PRODUCT USER MANUAL

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Ocean Physical and Biogeochemical reanalysis

NWSHELF_MULTIYEAR_PHY_004_009

NWSHELF_MULTIYEAR_BGC_004_011

Issue: 1.3

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11/02/2022

Issue: 1.3

Issue	Date	§	Description of Change	Author	Validated By
1.0	Aug 2020	All	Merged PUM_004_009 and PUM_004_011. Updated for Dec 2020 release.	M. Tonani and I. Ascione	C. Derval
1.1	Jan 2021	All	Updated for May 2021 Release	M. Tonani and I. Ascione	C. Derval
1.2	Aug 2021	II.3 and II.4	Details on vertical grid and vertical interpolation.	M. Tonani and I. Ascione	C. Derval
1.3	Feb 2022	11.2	removed reference to MDT	I. Ascione A. Saulter	C. Derval

11/02/2022

Issue: 1.3

TABLE OF CONTENTS

G	LOSSARY	AND ABBREVIATIONS	4
ı	INTRO	DUCTION	5
	I.1 Sumr	nary	5
	I.2 Histo	ry of changes	5
II.	Produ	ct DESCRIPTION:	<i>a</i>
		ral Information about products	
		ils of the datasets	
		ils on some parameters	
		uct System Description	
		essing information	
	II.5.1	Update Time	17
	II.5.2	Time coverage	17
	II.5.3	Time averaging	18
	II.5.4	Time variable in netCDF files	18
III	DOWN	NLOAD A PRODUCT	
IV	' FILES I	NOMENCLATURE and FORMAT	20
	IV.1 Nom	nenclature of files when downloaded through the Subsetter Service	20
	IV.2 Nom	nenclature of files when downloaded via CMEMS FTP Services	20
	IV.3 File I	Format: format name	21
	IV.4 File	size (netCDF4)	22
	IV.5 Rem	ember: scale_factor & add_offset / missing_value / land mask	20
	IV.6 Read	ling Software	26
	IV.7 Stru	cture and semantic of netCDF maps files	27
v	REFER	ENCES	29



11/02/2022

Issue: 1.3

GLOSSARY AND ABBREVIATIONS

CF	Climate Forecast (convention for NetCDF)
CMEMS	Copernicus Marine Environment Monitoring Service
DGF	DirectGetFile – CMEMS service tool (FTP like) to download a NetCDF file
FTP	Protocol to download files
Meridional Velocity	West to East component of the horizontal velocity vector
MFC	Monitoring and Forecasting Centre
NetCDF	Network Common Data Form
NWS	North-West Shelf
PC	Production Centre
PU	Production Unit
RMS	Root mean square
SSC	Sea surface currents
SSH	Sea surface height
SSS	Sea surface salinity.
SST	Sea surface temperature
Subsetter	CMEMS service tool to download a NetCDF file of a selected geographical box using values of longitude and latitude, and time range
Zonal Velocity	South to North component of the horizontal velocity vector

11/02/2022

Issue: 1.3

I INTRODUCTION

I.1 Summary

This document is the user manual for the North West-European Shelf reanalysis products:

NWSHELF_MULTIYEAR_PHY_004_009;

NWSHELF_MULTIYEAR_BGC_004_011.

These products are generated by a coupled physical-biogeochemistry model system.

The first release of the time series covers the period 01/01/1993-31/12/2019. The time series is regularly extended (see product improvements pages http://marine.copernicus.eu/services-portfolio/product-improvements/).

The products are published on the CMEMS dissemination server after automatic and human quality controls. Product is available on-line and disseminated through the CMEMS Information System. Files downloaded are in NetCDF format and follow CF-1.7 convention.

The analysis and forecasting system is described in the Quality Information Document (QUID): https://resources.marine.copernicus.eu/documents/QUID/CMEMS-NWS-QUID-004-011.pdf.

Information on operational issues on products and services can be found on our <u>User Notification</u> <u>Service</u>. If you have any questions, please <u>contact us</u>.

I.2 History of changes

Date	Description of changes and impacted product	
December 2020	New times series from 01/01/1993 to 31/12/2019.	
	Data assimilation of Phytoplankton Functional Types (PFT)	
May 2021	Additional interim datasets	

11/02/2022

Issue: 1.3

II PRODUCT DESCRIPTION:

II.1 General Information about products

Product name	NWSHELF_MULTIYEAR_PHY_004_009	
	NWSHELF_MULTIYEAR_BGC_004_011	
Geographical coverage	20°W → 13°E	
	40°N → 65°N	
	The outermost model grid points at the Atlantic and Baltic boundaries are masked.	
	Baltic boundary: all the grid points East of 10°E are masked.	
	Atlantic boundaries: grid points north of 64°18'48" N; west of -18°19'12" E and south of 40°43'58" N are masked (outermost 10-grid points).	
Variables PHY_004_009	Potential temperature	
	Salinity	
	Sea surface height	
	Horizontal velocity (eastward and northward components)	
	Bottom temperature	
	Mixed layer depth	
Variables BGC_004_011	1 Volume Beam Attenuation Coefficient of Radiative Flux	
	Concentration of Chlorophyll a	
	Mole Concentration of Dissolved Oxygen	
	Mole Concentration of Nitrate	
	Mole Concentration of Phosphate	
	Mole Concentration of Phytoplankton Expressed as Carbon	
	Net Primary Production	
	Surface partial pressure of carbon dioxide	
	pH reported on total scale	
	mass concentration of diatoms expressed as chlorophyll in sea water	
	mass concentration of dinoflagellates expressed as chlorophyll in sea water	
	mass concentration of nanophytoplankton expressed as chlorophyll in sea water	



