INDESO

Product User Manual – physical model outputs

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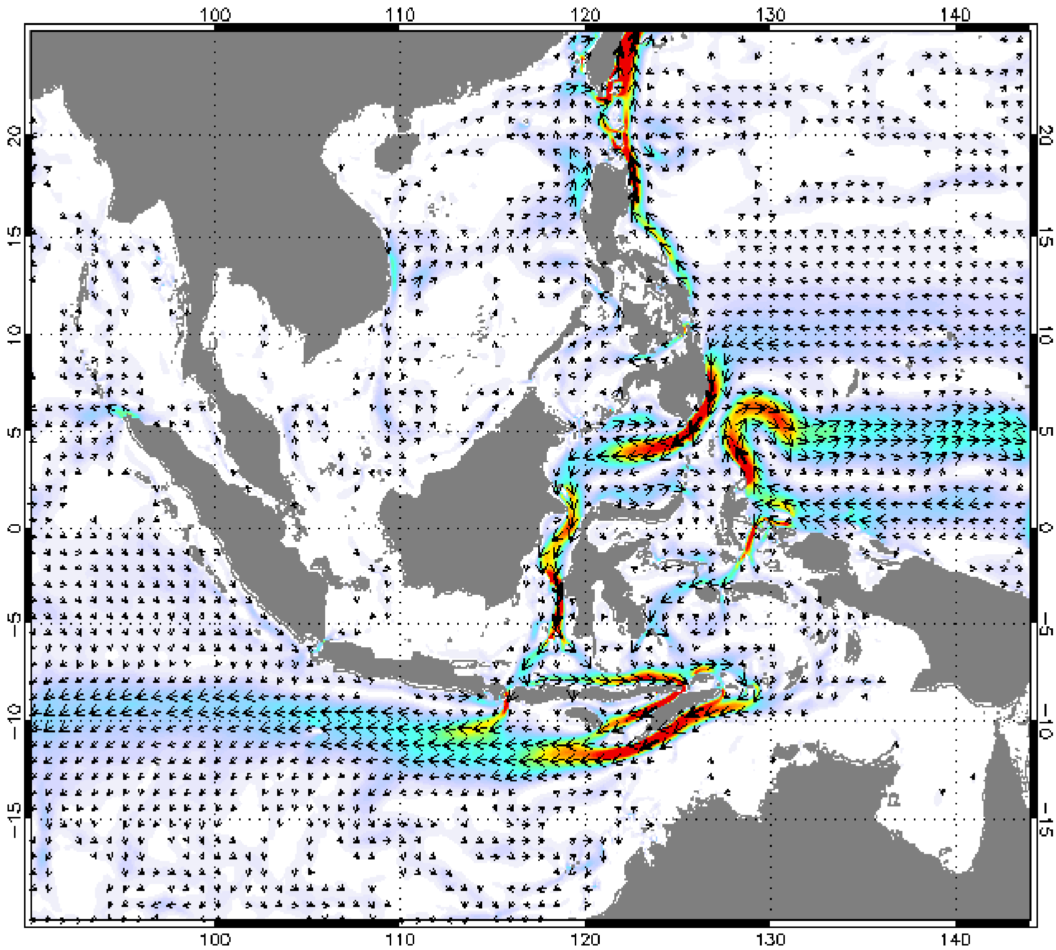
List of Contents

1. PURPOSE

This document presents the information needed by users for the **Physical 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.
- Chapter 6; bibliographical references



2. PROCESSING

2.1. INTRODUCTION

The Operational INDESO physical Ocean forecast system, at 1/12° horizontal resolution, provides 10 days of 3D ocean forecast and is updated weekly. This product includes daily mean fields of atmospheric fluxes, physical parameters (temperature, salinity, currents, sea level…), hourly surface variables (SST, SSH, currents), as well as hourly values of all fields at selected mooring sites and validation metrics.

