluxes account for nutrient supply from three different sources: atmospheric deposition, rivers for nutrients, dissolved inorganic carbon and alkalinity (Ludwig et al., 1996) and inputs of Fe from marine sediments. For more details on external supply of nutrients, please refer to the supplementary material of Aumont and Bopp (2006).

II.1.2 Data Assimilation

No biogeochemical data is assimilated.

The biogeochemical model PISCES is coupled online with the ocean physics code NEMO used to generate the IBI ocean physic reanalysis which assimilates Sea Level Anomaly, Sea Surface Temperature, In situ Temperature and Salinity (see MYO2-IBI-PUM-005-002-V1.0.pdf for data assimilation of the physics in product IBI_REANALYSIS_PHYS_005_002).

II.1.2.1 Description of Data Assimilation Scheme

None (see MYO2-IBI-PUM-005-002-V1.0.pdf for data assimilation of the physics in other product IBI_REANALYSIS_PHYS_005_002)

II.1.2.2 Which data is assimilated?

None (see MYO2-IBI-PUM-005-002-V1.0.pdf for data assimilation of the physics in other product IBI_REANALYSIS_PHYS_005_002)

III PRODUCT DESCRIPTION

III.1 General Information

The Product IBI_REANALYSIS_BIO_005_003 provides with monthly averages of 3D biogeochemistry variables for the IBI area. The time coverage starts the 01/02/2002 and ends the 28/12/2014. 3D Monthly averaged concentrations of chlorophyll, iron, nitrate, ammonium, oxygen, phosphate, silicate, phytoplankton, as well as values for the net Primary Productivity of Carbon and the euphotic zone depth are provided through this product. Outputs files are delivered in Netcdf format (using CF/COARDS 1.0 convention).

Next section is devoted to describe the datasets in IBI_REANALYSIS_BIO_005_003 product.

III.2 Details of datasets

Product IBI_REANALYSIS_BIO_005_003 contains 2 different datasets:

- **dataset-ibi-reanalysis-bio-005-003-monthly-regulargrid**
- **dataset-ibi-reanalysis-bio-005-003-monthly-nativegrid**

The first dataset provides information on monthly basis already post-processed into a regular lat/lon grid (analogous to the one used to deliver the physical ocean reanalysis product IBI_REANALYSIS_PHYS_005_002), whereas the latest dataset provides same monthly fields but in the original model native grid.

- **dataset-ibi-reanalysis-bio-005-003-monthly-regulargrid** contains **monthly averages** of the following variables for the whole water column:
  - Mass Concentration of Chlorophyll in Sea Water (mg.m-3)
  - Mole Concentration of Iron in Sea Water (mmol.m-3)
  - Mole Concentration of Ammonium in Sea Water (mmol.m-3)
  - Mole Concentration of Nitrate in Sea Water (mmol.m-3)
  - Mole Concentration of Dissolved Oxygen in Sea Water (mmol.m-3)
  - Mole Concentration of Phosphate in Sea Water (mmol.m-3)
  - Mole Concentration of Silicate in Sea Water (mmol.m-3)
  - Mole Concentration of Phytoplankton expressed as carbon in sea water (mmol.m-3)
  - Net Primary Productivity of Carbon (g.m-3/day)
  - Euphotic zone depth (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 same variables for the whole water column:

- Mass Concentration of Chlorophyll in Sea Water (mg.m-3)
- Mole Concentration of Iron in Sea Water (mmol.m-3)
- Mole Concentration of Ammonium in Sea Water (mmol.m-3)
- Mole Concentration of Nitrate in Sea Water (mmol.m-3)
- Mole Concentration of Dissolved Oxygen in Sea Water (mmol.m-3)
- Mole Concentration of Phosphate in Sea Water (mmol.m-3)
- Mole Concentration of Silicate in Sea Water (mmol.m-3)
- Mole Concentration of Phytoplankton expressed as carbon in sea water (mmol.m-3)
- Net Primary Productivity of Carbon (g.m-3/day)
- Euphotic zone depth (m)

In this specific dataset, data is delivered in the original model native grid. The native model grid is an irregular 1/12º ORCA tripolar grid. 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, where biogeochemical data is provided extends to 296x504x75 grid points.