11/02/2022

Issue: 1.3

	mass concentration of picophytoplankton expressed as chlorophyll in sea water		
Update frequency	The product is updated twice a year provinding six-month extension of the time series		
Available time series	The first release is from 01/01/1993 to 31/12/2019. The product is updated twice a year provinding six-month extension (see product improvements pages http://marine.copernicus.eu/services-portfolio/product-improvements/)		
Temporal resolution	Monthly, Daily means and hourly instantaneous		
Delivery mechanisms	Subsetter	DGF	FTP
Horizontal resolution	~7km 1/9°longitude x 1/15°latitude		
Number of vertical levels	24		
Format	NetCDF4 (FTP), NetCDF3-classic (SUBSETTER)		

II.2 Details of the datasets

NWSHELF_MULTIYEAR_PHY_004_009				
Daily(dm) and monthly (mm) means fields of:				
 Potential temperature, salini 	 Potential temperature, salinity, zonal and meridional velocity (3D); 			
 Sea Surface Height (SSH), mix 	 Sea Surface Height (SSH), mixed layer depth, and sea bottom temperature (2D) 			
2D Hourly (hi) fields of:				
 Potential temperature, salin 	ity, zonal and meridional velocity, sea surface height, and sea			
bottom temperature				
DATASETS	Variables name in the NetCDF file and Unit			
	Long_name			
	CF Standard_name			
cmems_mod_nws_phy-	vo [ms ⁻¹]			
uv_my_7km-3D_P1D-m	Northward Current Velocity in the Water Column			
	northward_sea_water_velocity			
cmems_mod_nws_phy-	uo [ms ⁻¹]			
uv_my_7km-3D_P1M-m	Eastward Current Velocity in the Water Column			
cmems_mod_nws_phy-	eastward_sea_water_velocity			
uv_myint_7km-3D_P1M-m				
cmems_mod_nws_phy-				
uv_my_7km-2D_PT1H-i				



11/02/2022

Issue: 1.3

cmems_mod_nws_phy-t_my_7km-	thetao [degrees_C]
3D_P1D-m	Sea Water Potential Temperature
cmems_mod_nws_phy-t_my_7km-	sea_water_potential_temperature
3D_P1M-m	
cmems_mod_nws_phy-	
t_myint_7km-3D_P1M-m	
cmems_mod_nws_phy-s_my_7km-	
2D_PT1H-i	
cmems_mod_nws_phy-s_my_7km-	so [1e-3]
3D_P1D-m	Sea Water Salinity
cmems_mod_nws_phy-s_my_7km-	sea_water_salinity
3D_P1M-m	
cmems_mod_nws_phy-	
s_myint_7km-3D_P1M-m	
cmems_mod_nws_phy-s_my_7km-	
2D_PT1H-i	
cmems_mod_nws_phy-	bottomT [degrees_C]
bottomt_my_7km-2D_P1D-m	Sea floor potential temperature
cmems_mod_nws_phy-	sea_water_potential_temperature_at_sea_floor
bottomt_my_7km-2D_P1M-m	
cmems_mod_nws_phy-	
bottomt_myint_7km-2D_P1M-m	
cmems_mod_nws_phy-	
bottomt_my_7km-2D_PT1H-i	
smams mad nus nhu	malatat[m]
cmems_mod_nws_phy-	mlotst[m]
mld_my_7km-2D_P1D-m	Ocean mixed layer thickness defined by density
cmems_mod_nws_phy- mld_my_7km-2D_P1M-m	ocean_mixed_layer_thickness_defined_by sigma_theta
cmems_mod_nws_phy-	
mld_myint_7km-2D_P1M-m	
cmems_mod_nws_phy-	
mld_my_7km-2D_PT1H-i	
cmems_mod_nws_phy-	zos[m]
ssh_my_7km-2D_P1D-m	Sea surface height above geoid
cmems_mod_nws_phy-	sea_surface_height_above_geoid
ssh_my_7km-2D_P1M-m	3ca_surface_fielgfit_above_geold
cmems_mod_nws_phy-	
ssh_myint_7km-2D_P1M-m	
cmems_mod_nws_phy-	
ssh_my_7km-2D_PT1H-i	
3311_1119_/KI11-2D_F 1111-1	

