INDESO

Product User Manual – biogeochemical model outputs

Reference:	IN-WP6.2-PUM-292
Nomenclature:	-
Issue:	1. 0
Date:	Sep. 4, 15

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Chronology Issues:			
Issue:	Date:	Reason for change:	Author:
0.1	22/04/15	Preliminary version	V. Rosmorduc
0.2	31/08/15	expert revision	S. Guinehut B. tranchant
1.0	04/09/15	Initial version	V. Rosmorduc

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Index Sheet:	
Context:	
Keywords:	[Mots clés]
Hyperlink:	

Distribution:		
Company	Means of distribution	Names
CLS	Notification	CLS Management review team
CLS	Soft copy	CLS INDESO team
Balitbang KP	Soft copy	Balitbang KP INDESO team

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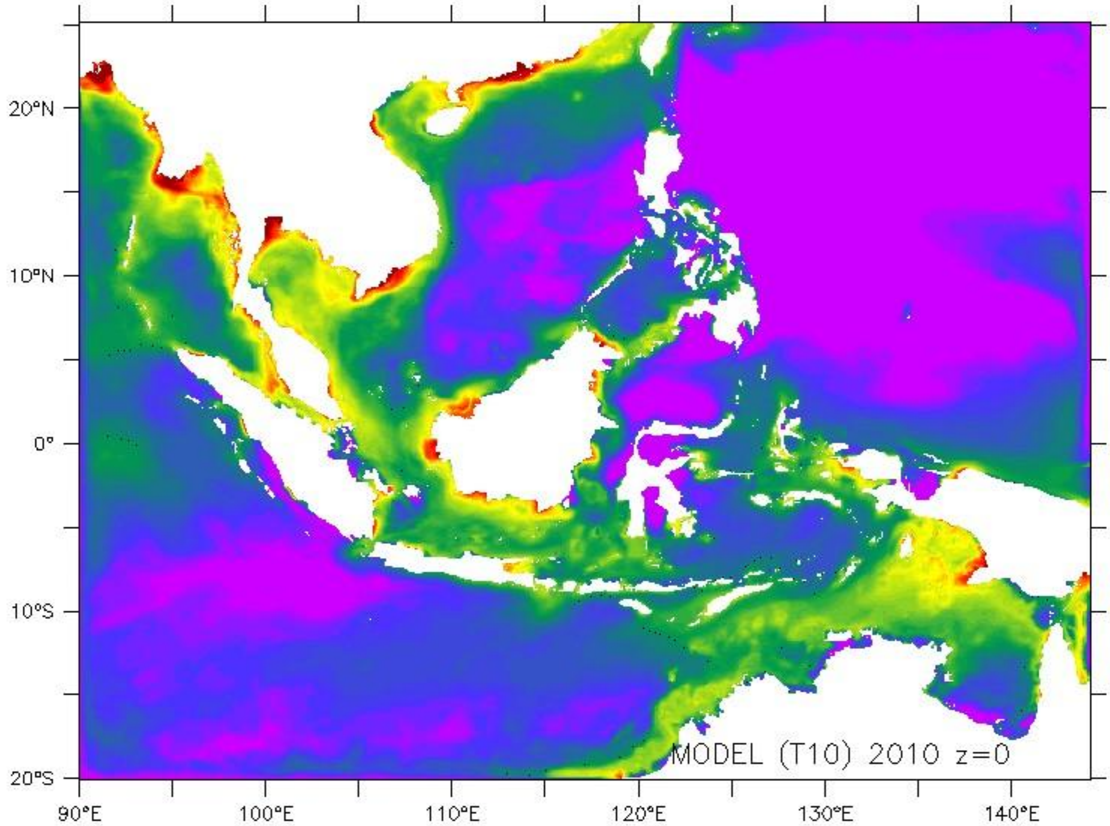
1. PURPOSE

This document presents the information needed by users for the **Biogeochemical Models Outputs** products provided in the frame of the Indeso project.

This document is organized as follows:

- Chapter 2; processing: input data and method applied.
- Chapter 3; the product description, with the different files provided, the nomenclature
- Chapter 4; the file format
- Chapter 5; how to download products.



2. Processing

The ocean biogeochemical model used for the INDESO project is a regionalized version of the PISCES model (Aumont & Bopp, 2006). The PISCES model simulates the marine primary production with explicit phyto- and zoo-plankton components. It describes the biogeochemical cycle of carbon and the main nutrients (nitrate, ammonium, phosphate, silicic acid and iron). The dissolved oxygen content and the alkalinity are explicitly simulated. As the physical and biogeochemical models are coupled in-line, the advection-diffusion of all biogeochemical variables is governed by the ocean velocity and diffusivity fields simulated by the physical ocean model. The biogeochemical model is forced at the lateral open boundaries using climatological estimates of the 24 simulated variables. The regional ocean biogeochemical model provides biogeochemical fields for the past two weeks and forecasts for the next 10 days. The model is activated once a week.