III.3 Details of variables and units

- Mass Concentration of Chlorophyll in Sea Water (mg.m-3)
- Mole Concentration of Iron in Sea Water (mmol.m-3)
- Mole Concentration of Ammonium in Sea Water (mmol.m-3)
- Mole Concentration of Nitrate in Sea Water (mmol.m-3)
- Mole Concentration of Dissolved Oxygen in Sea Water (mmol.m-3)
- Mole Concentration of Phosphate in Sea Water (mmol.m-3)
- Mole Concentration of Silicate in Sea Water (mmol.m-3)
- Mole Concentration of Phytoplankton expressed as carbon in sea water (mmol.m-3)
- Net Primary Productivity of Carbon (g.m-3/day)
- Euphotic zone depth (m)

III.4 Grid Characteristics and Geographical Projection

As it was stated in the dataset description, information from the IBI BioGeoChemistry non assimilative hindcast is provided on monthly basis. The Biogeochemical variables included in this product are delivered through 2 datasets. One deliver the data in a post-processed regular lat/lon grid (identical to the grid used for delivery the physical reanalysis product IBI_REANALYSIS_PHYS_005_002 and analogous to the one used with the daily IBI-MFC Forecast products IBI_ANALYSIS_FORECAST_PHYS_005_001_b, but with a 1/12º horizontal resolution, instead of the 1/36º used in the forecast product) and the other deliver the data in the original (irregular) model native 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 user interfaces available for downloading this product are:

- Subsetter
- DirectGetFile
- FTP

The **dataset-ibi-reanalysis-bio-005-003-monthly-regulargrid** can be downloaded through all the available mechanisms (Subsetter, FTP and DirectGetFile), whereas the **dataset-ibi-reanalysis-bio-005-003-monthly-nativegrid** can be download only through DirectGetFile and FTP (no subsetter capability available for datasets delivered in irregular grids).

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_BIO_005_003 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-bio-005-003**-monthly-regulargrid**

Monthly dateset in native grid only available through Directgetfile service interface.

. 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-bio-005-003-monthly-regulargrid_1399460336380.nc

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

IBI_REANALYSIS_BIO_005_003 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-bio-005-003**-monthly-regulargrid**

· dataset-ibi-reanalysis-bio-005-003**-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 from IBI reanalysis daily and hourly datasets:

http---purl.org-myocean-ontology-product-database-dataset-ibi-reanalysis-bio-005-003-monthly-regulargrid_1399967371003.zip for monthly postprocessed (into a regular grid) files

http---purl.org-myocean-ontology-product-database-dataset-ibi-reanalysis-bio-005-003-monthly-nativegrid_1399967277557.zip for monthly files in original (irregular) native grid.

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

{region}re{fileVersion}_BGQ${gridType}_01mav_{validDate}_{valiDate}_R{bulletinDate}_{productType}.nc

E.g.:

IBIreV2r1_BGQRE_01mav_20110801_20110831_R20131106_RE01.nc for monthly IBI BIO data in a regular lonlat grid.

IBIreV2r1_BGQNA_01mav_20110801_20110831_R20131106_RE01.nc for monthly IBI BIO data in an irregular native model 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

• **gridType** is RE/NA for regular or native grid type, respectively.

• **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_REANALYSIS_BIO_005_003 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}_BGQ${gridType}_01mav_{validDate}_{valiDate}_R{bulletinDate}_{productType}.nc

E.g.:

IBIreV2r1_BGQRE_01mav_20110801_20110831_R20131106_RE01.nc for monthly IBI BIO products in a regular lonlat grid.

IBIreV2r1_BGQNA_01mav_20110801_20110831_R20131106_RE01.nc for monthly IBI BIO products in an irregular native model 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

• **gridType** is RE/NA for regular or native grid type, respectively.

• **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.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_BIO_005_003** file downloaded through **DGF and FTP**.

