PRODUCT USER MANUAL For Global Ocean Reanalysis Products GLOBAL-REANALYSIS-PHY-001-025

Issue: 3.4

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CMEMS version scope : Version 4.1

Approval Date : 10/04/2018



Ref: CMEMS-GLO-PUM-001-025 Date : 10 April 2018

Issue : 3.4

CHANGE RECORD

Issue	Date	§	Description of Change	Author	Validated By
0.0	23 may 2011	-	Creation of the document with GLORYS Mercator Océan contribution	Nicolas Ferry	
0.1	27 May 2011	all	Merging with CMCC + ESSC contributions + various editing	E Dombrowsky, Simona Masina, Andrea Storto, Keith Haines, Maria Valdivieso	
2.0	20 October 2011	all	New template	Nicolas Ferry, Laurent Parent, Bernard Barnier, Jean-Marc Molines, Simona Masina, Andrea Storto, Keith Haines, Maria Valdivieso	
2.1	27 February 2012	all	Update for V2.1: CMCC and U-Reading changes	Andrea Storto, Maria Valdivieso, Nicolas Ferry	
2.2	14 January 2013	all	Change product name and add Authenticated FTP download mechanism	Laurence Crosnier	
2.3	14 February 2013		Remove DGF access from Met office DU	Alistair Sellar	E. Dombrowsky
2.4	27 September 2013	all	Update for V2.4: Production Unit changes	Nicolas Ferry, Laurent Parent, Bernard Barnier, Jean-Marc Molines, Simona Masina, Andrea Storto, Keith Haines, Maria Valdivieso	
2.5	12 April		Update for V2.5: add ECMWF products ORAP5.0	Hao Zuo, Magdalena Balmaseda	Y. Drillet L. Crosnier
2.6	17 Dec 2014	all	Various updates	Hao Zuo, Andrea Storto, Laurent Parent	L. Crosnier
2.7	May 1 2015	all	Change format to fit CMEMS graphical rules		L. Crosnier
2.8	July 25 2015	Page 32	Update description of ORAP5.0	Hao Zuo	L. Crosnier

PUM for Global Ocean Physical Reanalysis Products

GLOBAL_REANALYSIS_PHY_001_025

Ref: CMEMS-GLO-PUM-001-025 Date : 10 April 2018

Issue : 3.4

2.9	January 2016	all	Update for year 2014 Suppress references to products 001_004 and 001_010, no longer in V2 Suppress old references to MyOcean	Marie Drévillon	Y Drillet
3.1	September 2016		Replace products 001_009 by 001_025.	Gilles Garric	Y. Drillet
3.2	January 2017	all	Remove products 001_011 and 001_017	Yann Drillet	Y. Drillet
3.3	September 2017	All	Addition of new datasets. Refactoring following new template.	E. Fernandez	L. Nouel
3.4	April 2018	11.3	Addition of Information on SSH	C. Derval	C.Derval

Table of contents

Ι	INTRODUCTION
II	DESCRIPTION OF THE PRODUCT SPECIFICATION
	II.1 General Information about products
	II.2 Details of datasets
	II.3 Production Subsystem Description 11
	II.4 Product System Description
II	I HOW TO DOWNLOAD A PRODUCT
	III.1 Download a product through the CMEMS Web Portal Subsetter Service
	III.2 Download a product through the CMEMS Web Portal FTP Service
	III.3 Download a product through the CMEMS Web Portal Direct Get File Service
N	7 FILES NOMENCLATURE AND FORMAT
	IV.1 Nomenclature of files when downloaded through the Subsetter Service
	IV.2 Nomenclature of files when downloaded through the CMEMS Web Portal <u>Directgetfile</u> and <u>FTP</u> Service
	IV.3 File Format: format name
	IV.4 File size
	IV.5 Remember: scale_factor & add_offset / missing_value / land mask
	IV.6 Reading Software

GLOSSARY AND ABBREVIATIONS

CF	Climate Forecast (convention for NetCDF)
CMEMS	Copernicus Marine Environment Monitoring Service
DGF	Direct Get File (FTP like CMEMS service tool to download a NetCDF file)
ECMWF	European Centre for Medium Range Weather forecast
FTP	Protocol to download files
GLO	Global
NetCDF	Network Common Data Form
PUM	Product User Manual
QUID	Quality Information Document
Subsetter	CMEMS service tool to download a NetCDF file of a selected geographical box and time range

PUM for Global Ocean Physical Reanalysis Products GLOBAL_REANALYSIS_PHY_001_025 Ref: CMEMS-GLO-PUM-001-025-011-017 Date : 10 April 2018 Issue : 3.4

GLOBAL_REANALYSIS_PHYS_001_011 and 017

I INTRODUCTION

This document describes the global ocean reanalysis produced by the CMEMS Global Monitoring and Forecasting Centre, the data services that are available to access them and how to use the files and services.