As the regional INDESO biogeochemical ocean model is coupled in-line with the regional INDESO physical ocean model, it has the same characteristics. It is implemented with a horizontal resolution of 1/12° and 50 vertical layers with increased resolution near the surface. The horizontal grid is defined on a curvilinear ORCA but outputs are provided on a regular 1/12° grid.

The regional INDESO biogeochemical ocean model has the following additional characteristics:

- explicit resolution of phyto- and zoo-plankton components,
- explicit resolution of dissolved oxygen and alkalinity,
- explicit resolution of the biogeochemical cycle of carbon and of the main nutrients (nitrate, ammonium, phosphate, silicic acid and iron.

In order to measure the performance of the physical and biogeochemical model outputs (analysis and forecast), weekly metrics are computed just after production. The performance of the model outputs are evaluated by comparison with independent observations or with climatological fields and by comparing, a posteriori, the model analysis and forecasts at different dates. The selection of diagnostics and parameters to be validated are largely constrained by observations availability. Validation metrics are provided as pdf files.

2.1. Input data

2.1.1. Initialization And Open Boundary Conditions

Atmospheric forcing and open boundary conditions concerning temperature, salinity, currents and free surface are taken from the physical model.

For biogeochemistry, initial and open boundary conditions are presented in Table 2.

Variables	Initial Conditions	OBC
NO_3, O_2, PO_4, Si	From WOA January [a]	From WOA monthly [a]
DIC, ALK	GLODAP annual [b]	GLODAP annual [b]
DCHL, NCHL, PHY2, PHY1	From SeaWiFS January [c]	From SeaWiFS monthly [c]
NH_4	Analytical profile [d]	Analytical profile [d]
The others	ORCA2 January	ORCA2 monthly

[a]: From World Ocean Atlas (WOA 2009) monthly climatology, with increased nutrient concentrations along the coasts (necessary adaptation due to crucial lack of data in the studied area).
[b]: Key et al. (2004).
[c]: From SeaWiFS monthly climatology. Phytoplankton is deduced using constant ratios of 1.59 gChl $molN^{-1}$ and 122/16 molC $molN^{-1}$, and exponential decrease with depth.
[d]: Low values offshore and increasing concentrations onshore.

Table 1: Initial and open boundary conditions currently used for the INDO12BIO-V0 configuration. WOA and GLODAP climatologies, also used to confront the model results, are detailed in Section 3.3

2.1.2. External Inputs Of Carbon And Iron

Carbon input (dissolved inorganic and organic carbon, DIC and DOC, respectively) due to river discharges is specified following the monthly climatology from Ludwig & al. (1996) and Ludwig and Probst (1998). Nutrients and alkalinity are deduced from these carbon inputs using constant ratios. Iron flux due to atmospheric deposition (dust) comes from the monthly climatology of Aumont & al. (2003), and iron supply by the continental shelf erosion is also parameterized.

These distinct external inputs are compensated by a loss of organic matter to the sediments (matter definitely lost for the system). This enables to maintain the quantities of chemical elements in the ocean.

2.1.3. Simulated Period

The period of calibration/validation for the model extends from January 3rd, 2007 to December 31, 2010.

2.2. The Physical/Biogeochemical Coupled Model

2.2.1. Physical Model: NEMO

The regionalized version of OPA/NEMO (Madec & al., 1998; Madec, 2008), developed in Mercator-Ocean, is the circulation model used in the INDESO project in its NEMO2.3 version. The regionalization of the code deals with the addition of high-frequency processes such as tide and the atmospheric pressure forcing. For that, specific numerical schemes such as time-splitting, non-linear free surface (Levier & al., 2007) and open boundary algorithms have been implemented or improved. Moreover, specific physical parameterizations for regional modelling have been added such as GLS turbulence model including wave impact, logarithmic bottom friction… This model has already been successfully applied over the IBI area in the framework of the MyOcean project (Maraldi & al., 2013).

The Indonesian archipelago is characterized by strong internal tides, which are trapped in the different semi-enclosed seas of the archipelago, inducing a strong mixing of water masses. A parameterization of this tidal mixing has especially been developed for OPA/NEMO and gives satisfying results on Indonesian seas (Koch-Larrouy & al., 2007, 2010).