The ocean physical model named INDO12 used for the INDESO project is a regional configuration of the NEMO-OPA primitive equation OGCM (Madec et al., 1998; Madec, 2008). This model is forced at the surface using 3-hourly ECWMF atmospheric analysis and forecast fields and at the lateral open boundaries using Mercator Océan global operational analysis and forecast fields. This regional ocean physical model provides physical fields for the past two weeks (forced by a global 2-weeks analysis) and ocean forecasts (forced by a global 10-day forecast) for the next 10 days.

The regional INDESO physical ocean model 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 grid but outputs are provided on a regular 1/12° grid.

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

- partial step representation of the bathymetry,
- explicit resolution of the tides,
- non-linear free surface to allow a good representation of tidal waves in coastal regions where their amplitude is large compared to the local depth (Levier et al., 2007),
- parameterization of internal tidal mixing as developed by Kock-Larrouy et al. (2007) for the Indonesian sea

Validation metrics are provided as pdf files.

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2.2. INPUT DATA

2.2.1. INITIAL DATE AND INITIALIZATION

The simulation starts from January 3rd, 2007 with conditions given by the Global Ocean Forecasting System[1] at ¼°. These conditions include temperature, salinity, currents (T, S, U, V) and SSH (Sea Surface Height).

Open boundary conditions (OBCs) are located on a relaxation band of 10 grid points (~ 1 °) and come from daily output of the Global Ocean Forecasting System at ¼°.

In the INDESO simulation (ocean physic), the year 2007 can be considered as a spin-up, thus it will not be considered.

2.2.2. ATMOSPHERIC FORCING FIELDS

Atmospheric forcing fields come from the European center (ECMWF) and have a high frequency (3 hours). "Bulk" formulae from CORE are used to model the atmosphere-ocean interface, see Large and Yeager, 2004.

2.2.3. EXPLICIT TIDE

This configuration includes explicit tide. Harmonics used to force open boundaries and the entire domain via the astronomical potential are from TPX0.7 (Egbert and Erofeeva, 2002).

[1] On January 3, 2007, a three month simulation (spin-up) with this global ocean forecasting system has been realized starting from a Levitus climatology.

2.2.4. INTERNAL TIDE

The turbulent mixing induced by the internal tide is modeled using the parametrization Larrouy-Koch et al. (2007).

2.2.5. THE FRESH WATER FLUX: RUNOFF

A monthly runoff climatology is built with data on coastal runoffs and 99 major rivers from Dai and Trenberth (2002) and prescribed with a flux formulation into the model. The monthly climatology is shown on **Erreur ! Source du renvoi introuvable.** where the signal of two monsoons (SE and NW) appears.

In addition, the Mahakam River and Kapuas located in the Borneo island were added because they were missing from this database whereas their rates is large enough (Class 3). Moreover, the Mahakam River is ranked in the 50 largest in the world, personal communication with Maximiliano Massi.

2.2.6. CONFIGURATION

Characteristics	INDO12
Domain	Indonesian seas : 20°S-25°N/90°E-144°E
Resolution/grid	ORCA grid at 1/12° : 652x559x50
NEMO version	NEMO2.3
Bathymetry	ETOPO2V2g (2') /GEBCO (1') and hand made changes
Time step (baroclinic/barotropic) : Time Splitting	450s (baroclinic)/9s(barotropic)

2.2.6.1. PHYSICAL PARAMETERIZATIONS

Characteristics	INDESO12
Free surface	Explicit time-splitting
Bottom friction	Non linear
Lateral friction	Partial slip ; shlat=2
Vertical mixing	k-ε formulation + mixing parameterization induced by waves
Mixing due to internal tide	Koch-Larrouy parameterization
Light penetration (surface solar radiation)	Separation in three light bands: red, green, blue depending of the chlorophyl concentration -SEAWIFS (monthly climatology)
Tracer diffusion	No (only the numerical diffusion related to advection scheme is considered)
Dynamic diffusion	Bi-Laplacian