The goal of the CMEMS global ocean reanalysis is to provide an eddy permitting $(1/4^{\circ})$ global ocean simulation, covering the recent period during which altimeter data are available (period starting with the launch of TOPEX POSEIDON and ERS-1 satellites early in the nineties), constrained by assimilation of observations and describing the space-time evolution of:

- 3D thermodynamic variables (T, S)
- 3D dynamic variables (U, V)
- sea surface height
- sea-ice features (concentration, thickness and horizontal velocity).

The reanalysis is built to be as close as possible to the observations (i.e. realistic) and in agreement with the model physics. It covers the period 1993 to 2015. The numerical products available for users are 3D daily mean averages, 2D daily mean fields, and monthly mean averages. Static files are also available: grid, mask, bathymetry and mdt.

The reanalysis system is described in the Quality Information Document (QUID) CMEMS_GLO_QUID_001_025 (<u>http://marine.copernicus.eu/documents/PUM/CMEMS-GLO-QUID-001-025.pdf</u>).

More detailed information can be obtained from the CMEMS Service Desk (<u>servicedesk.cmems@mercator-ocean.eu</u>).

II DESCRIPTION OF THE PRODUCT SPECIFICATION

II.1 General Information about products

Products	GLOBAL-REANALYSIS-PHY-001-025				
Geographical coverage	-180°E → 180°E ; 89°S →	90°N			
Variables	Temperature				
	Salinity				
	Sea Surface Height				
	Horizontal velocity (meri	dional and zonal compor	nent)		
	Sea Ice concentration				
	Sea Ice thickness				
	Sea ice velocity (meridior	nal and zonal componen	t)		
	Sea floor potential temperature				
	Density ocean mixed layer thickness				
Update frequency	Yearly				
Available time series	01/01/1993 to 31/12/2015				
Target delivery time	n.a.				
Temporal resolution	daily and monthly means				
Delivery mechanism	Subsetter DGF FTP				
Horizontal resolution	1/4° (equirectangular grid	d)			
Number of vertical levels	75 levels				
Format	Netcdf CF1.0				

Table 1: GLOBAL-REANALYSIS-PHYS-001-025 product

II.2 Details of datasets

	GLOBAL_REANALYSIS_ PHY_001_025
	contains the <u>3D daily mean fields</u> : 3D potential temperature, salinity and currents information from top to bottom global ocean and 2D sea surface level, bottom potential temperature, mixed layer thickness, sea ice thickness, sea ice fraction and sea ice velocities information.
dataset-global-reanalysis-phy-001-025-ran-fr-glorys2v4-daily	temperature [K] Potential temperature sea_water_potential_temperature salinity [psu] Salinity sea_water_salinity u [m/s] Eastward ocean current velocity eastward_sea_water_velocity v [m/s] Northward ocean current velocity northward_sea_water_velocity
	ssh [m] Sea surface height sea_surface_height_above_geoid mlp [m] Mixed layer thickness ocean_mixed_layer_thickness_defined_by_sigma_theta bottomT [°C] Sea floor potential temperature sea_water_potential_temperature_at_sea_floor
	fice [1] Sea ice concentration sea_ice_area_fraction hice [m] Sea ice thickness sea_ice_thickness uice [m/s] Eastward sea ice velocity
	eastward_sea_ice_velocity vice [m/s] Northward sea ice velocity northward_sea_ice_velocity
ysis-phy- onthly	contains the <u>3D monthly mean fields</u> : 3D potential temperature, salinity and currents information from top to bottom global ocean and 2D sea surface level, bottom potential temperature, mixed layer thickness, sea ice thickness, sea ice fraction and sea ice velocities information.
global-reana 001-025-m	temperature [K] Potential temperature sea_water_potential_temperature salinity [psu] Salinity
i I	Samicy