2.2.2. BIOGEOCHEMICAL MODEL: PISCES

The biogeochemical model PISCES (Pelagic Interaction Scheme for Carbon and Ecosystem Studies; Aumont and Bopp, 2006; Aumont, 2012) is coupled to OPA hydrodynamic model by the TOP component of the NEMO system, and so it is a natural choice in the framework of the INDESO project. The PISCES 3.2 version is used.

PISCES is a model with intermediary complexity initially developed for the global ocean. It simulates the marine biological productivity and describes the biogeochemical cycles of carbon and the main nutrients. It has been successfully used in various biogeochemical studies (e.g. Bopp & al., 2005; Gehlen & al., 2006, 2007; Steinacher & al., 2010; Tagliabue & al., 2010). The model contains 24 prognostic variables. There are five modelled limiting nutrients for phytoplankton growth (nitrate, ammonium, phosphate, silicate and iron). Nitrate + ammonium and phosphate are linked by a Redfield ratio in PISCES, but the nitrogen pool undergoes nitrogen fixation and denitrification that change the N/P ratio. External sources (rivers, dust deposition) are not linked by a constant ratio either. Four living size-classified compartments are represented: two phytoplanktonic groups (nanophytoplankton and diatoms), and two zooplanktonic groups (microzooplankton and mesozooplankton). For phytoplankton, prognostic variables are the carbon, iron, chlorophyll-*a* and silicon biomasses (the latter only for diatoms). The model prognostically predicts Fe/C, Chl/C and Si/C ratios for each phytoplankton group (the latter only for diatoms). For zooplankton, the model only predicts the total biomass in carbon, assuming constant $C/N/P/O_2$ Redfield ratios set to 122/16/1/-138 in PISCES. There are three non-living compartments: small and big particulate organic matter (sPOM and bPOM) and semi-labile dissolved organic matter (DOM) only expressed in carbon content as the Redfield ratio for C/N/P content is considered to be constant for inert matter in PISCES. On the other hand, the iron, silicon and calcite content of the particulate matter are explicitly modelled, and then their ratios are allowed to vary. In addition to the ecosystem model (Fig. 5), PISCES also includes a compartment of dissolved inorganic carbon (DIC), total alkalinity (ALK) and dissolved oxygen (O_2).