Horizontal eddy diffusivity for tracers Horizontal eddy viscosity for the dynamics	Aht0=0 $m^2.s^{-1}$ Ahm0=-1.25 10^1 $m^2.s^{-1}$
Vertical eddy diffusivity for tracers Vertical eddy viscosity for the dynamic	Avt0=5.0 10^{-6} $m^2.s^{-1}$ Avm0=5.0 10^{-6} $m^2.s^{-1}$

2.2.6.2. BOUNDARY/FLUX

Characteristics	INDO12
Open Boundary	1-way PSY3V3R3 (U, V, T, S, η) and TPXO (11 tidal components)
Atmospheric fluxes	-ECMWF fluxes (3h) + pressure -temporal interpolation of instantaneous variables - Bulk CORE formulation (Large & Yeager, 2004)
Runoff	Dai & Trendberth 2002 + Mahakam and Kapuas rivers

2.3. METHOD

2.3.1. THE NEMO OCEAN MODEL

The ocean circulation model (INDO12) used in the INDESO project is based on the NEMO2.3 version and has been developed at Mercator-Ocean. 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, see (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). It has to be obviously considered in this study.

2.3.2. GRID

2.3.2.1. HORIZONTAL GRID

The domain is between 20°S-25°N and 90°E-144°E (Figure 3) and covers the entire EEZ (Exclusive Economic Zone) of Indonesia. The horizontal grid is an extraction of the global ORCA grid at 1/12° developed at Mercator Ocean. It is a quasi-regular grid on the Indonesian area and is approximately equal to 9 km, see Figure 1.