	sea_water_salinity
	u [m/s]
	Eastward ocean current velocity
	eastward_sea_water_velocity
	v [m/s]
	Northward ocean current velocity
	northward_sea_water_velocity
	ssh [m]
	Sea surface height
	sea_surface_height_above_geoid
	mlp [m]
	Mixed layer thickness
	ocean_mixed_layer_thickness_defined_by_sigma_theta
	bottomT [°C]
	Sea floor potential temperature
	sea_water_potential_temperature_at_sea_floor
	fice [1]
	Sea ice concentration
	sea_ice_area_fraction
	hice [m]
	Sea ice thickness
	sea_ice_thickness
	uice [m/s]
	Eastward sea ice velocity
	eastward_sea_ice_velocity
	vice [m/s]
	Northward sea ice velocity
	northward_sea_ice_velocity
	contains the static fields for the system: coordinates, mean sea surface level, mask and bathymetry.
	e1t [m]
	Cell dimension along X axis
S	e2t [m]
tati	Cell dimension along Y axis
5-st	e3t [m/s]
02	Cell dimension along 7 axis
01-	cell thickness
	mask [1]
hq	Land-sea mask: 1 = sea : 0 = land
'sis [.]	sea binary mask
laly	deptho [m]
ean	Bathymetry
	sea_floor_depth_below_geoid
obâ	deptho_lev [1]
20	Model level number at sea floor
	model_level_number_at_sea_floor
	mdt [m]
	Mean dynamic topography
	sea_surface_height_above_geoid

II.3 Details on some parameters

mlotst [m]	ocean_mixed_layer_thickness_defined_by_sigma_theta. It is the depth where the density increase compared to density at 10 m depth corresponds to a temperature decrease of 0.2°C in local surface conditions (θ10m, S10m, P0= 0 db, surface pressure)
zos [m]	sea_surface_height_above_geoid. The geoid is a surface of constant geopotential with which mean sea level would coincide if the ocean were at rest. The parameter "zos" is the difference between the actual sea surface height at any given time and place, and that which it would have if the ocean were at rest.

- The altimeter measures the SSH referenced to the ellipsoid of reference (Earth + Ocean contributions) = Geoid + ADT
- The NEMO Ocean General Circulation Model represents the SSH referenced to the geoid (Ocean only contribution) = ADT



The Offset to apply is notified as arguments for the SSH_model variable in the NetCDF file

II.4 Production Subsystem Description

- a. GLORYS2V4 reanalysis relies on three main components:
 - 1. the ocean model (including the surface atmospheric boundary condition)
 - 2. the data assimilation method
 - 3. the assimilated observations
- **b.** We review here these three components.

Ocean model:

- OGCM configuration:

The reanalysis system is based on the version 3.1 of NEMO (Nucelus for European Models of the Ocean) ocean model (Madec, 2008); the configuration uses the tripolar ORCA grid type (1442x1021 grid points) (Madec and Imbard, 1996) at ¼° horizontal resolution. (The three poles being located in Antarctica, Northern Asia and Northern Canada). The ¼° resolution of the ORCA grid type (ORCA025 hereafter) corresponds to 27 km at the equator, 22 km at Cape Hatteras (Gulf Stream area) and 12 km at high latitudes (Arctic Ocean & regional seas around Antarctica).

The vertical grid has 75 z-levels, with a resolution of 1 meter near the surface, 200 meters in the deepest ocean (> 3000m depth) and 24 levels with the upper 100m.

The bathymetry used in the system is a combination of interpolated ETOPO1 (Amante and Eakins, 2009) and GEBCO8 (Becker et al., 2009) databases. ETOPO datasets are used in regions deeper than 300 m and GEBCO8 is used in regions shallower than 200 m with a linear interpolation in the 200 m – 300 m layer. The minimum depth in the model is set to 12 meters, except in the Bahamas region (~ 3 meters). Three islands have been added in the Torres Strait to diminish the transport and the Palk Strait (between India and Sri Lanka) has been opened with a 3m depth.

"Partial cells" parameterization (Adcroft et al., 1997) is chosen to represent the topographic floor as staircases but making the depth of the bottom cell variable and adjustable to the real depth of the ocean floor (Barnier et al., 2006).

The horizontal pressure gradient is represented by a free surface formulation in which high frequency gravity waves are filtered out (Roullet and Madec, 2000).