11/02/2022

Issue: 1.3

Daily(dm) and monthly (mm) mean fields of:			
3D biogeochemical variables			
2D surface partial pressure of CO2			
DATASETS	Variable's name in the NetCDF file and Unit Long_name CF Standard_name		
cmems_mod_nws_bgc- kd_my_7km-3D_P1D-m cmems_mod_nws_bgc- kd_my_7km-3D_P1M-m cmems_mod_nws_bgc- kd_myint_7km-3D_P1M-m	attn [m-1] Volume Beam Attenuation Coefficient of Radiative Flux in Sewater volume_beam_attenuation_coefficient_of_radiative_flux_in_sea_water		
cmems_mod_nws_bgc- chl_my_7km-3D_P1D-m cmems_mod_nws_bgc- chl_my_7km-3D_P1M-m	chl [mg m-3] Mass Concentration of chlorophyll in Sea Water mass_concentration_of_chlorophyll_a_in_sea_water		
cmems_mod_nws_bgc- chl_myint_7km-3D_P1M-m			
cmems_mod_nws_bgc- o2_my_7km-3D_P1D-m cmems_mod_nws_bgc- o2_my_7km-3D_P1M-m cmems_mod_nws_bgc- o2_myint_7km-3D_P1M-m	o2 [mmol m-3] Mole Concentration of Dissolved Oxygen in Sea Water mole_concentration_of_dissolved_molecular_oxygen_in_sea _water		
cmems_mod_nws_bgc- no3_my_7km-3D_P1D-m cmems_mod_nws_bgc- no3_my_7km-3D_P1M-m cmems_mod_nws_bgc- no3_myint_7km-3D_P1M-m	no3 [mmol m-3] Mole Concentration of Nitrate in Sea Water mole_concentration_of_nitrate_in_sea_water		
cmems_mod_nws_bgc- po4_my_7km-3D_P1D-m cmems_mod_nws_bgc- po4_my_7km-3D_P1M-m	po4 [mmol m-3] Mole Concentration of Phosphate in Sea Water mole_concentration_of_phosphate_in_sea_water		



11/02/2022 Issue: 1.3

cmems_mod_nws_bgc- po4_myint_7km-3D_P1M-m	
cmems_mod_nws_bgc- phyc_my_7km-3D_P1D-m	<pre>phyc [mmol m-3] Mole Concentration of Phytoplankton Expressed as Carbon in Sea Water</pre>
cmems_mod_nws_bgc- phyc_my_7km-3D_P1M-m	Mole_concentration_of_phytoplankton_expressed_as_carbo n_in_sea_water
cmems_mod_nws_bgc- phyc_myint_7km-3D_P1M-m	
cmems_mod_nws_bgc- pp_my_7km-3D_P1D-m cmems_mod_nws_bgc- pp_my_7km-3D_P1M-m	nppv [mg m-3 day-1] Net Primary Production net_primary_production_of_biomass_expressed_as_carbon_ per_unit_volume_in_sea_water
cmems_mod_nws_bgc- pp_myint_7km-3D_P1M-m	
cmems_mod_nws_bgc- spco2_my_7km-2D_P1D-m cmems_mod_nws_bgc- spco2_my_7km-2D_P1M-m	spco2 [Pa] Surface partial pressure of carbon dioxide in sea water surface_partial_pressure_of_carbon_dioxide_in_sea_water
cmems_mod_nws_bgc- spco2_myint_7km-2D_P1M-m	
cmems_mod_nws_bgc- ph_my_7km-3D_P1D-m cmems_mod_nws_bgc- ph_my_7km-3D_P1M-m	<pre>ph[1] Sea Water pH reported on total scale Sea_water_ph_reported_on_total_scale</pre>
cmems_mod_nws_bgc- ph_myint_7km-3D_P1M-m	
cmems_mod_nws_bgc- pft_my_7km-3D-diato_P1M-m cmems_mod_nws_bgc- pft_my_7km-3D-diato_P1D-m	diato [mg m-3] mass_concentration_of_diatoms_expressed_as_chlorophyll_i n_sea_water mass concentration of diatoms expressed as chlorophyll in sea water
cmems_mod_nws_bgc- pft_myint_7km-3D-diato_P1M-m	
cmems_mod_nws_bgc- pft_my_7km-3D-dino_P1M-m cmems_mod_nws_bgc- pft_my_7km-3D-dino_P1D-m	dino [mg m-3] mass_concentration_of_dinoflagellates_expressed_as_chloro phyll_in_sea_water mass concentration of dinoflagellates expressed as chlorophyll in sea water

11/02/2022 Issue: 1.3

cmems_mod_nws_bgc- pft_myint_7km-3D-dino_P1M-m	
cmems_mod_nws_bgc- pft_my_7km-3D-nano_P1M-m cmems_mod_nws_bgc- pft_my_7km-3D-nano_P1D-m cmems_mod_nws_bgc- pft_myint_7km-3D-nano_P1M-m	nano [mg m-3] mass_concentration_of_nanophytoplankton_expressed_as_c hlorophyll_in_sea_water mass concentration of nanophytoplankton expressed as chlorophyll in sea water
cmems_mod_nws_bgc- pft_my_7km-3D-pico_P1M-m cmems_mod_nws_bgc- pft_my_7km-3D-pico_P1D-m cmems_mod_nws_bgc- pft_myint_7km-3D-pico_P1M-m	pico [mg m-3] mass_concentration_of_picophytoplankton_expressed_as_ch lorophyll_in_sea_water mass concentration of picophytoplankton expressed as chlorophyll in sea water

The model **bathymetry** and **Land-Sea** mask information are the same for the products:

- NWSHELF_MULTIYEAR_PHY_004_009;
- NWSHELF_MULTIYEAR_BGC_004_011;
- NWSHELF_ANALYSISFORECAST_PHY_LR_004_001;
- NWSHELF_ANALYSISFORECAST_BGC_004_002.

