PRODUCT USER MANUAL

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

IBI_REANALYSIS_BIO_005_003

Issue: 3.0

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Approval Date: March 2018

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	Enrique Álvarez
3.0	18/01/2018	all	Update for CMEMS V4	Arancha Amo, Elodie Gutknecht, Marcos García Sotillo	Enrique Álvarez & Angelique Melet

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GLOSSARY AND ABBREVIATIONS

AVHRR	Advanced Very High Resolution Radiometer – Optical instrument onboard NOAA satellites
Qual/val	Qualification / Validation
CIS	Central Information System
CORIOLIS	In situ data system for operational oceanography
DGF	Direct Get File. It is a CMEMS 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 CMEMS 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
CIS	CMEMS 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
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 : CMEMS 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
WMO	World Meteorological Organisation
WMS	Web Map Service

I OBJECTIVE OF THE DOCUMENT

This guide describes the biogeochemical multi-year (1992-2016) product files delivered by the CMEMS IBI-MFC (Iberia-Biscay-Ireland Monitoring and Forecasting Centre), the CMEMS user interfaces available to access them, and a brief description of the IBI biogeochemical non-assimilative hindcast model system used to generate the product.

The CMEMS IBI-MFC biogeochemical product (IBI_REANALYSIS_BIO_005_003) comprises daily and monthly mean fields of following variables: chlorophyll, oxygen, iron, nitrate, ammonium, phosphate, silicate, net primary production, euphotic zone depth and phytoplankton carbon.

II DESCRIPTION OF THE IBI-MFC BIOGEOCHEMICAL HINDCAST MODEL SYSTEM

Short description:

The IBI-MFC provides a 3D high-resolution biogeochemical multi-year product (covering from 1992 till 2016). To this aim, an application of the biogeochemical model PISCES is run simultaneously with the ocean physical IBI reanalysis, generating both products at the same 1/12° horizontal resolution. The PISCES model is able to simulate the first levels of the marine food web, from nutrients up to mesozooplankton and it has 24 state variables. The main biogeochemical variables, such as chlorophyll, oxygen, iron, nitrate, ammonium, phosphate, silicate, net primary production and the euphotic zone depth, are distributed as part of this IBI biogeochemical multi-year product.

Detailed description:

The biogeochemical model PISCES v2 (Aumont et al., 2015), part of NEMO 3.6 modeling platform, is a model of intermediate complexity. It considers 24 prognostic variables. There are five limiting nutrients for phytoplankton growth: nitrate and ammonium, phosphate, silicate and iron. Phosphate and nitrate + ammonium are linked by a constant Redfield ratio C/N/P (122/16/1; Takahashi et al., 1985) in all organic compartments of PISCES. The model distinguishes two phytoplankton size compartments (nanophytoplankton and diatoms), for which prognostic variables are total biomass in carbon, iron, chlorophyll, and silicon (the latter only for diatoms), and hence the Fe/C, Chl/C, and Si/C ratios are variable and then prognostically predicted by the model. Two zooplankton size classes (microzooplankton and mesozooplankton) are considered, with constant ratios. Total biomass in C is thus the only prognostic variable for zooplankton. 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 content of the particles is prognostically computed. Next to the three organic detrital pools, calcium carbonate (calcite) and biogenic silicate particles are modeled. Besides, the model simulates the carbonate system (dissolved inorganic carbon and total alkalinity) and dissolved oxygen.

Even if PISCES was initially designed for global ocean applications, 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 at global and regional scales, at low and high spatial resolutions as well as for short-term and long-term analyses (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, 2013; Gutknecht et al.; 2016). PISCES is also the biogeochemical model used for the IBI Analysis and Forecast products (IBI_ANALYSIS_FORECAST_BIO_005_004), the Global Ocean Analysis Product (GLOBAL_ANALYSIS_BIO_001_014) and the Non-Assimilative Hindcast Product (GLOBAL_REANALYSIS_BIO_001_018), developed and produced at Mercator Ocean for delivery to CMEMS.

PISCES is coupled to NEMO-OPA via the TOP component that manages the advection/diffusion equations of passive tracers but also the sources and sinks terms due to biogeochemistry. For this regional configuration, physics and biogeochemistry are running simultaneously ("on-line" coupling), with the same 1/12° horizontal resolution.

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 CMEMS-IBI-PUM-005-002-pdf for data assimilation of the physics in product IBI_REANALYSIS_PHYS_005_002). The numerical scheme of PISCES for biogeochemical processes is forward in time (Euler), which does not correspond to the classical leap-frog scheme used for the physical component. In order to respect the conservation of the tracers, the coupling between biogeochemical and physical components is done one time step over two. The time step for the biogeochemical model is twice that of the physical component, i.e. 900 s. The advection scheme TOP-PISCES is the QUICKEST scheme (Leonard, 1979) with limiter of Zalezak (1979).