The advection of the tracers (temperature and salinity) is computed with a total variance diminishing (TVD) advection scheme (Lévy et al., 2001; Cravatte et al., 2007). A Laplacian lateral isopycnal diffusion on tracers is used (300m2.s-1at the Equator and decreasing poleward proportionally to the grid size).

The momentum advection term is computed with the energy and enstrophy conserving scheme proposed by Arakawa and Lamb (1981).

An horizontal bi-harmonic viscosity for the lateral dissipation of momentum (-1×1011 m4 s-1 at the Equator and decreasing poleward as the cube of the grid size) is used. In this system, a Laplacian operator (2000 m2.s-1) is applied in the Ob and lenissei estuaries to avoid local numerical instabilities.

The vertical mixing is parameterized according to a turbulent closure model (order 1.5) adapted by Blanke and Delecluse (1993).

The lateral friction condition is a partial-slip condition with a regionalisation of a no-slip condition (over the Mediterranean Sea).

Instead of being constant, the depth of light extinction is separated in Red-Green-Blue bands depending on the chlorophyll data distribution from mean monthly SeaWIFS climatology.

Barotropic mixing due to tidal currents in the semi-enclosed Indonesian throughflow region has been parameterized following Koch-Larrouy et al. (2008).

The reanalysis system uses the thermodynamic-dynamic sea-ice model LIM2 (Fichefet and Maqueda, 1997) with the Elastic-Viscous-Plastic rheology (Hunke and Dukowicz, 1997). The thermodynamics are based on the 2+1 (ice+snow) layers formulation.

- Surface forcing fields / corrections:

The reanalysis system is driven at the surface by the ERA-Interim reanalysis products (Dee et al., 2011), interpolated onto the ORCA025 grid using the Akima interpolation algorithm. Momentum and heat turbulent surface fluxes are computed from the Large and Yeager (2004) bulk formulae using the following set of atmospheric variables at 3H sampling: surface air temperature and surface humidity at 2 m height, mean sea level pressure and wind at 10 m height. Daily downward longwave and shortwave radiative fluxes and rainfall (solid + liquid) fluxes are also used in the surface heat and freshwater budgets. An analytical formulation (Bernie et al., 2005) is applied to the daily shortwave flux in order to reproduce an ideal diurnal cycle.

Due to large known biases in precipitations and radiative fluxes at the surface, a satellite-based largescale corrections (Garric et al., 2011) is applied to the ERA-Interim fluxes. These corrections are applied (1) to the low-passed filtered ERA-Interim fluxes (80% amplitude attenuation at the synoptic scales) and (2) to the seasonal climatology. No corrections are applied at high latitudes (poleward 65°N and 60°S). Large-scale corrections of precipitations, resp. radiatives fluxes, at the surface are performed with the Passive Microwave Water Cycle (PMWC) (Hilburn, 2009), resp GEWEX SRB 3.1 (http://eosweb.larc.nasa.gov/PRODOCS/srb/table srb.html), satellite data sets.

Also, specific corrections are applied at high latitudes to counteract kwown warm biases in ERA-Interim surface conditions. In the Arctic Ocean northward 80°N: surface air temperature is cooled by 2°C and 85% of air humidity is retained. Southward 60°S in the Southern Ocean: 80% of downward ERAinterim SW is retained and 110% of downward ERAinterim LW is applied.

The evaporation minus precipitation quantities (EmP hereafter) is set equal to zero at each model time-step. In addition, a global mean EmP seasonal cycle is imposed to the one observed by the GRACE geodetic mission. Despite the previous correction and updates, the freshwater budget (EmP) is far from being balanced. We add a trend of 1.4 mm/year to the runoffs in order to represent somehow the recent estimation of the global mass (glaciers, land water storage, Greenland & Antarctica) (Chambers et al., 2016)

The monthly seasonal climatology river runoff is now inferred from Dai et al. (2009). It is a reliable estimate for the world's 925 largest rivers of continental freshwater discharge. This database uses new data, mostly from recent years, streamflow simulated by Community Land Model version 3 to fill the gaps, in all lands areas except Antarctica and Greenland. In addition, the runoff fluxes coming from Greenland and Antarctica ice sheets and glaciers melting is built with Altiberg icebergs database project (Tournadre et al., 2012). This complements the estimation of Silva et al. (2006) for Antarctica already present in the previous system. The total river runoff represents 1.3 Sv.

