PRODUCT USER MANUAL

for the Black Sea Waves Analysis and Forecast Product

BLKSEA_ANALYSIS_FORECAST_WAV_007_003

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CHANGE RECORD

Issue	Date	§	Description of Change	Author	Validated By
1.0	20.11.16	all	First version of PUM doc for Waves prod.	S. Ciliberti	
	13.01.17	all	Revision n.1 of PUM doc for Waves prod	S. Ciliberti	
	16.01.17	all	Revision n.2 of PUM doc for Waves prod	J. Staneva	
	18.01.17	all	Final version	S. Ciliberti, A. Behrens, J. Staneva	
1.1	21.01.19	all	General revision in the framework of Q2/2019 and addition of static files description	R. Lecci, A. Behrens, J. Staneva	C. Derval
1.2	03.04.20	all	Change of target delivery time from 00UTC to 12UTC New template and new timeseries temporal coverage	R. Lecci, A. Behrens, J. Staneva	C. Derval

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GLOSSARY AND ABBREVIATIONS

BS	Black Sea
CF	Climate Forecast (convention for NetCDF)
CLS	Collecte Localisation Satellites
CMAP	CPC Merged Analysis of *Precipitation*
CMEMS	Copernicus Marine Environment Monitoring Service
CTD	Conductivity Temperature Depth
DAC	Dynamic Atmospheric Correction
DGF	DirectGetFile
DirectGetFile	CMEMS service tool (FTP like) to download a NetCDF file
ECMWF	European Centre for Medium-Range Weather Forecasts
EOF	Empirical Orthogonal Function
FAQ	Frequently Asked Question
FTP	File Transfer Protocol
HZG	Helmholtz-Zentrum Geesthacht
Meridional Velocity	South to North component of the horizontal velocity vector
MFC	Monitoring and Forecasting Centre
NEMO	Nucleous for European Modelling of the Ocean
NetCDF	Network Common Data Form
NOAA	National Oceanic and Atmospheric Administration
OA	Objective Analyses
OCEANVAR	Oceanographic variational data assimilation scheme developed at INGV/CMCC.
OGCM	Ocean General Circulation Model

OpenDAP	Open-Source Project for a Network Data Access Protocol. Protocol to download subset of data from a n-dimensional gridded dataset (ie: 4 dimensions: lon-lat,depth,time)
OSI	Ocean and Sea Ice
PU	Production Unit
Subsetter	CMEMS service tool to download a NetCDF file of a selected geographical box using values of longitude and latitude, and time range
TAC	Thematic Assembly Centre
WAM	Wave Model Wave
Zonal Velocity	West to East component of the horizontal velocity vector

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GLOSSARY AND ABBREVIATIONS

Analysis (Numerical)	a detailed study of the state of the ocean done in Near real Time based on observations and numerical model. The operational prediction centre produces 3D time-space analysis systems. A long series of analyses is of great utility for studying the behavior of the ocean system.
BAMHBI	BiogeochemicAl Model for Hypoxic and Benthic Influenced areas (MAST / Université de Liège, Belgium)
BCs	Boundary Conditions
BS	Black Sea
BFM	Biogeochemical Flux Model
CF	Climate Forecast (convention for NetCDF)
CHL	Chlorophyll
CMEMS	Copernicus Marine Environment Monitoring Service
DGF	DirectGetFile
DIC	Dissolved Inorganic Carbon
DirectGetFile	CMEMS service tool (FTP like) to download a NetCDF file
FAQ	Frequently Asked Question
Forecast (Numerical)	a computer forecast or prediction based on equations governing the motions and the forces affecting motion of fluids. The equations are based, or initialized, on specified ocean conditions at a certain place and time (NOAA Glossary).
FTP	File Transfer Protocol
GHER	Geo-Hydrodynamics Environmental Research laboratory of the Liege University(Belgium), and the synonym 3D circulation model
MFC	Monitoring and Forecasting Centre
NetCDF	Network Common Data Form
NOAA	National Oceanic and Atmospheric Administration

OCTAC	Ocean Color Thematic Assembly Centre
OpenDAP	Open-Source Project for a Network Data Access Protocol. Protocol to download subset of data from a n-dimensional gridded dataset (ie: 4 dimensions: lon-lat,depth,time)
pCO2	partial pressure of carbon dioxide
PFT	Plankton Functional Types
pH	potential of Hydrogen
PU	Production Unit
Subsetter	CMEMS service tool to download a NetCDF file of a selected geographical box using values of longitude and latitude, and time range
ULg MAST (ULg)	Université de Liège, Belgium Modelling for Aquatic SysTems research Unit
3DVAR	Three-Dimensional Variational

I INTRODUCTION

I.1 Summary

This document is the user manual for the CMEMS analysis and forecast product **BLKSEA_ANALYSIS_FORECAST_WAV_007_003**. It provides aggregated simulations updated daily with 10-day forecast. A rolling archive of simulations over the last two years up to real-time is available on the CMEMS server.