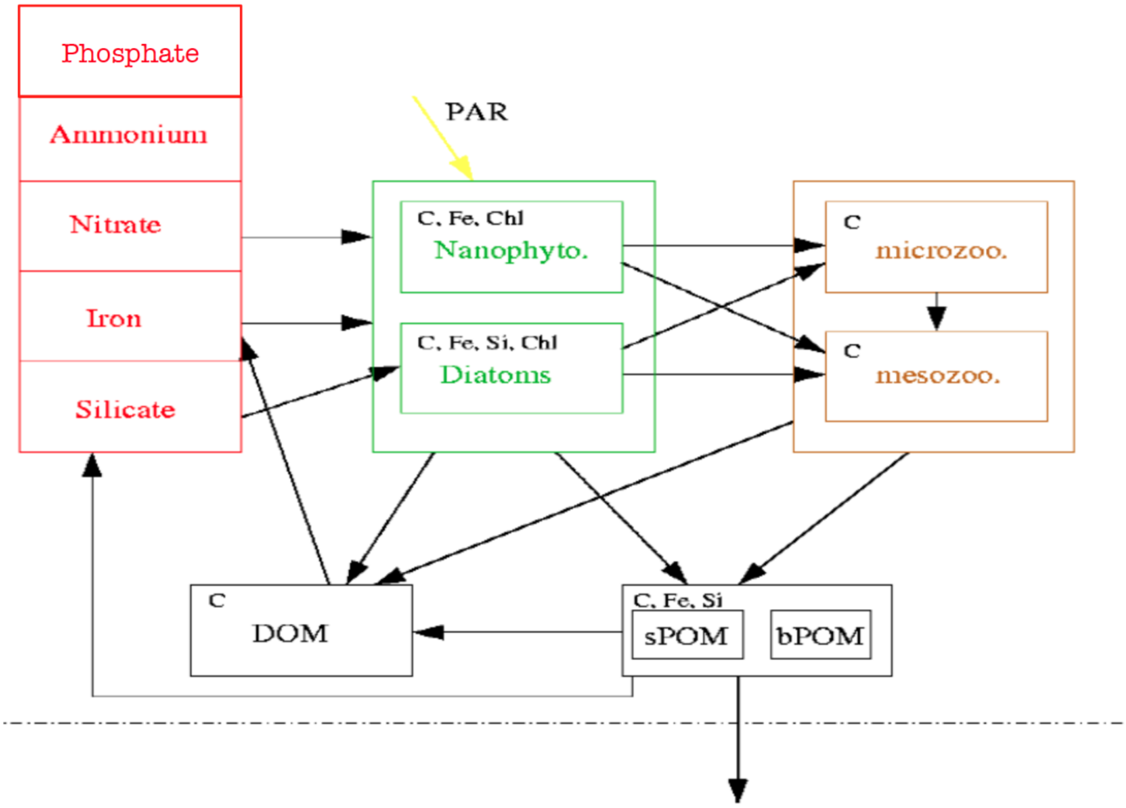


Figure 1: Description of the PISCES ecosystem model, omitting thus oxygen and the carbon system. The elements explicitly modelled are indicated in the left corner of each box

The model contains a hundred parameters. Range values of these biogeochemical parameters can be huge so a consequent sensitivity analysis is required for calibration. In this first version of the configuration, we kept native values of the PISCES 3.2 version.

3. DESCRIPTION OF THE PRODUCT

3.1. PRODUCT GENERAL CONTENT AND SPECIFICATIONS

Each Indeso product includes a series of related datasets. Those datasets are delivered with different names (see nomenclature), conten (see NetCDF contents and PDF contents) and format (below).

Note that the datasets available for a given user depend on the user profile.

Dataset Name	Dataset time coverage	Production frequency	Geographical coverage	Spatial Resolution	File format
Biogeochemical model daily historical & real-time analysis&forecast	from start to (T0+10 days)	weekly	20S-25N/90E-144E	1/12° regular grid	netCDF CF
Biogeochemical model daily historical analysis	from start to (T0 - 30 days)	weekly	20S-25N/90E-144E	1/12° regular grid	netCDF CF
Biogeochemical model moorings hourly historical & real time analysis	from start to (T0+10 days)	weekly	NA	NA	Netcdf CF
Critical & weekly biogeochemical model historical & real-time metrics	from start to (T0+10 days)	weekly	NA	NA	pdf
Critical & weekly biogeochemical model historical metrics	from start to (T0 - 30 days)	weekly	NA	NA	pdf
Long term biogeochemical model metrics	on demand	on demand	NA	NA	pdf

Table 2: list of biogeochemical model output datasets

3.2. NOMENCLATURE OF FILES

Files downloaded using Indeso downloading services are named using a unique identifier (13 digits, corresponding to the current time (downloading time) in milliseconds since January 1, 1970 midnight UTC.) at the end of the file name. The metrics pdf are compressed within a zip file (nomenclature of both the zip file and the pdf within are listed here).

Biogeochemical model daily historical analysis
INDESO_BIO_1dAV_%nnnnnnnnnnnnn.nc

Biogeochemical model daily historical&real time analysis&forecast
INDESO_BIO_1dAV-RT_%nnnnnnnnnnnnn.nc

Biogeochemical model moorings hourly historical&real time analysis&forecast
INDESO_MOORING_%NAME-RT_%nnnnnnnnnnnnn.zip

INDESO_MOORING_%NAME_%Y%m%d(fied_MIN)_%Y%m%d(field_MAX)_%Y%m%d(prod).nc

Critical&Weekly biogeochemical model historical metrics
INDESO_BIO_CWMetrics_%nnnnnnnnnnnnn.zip