No global restoring strategy has been implemented in this system to sea surface salinity or the sea surface temperature. But a temperature and salinity 3D-restoring towards EN4 products (Good et al., 2013) is applied below 2000m and poleward 60°S with a representative time scale of 20 years. Also, a temperature and salinity restoring toward EN4 products has been added at Gibraltar and Bab-el-Mandeb straits.

- Initial Conditions:

The simulation started at rest the 4th December 1991, with prescribed temperature and salinity. Initial conditions for temperature and salinity based from EN4 (Good et al., 2013) are used. A method using a robust regression model applied to the EN4 monthly objective analysis, allowed to re-built the December 1991 water masses conditions.

Initial conditions for sea ice (ice concentration) were inferred from the NSDIC Bootstrap products for December 1991. The ice thickness has been issued from analytical relationships found between a mean (2002-2009) GLORYS1V1 January sea ice concentration and its ice thickness counterpart.

Time step and ramp up phase: the time step is set to 720 sec the first and second week of the run; then, the time step is set to 1440s all along the experiment. No data are assimilated during the first two weeks.

Data Assimilation method

The data assimilation method relies on a reduced order Kalman filter based on the SEEK formulation introduced by Pham et al. (1998). Here we present a short description of what we call Système d'Assimilation Mercator version 2 (SAM2).

An important feature of GLORYS2V4 reanalysis system (implemented also in the real-time global forecasting systems) is the analysis is performed at the middle of the 7-day assimilation cycle, and not at the end of the assimilation cycle.

The SEEK formulation requires knowledge of the forecast error covariance of the control vector. In GLORYS2V4, this vector is composed of the 2D barotropic height, the 3D temperature, salinity, zonal and meridional velocity fields and finally sea ice concentration. The forecast error covariance is based on the statistics of a collection of 3D ocean state anomalies (typically a few hundred) and is seasonally variable (i.e. fixed basis, seasonally variable). This approach is similar to the Ensemble optimal interpolation (EnOI) developed by Oke et al., (2008) which is an approximation to the EnKF that uses a stationary ensemble to define background error covariances. In our case, the anomalies are high pass filtered ocean states (Hanning filter, length cut-off frequency = 1/30 days-1) available over the 1993-2009 time period every 3 days. These ocean states come from a reference simulation but without data assimilation.

A 3D-VAR bias correction method has been implemented to correct large-scale temperature and salinity biases when enough observations are present.

These increments are applied with an Incremental Analysis Update (Bloom et al., 1996, Benkiran and Greiner, 2008). The IAU is a low-pass filter giving a smooth model integration.

We set to zero the global mean increment of the steric sea surface height.

Assimilated observations:

The assimilated data consist of satellite SST and SLA data, in situ temperature and salinity profiles, and sea ice concentration. The model innovation (observation minus model equivalent, y-Hx) is computed at appropriate time (FGAT, First Guess at Appropriate Time).

As stated in the model description section, the start time for GLORYS2V4 reanalysis is the 4th December 1992 at 00H UTC. The ocean model is integrated during the first two weeks without data assimilation. Then, all available observations are assimilated.

SLA: provided by CMEMS SLA TAC (CLS: Collecte Localisation Satellites):

SEALEVEL-GLO-SLA-L3-REP-OBSERVATIONS-008-001-b product

Here is a short summary of the DT altimetric data sets availability:

	Jason-2	Jason-1 new (1)	Jason-1	GFO	Envisat	Envisat new (2)	ERS-1(3) ERS-2
Temporal Time availability: beginning / end	2008/10	2009/02 2012/03	2002/04 2008/10	2000/01 2008/09	2002/10 2010/10	2010/10 2012/04	1992/10 2002/10

	Topex new (4)	Topex	Cryosat2	AltiKa	H2-YA2
Temporal Time availability: beginning / end	2002/09 2005/10	1992/09 2002/04	2011/01	2013/03	2014/04 2016/01

Table: Time period during which altimetric data sets available

- (1) Jason-1 new orbit: starting 2009/02
- (2) Envisat new orbit: starting 2010/10
- (3) There are no ERS-1 data between December 23, 1993 and April 10, 1994 (ERS-1 phase D 2nd ice phase)
- (4) T/P new orbit: starting 2002/09

The assimilation of SLA observations requires the knowledge of a mean sea surface height. This surface reference is an adjusted version of Mean Dynamic Topography (MDT hereafter) dataset. . We use the MDT based on the "CNES-CLS13" MDT with adjustment using high resolution analysis and with the Post Glacial Rebound. This product, referenced on the 20-year altimeter period, takes also into account the last version of GOCE geoid and is replacing the MDT named "CNES-CLS09" derived from observations (Rio et al., 2011) used in the previous system.