The wave products are the integrated parameters computed from the total wave spectrum (significant wave height, period, direction, Stokes drift,...etc), as well as the following partitions: the wind wave, the primary swell wave and the secondary swell wave.

The product is organised in 2 datasets:

- **bs-hzg-wav-an-fc-h** containing hourly instantaneous values for all the variables;
- **BLKSEA_ANALYSIS_FORECAST_WAV_007_003-statics** containing the coordinates, mask and bathymetry

The product is 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.

The simulation and forecasting system is described in the Quality Information Document (QUID): http://cmems-resources.cls.fr/documents/QUID/CMEMS-BS-QUID-007-003.pdf.
More detailed information can be obtained from http://marine.copernicus.eu/services-portfolio/contact-us/. See also News flash.

I.2 History of changes

- In Jan 2019, adding the description of static files
- In Apr 2020, new template and new timeseries temporal coverage, change of target delivery time from 00UTC to 12UTC

II PRODUCT DESCRIPTION

II.1 General Information about product

Product name	BLKSEA_ANALYSIS_FORECAST_WAV_007_003		
Geographical coverage	27.73°E → 41.96°E ; 40.86°N → 46.80°N		
Variables	Spectral significant wave height (Hm0) Spectral moments (-1,0) wave period (Tm-10) Spectral moments (0,2) wave period (Tm02) Wave period at spectral peak / peak period (Tp) Mean wave direction from (Mdir) Wave principal direction at spectral peak Stokes drift U Stokes drift V Spectral significant wind wave height Spectral moments (0,1) wind wave period Mean wind wave direction from Spectral significant primary swell wave height Spectral moments (0,1) primary swell wave period Mean primary swell wave direction from Spectral significant secondary swell wave height Spectral moments (0,1) secondary swell wave period Mean secondary swell wave direction from		
	Hindcast	**Forecast**	
Update frequency	daily	daily	
Available time series	last two years up to real-time	10-days forecast	
Target delivery time	Daily at 12:00 UTC of the day+1 from the nominal start of the forecast	Daily at 12:00 UTC of the day+1 from the nominal start of the forecast	
Temporal resolution	1-hourly instantaneous	1-hourly instantaneous	
Delivery mechanisms	Subsetter	DGF	FTP
Horizontal resolution	About 3 km (1/36° zonal resolution, 1/27° meridional resolution)		
Number of vertical levels	surface only		
Format	Netcdf CF1.0		

Detailed information on the systems and products are on CMEMS web site: http://marine.copernicus.eu

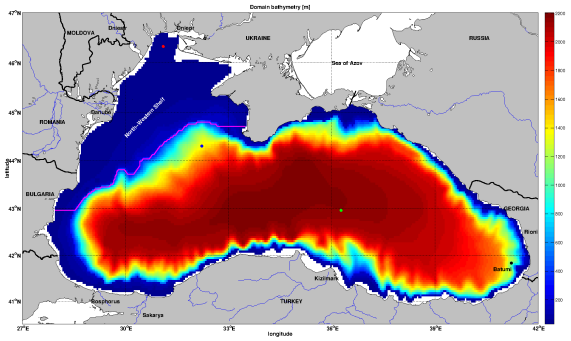
II.2 Details of the datasets

BLKSEA_ANALYSIS_FORECAST_WAV_007_003	
bs-hzg-wav-an-fc-h	contains all the variables.
	VHM0 [m] Spectral significant wave height (Hm0) sea_surface_wave_significant_height
	VTM10 [s] Spectral moments (-1,0) wave period (Tm-10) sea_surface_wave_mean_period_from_variance_spectral_density_inverse_frequency_moment
	VTM02 [s] Spectral moments (0,2) wave period (Tm02) sea_surface_wave_mean_period_from_variance_spectral_density_second_frequency_moment
	VTPK [s] Wave period at spectral peak / peak period (Tp) sea_surface_wave_period_at_variance_spectral_density_maximum
	VMDR [degree] Mean wave direction from (Mdir) sea_surface_wave_from_direction
	VPED [degree] Wave principal direction at spectral peak sea_surface_wave_from_direction_at_variance_spectral_density_maximum
	VSDX [m s-1] Stokes drift U sea_surface_wave_stokes_drift_x_velocity
	VSDY [m s-1] Stokes drift V sea_surface_wave_stokes_drift_y_velocity
	VHM0_WW [m] Spectral significant wind wave height sea_surface_wind_wave_significant_height
	VTM01_WW [s] Spectral moments (0,1) wind wave period sea_surface_wind_wave_mean_period
	VMDR_WW [degree] Mean wind wave direction from sea_surface_wind_wave_from_direction
	VHM0_SW1 [m] Spectral significant primary swell wave height sea_surface_primary_swell_wave_significant_height