The simulation started on on January 1st, 1992 up to December 24, 2016. The biogeochemical model is initialized with a monthly climatology build from the Global Ocean Analysis Product (GLOBAL_ANALYSIS_BIO_001_014) at ¼° horizontal resolution for the same starting month. The climatology is built using years 2010 to 2015. Open boundary conditions come from this same climatology on a monthly basis.

Other boundary fluxes account for external supply of nutrients (N, P, Si, Fe and DIC) from three different sources: atmospheric dust deposition, rivers, and marine sediment mobilization. For more details on external supply of nutrients, please refer to Aumont et al. (2015). Following the CMEMS recommendations, the carbon cycle has been improved through the condition at the surface boundary of the CO_2 partial pressure taking into account the anthropogenic effects.

Two regional adaptations have been considered. First one concerns the vertical sedimentation. By default PISCES considers ~40% loss at the sediments. But literature shows that strong tidal currents prevent organic matter (POM, BSi, CaCO3) from settling on the bottom and being stored in sediments in the English Channel and North Sea. So, taking into account this regional specificity, 0% sediment losses were considered. Second adaptation deals with nutrient input from rivers. To have a more realistic system, two types of inputs are considered. The natural inputs are injected into the model in the form of surface flow in the river plumes but also along the coastline, from the annual ½ ° Global News 2 climatology which reproduces a realistic hydrology for the year 2000. Additional (anthropogenic) inputs of NO3 and PO4 are introduced into the system as lateral fluxes (similar to an open boundary) prescribed at the river sources points. These additional NO3 and PO4 come from rivers monitored and listed by the European Environment Agency (annual average). For the other variables, a reminder to the initial conditions is made.

PRODUCTION SUBSYSTEM DESCRIPTION

Production Center: **CMEMS IBI MFC**

Production Unit: **Mercator Ocean**

Dissemination Unit: Puertos del Estado

Scientific Validation Expertise: Marine Institute

The IBI MFC biogeochemical model system used to generate this multi-year product is aimed to be evolved, updating the service based on upgraded numerical model applications and forcings. Table 1 shows the evolution of the IBI multi-model service (in terms of main operational versions and main changes associated to each updated IBI system) along the service.

System Version (Project/Service)	Operational launch	End of operations	Novelties
IBI-V2 (MyOcean2)	19/04/2016	26/04/2018	First release of the IBI MFC BIO MY hindcast. The IBI biogeochemical Product, delivered to users from CMEMS V3 release, (temporal coverage 2002-2014).
IBI-V4 (CMEMS-I)	26/04/2018	…	New CMEMS V4 IBI REA System used to run the period 1992-2016. Both physical and biogeochemical models updated (NEMO/PISCES V3.6). In the BIO model, the carbon cycle was improved (The condition at the surface boundary of the CO_2 partial pressure now takes into account anthropogenic effects). The physical solution where coupled improved with a new Data assimilation scheme and new observational data sources included.

Table 1 Historical evolution of the IBI Multi-Year Biogeochemical Non-assimilative Hindcast System along the Service. Time coverage of each model set-up used to produce the IBI MFC MY product (i.e. IBI_REANALYSIS_BIO_005_003), as well as main novelties introduced by the upgraded version are provided.

III PRODUCT DESCRIPTION

III.1 General Information

The Product IBI_REANALYSIS_BIO_005_003 provides with monthly and daily averages of 3D biogeochemistry variables for the IBI area. The time coverage starts the 01/01/1992 and ends the 31/12/2016. 3D 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).

Product Specification	IBI_REANALYSIS_BIO_005_003
Geographical coverage	19°W → 5°E ; 26°N → 56°N
Variables	Mass Concentration of Chlorophyll in Sea Water Mole Concentration of Dissolved Oxygen in Sea Water Mole Concentration of Iron in Sea Water Mole Concentration of Nitrate in Sea Water Mole Concentration of Ammonium in Sea Water Mole Concentration of Phosphate in Sea Water Mole Concentration of Silicate in Sea Water Net Primary Productivity of Carbon Euphotic Zone Depth Mole Concentration of Phytoplankton Expressed as Carbon in Sea Water
Analysis	The IBI BIO model system has no data assimilation. Nevertheless, the IBI BIO estimates are derived from a bio run coupled into an IBI ocean physical solution with data assimilation, done by means of a IBI NEMO reanalysis run forced with ECMWF atmospheric re-analysis (ERA).
Forecast	No
Available time series	From 1st January 1992 to 31st December 2016
Temporal resolution	Daily/monthly
Delivery mechanism	CMEMS Information Systems: SubSetter, FTP and DirectGetFile

Horizontal resolution	1/12º
Number of vertical levels	50
Format	Netcdf CF1.0

Table 2 IBI_REANALYSIS_BIO_005_003 Product Specification

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-daily**
- **dataset-ibi-reanalysis-bio-005-003-monthly**

The first dataset provides information on daily basis already post-processed into a regular lat/lon grid, whereas the latest dataset provides monthly averaged fields (analogous to the ones used to deliver the physical ocean reanalysis product IBI_REANALYSIS_PHYS_005_002).