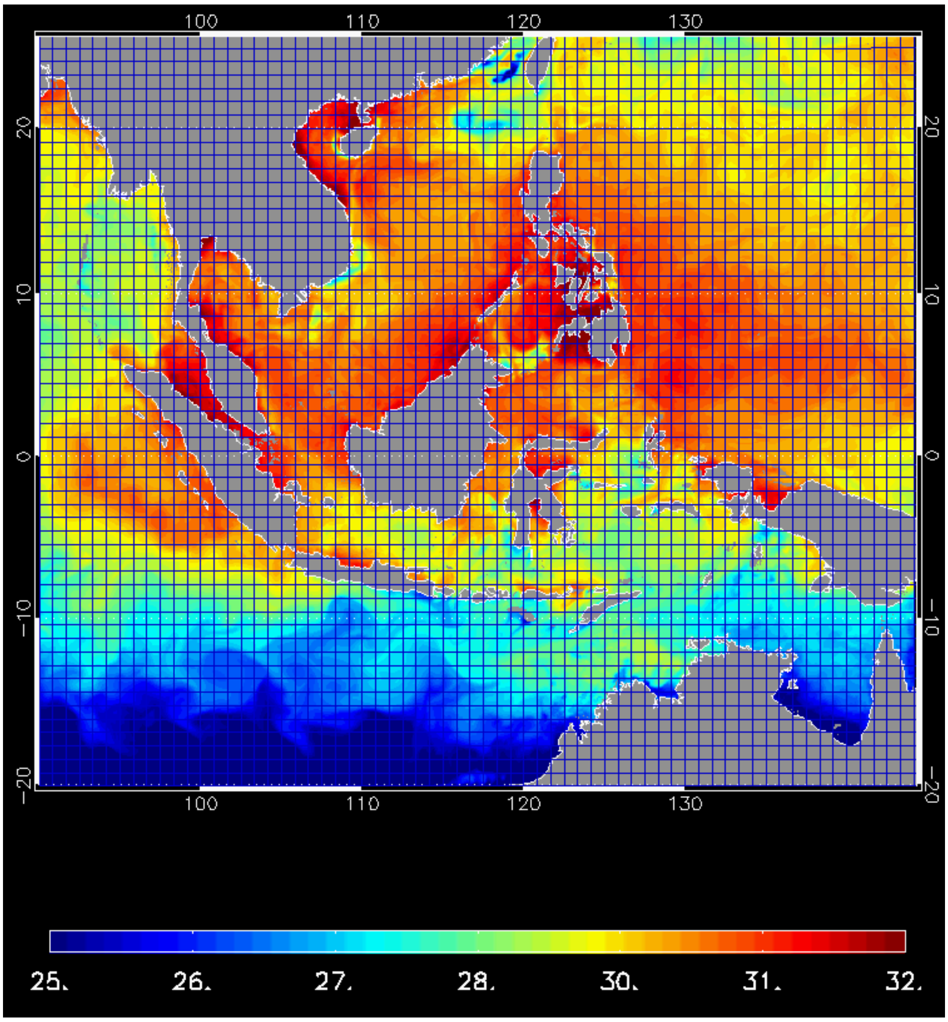


Figure 1 : SST (6 June 2010) and the horizontal grid (1 point over 10)

2.3.2.2. VERTICAL GRID

In the vertical direction, the model uses a partial step z-coordinate, see (Barnier et al., 2006). The vertical grid is spread over 50 levels and a depth-dependent resolution (1 m at surface to 450 m at the bottom), see Figure 2. In the first 10 meters, the layer thickness is less than 2 meters, then raise to about 10 to 50 meters deep.

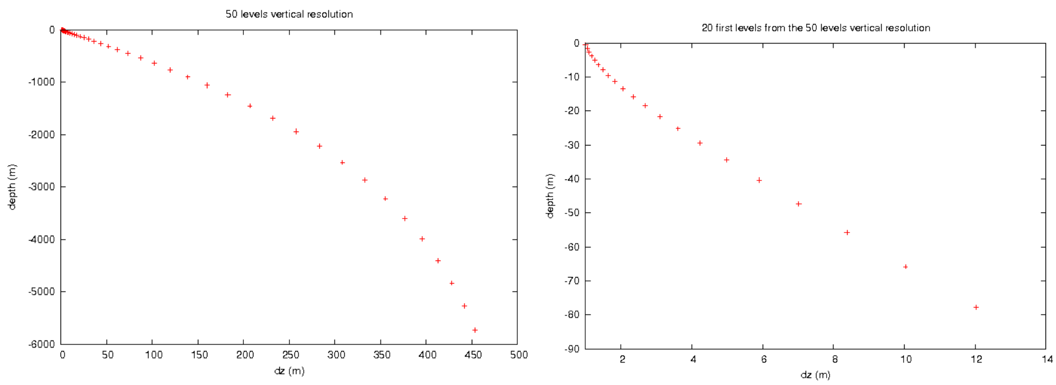


Figure 2: Vertical grid: layer thickness (m) are on the horizontal axis and depths (m) are on the vertical axis: 50 levels (left) and (right) a zoom on the first 20 levels (0 to 80 m)

2.3.3. BATHYMETRY

The bathymetry used in this configuration is based on ETOPO2V2g (2 ') and GEBCO (1') and has been locally modified by a hand editing mainly in the straits and on the sill depths of major interest. It has not been smoothed and has a threshold value of 7m.