INDESO_BIO_CWMetrics_%Y%m%d(prod).pdf

Critical&Weekly biogeochemical model historical&real time metrics

INDESO_BIO_CWMetrics-RT_%nnnnnnnnnnnnn.zip

INDESO_BIO_CWMetrics_%Y%m%d(prod).pdf

Long term biogeochemical model metrics

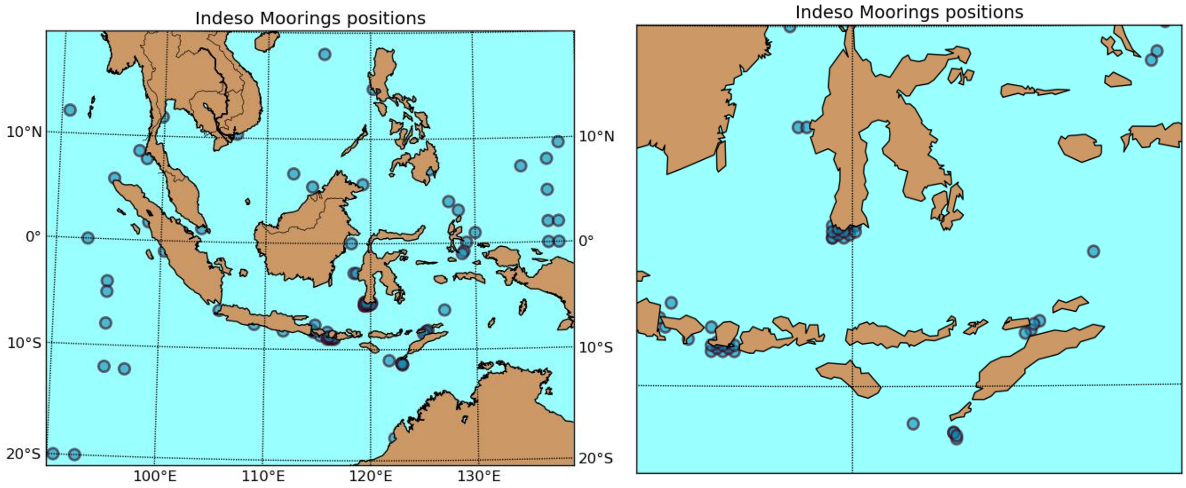
INDESO_BIO_LTMetrics_%nnnnnnnnnnnn.zip

INDESO_BIO_LTMetrics_%Y%m%d(Min)_%Y%m%d(Max)_%Y%m%d(prod).pdf

Where:

%nnnnnnnnnnnn is the identifier inserted by the downloading service

%NAME is the name of the mooring,



Mooring positions (zoom left)

among the following:

Name	Latitude	Longitude
Brunei	5.40862	114.417
CLASS2_MOO_IND_Benoa_Tide	-8.71619	115.25
CLASS2_MOO_IND_Cilacap_Tide	-7.72648	109
CLASS2_MOO_IND_Cocos_Tide	-12.1577	96.9167
CLASS2_MOO_IND_CUR_99098	-2.83218	118.417
CLASS2_MOO_IND_CUR_99144	-19.9978	90.5833
CLASS2_MOO_IND_CUR_99145	-19.9978	92.5833
CLASS2_MOO_IND_CUR_99146	-8.46899	125.167
CLASS2_MOO_IND_CUR_99147	-11.2601	122.917
CLASS2_MOO_IND_CUR_99148	-11.4236	123
CLASS2_MOO_IND_CUR_99149	-11.0149	121.75
CLASS2_MOO_IND_CUR_99150	-11.2601	122.917
CLASS2_MOO_IND_CUR_99196	3.99675	127.5
CLASS2_MOO_IND_CUR_99197	3.16506	128.417
CLASS2_MOO_IND_IOOOS_OceanSITES1	0	93
CLASS2_MOO_IND_Ko_Lak_Tide	11.8317	99.8333
CLASS2_MOO_IND_Ko_Taphao_Tide	7.80904	98.4167
CLASS2_MOO_IND_NIOT14_OceanSITES	12.1577	90.75
CLASS2_MOO_IND_Padang_Tide	-0.999949	100.333
CLASS2_MOO_IND_PRIGI_Tide	-8.30411	111.75
CLASS2_MOO_IND_Sabang_Tide	5.82328	95.3333
CLASS2_MOO_IND_Sibolga_Tide	1.74973	98.75
CLASS2_MOO_IND_Tanjong_Tide	1.2499	103.833