They are distributed via **FTP** as NWSHELF_ANALYSISFORECAST_PHY_LR_004_001/cmems_mod_nws_phy_anfc_7km-3D_static

NWS-MFC_004_001_mask_bathy.nc

DATASETS	Variable's name in the NetCDF file and Unit Long_name
	CF Standard_name
cmems_mod_nws_phy_anfc_7km-3D_static	mask
	Land-sea mask
	sea_binary_mask
	depth [m]
	depth
	depth



11/02/2022 Issue: 1.3

deptho [m] Bathymetry sea_floor_depth_below_geoid
deptho_lev_interp
Deepest wet grid point of the interpolated 3D fields model_level_number_at_sea_floor

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 3m depth corresponds to a temperature decrease of 0.2°C in local surface conditions.
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 SSH 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.
bottomT (degrees_C)	sea_water_potential_temperature_at_sea_floor is output directly from the native model; it is not interpolated. It means that bottom and the last wet point of the 3D temperature dataset could be different.
deptho_lev_interp	Deepest wet grid point of the Interpolated 3D fields.

11/02/2022

Issue: 1.3

200

100

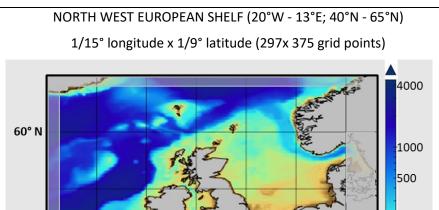
50

II.4 Product System Description



50° N

20° W



NWS bathymetry and the domain of the PHY_004_009 and BGC_004_011 products. The grey translucent areas show where the model output is masked.

The domain extends beyond the continental shelf in order to place the model's boundary region in the deep waters of the adjacent North-East Atlantic, but the focus region for the model comprises open waters of the shelf seas, i.e. (using UK terminology) the North Sea, Irish Sea, English Channel, Celtic Sea and Bay of Biscay.

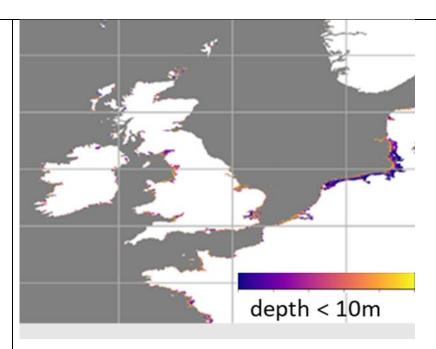
The model is a nested regional ocean model configuration, coupled with the biogeochemical model. PHY and BGC products are delivered on an identical horizontal grid.

A **minimum depth of 10m** is imposed in the ocean model for considering the sea level tidal excursion. Products below the surface in areas where the bathymetry is less than 10m could be affected by this modelling choice.



Issue: 1.3





1) What is done:

We literally take any bathymetric grid point < 10 m in the domain and reassign it with a depth of 10 m, coloured point in the figure above. These grid points are interpolated back to their original depth before delivering the file to the CMEMS catalogue. Cleary areas such as the Wadden Sea are particularly affected (see below reference for a case study in the Wadden sea).

2) Why it is done:

This is because version 3.6 of NEMO does not have wetting and drying capability. If the bathymetry were not modified, it would mean that with the large tides that exist in this domain the model would not be able to handle the case when the tide goes out.

The minimum depth prevents such a situation from occurring and keeps the model as a whole stable.

3) What is the likely effect.

The prorogation of tides and surges are inherently related to the water depth. The speed is proportional to \sqrt{gH} where H is the water depth and thus as the model water depth is deeper than reality the prorogation will incorrect.

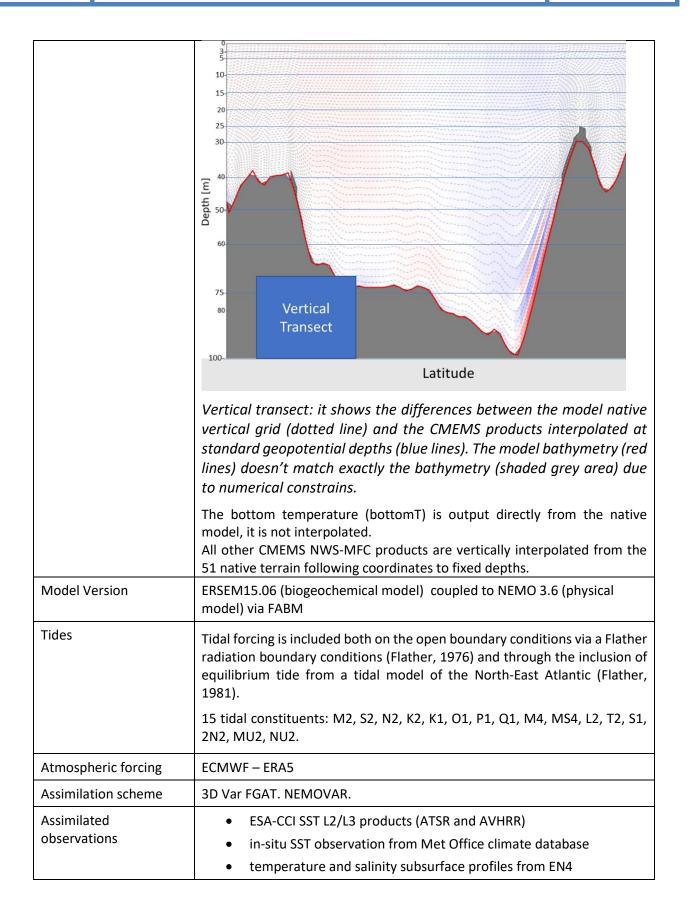
In cases where the seabed is exposed then this process is completely absent from the model by design (there will be water in the model where in reality there is none). It is thus not recommended to the user to directly use the model fields in regions where there are extensive areas of bathymetry less than 10 m in depth. If a model is to be nested within this product, then it is