	VTM01_SW1 [s] Spectral moments (0,1) primary swell wave period sea_surface_primary_swell_wave_mean_period
	VMDR_SW1 [degree] Mean primary swell wave direction from sea_surface_primary_swell_wave_from_direction
	VHM0_SW2 [m] Spectral significant secondary swell wave height sea_surface_secondary_swell_wave_significant_height
	VTM01_SW2 [s] Spectral moments (0,1) secondary swell wave period sea_surface_secondary_swell_wave_mean_period
	VMDR_SW2 [degree] Mean secondary swell wave direction from sea_surface_secondary_swell_wave_from_direction
BLKSEA_ANALYSIS_FORECAST_WAV_007_003-statics	contains the static fields for the system: coordinates, mask and bathymetry.
	e1t [m] Cell dimension along X axis
	e2t [m] Cell dimension along Y axis
	mask [1] Land-sea mask: 1 = sea ; 0 = land sea_binary_mask
	deptho [m] Bathymetry sea_floor_depth_below_geoid

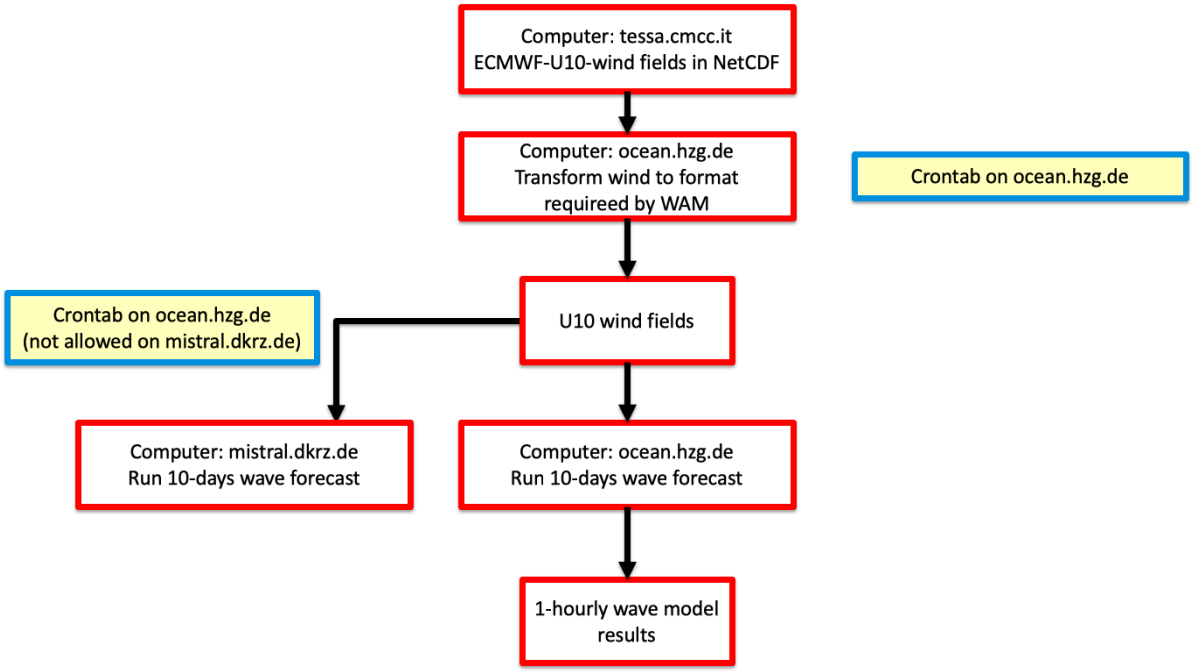
II.3 Product System Description

The third-generation spectral wave model WAM Cycle 4.6 has been adapted to the Black Sea area und runs successfully on the Sun-Cluster at HZG. The shallow water version is implemented on a spherical grid with a spatial resolution of about 3 km (133 * 100 sec) with 24 directional and 30 frequency bins. The number of active wave model grid points is 44699. The model considers depth refraction and wave breaking and provides currently three days forecast with one-hourly output once a day. The atmospheric forcing is taken from tessa.cmcc.it in NetCDF and locally (on ocean.hzg.de) transformed into WAM format forcing, following the PQWG metrics definitions. Detailed description.