CLASS2_MOO_IND_TANJUNG_Tide	-6.4861	105.667
CLASS2_MOO_IND_TAOlike_futur_90E_4S	-3.99675	95
CLASS2_MOO_IND_TAOlike_futur_95E_12S	-11.9947	95
CLASS2_MOO_IND_TAOlike_futur_95E_8S	-7.97413	95
CLASS2_MOO_IND_TRITON_West_Sumatra_OceanSITES	-4.99367	95
CLASS2_MOO_IND_VUNG_TAU_Tide	10.3598	107.083
CLASS2_MOO_KOMIANG_Tide	8.55141	97.6667
CLASS2_MOO_PAC_Booby_Tide	-10.6056	141.917
CLASS2_MOO_PAC_Broome_Tide	-18.0283	122.25
CLASS2_MOO_PAC_Davao_Tide	7.06536	125.667
CLASS2_MOO_PAC_Malakal_Tide	7.31339	134.5
CLASS2_MOO_PAC_SouthChinaSea_OceanSITES	18.0283	115.5
CLASS2_MOO_PAC_Subic_Tide	14.751	120.25
CLASS2_MOO_PAC_Warm_Pool_137E_0N_TAO	0	137
CLASS2_MOO_PAC_Warm_Pool_137E_2N_TAO	1.99959	137
CLASS2_MOO_PAC_Warm_Pool_137E_5N_TAO	4.99367	137
CLASS2_MOO_PAC_Warm_Pool_137E_8N_TAO	7.97413	137
CLASS2_MOO_PAC_Warm_Pool_138E_2N_TAO	1.99959	138
CLASS2_MOO_PAC_Warm_Pool_138E_TAO	0	138
CLASS2_MOO_PAC_Yap_Tide	9.53896	138.167
Donggala	0	118.167
INDOMIX_S0	0.999949	130
INDOMIX_S1	0.0833333	129.167
INDOMIX_S2	-0.749979	128.917
INDOMIX_S3	-0.999949	128.75
INDOMIX_S4	-6.32048	127
INDOMIX_S5a	-8.22164	125.417
INDOMIX_S5b	-8.30411	125.25
Lombok	-8.38656	115.917
Makassar	-2.83218	118.667
Mangrove_Perancak	-8.38656	114.583
Mangrove_west_Bali	-8.13915	114.417
North	-7.72648	114.75
Ombai	-8.55141	125
Seaweed_Lombok_10	-8.79855	116.417
Seaweed_Lombok_1	-9.04552	115.917
Seaweed_Lombok_2	-9.04552	116.25
Seaweed_Lombok_3	-9.04552	116.583
Seaweed_Lombok_4	-8.96322	116.083
Seaweed_Lombok_5	-8.96322	116.417
Seaweed_Lombok_6	-8.88089	115.917
Seaweed_Lombok_7	-8.88089	116.25
Seaweed_Lombok_8	-8.88089	116.583
Seaweed_Lombok_9	-8.79855	116.083
Seaweed_Sulawesi_Jenponto_10	-5.65745	119.917
Seaweed_Sulawesi_Jenponto_11	-5.57452	119.417
Seaweed_Sulawesi_Jenponto_1	-5.90618	119.417
Seaweed_Sulawesi_Jenponto_12	-5.57452	119.75
Seaweed_Sulawesi_Jenponto_13	-5.57452	120.083
Seaweed_Sulawesi_Jenponto_14	-5.49157	119.583
Seaweed_Sulawesi_Jenponto_15	-5.49157	119.917
Seaweed_Sulawesi_Jenponto_2	-5.90618	119.75
Seaweed_Sulawesi_Jenponto_3	-5.90618	119.417

Seaweed_Sulawesi_Jenponto_4	-5.82328	119.583
Seaweed_Sulawesi_Jenponto_5	-5.82328	119.917
Seaweed_Sulawesi_Jenponto_6	-5.74037	119.417
Seaweed_Sulawesi_Jenponto_7	-5.74037	119.75
Seaweed_Sulawesi_Jenponto_8	-5.74037	120.083
Seaweed_Sulawesi_Jenponto_9	-5.65745	119.583
Shrimp_Grezik	6.65167	112.583
Shrimp_Takalar	5.65745	119.25
Timor	-11.3419	123
Brunei	5.40862	114.417
CLASS2_MOO_IND_Benoa_Tide	-8.71619	115.25
CLASS2_MOO_IND_Cilacap_Tide	-7.72648	109
CLASS2_MOO_IND_Cocos_Tide	-12.1577	96.9167

and

Date	Macro used	# digits	Ex: Date 2001/03/20 9H15M20S
Year	%Y	4	2001
Year	%y	2	01
Month	%m	2	03
Day in month	%d	2	20
Day of the year	%j	3	079
Hour	%H	2	09
Minute	%M	2	15
Second	%S	2	20

3.3. ACKNOWLEDGMENTS

Original INDESO Products - or Value Added Products or Derivative Works developed from INDESO Products including pictures - shall include the following credit conspicuously displayed and written in full:

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4. DATA FORMAT

4.1. NETCDF

The products are stored using the NetCDF CF format. NetCDF (network Common Data Form) is an interface for array-oriented data access and a library that provides an implementation of the inter-face. 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 retreive NetCDF software package on: http://www.unidata.ucar.edu/packages/netcdf/ .

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.