11/02/2022 Issue: 1.3

	recommended that the boundaries of the nested domain are sufficiently far from such areas to reduce their impact.
	4) Wetting and Drying is implemented in NEMO 4.
	This specific problem is addressed with the wetting and drying module in NEMO 4 which will be part of future development of this operational Copernicus product.
	The interested reader is directed to the recent paper on its development: https://doi.org/10.1016/j.ocemod.2020.101708
	Enda O'Dea, Michael J. Bell, Andrew Coward, Jason Holt, Implementation and assessment of a flux limiter based wetting and drying scheme in NEMO, Ocean Modelling, Volume 155,2020.
Horizontal grid	~7km (1/9°longitude x 1/15°latitude)
Vertical grid	The products are interpolated for users' convenience, into 24 standard IOC geopotential levels: [surface, 3, 10, 15, 20, 30, 50, 75, 100, 125, 150, 200, 250,300, 400, 500, 600, 750, 1000, 1500, 2000, 3000, 4000, 5000 m].
	The surface level is not interpolated, it is the first model level. It has a thickness of 1m where the bathymetry is deeper than 50m. Its thickness is less than 1m where the bathymetry is shallower than 50m.
	The model native vertical grid has Hybrid S-σ-z-coordinates. The terrain-following coordinates system uses a stretching function to maintain near uniform vertical resolution at the surface. The number of S-σ-z levels is 51 almost everywhere in model domain. It means that the thickness of the model vertical grid cells is smaller in shallow area compare to the deep part of the basin.
	The thickness of the model native vertical grid varies from 0.3m (in areas with a bathymetry < 50m) to 99m (where the bathymetry is > 4000m).







11/02/2022 Issue: 1.3

	satellite Chlorophyll PFTs from ESA-CCI.
	OCEANCOLOUR_GLO_CHL_L3_REP_OBSERVATIONS_009_065
Boundaries conditions	T, S, SSH, barotropic u and v at the Atlantic lateral boundary: UK Met Office Global reanalysis v13
	T, S, barotropic u and v at the Baltic lateral boundary: BALTICSEA_REANALYSIS_PHY_003_011
	Nitrate, Phosphate and Oxygen at the Atlantic and Baltic boundaries: WOA 2013v2 monthly climatology Alkalinity and dissolved inorganic carbon from GLODAP v2 climatology Nitrogen deposition at surface from EMEP project (time-varying).
	Daily timeseries of river discharge, nutrient loads (nitrate, phosphate, silicate, ammonia), alkalinty (total alkalinity, bioalkalinity, dissolved organic carbon), and oxygen from 1991-2017. Timeseries data are produced from an updated version of the river dataset used in Lenhart et al. (2010) combined with climatology of daily discharge data from the Global River Discharge Data Base (Vörösmarty et al., 2000) and from data prepared by the Centre for Ecology and Hydrology as used by Young and Holt (2007). Interannual changes in the series are small and so the 2017 time series is repeated for subsequent years.
Initial conditions	The model run started on 01/01/1991 from initial conditions from the previous version of the NWS reanalysis. 01/01/1991-31/12/1992 is not a product as considered model spin up time.
Coupling	One-way on-line coupling: physics forcing the biogeochemistry. Coupling frequency: at every model time step.
Bathymetry	GEBCO 1 arc-minute data together with a variety of other local data sources, supplied by the North West-European Shelf Operational Oceanographic System (NOOS) partners.

II.5 Processing information

II.5.1 Update Time

Reanalysis: twice a year, providing time series extension of six months.

Reanalysis-interim (RAN-INT): monthly.

II.5.2 Time coverage

The first release is from 01/01/1993 to 31/12/2019. The product is updated twice a year, providing sixmonth extension of the time series (see product improvements pages http://marine.copernicus.eu/services-portfolio/product-improvements/), to be around seven months behind real time.



11/02/2022

Issue: 1.3

The RAN-INT timeseries starts from the last available day of the reanalysis described above and is updated monthly to be around two/three months behind real-time.

II.5.3 Time averaging

<u>Daily mean value</u>: the fields are daily means over a day, midnight to midnight, centered at noon. The mean is computed over 25 hours (from 00:00 of T to 00:00 UTC of T+1) to remove (de-tide) the tidal signal.

<u>Monthly mean values</u>: the fields are monthly means over the calendar month (first to last day of the month).