Domain Resolution and grid Geographic coverage	BLKSEA (27.37°E → 41.96°E; 40.86°N → 46.80°N) ~3km ; regular grid ; 395 x 215 This product covers the Black Sea Area, the horizontal resolution is approx 3 km 
Algorithm	WAM
Atmospheric forcings	ECMWF atmospheric forcing at 1/8 degree: 6-hourly analysis and 3-hourly for the first 3 days of forecast
Assimilation scheme	N/A
Assimilated observations	N/A
Initial conditions	Zero initial Condition
Bathymetry	GEBCO 1min interpolated on the model grid

II.4 Processing information

The daily prediction system runs once per day. A schematic of the flow of data in the prediction system is shown below. In the forecast part of the cycle, the system is forced by the ECMWF 10m forecast winds at 1/8° resolution, at 3-hourly intervals for the first 72 hours of the forecast and at 6-hourly intervals from 90 to 240 hours of forecast.



BLKSEA_ANALYSIS_FORECAST_WAV_007_003 products temporal coverage: for the hourly instantaneous fields, every day J is available a time series starting over the last two years to the day J+10. Every day, the time series is updated 1-day of simulation and 10-days of forecast.

II.4.1 Update Time

The product is updated daily at 12:00 UTC of the day+1 from the nominal start of the forecast

II.4.2 Time coverage

A rolling archive of simulation over the last two years up to real-time is available.

II.4.3 Time averaging

The fields are 1-hourly instantaneous centered at noon (12:00 UTC) of J.

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: http://marine.copernicus.eu/web/34-products-and-services-faq.php#1

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

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

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

Once registered, the CMEMS FAQ http://marine.copernicus.eu/web/34-products-and-services-faq.php will guide you on how to download a product through the CMEMS Web Portal 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: http://marine.copernicus.eu/web/34-products-and-services-faq.php#1

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

IV FILES NOMENCLATURE AND FORMAT

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

BLKSEA_ANALYSIS_FORECAST_WAV_007_003 files nomenclature when downloaded through the CMEMS Web Portal Subsetter is based on product dataset name and a numerical reference related to the request date on the portal.

The scheme is: **datasetname_nnnnnnnnnnnnn.nc**

where :

- **datasetname**: as described previously
- **nnnnnnnnnnnnn**: 13 digit integer corresponding to the current time (download time) in milliseconds since January 1, 1970 midnight UTC.
- **.nc**: standard NetCDF filename extension.

Example: bs-hzg-wav-an-fc-h_1303461772348.nc

IV.2 Nomenclature of files when downloaded through the DGF and CMEMS FTP Services

BLKSEA_ANALYSIS_FORECAST_WAV_007_003 files nomenclature when downloaded through the CMEMS Web Portal DGF or FTP service is based as follows:

{valid date}_{freq flag}-{producer}--{parameter}-{config}-{region}-{bul date}_{product type}-fv{file version}.nc

where

- **valid date** YYYYMMDD is the validity day of the data in the file
- **freq flag** is the frequency of data values in the file (h = hourly)
- **producer** is a short version of the CMEMS production unit
- **parameter** is a four-letter code for the parameter or parameter set from Standard BODC
- **config** identifies the producing system and configuration
- **region** is a six-letter code for the region
- **bul date** bYYYYMMDD is the bulletin date the product was produced
- **product type** is a two-letter code for the product type, for example fc for forecast, an for analysis.
- **file version** is xx.yy where xx is the CMEMS version and yy is an incremental version number
-

Table 1 shows the nomenclature for the BLKSEA_ANALYSIS_FORECAST_WAV_007_003 product.

Table 1 Description of the nomenclature for BLKSEA_ANALYSIS_FORECAST_WAV_007_003

valid date	YYYYMMDD
freq flag	h (hourly)
producer	HZG
config	BSeas3
region	BS
parameter	WAVES
bul date	bYYYYYMMDD
product type	sm (hindcast) fc (forecast)
file version	07.00

Example for a forecast file:

`20161001_h-HZG--WAVES-BSeas3-BS-b20140306_fc-fv07.00.nc`

This file contains the hourly instantaneous fields of the wave parameters each one centered at 30' of every hour from noon (12:00 UTC) of the 30th September 2016 to noon (12:00 UTC) of the 1st October 2016.