4.2. STRUCTURE AND SEMANTIC OF NETCDF FILES

Variable name	Description	Standard_name	Dimensions	Units
Daily biological model prognostic and diagnostic variables **INDESO_BIO_1dAV-RT_%nnnnnnnnnnnn.nc** or **INDESO_BIO_1dAV_%nnnnnnnnnnnn.nc**				
Netcdf-CF Grid Dimensions: lon=649, lat=541, time=1, depth=50				
lon	longitude	longitude	(lon)	degrees_east
lat	latitude	latitude	(lat)	degrees_north
time	time	time	(time)	seconds since YYY-MM-DD 00:00:00
depth	depth	depth	(depth)	m
ZOO	Microzooplankton	mole_concentration_of_microzooplankton_expressed_as_carbon_in_sea_water	(time,depth,lat,lon)	mmol C m-3
Si	Silicate	mole_concentration_of_silicate_in_sea_water	(time,depth,lat,lon)	mmol Si m-3
DCHL	Chlorophyll of the diatoms	mass_concentration_of_diatoms_expressed_as_chlorophyll_in_sea_water	(time,depth,lat,lon)	mg Chl m-3
PHY2	Phytoplankton of the diatoms	mole_concentration_of_diatoms_expressed_as_carbon_in_sea_water	(time,depth,lat,lon)	mmol C m-3
NH4	Ammonium	mole_concentration_of_ammonium_in_sea_water	(time,depth,lat,lon)	mmol N m-3 (b)
PO4	Phosphate	mole_concentration_of_phosphate_in_sea_water	(time,depth,lat,lon)	mmol P m-3 (a)
DOC	Dissolved Organic	mole_concentration_of_dissolved_organic_carbon_in_sea_water	(time,depth,lat,lon)	mmol C m-3

	Carbon			
O2	Dissolved oxygen	mole_concentration_of_dissolved_molecular_oxygen_in_sea_water	(time,depth,lat,lon)	ml O2 l-1
NPP	Primary production due to the diatoms + Primary production due to the nanophytoplankton (PPD + PPN)	net_primary_production	(time,lat,lon)	mmol C m-2 day-1
ALK	Alkalinity	sea_water_alkalinity_expressed_as_mole_equivalent	(time,depth,lat,lon)	µeq kg-1
PHY	Phytoplank-ton of the flagellates	mole_concentration_of_flagellates_expressed_as_carbon_in_sea_water	(time,depth,lat,lon)	mmol C m-3
Fer	Dissolved Iron	mole_concentration_of_dissolved_iron_in_sea_water	(time,depth,lat,lon)	µmol Fe m-3
PPN	Primary production due to the nanophytoplankton	primary_production_nanophytoplankton	(time,latl,lon)	mmol C m-2 day-1
NO3	Nitrate	mole_concentration_of_nitrate_in_sea_water	(time,depth,lat,lon)	mmol N m-3 (b)
Heup	Euphotic depth	euphotic_layer_depth	(time,lat,lon)	m
ZOO2	Mesozooplankton	mole_concentration_of_mesozooplankton_expressed_as_carbon_in_sea_water	(time,depth,lat,lon)	mmol C m-3
NCHL	Chlorophyll of the nanophytoplankton	mass_concentration_of_flagellates_expressed_as_chlorophyll_in_sea_water	(time,depth,lat,lon)	mg Chl m-3
DIC	Dissolved Inorganic Carbon	mole_concentration_of_dissolved_inorganic_carbon_in_sea_water	(time,depth,lat,lon)	mmol C m-3
PPD	Primary production due to the diatoms	primary_production_diatoms	(time,lat,lon)	mmol C m-2 day-1
pH	pH	sea_water_ph_reported_on_total_scale	(time,depth,lat,lon)	

Variable name	Description	Standard_name	Dimensions	Units
Hourly physical&biogeochemical model moorings				
INDESO_MOORING_%NAME_%Y%m%d(fied_MIN)_%Y%m%d(field_MAX)_%Y%m%d(prod).nc				
Netcdf-CF station				