- **dataset-ibi-reanalysis-bio-005-003-daily:** contains **daily 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 (mg.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-bio-005-003-monthly:** 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 (mg.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.

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 (mg.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 daily and monthly basis, that is, the Biogeochemical variables included in this product are delivered through 2 datasets. Both of them 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, but with a 1/12º horizontal resolution, instead of the 1/36º used in the forecast product).

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-daily** and **dataset-ibi-reanalysis-bio-005-003-monthly** datasets can be downloaded through all the available mechanisms (Subsetter, FTP and DirectGetFile).

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_nnnnnnnnnnnn.nc**

where:

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

· dataset-ibi-reanalysis-bio-005-003**-daily**

. dataset-ibi-reanalysis-bio-005-003**-monthly**

. nnnnnnnnnnnn: 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-daily_1518192810683.nc

dataset-ibi-reanalysis-bio-005-003-monthly_1518192823120.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:

${datasetname}_{nnnnnnnnnnnn}.zip

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

· dataset-ibi-reanalysis-bio-005-003**-daily**

· dataset-ibi-reanalysis-bio-005-003**-monthly**

. nnnnnnnnnnnn: 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 BIO reanalysis daily and monthly datasets:

dataset-ibi-reanalysis-bio-005-003_daily_1518192637653.zip

dataset-ibi-reanalysis-bio-005-003_monthly_1518192764704.zip

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

CMEMS_{fileVersion}_{region}_BIO_MY_PdE_{freqFlag}_{validDate}_{valiDate}_R{bulletinDate}_{productType}.nc

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

dataset-ibi-reanalysis-bio-005-003_daily_1518192637653.zip

CMEMS_v4r1_IBI_BIO_MY_PdE_01dav_19930301_19930301_R20170901_RE01.nc

CMEMS_v4r1_IBI_BIO_MY_PdE_01dav_19930302_19930302_R20170901_RE01.nc

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

dataset-ibi-reanalysis-bio-005-003_monthly_1518192764704.zip

CMEMS_v4r1_IBI_BIO_MY_PdE_01mav_19920101_19920131_R20170901_RE01.nc

CMEMS_v4r1_IBI_BIO_MY_PdE_01mav_19920201_19920229_R20170901_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
- **freqFlag** is the frequency of data values in the file (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 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: **CMEMS_{fileVersion}_{region}_BIO_MY_PdE_{freqFlag}_{validDate}_{valiDate}_R{bulletinDate}_{productType}.nc**

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

CMEMS_v4r1_IBI_BIO_MY_PdE_01dav_19930301_19930301_R20170901_RE01.nc

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

CMEMS_v4r1_IBI_BIO_MY_PdE_01mav_19920101_19920131_R20170901_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
- **freqFlag** is the frequency of data values in the file (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 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-daily**: when a user requests for instance daily data for 2 days to be downloaded, the user gets a zip file with 2 netCDF files inside. Each file corresponds to each specific requested day.

  dataset-ibi-reanalysis-bio-005-003_daily_1518192637653.zip

  CMEMS_v4r1_IBI_BIO_MY_PdE_01dav_19930301_19930301_R20170901_RE01.nc

  CMEMS_v4r1_IBI_BIO_MY_PdE_01dav_19930302_19930302_R20170901_RE01.nc

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

  Example of netcdf map file:

```
ncdump -h CMEMS_v4r1_IBI_BIO_MY_PdE_01dav_19930301_19930301_R20170901_RE01.nc
netcdf CMEMS_v4r1_IBI_BIO_MY_PdE_01dav_19930301_19930301_R20170901_RE01 {
dimensions:
        time = UNLIMITED ; // (1 currently)
        longitude = 289 ;
        latitude = 361 ;
        depth = 50 ;
variables:
        float time(time) ;
                time:_CoordinateAxisType = "Time" ;
                time:axis = "T" ;
                time:calendar = "gregorian" ;
                time:long_name = "time" ;
                time:standard_name = "time" ;
                time:units = "hours since 1950-01-01 00:00:00" ;
                time:valid_max = 378372.f ;
                time:valid_min = 378372.f ;
        float longitude(longitude) ;
                longitude:standard_name = "longitude" ;
                longitude:long_name = "Longitude" ;
                longitude:units = "degrees_east" ;
                longitude:axis = "X" ;
                longitude:unit_long = "Degrees East" ;
                longitude:step = "0.08333f" ;
                longitude:valid_min = -19.f ;
                longitude:valid_max = 5.f ;
                longitude:_CoordinateAxisType = "Lon" ;
        float latitude(latitude) ;
                latitude:standard_name = "latitude" ;
                latitude:long_name = "Latitude" ;
                latitude:units = "degrees_north" ;
                latitude:axis = "Y" ;
                latitude:unit_long = "Degrees North" ;
                latitude:step = "0.08333f" ;
                latitude:valid_min = 26.f ;
                latitude:valid_max = 56.f ;
                latitude:_CoordinateAxisType = "Lat" ;
        float depth(depth) ;
                depth:long_name = "Depth" ;
                depth:units = "m" ;
                depth:axis = "Z" ;
```