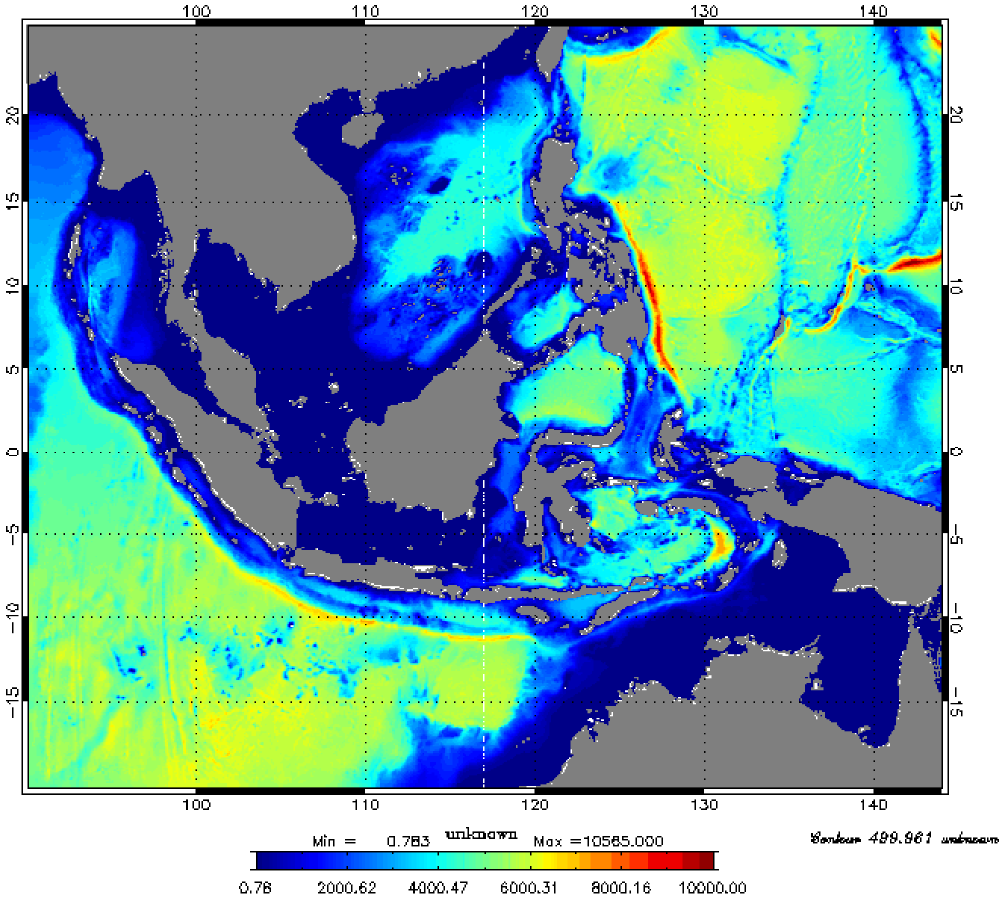


Figure 3: Bathymetry (meter) of the INDESO configuration (Latitudes: 20°S-25°N and longitudes: 90°E-145°E). (ETOPOV2g/GEBCO1 + in-house adjustments in straits of major interest)

3. DESCRIPTION OF THE PRODUCT SPECIFICATION

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), contents (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
Physical model hourly historical & real-time analysis & forecast	from start to (T0+10 days)	weekly	20S-25N/90E-144E	1/12° regular grid	NetCDF CF
Physical model daily historical & real-time analysis & forecast	from start to (T0+10 days)	weekly	20S-25N/90E-144E	1/12° regular grid	NetCDF CF
Physical model daily historical analysis	from start to (T0 - 30 days)	weekly	20S-25N/90E-144E	1/12° regular grid	NetCDF CF
Physical model daily atmos flux historical & real time analysis & forecast	from start to (T0+10 days)	weekly	20S-25N/90E-144E	1/12° regular grid	NetCDF CF
Physical model daily atmos flux historical analysis	from start to (T0 - 30 days)	weekly	20S-25N/90E-144E	1/12° regular grid	NetCDF CF
Physical model moorings hourly historical & real time analysis & forecast	from start to (T0+10 days)	weekly	NA	NA	Netcdf CF
Critical & weekly physical model historical & real-time metrics	from start to (T0+10 days)	weekly	NA	NA	Pdf
Long term physical model metrics	on demand	on demand	NA	NA	Pdf

Table 1: list of physical 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).