- For **dataset-ibi-reanalysis-bio-005-003-monthly-regulargrid**: when an user requests for instance monthly data for 2 months to be downloaded, the user gets a zip file with 2 netCDF files inside. Each file corresponds to each specific requested month.

http---purl.org-myocean-ontology-product-database-dataset-ibi-reanalysis-bio-005-003-monthly-regulargrid_1399967277557.zip:

IBIreV2r1_BGQRE_01mav_20110801_20110831_R20131106_RE01.nc

IBIreV2r1_BGQRE_01mav_20110901_20110930_R20131106_RE01.nc

In case of downloading through FTP, the user will download directly the data files.

Example of netcdf map file:

```
ncdump -h IBIreV2r1_BGQRE_01mav_20110801_20110831_R20131106_RE01.nc
netcdf IBIreV2r1_BGQRE_01mav_20110801_20110831_R20131106_RE01 {
dimensions:
        time = 1 ;
        depth = 50 ;
        latitude = 361 ;
        longitude = 289 ;
variables:
        short chl(time, depth, latitude, longitude) ;
                chl:long_name = "Mass Concentration of Chlorophyll in Sea Water" ;
                chl:standard_name = "mass_concentration_of_chlorophyll_in_sea_water" ;
                chl:units = "mg.m-3" ;
                chl:add_offset = 0.f ;
                chl:scale_factor = 0.01f ;
                chl:_FillValue = -32767s ;
                chl:unit_long = "milligram of chlorophyll per cubic meter" ;
                chl:valid_max = 200.f ;
                chl:valid_min = 0.f ;
        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 eup(time, latitude, longitude) ;
                eup:long_name = "Euphotic zone depth" ;
                eup:standard_name = "euphotic_zone_depth" ;
                eup:units = "m" ;
                eup:add_offset = 0.f ;
                eup:scale_factor = 0.01f ;
                eup:_FillValue = -32767s ;
                eup:unit_long = "Meters" ;
                eup:valid_max = 200.f ;
                eup:valid_min = 0.f ;
        short fer(time, depth, latitude, longitude) ;
```

fer:long_name = "Mole Concentration of Iron in Sea Water" ;
fer:standard_name = "mole_concentration_of_dissolved_iron_in_sea_water" ;
fer:units = "mmol.m-3" ;
fer:add_offset = 0.f ;
fer:scale_factor = 1.e-05f ;
fer:_FillValue = -32767s ;
fer:unit_long = "millimoles of Iron per cubic meter" ;
fer:valid_max = 0.1f ;
fer:valid_min = 0.f ;
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 nh4(time, depth, latitude, longitude) ;
nh4:long_name = "Mole Concentration of Ammonium in Sea Water" ;
nh4:standard_name = "mole_concentration_of_ammonium_in_sea_water" ;
nh4:units = "mmol.m-3" ;
nh4:add_offset = 0.f ;
nh4:scale_factor = 0.01f ;
nh4:_FillValue = -32767s ;
nh4:unit_long = "millimoles of Ammonium per cubic meter" ;
nh4:valid_max = 320.f ;
nh4:valid_min = 0.f ;
short no3(time, depth, latitude, longitude) ;
no3:long_name = "Mole Concentration of Nitrate in Sea Water" ;
no3:standard_name = "mole_concentration_of_nitrate_in_sea_water" ;
no3:units = "mmol.m-3" ;
no3:add_offset = 300.f ;
no3:scale_factor = 0.01f ;
no3:_FillValue = -32767s ;
no3:unit_long = "millimoles of Nitrate per cubic meter" ;
no3:valid_max = 600.f ;
no3:valid_min = 0.f ;
short oxi(time, depth, latitude, longitude) ;
oxi:long_name = "Mole Concentration of Dissolved Oxygen in Sea Water" ;
oxi:standard_name = "mole_concentration_of_dissolved_molecular_oxygen_in_sea_water" ;
oxi:units = "mmol.m-3" ;
oxi:add_offset = 0.f ;
oxi:scale_factor = 0.1f ;
oxi:_FillValue = -32767s ;
oxi:unit_long = "millimoles of Oxygen per cubic meter" ;
oxi:valid_max = 3200.f ;
oxi:valid_min = 0.f ;
short phy(time, depth, latitude, longitude) ;
phy:long_name = "Mole Concentration of Phytoplankton expressed as carbon in sea water" ;