Dimensions: lon=1, lat=1, time, depth=50				
lon	longitude	longitude	(lon)	degrees_east
lat	latitude	latitude	(lat)	degrees_north
depth	depth	depth	(depth)	m
depthw	depthw	depthw	(depthw)	m
time	time	time	(time)	seconds since YYY-MM-DD 00:00:00
temperature	Temperature	sea_water_potential_temperature	(time,depth,lat,lon)	°C
salinity	Salinity	sea_water_salinity	(time,depth,lat,lon)	psu
U	Eastward velocity	eastward_sea_water_velocity	(time,depth,lat,lon)	m/s
V	Northward velocity	northward_sea_water_velocity	(time,depth,lat,lon)	m/s
vovecrtz	Vertical Velocity	upward_sea_water_velocity	(time,depthw,lat,lon)	m s-1
votkeavt	Vertical Eddy Diffusivity	ocean_vertical_eddy_diffusivity	(time,depthw,lat,lon)	m2 s-1
votkeavm	Vertical Eddy Viscosity	ocean_vertical_eddy_viscosity	(time,depthw,lat,lon)	m2 s-1
votkemxl	Vertical Mixing Length	ocean_vertical_mixing_length	(time,depthw,lat,lon)	m
votketke	Turbulent kinetic energy	ocean_turbulent_kinetic_energy	(time,depthw,lat,lon)	m2 s-2
SSH	Sea surface height	sea_surface_height_above_geoid	(time,lat,lon)	m
somslpre	Atmospheric al pressure	air_pressure_at_sea_level	(time,lat,lon)	Pa
sozotaux	Zonal wind stress over ocean	sea_water_downward_x_stress	(time,lat,lon)	Pa
sometauy	Meridional wind stress over ocean	sea_water_downward_y_stress	(time,lat,lon)	Pa
MLP	MLD defined by sigma theta	ocean_mixed_layer_thickness_defined_by_sigma_theta	(time,lat,lon)	m
MLT	MLD defined by temperature	ocean_mixed_layer_thickness_defined_by_temperature	(time,lat,lon)	m
QNET	Net Downward Heat	net_downward_heat_flux	(time,lat,lon)	W m-2

	Flux			
QSR	Net solar flux at the ocean surface (under ice if ice)	net_downward_shortwave_flux	(time,lat,lon)	W m-2
EMP	Net fresh water flux into ocean	water_flux_into_ocean	(time,lat,lon)	kg m-2 s-1
QLWO	Infra-red Heat Flux over Ocean	surface_net_downward_longwave_flux	(time,lat,lon)	W m-2
QSBO	Sensible Heat Flux over Ocean	surface_downward_sensible_heat_flux	(time,lat,lon)	W m-2
QLAO	Latent Heat Flux over Ocean	surface_downward_latent_heat_flux	(time,lat,lon)	W m-2
sohumrel	Relative humidity at 2m	relative_humidity_at_2m	(time,lat,lon)	1e-2
sotemair	Air temperature at 2m	air_temperature_at_2m	(time,lat,lon)	°C
sowinmod	Wind speed at 10m	wind_speed_at_10m	(time,lat,lon)	m s-1
sowaprec	Surface rainfall flux	surface_rainfall_flux	(time,lat,lon)	kg m-2 s-1
soclotot	Cloud cover	cloud_cover	(time,lat,lon)	1e-2

There are 50 vertical levels (in m) :

0.494025, 1.541375, 2.645669, 3.819495, 5.078224, 6.440614, 7.92956, 9.572997, 11.405, 13.46714, 15.81007, 18.49556, 21.59882, 25.21141, 29.44473, 34.43415, 40.34405, 47.37369, 55.76429, 65.80727, 77.85385, 92.32607, 109.7293, 130.666, 155.8507, 186.1256, 222.4752, 266.0403, 318.1274, 380.213, 453.9377, 541.0889, 643.5668, 763.3331, 902.3393, 1062.44, 1245.291, 1452.251, 1684.284, 1941.893, 2225.078, 2533.336, 2865.703, 3220.82, 3597.032, 3992.484, 4405.224, 4833.291, 5274.784, 5727.917

4.3. STRUCTURE OFPDF FILES

The metrics files are automated pdf reports

Typical contents of those reports is:

1. Compliance table for the number of valid points in the grid
2. Compliance table for the biogeochemical model field
3. Biogeochemical model subsurface Dissolved Oxygen departure to the climatology
4. Biogeochemical model subsurface Nitrates departure to the climatology
5. Error spatial patterns of Biogeochemical model surface Chla
6. Model Chla versus observed Chla

7. Error spatial patterns of Biogeochemical model surface NPP
8. Model NPP versus observed NPP

5. How to download a product

5.1. Registration

To access data, registration is required. During registration process, the user shall accept using licenses for the use of INDESO products and services.

License shall include:

- Data use conditions,
- Legal and contractual clauses

5.2. Access Services

Different services enable registered users to access the data. Depending on the dataset, not all of them are relevant.

Dataset Name	File format	Discover	View	Get
Biogeochemical model daily historical & real-time analysis	netCDF CF	Yes	Yes	Yes
Biogeochemical model daily historical analysis	netCDF CF	Yes	Yes	Yes
Biogeochemical model moorings hourly historical&real time analysis&forecast	netCDF CF	Yes	No	Yes
Critical & weekly biogeochemical model historical & real-time metrics	pdf	Yes	No	Yes
Critical & weekly biogeochemical model historical metrics	pdf	Yes	No	Yes
Long term biogeochemical model metrics	pdf	Yes	No	Yes

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