Physical model hourly historical&real time analysis&forecast
INDESO_PHYS_1hAV-RT_%nnnnnnnnnnnnn.nc

Physical model daily historical&real time analysis&forecast
INDESO_PHYS_1dAV-RT_%nnnnnnnnnnnnn.nc

Physical model daily historical analysis
INDESO_PHYS_1dAV_%nnnnnnnnnnnnn.nc

Physical model daily atmospheric flux historical&real time analysis&forecast
INDESO_FLUX_1dAV-RT_%nnnnnnnnnnnn.nc

Physical model daily atmospheric flux historical analysis
INDESO_FLUX_1dAV_%nnnnnnnnnnnn.nc

Physical model moorings hourly historical&real time analysis&forecast
INDESO_MOORING_%NAME-RT_%nnnnnnnnnnnn.zip
INDESO_MOORING_%NAME_%Y%m%d(fied_MIN)_%Y%m%d(field_MAX)_%Y%m%d(prod).nc

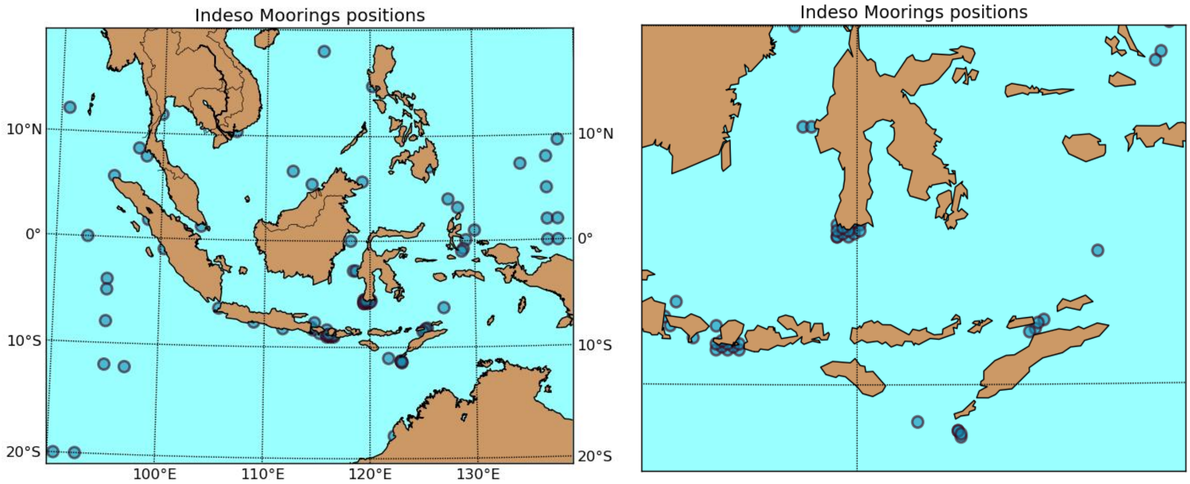
Critical&Weekly physical model historical&real time metrics
INDESO_PHYS_CWMetrics-RT_%nnnnnnnnnnnn.zip
INDESO_PHYS_CWMetrics_%Y%m%d(prod).pdf

Long term physical model metrics
INDESO_PHYS_LTMetrics_%nnnnnnnnnnnn.zip
INDESO_PHYS_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 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 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
Hourly physical model prognostic variables INDESO_PHYS_1hAV-RT_%nnnnnnnnnnnn.nc				
Netcdf-CF Grid Dimensions: lon=649, lat=541, time=24				
lon	longitude	longitude	(lon)	degrees_east
lat	latitude	latitude	(lat)	degrees_north
time	time	time	(time)	seconds since YYY-MM-DD 00:00:00
SSH	Sea surface height	sea_surface_height_above_geoid	(time,lat,lon)	m
VBAR	Meridional barotropic velocity	barotropic_northward_sea_water_velocity	(time,lat,lon)	m/s
UBAR	Zonal barotropic velocity	barotropic_eastward_sea_water_velocity	(time,lat,lon)	m/s
USUR	Surface zonal baroclinic velocity	baroclinic_eastward_sea_water_velocity	(time,lat,lon)	m/s
VSUR	Surface meridional baroclinic velocity	baroclinic_northward_sea_water_velocity	(time,lat,lon)	m/s
SST	Sea surface temperature	sea_water_potential_temperature	(time,lat,lon)	°C