depth:positive = "down" ;
depth:valid_min = 0.50576f ;
depth:valid_max = 5698.061f ;
depth:unit_long = "Meters" ;
depth:standard_name = "depth" ;
depth:_CoordinateAxisType = "Height" ;
depth:_CoordinateZisPositive = "down" ;
short chl(time, depth, latitude, longitude) ;
chl:standard_name = "mass_concentration_of_chlorophyll_a_in_sea_water" ;
chl:long_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 = "milligrams of chloropyll per cubic meter" ;
chl:valid_min = 0.f ;
chl:valid_max = 200.f ;
short fe(time, depth, latitude, longitude) ;
fe:standard_name = "mole_concentration_of_dissolved_iron_in_sea_water" ;
fe:long_name = "Mole Concentration of Iron in Sea Water" ;
fe:units = "mmol.m-3" ;
fe:add_offset = 0.f ;
fe:scale_factor = 0.0001f ;
fe:_FillValue = -32767s ;
fe:unit_long = "millimoles of Iron per cubic meter" ;
fe:valid_min = 0.f ;
fe:valid_max = 0.1f ;
short nh4(time, depth, latitude, longitude) ;
nh4:standard_name = "mole_concentration_of_ammonium_in_sea_water" ;
nh4:long_name = "Mole Concentration of Ammonium in Sea Water" ;
nh4:units = "mmol.m-3" ;
nh4:add_offset = 0.f ;
nh4:scale_factor = 0.1f ;
nh4:_FillValue = -32767s ;
nh4:unit_long = "millimoles of Ammonium per cubic meter" ;
nh4:valid_min = 0.f ;
nh4:valid_max = 320.f ;
short no3(time, depth, latitude, longitude) ;
no3:standard_name = "mole_concentration_of_nitrate_in_sea_water" ;
no3:long_name = "Mole Concentration of Nitrate in Sea Water" ;
no3:units = "mmol.m-3" ;
no3:add_offset = 300.f ;
no3:scale_factor = 0.1f ;
no3:_FillValue = -32767s ;
no3:unit_long = "millimoles of Nitrate per cubic meter" ;
no3:valid_min = 0.f ;
no3:valid_max = 600.f ;
short o2(time, depth, latitude, longitude) ;
o2:standard_name = "mole_concentration_of_dissolved_molecular_oxygen_in_sea_water" ;
o2:long_name = "Mole Concentration of Dissolved Oxygen in Sea Water" ;
o2:units = "mmol.m-3" ;
o2:_FillValue = -32767s ;
o2:unit_long = "millimoles of Oxygen per cubic meter" ;
o2:valid_min = 0.f ;
o2:valid_max = 3200.f ;
o2:scale_factor = 1.f ;
o2:add_offset = 0.f ;
short phyc(time, depth, latitude, longitude) ;
phyc:standard_name =
"mole_concentration_of_phytoplankton_expressed_as_carbon_in_sea_water" ;
phyc:long_name = "Mole Concentration of Phytoplankton expressed as carbon in sea water" ;

```
            phyc:units = "mmol.m-3" ;
            phyc:add_offset = 300.f ;
            phyc:scale_factor = 0.1f ;
            phyc:_FillValue = -32767s ;
            phyc:unit_long = "millimoles of Phytoplankton Carbon per cubic meter" ;
            phyc:valid_min = 0.f ;
            phyc:valid_max = 600.f ;
      short po4(time, depth, latitude, longitude) ;
            po4:standard_name = "mole_concentration_of_phosphate_in_sea_water" ;
            po4:long_name = "Mole Concentration of Phosphate in Sea Water" ;
            po4:units = "mmol.m-3" ;
            po4:add_offset = 20.f ;
            po4:scale_factor = 0.01f ;
            po4:_FillValue = -32767s ;
            po4:unit_long = "millimoles of Phosphate per cubic meter" ;
            po4:valid_min = 0.f ;
            po4:valid_max = 50.f ;
      short nppv(time, depth, latitude, longitude) ;
            nppv:standard_name                                                                                =
"net_primary_production_of_biomass_expressed_as_carbon_per_unit_volume_in_sea_water" ;
            nppv:long_name = "Net PrimaryProductivity of Carbon" ;
            nppv:units = "mg.m-3/day" ;
            nppv:_FillValue = -32767s ;
            nppv:unit_long = "milligrams of Carbon per cubic meter per day" ;
            nppv:valid_min = 0.f ;
            nppv:valid_max = 10000.f ;
            nppv:scale_factor = 1.f ;
            nppv:add_offset = 0.f ;
      short si(time, depth, latitude, longitude) ;
            si:standard_name = "mole_concentration_of_silicate_in_sea_water" ;
            si:long_name = "Mole Concentration of Silicate in Sea Water" ;
            si:units = "mmol.m-3" ;
            si:add_offset = 0.f ;
            si:scale_factor = 0.1f ;
            si:_FillValue = -32767s ;
            si:unit_long = "millimoles of Silicate per cubic meter" ;
            si:valid_min = 0.f ;
            si:valid_max = 2500.f ;
      short zeu(time, latitude, longitude) ;
            zeu:standard_name = "euphotic_zone_depth" ;
            zeu:long_name = "Euphotic zone depth" ;
            zeu:units = "m" ;
            zeu:add_offset = 0.f ;
            zeu:scale_factor = 0.1f ;
            zeu:_FillValue = -32767s ;
            zeu:unit_long = "meters" ;
            zeu:valid_min = 0.f ;
            zeu:valid_max = 200.f ;

// global attributes:
            :CDI = "Climate Data Interface version 1.7.0 (http://mpimet.mpg.de/cdi)" ;
            :Conventions = "CF-1.0" ;
            :institution = "Puertos del Estado (PdE) - Mercator-Ocean (MO)" ;
            :references = "http://marine.copernicus.eu" ;
            :nco_openmp_thread_number = 1 ;
            :CDO = "Climate Data Operators version 1.7.0 (http://mpimet.mpg.de/cdo)" ;
            :title = "CMEMS IBI REANALYSIS: DAILY BIOGEOCHEMICAL PRODUCTS " ;
            :easting = "longitude" ;
            :northing = "latitude" ;
            :source = "CMEMS IBI-MFC" ;
            :domain_name = "IBI12" ;
```

```
        :field_type = "mean" ;
        :field_date = "19930301" ;
        :comment = "Class1 metrics" ;
        :longitude_min = "-19.f" ;
        :longitude_max = "5.f" ;
        :latitude_min = "26.f" ;
        :latitude_max = "56.f" ;
        :z_min = "0.50576f" ;
        :z_max = "5902.058f" ;
        :contact = "mailto: servicedesk.cmems@mercator-ocean.eu" ;
        :netcdf_version_id = "4.4.3" ;
        :bulletin_date = "2017-09-01" ;
        :bulletin_type = "Reanalysis" ;
        :julian_day_unit = "Hours since 1950-01-01 00:00:00" ;
        :field_julian_date = "15765.f" ;
}
```