Ref: CMEMS-NWS-PUM-004-009_011

II.5.4 Time variable in netCDF files

Time is expressed in seconds since epoch 1970-01-01, as follows:

```
double time(time);
time:units = "seconds since 1970-01-01T00:00:00Z";
time:long_name = "Validity time";
time:standard_name = "time";
time:calendar = "Gregorian";
time:axis = "T";
```



11/02/2022

Issue: 1.3

III DOWNLOAD A PRODUCT

After registration, you will be able to download our data. To assist you, our <u>HelpCenter</u> is available, and more specifically its <u>section about download</u>.

Information on operational issues on products and services can be found on our $\underline{\text{User Notification}}$ $\underline{\text{Service}}$. If you have any questions, please $\underline{\text{contact us}}$.



11/02/2022

Issue: 1.3

IV FILES NOMENCLATURE AND FORMAT

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

The NWSHELF_MULTIYEAR_BGC_004_011 and NWSHELF_MULTIYEAR_PHY_004_009 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-nnnnnnnnnnnnnnn.nc

where:

- datasetname: as described in section Erreur! Source du renvoi introuvable.
- .nc: standard NetCDF filename extension.

Example:

```
cmems mod nws bgc-kd my 7 \, \text{km-3D} P1D-m-1303461772348.nc
```

Remark: downloading via subsetter generates data in netCDF3 format

IV.2 Nomenclature of files when downloaded via CMEMS FTP Services

The below describes the multiyear products:

- NWSHELF_MULTIYEAR_BGC_004_011
- NWSHELF_MULTIYEAR_PHY_004_009

The files are delivered containing data for:

- * the full spatial coverage of the model domain
- * one variable or variable group
- * a single day data

For example, a multiyear daily file contains daily mean values. The filenames contain fields that identify the model, domain, variable and time of the contents:

```
metoffice_foam1_amm7_NWS_XXX_dm20091024.nc
NWSHELF_MULTIYEAR_PHY_004_009
metoffice_foam1_amm7_NWS_XXXX_*dm20091024.nc, or
metoffice_foam1_amm7_NWS_XXXXX_*dm20091024.nc
NWSHELF_MULTIYEAR_BGC_004_011
for
```

^{*} metoffice: production centre that produced the file



11/02/2022

Issue: 1.3

* foam1: model system and version

* amm7: model configuration

* NWS: region

* XXX, XXXX, XXXXX: variable or variable group, see II.2

* 20091024: dm = daily mean (if mm = monthly mean), then data validity date YYYYMMDD

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.

Ref: **CMEMS-NWS-PUM-004-009_011**

* Sharable. One writer and multiple readers may simultaneously access the same NetCDF file.



11/02/2022

Issue: 1.3

IV.4 File size (netCDF4)

NWSHELF_MULTIYEAR_PHY_004_009		
DATASET NAME	NAME OF FILE	DIMENSI ON [MB]
cmems_mod_nws_phy- bottomt_my_7km-2D_P1D-m	metoffice_foam1_amm7_NWS_BED_dm{{yy yymmdd}}.nc	0.1
cmems_mod_nws_phy-uv_my_7km- 3D_P1D-m	metoffice_foam1_amm7_NWS_CUR_dm{{yy yymmdd}}.nc	2.6
cmems_mod_nws_phy-mld_my_7km- 2D_P1D-m	metoffice_foam1_amm7_NWS_MLD_dm{{y yyymmdd}}.nc	0.1
cmems_mod_nws_phy-s_my_7km- 3D_P1D-m	metoffice_foam1_amm7_NWS_SAL_dm{{yy yymmdd}}.nc	1.3
cmems_mod_nws_phy-ssh_my_7km- 2D_P1D-m	metoffice_foam1_amm7_NWS_SSH_dm{{yy yymmdd}}.nc	0.1
cmems_mod_nws_phy-t_my_7km- 3D_P1D-m	metoffice_foam1_amm7_NWS_TEM_dm{{y yyymmdd}}.nc	1.6
cmems_mod_nws_phy- bottomt_my_7km-2D_P1M-m cmems_mod_nws_phy- bottomt_myint_7km-2D_P1M-m	metoffice_foam1_amm7_NWS_BED_mm{{y yyymm}}.nc	0.2
cmems_mod_nws_phy-uv_my_7km- 3D_P1M-m cmems_mod_nws_phy-uv_myint_7km- 3D_P1M-m	metoffice_foam1_amm7_NWS_CUR_mm{{y yyymm}}.nc	7.1
cmems_mod_nws_phy-mld_my_7km- 2D_P1M-m cmems_mod_nws_phy-mld_myint_7km- 2D_P1M-m	metoffice_foam1_amm7_NWS_MLD_mm{{y yyymm}}.nc	0.2
cmems_mod_nws_phy-s_my_7km- 3D_P1M-m cmems_mod_nws_phy-s_myint_7km- 3D_P1M-m	metoffice_foam1_amm7_NWS_SAL_mm{{yy yymm}}.nc	2.6