phy:standard_name = "mole_concentration_of_phytoplankton_expressed_as_carbon_in_sea_water" ;
phy:units = "mmol.m-3" ;
phy:add_offset = 300.f ;
phy:scale_factor = 0.01f ;
phy:_FillValue = -32767s ;
phy:unit_long = "mole_concentration_of_phytoplankton_expressed_as_carbon_in_sea_water" ;
phy:valid_max = 600.f ;
phy:valid_min = 0.f ;
short po4(time, depth, latitude, longitude) ;
po4:long_name = "Mole Concentration of Phosphate in Sea Water" ;
po4:standard_name = "mole_concentration_of_phosphate_in_sea_water" ;
po4:units = "mmol.m-3" ;
po4:add_offset = 20.f ;
po4:scale_factor = 0.001f ;
po4:_FillValue = -32767s ;
po4:unit_long = "millimoles of Phosphate per cubic meter" ;
po4:valid_max = 50.f ;
po4:valid_min = 0.f ;
short prp(time, depth, latitude, longitude) ;
prp:long_name = "Net PrimaryProductivity of Carbon" ;
prp:standard_name =
"net_primary_production_of_biomass_expressed_as_carbon_per_unit_volume_in_sea_water" ;
prp:units = "g.m-3/day" ;
prp:add_offset = 0.f ;
prp:scale_factor = 0.001f ;
prp:_FillValue = -32767s ;
prp:unit_long = "grams of Carbon per cubic meter per day" ;
prp:valid_max = 10.f ;
prp:valid_min = 0.f ;
short sil(time, depth, latitude, longitude) ;
sil:long_name = "Mole Concentration of Silicate in Sea Water" ;
sil:standard_name = "mole_concentration_of_silicate_in_sea_water" ;
sil:units = "mmol.m-3" ;
sil:add_offset = 0.f ;
sil:scale_factor = 0.1f ;
sil:_FillValue = -32767s ;
sil:unit_long = "millimoles of Silicate per cubic meter" ;
sil:valid_max = 2500.f ;
sil:valid_min = 0.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" ;

// 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 BIOGEOCHEMICAL 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" ;
}
```

- For **dataset-ibi-reanalysis-bio-005-003-monthly-nativegrid**: when a user request for instance 2 months of monthly data to be downloaded, the user gets a zip file with 2 netCDF inside, each one corresponding to each specific requested month.

  http---purl.org-myocean-ontology-product-database-dataset-ibi-reanalysis-bio-005-003-monthly-nativegrid_1399967277557.zip:

  IBIreV2r1_BGQNA_01mav_20110801_20110831_R20131106_RE01.nc

  IBIreV2r1_BGQNA_01mav_20110901_20110930_R20131106_RE01.nc

  In case of downloading through FTP, the user will download directly the data files.

Example of netcdf map file:

```
ncdump -h IBIreV2r1_BGQNA_01mav_20110801_20110831_R20131106_RE01.nc
netcdf IBIreV2r1_BGQNA_01mav_20110801_20110831_R20131106_RE01 {
dimensions:
        time = 1 ;
        depth = 75 ;
        latitude = 504 ;
        longitude = 296 ;
variables:
        short chl(time, depth, latitude, longitude) ;
                chl:long_name = "Mass Concentration of Chlorophyll in Sea Water" ;
                chl:standard_name = "mass_concentration_of_chlorophyll_in_sea_water" ;
                chl:units = "mg.m-3" ;
                chl:add_offset = 0.f ;
                chl:scale_factor = 0.01f ;
                chl:_FillValue = -32767s ;
                chl:unit_long = "milligram of chlorophyll per cubic meter" ;
                chl:valid_max = 200.f ;
                chl:valid_min = 0.f ;
        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" ;
short eup(time, latitude, longitude) ;
eup:long_name = "Euphotic zone depth" ;
eup:standard_name = "euphotic_zone_depth" ;
eup:units = "m" ;
eup:add_offset = 0.f ;
eup:scale_factor = 0.01f ;
eup:_FillValue = -32767s ;
eup:unit_long = "Meters" ;
eup:valid_max = 200.f ;
eup:valid_min = 0.f ;
short fer(time, depth, latitude, longitude) ;
fer:long_name = "Mole Concentration of Iron in Sea Water" ;
fer:standard_name = "mole_concentration_of_dissolved_iron_in_sea_water" ;
fer:units = "mmol.m-3" ;
fer:add_offset = 0.f ;
fer:scale_factor = 1.e-05f ;
fer:_FillValue = -32767s ;
fer:unit_long = "millimoles of Iron per cubic meter" ;
fer:valid_max = 0.1f ;
fer:valid_min = 0.f ;
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 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" ;
short nh4(time, depth, latitude, longitude) ;
nh4:long_name = "Mole Concentration of Ammonium in Sea Water" ;
nh4:standard_name = "mole_concentration_of_ammonium_in_sea_water" ;
nh4:units = "mmol.m-3" ;
nh4:add_offset = 0.f ;
nh4:scale_factor = 0.01f ;
nh4:_FillValue = -32767s ;
nh4:unit_long = "millimoles of Ammonium per cubic meter" ;
nh4:valid_max = 320.f ;
nh4:valid_min = 0.f ;
short no3(time, depth, latitude, longitude) ;
no3:long_name = "Mole Concentration of Nitrate in Sea Water" ;
no3:standard_name = "mole_concentration_of_nitrate_in_sea_water" ;

no3:units = "mmol.m-3" ;
no3:add_offset = 300.f ;
no3:scale_factor = 0.01f ;
no3:_FillValue = -32767s ;
no3:unit_long = "millimoles of Nitrate per cubic meter" ;
no3:valid_max = 600.f ;
no3:valid_min = 0.f ;
short oxi(time, depth, latitude, longitude) ;
oxi:long_name = "Mole Concentration of Dissolved Oxygen in Sea Water" ;
oxi:standard_name = "mole_concentration_of_dissolved_molecular_oxygen_in_sea_water" ;
oxi:units = "mmol.m-3" ;
oxi:add_offset = 0.f ;
oxi:scale_factor = 0.1f ;
oxi:_FillValue = -32767s ;
oxi:unit_long = "millimoles of Oxygen per cubic meter" ;
oxi:valid_max = 3200.f ;
oxi:valid_min = 0.f ;
short phy(time, depth, latitude, longitude) ;
phy:long_name = "Mole Concentration of Phytoplankton expressed as carbon in sea water" ;
phy:standard_name = "mole_concentration_of_phytoplankton_expressed_as_carbon_in_sea_water" ;
phy:units = "mmol.m-3" ;
phy:add_offset = 300.f ;
phy:scale_factor = 0.01f ;
phy:_FillValue = -32767s ;
phy:unit_long = "mole_concentration_of_phytoplankton_expressed_as_carbon_in_sea_water" ;
phy:valid_max = 600.f ;
phy:valid_min = 0.f ;
short po4(time, depth, latitude, longitude) ;
po4:long_name = "Mole Concentration of Phosphate in Sea Water" ;
po4:standard_name = "mole_concentration_of_phosphate_in_sea_water" ;
po4:units = "mmol.m-3" ;
po4:add_offset = 20.f ;
po4:scale_factor = 0.001f ;
po4:_FillValue = -32767s ;
po4:unit_long = "millimoles of Phosphate per cubic meter" ;
po4:valid_max = 50.f ;
po4:valid_min = 0.f ;
short prp(time, depth, latitude, longitude) ;
prp:long_name = "Net PrimaryProductivity of Carbon" ;
prp:standard_name =
"net_primary_production_of_biomass_expressed_as_carbon_per_unit_volume_in_sea_water" ;
prp:units = "g.m-3/day" ;
prp:add_offset = 0.f ;
prp:scale_factor = 0.001f ;
prp:_FillValue = -32767s ;
prp:unit_long = "grams of Carbon per cubic meter per day" ;
prp:valid_max = 10.f ;
prp:valid_min = 0.f ;
short sil(time, depth, latitude, longitude) ;
sil:long_name = "Mole Concentration of Silicate in Sea Water" ;
sil:standard_name = "mole_concentration_of_silicate_in_sea_water" ;
sil:units = "mmol.m-3" ;
sil:add_offset = 0.f ;
sil:scale_factor = 0.1f ;
sil:_FillValue = -32767s ;
sil:unit_long = "millimoles of Silicate per cubic meter" ;
sil:valid_max = 2500.f ;
sil:valid_min = 0.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" ;