- For **dataset-ibi-reanalysis-bio-005-003-monthly**: when a 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.

  dataset-ibi-reanalysis-bio-005-003_monthly_1518192764704.zip

  CMEMS_v4r1_IBI_BIO_MY_PdE_01mav_19920101_19920131_R20170901_RE01.nc

  CMEMS_v4r1_IBI_BIO_MY_PdE_01mav_19920201_19920229_R20170901_RE01.nc

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

  Example of netcdf map file:

```
ncdump -h CMEMS_v4r1_IBI_BIO_MY_PdE_01mav_19920101_19920131_R20170901_RE01.nc
netcdf CMEMS_v4r1_IBI_BIO_MY_PdE_01mav_19920101_19920131_R20170901_RE01 {
dimensions:
        time = UNLIMITED ; // (1 currently)
        longitude = 289 ;
        latitude = 361 ;
        depth = 50 ;
variables:
        float time(time) ;
                time:_CoordinateAxisType = "Time" ;
                time:axis = "T" ;
                time:calendar = "gregorian" ;
                time:long_name = "time" ;
                time:standard_name = "time" ;
                time:units = "hours since 1950-01-01 00:00:00" ;
                time:valid_max = 368532.f ;
                time:valid_min = 368532.f ;
        float longitude(longitude) ;
                longitude:standard_name = "longitude" ;
                longitude:long_name = "Longitude" ;
                longitude:units = "degrees_east" ;
                longitude:axis = "X" ;
                longitude:unit_long = "Degrees East" ;
                longitude:step = "0.08333f" ;
                longitude:valid_min = -19.f ;
                longitude:valid_max = 5.f ;
                longitude:_CoordinateAxisType = "Lon" ;
        float latitude(latitude) ;
```