11/02/2022

Issue: 1.3

cmems_mod_nws_phy-ssh_my_7km- 2D_P1M-m cmems_mod_nws_phy-ssh_myint_7km- 2D_P1M-m	metoffice_foam1_amm7_NWS_SSH_mm{{yy yymm}}.nc	0.2
cmems_mod_nws_phy-t_my_7km- 3D_P1M-m cmems_mod_nws_phy-t_myint_7km- 3D_P1M-m	metoffice_foam1_amm7_NWS_TEM_mm{{y yyymm}}.nc	3.2
cmems_mod_nws_phy- bottomt_my_7km-2D_PT1H-i	metoffice_foam1_amm7_NWS_BED_hi{{yyy ymmdd}}.nc	4.4
cmems_mod_nws_phy-mld_my_7km- 2D_PT1H-i	metoffice_foam1_amm7_NWS_MLD_hi{{yyy ymmdd}}.nc	4.8
cmems_mod_nws_phy-sss_my_7km- 2D_PT1H-i	metoffice_foam1_amm7_NWS_SSS_hi{{yyyy mmdd}}.nc	3.3
cmems_mod_nws_phy-ssh_my_7km- 2D_PT1H-i	metoffice_foam1_amm7_NWS_SSH_hi{{yyy ymmdd}}.nc	4.4
cmems_mod_nws_phy-sst_my_7km- 2D_PT1H-i	metoffice_foam1_amm7_NWS_SST_hi{{yyyy mmdd}}.nc	4
cmems_mod_nws_phy-uv_my_7km- 2D_PT1H-i	metoffice_foam1_amm7_NWS_SSC_hi{{yyyy mmdd}}.nc	10

NWSHELF_MULTIYEAR_BGC_004_011		
DATASET NAME	NAME OF FILE	DIME NSIO N [MB]
cmems_mod_nws_bgc-kd_my_7km-3D_P1D- m	metoffice_foam1_amm7_NWS_ATTN_dm{ { yyyymmdd}}.nc	0.7
cmems_mod_nws_bgc-chl_my_7km- 3D_P1D-m	metoffice_foam1_amm7_NWS_CPWC_dm{ { yyyymmdd}}.nc	1.4



11/02/2022

Issue: 1.3

cmems_mod_nws_bgc-o2_my_7km-3D_P1D- m	metoffice_foam1_amm7_NWS_DOXY_dm{ { yyyymmdd}}.nc	2.6
cmems_mod_nws_bgc-no3_my_7km- 3D_P1D-m	metoffice_foam1_amm7_NWS_NITR_dm{{ yyyymmdd}}.nc	1.9
cmems_mod_nws_bgc-po4_my_7km- 3D_P1D-m	metoffice_foam1_amm7_NWS_PHOS_dm{ { yyyymmdd}}.nc	1.7
cmems_mod_nws_bgc-phyc_my_7km- 3D_P1D-m	metoffice_foam1_amm7_NWS_PHYT_dm{{ yyyymmdd}}.nc	1.2
cmems_mod_nws_bgc-pp_my_7km-3D_P1D- m	metoffice_foam1_amm7_NWS_PPRD_dm{{ yyyymmdd}}.nc	1.3
cmems_mod_nws_bgc-spco2_my_7km- 2D_P1D-m	metoffice_foam1_amm7_NWS_PCO2_dm{ { yyyymmdd}}.nc	0.1
cmems_mod_nws_bgc-ph_my_7km-3D_P1D- m	metoffice_foam1_amm7_NWS_PHPH_dm{ { yyyymmdd}}.nc	0.5
cmems_mod_nws_bgc-kd_my_7km- 3D_P1M-m	metoffice_foam1_amm7_NWS_ATTN_mm{ { yyyymm}}.nc	2.4
cmems_mod_nws_bgc-kd_myint_7km- 3D_P1M-m		
cmems_mod_nws_bgc-chl_my_7km- 3D_P1M-m	metoffice_foam1_amm7_NWS_CPWC_mm {{yyyymm}}.nc	2.6
cmems_mod_nws_bgc-kd_myint_7km- 3D_P1M-m		
cmems_mod_nws_bgc-o2_my_7km- 3D_P1M-m	metoffice_foam1_amm7_NWS_DOXY_mm {{yyyymm}}.nc	3.2
cmems_mod_nws_bgc-o2_myint_7km- 3D_P1M-m		
cmems_mod_nws_bgc-no3_my_7km- 3D_P1M-m	metoffice_foam1_amm7_NWS_NITR_mm{ { yyyymm}}.nc	0.2
cmems_mod_nws_bgc-no3_myint_7km- 3D_P1M-m		
cmems_mod_nws_bgc-po4_my_7km- 3D_P1M-m	metoffice_foam1_amm7_NWS_PHOS_mm {{yyyymm}}.nc	3.1