SST: The daily Reynolds 1/4° AVHRR-only daily SST version 2 product (see http://www.ncdc.noaa.gov/oa/climate/research/sst/oi-daily.php) is assimilated once at the date of the analysis (i.e. the day 4 at 24H00 of the assimilation cycle).

In Situ profiles (T, S): The CORA 4.1 in situ database provides by the CMEMS IS TAC (Szekely et al., 2015) is assimilated (http://www.coriolis.eu.org/Science/Data-and-Products). For 2014-2015 years, the delayed mode database was not available; the real-time database produced by Coriolis data center was used instead.

Sea Ice concentration: The IFREMER/CERSAT products (Ezraty et al., 2007) are assimilated once at the date of the analysis (i.e. the day 4 at 24H00 of the assimilation cycle).

Observation error:

Observation error includes both the instrumental error (R_{me}) and the model representativeness error (R_{re}). These errors are supposed to be uncorrelated and are modelled by diagonal matrices (i.e. the observation errors are mutually uncorrelated).

SST: An empirical error is used. It is function of the representativeness error \mathbf{R}_{re} of in-situ measurements and equal to $\mathbf{R}_{sst} = \max(0,5^{\circ}C, \mathbf{R}_{in_situ}(T))$.

SLA: The SLA observation error R_{me} (in variance) is specified according to the knowledge of instrumental features. We use a 2 cm error for JASON (with new orbit or not) and TOPEX-POSEIDON (with new orbit or not) and a 3.5 cm error for ERS-2, GFO and ENVISAT. In October 2010, the Envisat altimeter was brought to a lower orbit, which has led to a slight degradation of data quality (Ollivier and Faugere, 2010). In consequence, a 5.5 cm error is attributed to this altimeter (Envisat new). We use a 4 cm error for Cryosat-2, 2 cm error for Altika and 4 cm error for HY-2A.

Mean Dynamic Topography: A representativeness error for the MDT has been added to the SLA observation error. This error is 5 cm on average. Largest values (~10 cm) are located on shelves, along the coast (model representativeness + observation error due to tides) and in the regions of sharp fronts (Gulf Stream, Kuroshio,...).

In situ profiles: The observation error of temperature and salinity profiles includes both the instrument error and the representativeness error by assuming that the model representativeness is a function of the geographical location and depth. For temperature, this error is dominated by the inaccuracy of the thermocline position given by the model and the data (profilers depth uncertainty can reach 5 m or 2 % of the depth). It ranges from about ~1°C at the surface to 0.1°C below 500m. The higher surface values correspond to mixed layer processes or thermocline motions that are not resolved by the model (filaments, internal gravity waves ...). Contrary to the temperature, the salinity observation error can

be very large in coastal areas due to run-off uncertainty. The halocline gradient is also weaker than the thermocline gradient, leading to a more homogeneous error on the vertical.

Sea Ice concentration: An empirical error is used. The error is 0.01 when the concentration is equal to 0, then a linear decreasing trend is applied from 0.25 (concentration equal to 0.01) to 0.05 (concentration equal to 1).

For all the bibliographic references cited in text, refer to the Quid document.

II.5 Product System Description

Domain	GLOBAL (180°W-180°E ; 89°S – 90°N)
Resolution and grid	1/4º ; regular grid ; 1440 x 681
Geographic coverage	This product is global with dedicated projection and spatial resolution. It is defined on a standard collocated grid at 1/4 degree (approx. 25 km). The parameters are interpolated from the native grid model, the 1/4 degree and 75 vertical levels Arakawa C native grid.
Model Version	LIM2 EVP NEMO 3.1
Atmospheric forcings	3-hourly atmospheric forcing from ERA-Interim, including SW+LW+PRECIP corrections
Assimilation scheme	SAM2 (SEEK Kernel) + FGAT + IAU and bias correction
Assimilated	Reynolds 0.25° AVHRR-only-SST,
observations	DT SLA from all altimetric satellites, in situ T, S profiles from CORIOLIS CORAv4.1 data base, CERSAT Sea Ice Concentration
Bathymetry	ETOPO1 for deep ocean and GEBCO8 on coast and continental shelf.