// 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" ;
            :comment = "Class1 metrics" ;
            :nco_openmp_thread_number = 1 ;
            :title = "CMEMS IBI REANALYSIS: MONTHLY BIOGEOCHEMICAL PRODUCTS (NATIVE GRID) " ;
            :easting = "longitude" ;
            :northing = "latitude" ;
            :domain_name = "IBI12" ;
            :field_type = "mean" ;
            :field_date = "201108" ;
            :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 correspond to the complete IBI BIO REA files, which are downloaded through DGF. However, when data from the IBI BIO reanalysis product is download through **the MIS-GW Subsetter interface** the file map and structure may 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 the single IBI BIO dataset provided through this interface (dataset-ibi-reanalysis-bio-005-003-monthly-regulargrid).

- For **dataset-ibi-reanalysis-bio-005-003-monthly-regulargrid:** A request of 3 variables (concentration of chlorophyll, nitrate and phosphate) has been performed selecting data for August 2011 and the following regional coverage: 10W-1W / 30N-40N.

The map of the downloaded nc file (with 1 monthly record for the 50 available levels in the requested subset region with 121x133 gridpoint) is the following one:

```
ncdump -h dataset-ibi-reanalysis-bio-005-003-monthly-regulargrid_1452598899574.nc
netcdf dataset-ibi-reanalysis-bio-005-003-monthly-regulargrid_1452598899574 {
dimensions:
        time = 1 ;
        depth = 50 ;
```

```
        latitude = 121 ;
        longitude = 133 ;
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 chl(time, depth, latitude, longitude) ;
                chl:_CoordinateAxes = "time depth latitude longitude " ;
                chl:long_name = "Mass Concentration of Chlorophyll in Sea Water" ;
                chl:standard_name = "mass_concentration_of_chlorophyll_in_sea_water" ;
                chl:units = "mg.m-3" ;
                chl:add_offset = 0.f ;
                chl:scale_factor = 0.01f ;
                chl:_FillValue = -32767s ;
                chl:unit_long = "milligram of chlorophyll per cubic meter" ;
        short no3(time, depth, latitude, longitude) ;
                no3:_CoordinateAxes = "time depth latitude longitude " ;
                no3:long_name = "Mole Concentration of Nitrate in Sea Water" ;
                no3:standard_name = "mole_concentration_of_nitrate_in_sea_water" ;
                no3:units = "mmol.m-3" ;
                no3:add_offset = 300.f ;
                no3:scale_factor = 0.01f ;
                no3:_FillValue = -32767s ;
                no3:unit_long = "millimoles of Nitrate per cubic meter" ;
        short po4(time, depth, latitude, longitude) ;
                po4:_CoordinateAxes = "time depth latitude longitude " ;
                po4:long_name = "Mole Concentration of Phosphate in Sea Water" ;
                po4:standard_name = "mole_concentration_of_phosphate_in_sea_water" ;
                po4:units = "mmol.m-3" ;
                po4:add_offset = 20.f ;
                po4:scale_factor = 0.001f ;
                po4:_FillValue = -32767s ;
                po4:unit_long = "millimoles of Phosphate per cubic meter" ;
        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" ;

// global attributes:
:title = "CMEMS IBI REANALYSIS: MONTHLY BIOGEOCHEMICAL 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-bio-005-003-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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