latitude:standard_name = "latitude" ;
latitude:long_name = "Latitude" ;
latitude:units = "degrees_north" ;
latitude:axis = "Y" ;
latitude:unit_long = "Degrees North" ;
latitude:step = "0.08333f" ;
latitude:valid_min = 26.f ;
latitude:valid_max = 56.f ;
latitude:_CoordinateAxisType = "Lat" ;
float depth(depth) ;
depth:long_name = "Depth" ;
depth:units = "m" ;
depth:axis = "Z" ;
depth:positive = "down" ;
depth:valid_min = 0.50576f ;
depth:valid_max = 5698.061f ;
depth:unit_long = "Meters" ;
depth:standard_name = "depth" ;
depth:_CoordinateAxisType = "Height" ;
depth:_CoordinateZisPositive = "down" ;
short chl(time, depth, latitude, longitude) ;
chl:standard_name = "mass_concentration_of_chlorophyll_a_in_sea_water" ;
chl:long_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 = "milligrams of chlorophyll per cubic meter" ;
chl:valid_min = 0.f ;
chl:valid_max = 200.f ;
short fe(time, depth, latitude, longitude) ;
fe:standard_name = "mole_concentration_of_dissolved_iron_in_sea_water" ;
fe:long_name = "Mole Concentration of Iron in Sea Water" ;
fe:units = "mmol.m-3" ;
fe:add_offset = 0.f ;
fe:scale_factor = 0.0001f ;
fe:_FillValue = -32767s ;
fe:unit_long = "millimoles of Iron per cubic meter" ;
fe:valid_min = 0.f ;
fe:valid_max = 0.1f ;
short nh4(time, depth, latitude, longitude) ;
nh4:standard_name = "mole_concentration_of_ammonium_in_sea_water" ;
nh4:long_name = "Mole Concentration of Ammonium in Sea Water" ;
nh4:units = "mmol.m-3" ;
nh4:add_offset = 0.f ;
nh4:scale_factor = 0.1f ;
nh4:_FillValue = -32767s ;
nh4:unit_long = "millimoles of Ammonium per cubic meter" ;
nh4:valid_min = 0.f ;
nh4:valid_max = 320.f ;
short no3(time, depth, latitude, longitude) ;
no3:standard_name = "mole_concentration_of_nitrate_in_sea_water" ;
no3:long_name = "Mole Concentration of Nitrate in Sea Water" ;
no3:units = "mmol.m-3" ;
no3:add_offset = 300.f ;
no3:scale_factor = 0.1f ;
no3:_FillValue = -32767s ;
no3:unit_long = "millimoles of Nitrate per cubic meter" ;
no3:valid_min = 0.f ;
no3:valid_max = 600.f ;
short o2(time, depth, latitude, longitude) ;