III HOW TO DOWNLOAD A PRODUCT

III.1 Download a product through the CMEMS Web Portal Subsetter Service

You first need to register. Please find below the registration steps: <u>http://marine.copernicus.eu/web/34-products-and-services-faq.php#1</u>

Once registered, the CMEMS FAQ <u>http://marine.copernicus.eu/web/34-products-and-services-faq.php</u> will guide you on How to download a product through the CMEMS Web Portal Subsetter Service.

III.2 Download a product through the CMEMS Web Portal FTP Service

You first need to register. Please find below the registration steps: <u>http://marine.copernicus.eu/web/34-products-and-services-faq.php#1</u>

Once registered, the CMEMS FAQ <u>http://marine.copernicus.eu/web/34-products-and-services-faq.php</u> will guide you on How to download a product through the CMEMS Web Portal Authenticated FTP Service.

III.3 Download a product through the CMEMS Web Portal Direct Get File Service

You first need to register. Please find below the registration steps: <u>http://marine.copernicus.eu/web/34-products-and-services-faq.php#1</u>

Once registered, the CMEMS FAQ <u>http://marine.copernicus.eu/web/34-products-and-services-faq.php</u> will guide you on How to download a product through the CMEMS Web Portal Direct Get File Service.

IV FILES NOMENCLATURE AND FORMAT

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

GLOBAL_ANALYSIS_PHY_001_025 file nomenclature when downloaded through the **Subsetter** functionality (TDS) is based on product dataset name and a numerical reference related to each product request date on the server.

The scheme is:

datasetname-nnnnnnnnnnnnn.nc

where :

.datasetname is a character string containing the dataset name as described previously

. nnnnnnnnnn: 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-global-reanalysis-phy-001-025-ran-fr-glorys2v4-daily_1484236987711.nc

IV.2 Nomenclature of files when downloaded through the CMEMS Web Portal <u>Directgetfile</u> and <u>FTP</u> Service

When downloading product via Directgetfile, you get data in ZIP archive format with a specific nomenclature. When ZIP archive is uncompressed, files are provided with the native nomenclature. When downloading via FTP, the files are provided with the native nomenclature.

ZIP nomenclature: The scheme is:

datasetname_nnnnnnnnnn.zip

Where:

.datasetname is a character string containing the dataset name as described previously

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

.zip: ZIP Archive filename extension.

• Native nomenclature:

For the daily dataset, the scheme is:

mercatorglorys2v4_gl4_mean_yyyymmdd_RYYYYMMDD.nc

Where:

- yyyymmdd: field daily mean central date, on YYYYMMDD format
- YYYYMMDD : creation date of the file
- .nc: standard NetCDF filename extension.

For the monthly dataset, the scheme is:

mercatorglorys2v4_gl4_mean_yyyymm.nc

Where:

- yyyymm: field monthly mean central date, on YYYYMM format
- .nc: standard NetCDF filename extension.

IV.3 File Format: format name

The products are stored using the NetCDF 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 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.

IV.4 File size

DATASET NAME	NAME OF FILE	DIMENSION [MB]
global-reanalysis-phy-001- 025-monthly	mercatorglorys2v4_gl4_mean_\${YYYYMM}.nc	575
dataset-global-reanalysis- phy-001-025-ran-fr- glorys2v4-daily	mercatorglorys2v4_gl4_mean_\${YYYMMDD}_R\${YYYY MMDD2}.nc	575
global-reanalysis-phy-001- 025-statics	GLO-MFC_001_025_\${field}.nc	289

IV.5 Remember: scale_factor & add_offset / missing_value / land mask

Real_Value = (Display_Value X scale_factor) + add_offset The missing value for this product is: -32767s Land mask are equal to "_FillValue" (see variable attribute on NetCDF file).

IV.6 Reading Software

NetCDF data can be browsed and used through a number of software, like:

- ncBrowse: http://www.epic.noaa.gov/java/ncBrowse/,
- NetCDF Operator (NCO): <u>http://nco.sourceforge.net/</u>
- IDL, Matlab, GMT...

Useful information on UNIDATA: <u>http://www.unidata.ucar.edu/software/netcdf/</u>