Variable name	Description	Standard_name	Dimensions	Units
Daily physical model prognostic and diagnostic variables INDESO_PHYS_1dAV-RT_%nnnnnnnnnnnn.nc.nc or INDESO_PHYS_1dAV_%nnnnnnnnnnnn.nc.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
U	Eastward velocity	eastward_sea_water_velocity	(time,depth,lat,lon)	m/s
SSH	Sea surface height	sea_surface_height_above_geoid	(time,lat,lon)	m
V	Northward velocity	northward_sea_water_velocity	(time,depth,lat,lon)	m/s
MLT	MLD defined by temperature	ocean_mixed_layer_thickness_defined_by_temperature	(time,lat,lon)	m
MLD	MLD defined by sigma theta	ocean_mixed_layer_thickness_defined_by_sigma_theta	(time,lat,lon)	m
salinity	Salinity	sea_water_salinity	(time,depth,lat,lon)	psu
MLP	MLD defined by turbocline	ocean_mixed_layer_thickness_defined_by	(time,lat,lon)	m

		_turbocline		
tempera-ture	Temperature	sea_water_potential_temperature	(time,depth,lat,lon)	°C

Variable name	Description	Standard_name	Dimensions	Units
Daily physical model atmospheric fluxes INDESO_FLUX_1dAV-RT_%nnnnnnnnnnnn.nc or INDESO_FLUX_1dAV_%nnnnnnnnnnnn.nc				
Netcdf-CF Grid Dimensions: lon=649, lat=541, time=1				
lon	longitude	longitude	(lon)	degrees_east
lat	latitude	latitude	(lat)	degrees_north
time	time	time	(time)	seconds since YYY-MM-DD 00:00:00
VAIR	Module wind stress over ocean	sea_surface_water_stress	(time,lat,lon)	N m^{-2}
QSR	net solar flux at the ocean surface	net_downward_shortwave_flux	(time,lat,lon)	W/m^2
QLAO	latent heat flux at the ocean sur-face	surface_downward_latent_heat_flux	(time,lat,lon)	W/m^2
QSBO	sensible heat flux over ocean	surface_downward_sensible_heat_flux	(time,lat,lon)	W/m^2
QNET	net downward heat flux at the ocean surface	net_downward_heat_flux	(time,lat,lon)	W/m^2
QLWO	infra-red heat flux over ocean	surface_net_downward_longwave_flux	(time,lat,lon)	W/m^2
EMP	net fresh water flux into the ocean	water_flux_into_ocean	(time,lat,lon)	kg.m^{-2}. s-1

Variable name	Description	Standard_name	Dimensions	Units
Hourly Physical 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
tempera-ture	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	Atmospherical 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 Flux	net_downward_heat_flux	(time,lat,lon)	W m-2
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 AND SEMANTIC OF PDF 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 values of the physical model fields
3. 2D errors patterns of the model Sea Surface Temperature
4. Time monitoring and distribution of the physical model SST error
5. Atmospheric forcing fields patterns
6. Physical model subsurface temperature departure from the climatology
7. Physical model subsurface salinity departure from the climatology
8. Iso-density layers
9. T/S model versus T/S in situ profiles
10. Model surface velocities mean patterns and 2D maps of velocities error where drifters
11. Model surface velocities errors: histogram and scattering plot
12. Volume transports monitoring

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
Physical model daily historical & real-time analysis & forecast	netCDF CF	Yes	Yes	Yes
Physical model daily historical analysis & forecast	netCDF CF	Yes	Yes	Yes
Physical model hourly historical & real-time analysis & forecast	netCDF CF	Yes	Yes	Yes
Physical model moorings hourly historical&real time analysis&forecast	netCDF CF	Yes	No	Yes
Physical model moorings hourly historical analysis&forecast	netCDF CF	Yes	No	Yes
Critical & weekly physical model historical & real-time metrics	pdf	Yes	No	Yes
Long term physical model metrics	pdf	Yes	No	Yes

6. REFERENCES

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