o2:standard_name = "mole_concentration_of_dissolved_molecular_oxygen_in_sea_water" ;
o2:long_name = "Mole Concentration of Dissolved Oxygen in Sea Water" ;
o2:units = "mmol.m-3" ;
o2:_FillValue = -32767s ;
o2:unit_long = "millimoles of Oxygen per cubic meter" ;
o2:valid_min = 0.f ;
o2:valid_max = 3200.f ;
o2:scale_factor = 1.f ;
o2:add_offset = 0.f ;
short phyc(time, depth, latitude, longitude) ;
phyc:standard_name =
"mole_concentration_of_phytoplankton_expressed_as_carbon_in_sea_water" ;
phyc:long_name = "Mole Concentration of Phytoplankton Expressed as Carbon in Sea Water"
;
phyc:units = "mmol.m-3" ;
phyc:add_offset = 300.f ;
phyc:scale_factor = 0.1f ;
phyc:_FillValue = -32767s ;
phyc:unit_long = "millimoles of Phytoplankton Carbon per cubic meter" ;
phyc:valid_min = 0.f ;
phyc:valid_max = 600.f ;
short po4(time, depth, latitude, longitude) ;
po4:standard_name = "mole_concentration_of_phosphate_in_sea_water" ;
po4:long_name = "Mole Concentration of Phosphate in Sea Water" ;
po4:units = "mmol.m-3" ;
po4:add_offset = 20.f ;
po4:scale_factor = 0.01f ;
po4:_FillValue = -32767s ;
po4:unit_long = "millimoles of Phosphate per cubic meter" ;
po4:valid_min = 0.f ;
po4:valid_max = 50.f ;
short nppv(time, depth, latitude, longitude) ;
nppv:standard_name =
"net_primary_production_of_biomass_expressed_as_carbon_per_unit_volume_in_sea_water" ;
nppv:long_name = "Net Primary Productivity of Carbon" ;
nppv:units = "mg.m-3.day-1" ;
nppv:_FillValue = -32767s ;
nppv:unit_long = "milligrams of Carbon per cubic meter per day" ;
nppv:valid_min = 0.f ;
nppv:valid_max = 10000.f ;
nppv:scale_factor = 1.f ;
nppv:add_offset = 0.f ;
short si(time, depth, latitude, longitude) ;
si:standard_name = "mole_concentration_of_silicate_in_sea_water" ;
si:long_name = "Mole Concentration of Silicate in Sea Water" ;
si:units = "mmol.m-3" ;
si:add_offset = 0.f ;
si:scale_factor = 0.1f ;
si:_FillValue = -32767s ;
si:unit_long = "millimoles of Silicate per cubic meter" ;
si:valid_min = 0.f ;
si:valid_max = 2500.f ;
short zeu(time, latitude, longitude) ;
zeu:standard_name = "euphotic_zone_depth" ;
zeu:long_name = "Euphotic Zone Depth" ;
zeu:units = "m" ;
zeu:add_offset = 0.f ;
zeu:scale_factor = 0.1f ;
zeu:_FillValue = -32767s ;
zeu:unit_long = "meters" ;
zeu:valid_min = 0.f ;

```
            zeu:valid_max = 200.f ;

    // global attributes:
            :CDI = "Climate Data Interface version 1.7.0 (http://mpimet.mpg.de/cdi)" ;
            :Conventions = "CF-1.0" ;
            :institution = "Puertos del Estado (PdE) - Mercator-Ocean (MO)" ;
            :references = "http://marine.copernicus.eu" ;
            :nco_openmp_thread_number = 1 ;
            :CDO = "Climate Data Operators version 1.7.0 (http://mpimet.mpg.de/cdo)" ;
            :title = "CMEMS IBI REANALYSIS: MONTHLY BIOGEOCHEMICAL PRODUCTS " ;
            :easting = "longitude" ;
            :northing = "latitude" ;
            :source = "CMEMS IBI-MFC" ;
            :domain_name = "IBI12" ;
            :field_type = "mean" ;
            :field_date = "19920116" ;
            :comment = "Class1 metrics" ;
            :longitude_min = "-19.f" ;
            :longitude_max = "5.f" ;
            :latitude_min = "26.f" ;
            :latitude_max = "56.f" ;
            :z_min = "0.50576f" ;
            :z_max = "5902.058f" ;
            :contact = "mailto: servicedesk.cmems@mercator-ocean.eu" ;
            :netcdf_version_id = "4.4.3" ;
            :bulletin_date = "2017-09-01" ;
            :bulletin_type = "Reanalysis" ;
            :julian_day_unit = "Hours since 1950-01-01 00:00:00" ;
            :field_julian_date = "15355.f" ;
    }
```

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 the files downloaded through Subsetter for both IBI BIO dataset provided through this interface.

- For **dataset-ibi-reanalysis-bio-005-003-daily:** A request of 3 variables (concentration of chlorophyll, nitrate and phosphate) has been performed selecting data for 2 days, the whole water column and the following regional coverage: 10W-1E / 30N-40N.

```
ncdump -h dataset-ibi-reanalysis-bio-005-003-daily_1518194242064.nc
netcdf dataset-ibi-reanalysis-bio-005-003-daily_1518194242064 {
dimensions:
        time = 2 ;
        depth = 50 ;
        latitude = 121 ;
        longitude = 133 ;
variables:
        int time(time) ;
                time:_CoordinateAxisType = "Time" ;
                time:axis = "T" ;
                time:calendar = "gregorian" ;
                time:long_name = "time" ;
                time:standard_name = "time" ;
                time:units = "Days since 1993-03-01 12:00:00 UTC" ;
```

short chl(time, depth, latitude, longitude) ;
chl:_CoordinateAxes = "time depth latitude longitude " ;
chl:standard_name = "mass_concentration_of_chlorophyll_a_in_sea_water" ;
chl:long_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 = "milligrams of chloropyll per cubic meter" ;
short no3(time, depth, latitude, longitude) ;
no3:_CoordinateAxes = "time depth latitude longitude " ;
no3:standard_name = "mole_concentration_of_nitrate_in_sea_water" ;
no3:long_name = "Mole Concentration of Nitrate in Sea Water" ;
no3:units = "mmol.m-3" ;
no3:add_offset = 300.f ;
no3:scale_factor = 0.1f ;
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:standard_name = "mole_concentration_of_phosphate_in_sea_water" ;
po4:long_name = "Mole Concentration of Phosphate in Sea Water" ;
po4:units = "mmol.m-3" ;
po4:add_offset = 20.f ;
po4:scale_factor = 0.01f ;
po4:_FillValue = -32767s ;
po4:unit_long = "millimoles of Phosphate per cubic meter" ;
float longitude(longitude) ;
longitude:standard_name = "longitude" ;
longitude:long_name = "Longitude" ;
longitude:units = "degrees_east" ;
longitude:axis = "X" ;
longitude:unit_long = "Degrees East" ;
longitude:step = "0.08333f" ;
longitude:_CoordinateAxisType = "Lon" ;
float latitude(latitude) ;
latitude:standard_name = "latitude" ;
latitude:long_name = "Latitude" ;
latitude:units = "degrees_north" ;
latitude:axis = "Y" ;
latitude:unit_long = "Degrees North" ;
latitude:step = "0.08333f" ;
latitude:_CoordinateAxisType = "Lat" ;
float depth(depth) ;
depth:long_name = "Depth" ;
depth:units = "m" ;
depth:axis = "Z" ;
depth:positive = "down" ;
depth:unit_long = "Meters" ;
depth:standard_name = "depth" ;
depth:_CoordinateAxisType = "Height" ;
depth:_CoordinateZisPositive = "down" ;