11/02/2022

Issue: 1.3

cmems_mod_nws_bgc-po4_myint_7km- 3D_P1M-m		
cmems_mod_nws_bgc-phyc_my_7km- 3D_P1M-m cmems_mod_nws_bgc-phyc_myint_7km- 3D_P1M-m	metoffice_foam1_amm7_NWS_PHYT_mm{ { yyyymm}}.nc	2.4
cmems_mod_nws_bgc-pp_my_7km- 3D_P1M-m cmems_mod_nws_bgc-pp_myint_7km- 3D_P1M-m	metoffice_foam1_amm7_NWS_PPRD_mm{ { yyyymm}}.nc	2.4
cmems_mod_nws_bgc-spco2_my_7km- 2D_P1M-m cmems_mod_nws_bgc-spco2_myint_7km- 2D_P1M-m	metoffice_foam1_amm7_NWS_PCO2_mm{ { yyyymm}}.nc	0.2
cmems_mod_nws_bgc-ph_my_7km- 3D_P1M-m cmems_mod_nws_bgc-ph_myint_7km- 3D_P1M-m	metoffice_foam1_amm7_NWS_PHPH_mm {{yyyymm}}.nc	1.3
cmems_mod_nws_bgc-pft_my_7km-3D-diato_P1D-m	metoffice_foam1_amm7_NWS_DIATO_CP WC_dm{{yyyymmdd}}.nc	3
cmems_mod_nws_bgc-pft_my_7km-3D-dino_P1D-m	metoffice_foam1_amm7_NWS_DINO_CPW C_dm{{yyyymmdd}}.nc	3
cmems_mod_nws_bgc-pft_my_7km-3D- nano_P1D-m	metoffice_foam1_amm7_NWS_NANO_CP WC_dm{{yyyymmdd}}.nc	3
cmems_mod_nws_bgc-pft_my_7km-3D-pico_P1D-m	metoffice_foam1_amm7_NWS_PICO_CPW C_dm{{yyyymmdd}}.nc	3
cmems_mod_nws_bgc-pft_my_7km-3D-diato_P1M-m cmems_mod_nws_bgc-pft_myint_7km-3D-diato_P1M-m	metoffice_foam1_amm7_NWS_DIATO_CP WC_mm{{yyyymm}}.nc	3



11/02/2022 Issue: 1.3

cmems_mod_nws_bgc-pft_my_7km-3D-dino_P1M-m cmems_mod_nws_bgc-pft_myint_7km-3D-dino_P1M-m	metoffice_foam1_amm7_NWS_DINO_CPW C_mm{{yyyymm}}.nc	3
cmems_mod_nws_bgc-pft_my_7km-3D- nano_P1M-m cmems_mod_nws_bgc-pft_myint_7km-3D- nano_P1M-m	metoffice_foam1_amm7_NWS_NANO_CP WC_mm{{yyyymm}}.nc	3
cmems_mod_nws_bgc-pft_my_7km-3D-pico_P1M-m cmems_mod_nws_bgc-pft_myint_7km-3D-pico_P1M-m	metoffice_foam1_amm7_NWS_PICO_CPW C_mm{{yyyymm}}.nc	3

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

Real_Value = (Display_Value X scale_factor) + add_offset (only for NWSHELF_MULTIYEAR_PHY_004_011)

The missing value for this product is: -32768s for NWSHELF_MULTIYEAR_PHY_004_011 and -32768.f for NWSHELF_MULTIYEAR_BGC_004_011

Ref: **CMEMS-NWS-PUM-004-009_011**

Land and sea-ice masks 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): http://nco.sourceforge.net/
- ✓ PANOPLY (NASA): https://www.giss.nasa.gov/tools/panoply/
- ✓ IDL, Matlab, GMT...

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

11/02/2022

Issue: 1.3

IV.7 Structure and semantic of netCDF maps files

```
netcdf metoffice_foam1_amm7_NWS_SSH_dm20180301 {
dimensions:
       time = UNLIMITED; // (1 currently)
       latitude = 375;
       longitude = 297;
variables:
       double time(time);
               time:axis = "T";
               time:calendar = "Gregorian";
               time:long_name = "Validity time";
               time:standard_name = "time";
               time:units = "seconds since 1970-01-01 00:00:00";
       float latitude(latitude);
              latitude:standard_name = "latitude";
               latitude:long_name = "latitude";
               latitude:units = "degrees_north";
               latitude:nav_model = "grid_T";
       float longitude(longitude);
               longitude:standard_name = "longitude";
               longitude:long_name = "longitude";
               longitude:units = "degrees east";
               longitude:nav_model = "grid_T";
       short zos(time, latitude, longitude);
               zos:_FillValue = -32768s;
              zos:missing_value = -32768s;
               zos:scale_factor = 0.001f;
              zos:add_offset = 0.f;
               zos:standard_name = "sea_surface_height_above_geoid";
               zos:long_name = "Sea surface height above geoid";
               zos:units = "m";
               zos:valid_min = -10000s;
```



11/02/2022

Issue: 1.3

```
zos:valid_max = 10000s;
// global attributes:
               :title = "daily-mean sea surface height (2D)";
               :Conventions = "CF-1.7";
               :references = "http://marine.copernicus.eu/";
               :institution = "UK Met Office";
               :contact = "servicedesk.cmems@mercator-ocean.eu";
               :netcdf-version-id = "netCDF-4";
               :creation_date = "2020-08-08T00:00:00Z";
               :source = "AMM-FOAM 7 km (tidal) NEMO v3.6_FABM-ERSEM v19.04_NEMOVAR v6";
               :product = "NWSHELF_MULTIYEAR_PHY_004_009";
               :credit = "E.U. Copernicus Marine Service Information (CMEMS)";
               :forcing_data_source = "ECMWF; ERA5";
               :licence = "http://marine.copernicus.eu/services-portfolio/service-commitments-and-
licence/";
               :history = "See source and creation_date attributes";
```



11/02/2022

Issue: 1.3

V REFERENCES

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