// global attributes:
:title = "CMEMS IBI REANALYSIS: DAILY BIOGEOCHEMICAL PRODUCTS " ;
: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-puertos2.cesga.es:8080/thredds/dodsC/dataset-ibi-reanalysis-bio-005-003-daily" ;

```
            :time_min = 0. ;
            :time_max = 1. ;
            :julian_day_unit = "Days since 1993-03-01 12:00:00 UTC" ;
            :z_min = 0.505760014057159 ;
            :z_max = 5698.060546875 ;
            :latitude_min = 30. ;
            :latitude_max = 40. ;
            :longitude_min = -10. ;
            :longitude_max = 0.999999225139618 ;
}
```

- For **dataset-ibi-reanalysis-bio-005-003-monthly:** A request of 3 variables (concentration of chlorophyll, nitrate and phosphate) has been performed selecting data for 2 months, the whole water column and the following regional coverage: 10W-1E / 30N-40N.

```
ncdump -h dataset-ibi-reanalysis-bio-005-003-monthly_1518193926479.nc
netcdf dataset-ibi-reanalysis-bio-005-003-monthly_1518193926479 {
dimensions:
      time = 2 ;
      depth = 50 ;
      latitude = 121 ;
      longitude = 133 ;
variables:
      int time(time) ;
            time:_CoordinateAxisType = "Time" ;
            time:axis = "T" ;
            time:calendar = "gregorian" ;
            time:long_name = "time" ;
            time:standard_name = "time" ;
            time:units = "Hours since 1992-01-15" ;
      short chl(time, depth, latitude, longitude) ;
            chl:_CoordinateAxes = "time depth latitude longitude " ;
            chl:standard_name = "mass_concentration_of_chlorophyll_a_in_sea_water" ;
            chl:long_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 = "milligrams of chlorophyll per cubic meter" ;
      short no3(time, depth, latitude, longitude) ;
            no3:_CoordinateAxes = "time depth latitude longitude " ;
            no3:standard_name = "mole_concentration_of_nitrate_in_sea_water" ;
            no3:long_name = "Mole Concentration of Nitrate in Sea Water" ;
            no3:units = "mmol.m-3" ;
            no3:add_offset = 300.f ;
            no3:scale_factor = 0.1f ;
            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:standard_name = "mole_concentration_of_phosphate_in_sea_water" ;
            po4:long_name = "Mole Concentration of Phosphate in Sea Water" ;
            po4:units = "mmol.m-3" ;
            po4:add_offset = 20.f ;
            po4:scale_factor = 0.01f ;
            po4:_FillValue = -32767s ;
            po4:unit_long = "millimoles of Phosphate per cubic meter" ;
      float longitude(longitude) ;
            longitude:standard_name = "longitude" ;
```

longitude:long_name = "Longitude" ;
longitude:units = "degrees_east" ;
longitude:axis = "X" ;
longitude:unit_long = "Degrees East" ;
longitude:step = "0.08333f" ;
longitude:_CoordinateAxisType = "Lon" ;
float latitude(latitude) ;
latitude:standard_name = "latitude" ;
latitude:long_name = "Latitude" ;
latitude:units = "degrees_north" ;
latitude:axis = "Y" ;
latitude:unit_long = "Degrees North" ;
latitude:step = "0.08333f" ;
latitude:_CoordinateAxisType = "Lat" ;
float depth(depth) ;
depth:long_name = "Depth" ;
depth:units = "m" ;
depth:axis = "Z" ;
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 " ;
: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-puertos2.cesga.es:8080/thredds/dodsC/dataset-ibi-reanalysis-bio-005-003-monthly" ;
:time_min = 0. ;
:time_max = 744. ;
:julian_day_unit = "Hours since 1992-01-15" ;
:z_min = 0.505760014057159 ;
:z_max = 5698.060546875 ;
:latitude_min = 30. ;
:latitude_max = 40. ;
:longitude_min = -10. ;
:longitude_max = 0.999999225139618 ;

}

VI REFERENCES

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