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]
bs-hzg-wav-an-fc-h	{date1}_h-HZG-- WAVES -BSeas3-BS-b{date2}_sm-fv07.00.nc {date1}_h-HZG--WAVES-BSeas3-BS-b{date2}_fc-fv07.00.nc	264
BLKSEA_ANALYSIS_FORECAST_WAV_007_003-statics	BS-MFC_007_003_${field}.nc	1

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: 1e+20

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/
- ✓ IDL, Matlab, GMT…

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

IV.7 Structure and semantic of netCDF maps files

Table 1 Dimensions and variables included in the files NetCDF of BLKSEA_ANALYSIS_FORECAST_WAV_007_003

DIMENSIONS	VARIABLES		
lon=395 lat=215 time=24	**NAME**	**DIMENSIONS**	**TYPE**
	lon	lon	float
	lat	lat	float
	time	time	int
	VHM0	time,lat,lon	float
	VTM10	time,lat,lon	float
	VTM02	time,lat,lon	float
	VTPK	time,lat,lon	float
	VMDR	time,lat,lon	float
	VPED	time,lat,lon	float
	VSDX	time,lat,lon	float
	VSDY	time,lat,lon	float
	VHM0_WW	time,lat,lon	float
	VTM01_WW	time,lat,lon	float
	VMDR_WW	time,lat,lon	float
	VHM0_SW1	time,lat,lon	float
	VTM01_SW1	time,lat,lon	float
	VMDR_SW1	time,lat,lon	float
	VHM0_SW2	time,lat,lon	float
	VTM01_SW2	time,lat,lon	float
	VMDR_SW2	time,lat,lon	float

For 20160401_h-HZG--WAVES-BSeas3-BS-b20160402_fc-fv07.00.nc

```
netcdf \20160401_h-HZG--WAVES-BSeas3-BS-b20160402_fc-fv07.00.{
dimensions:
        lat = 215 ;
        lon = 395 ;
        time = UNLIMITED ; // (24 currently)
variables:
        float lat(lat) ;
                lat:units = "degrees_north" ;
                lat:long_name = "latitude" ;
                lat:standard_name = "latitude" ;
                lat:axis = "Y" ;
                lat:valid_max = 46.80458f;
                lat:valid_min = 40.86015f;
        float lon(lon) ;
                lon:units = "degrees_east" ;
                lon:long_name = "longitude" ;
                lon:standard_name = "longitude" ;
                lon:axis = "X" ;
                lon:valid_max = 41.96229f;
                lon:valid_min = 27.37007f;
        int time(time) ;
                time:units = "seconds since 1970-01-01 00:00:00" ;
                time:calendar = "standard" ;
                time:long_name = "time" ;
                time:standard_name = "time" ;
                time:axis = "T" ;
        float VHM0(time, lat, lon) ;
                VHM0:standard_name = "sea_surface_wave_significant_height" ;
                VHM0:long_name = "Spectral significant wave height (Hm0)" ;
                VHM0:units = "m" ;
                VHM0:_FillValue = 1.e+20f ;
                VHM0:valid_min = 0.f ;
                VHM0:valid_max = 20.f ;
                VHM0:missing_value = 1.e+20f ;
                VHM0:Coordinates = "time lat lon" ;
        float VTPK(time, lat, lon) ;
                VTPK:standard_name                                                    =
"sea_surface_wave_period_at_variance_spectral_density_maximum" ;
                VTPK:long_name = "Wave period at spectral peak / peak period (Tp)" ;
```

```
		VTPK:units = "s" ;
		VTPK:_FillValue = 1.e+20f ;
		VTPK:valid_min = 1.f ;
		VTPK:valid_max = 30.f ;
		VTPK:missing_value = 1.e+20f ;
		VTPK:Coordinates = "time lat lon" ;
	float VTM10(time, lat, lon) ;
		VTM10:standard_name = "sea_surface_wave_mean_period_from_variance_spectral_density_inverse_frequency_moment" ;
		VTM10:long_name = "Spectral moments (-1,0) wave period (Tm-10)" ;
		VTM10:units = "s" ;
		VTM10:_FillValue = 1.e+20f ;
		VTM10:valid_min = 1.f ;
		VTM10:valid_max = 20.f ;
		VTM10:missing_value = 1.e+20f ;
		VTM10:Coordinates = "time lat lon" ;
	float VTM02(time, lat, lon) ;
		VTM02:standard_name = "sea_surface_wave_mean_period_from_variance_spectral_density_second_frequency_moment" ;
		VTM02:long_name = "Spectral moments (0,2) wave period (Tm02)" ;
		VTM02:units = "s" ;
		VTM02:_FillValue = 1.e+20f ;
		VTM02:valid_min = 1.f ;
		VTM02:valid_max = 20.f ;
		VTM02:missing_value = 1.e+20f ;
		VTM02:Coordinates = "time lat lon" ;
	float VMDR(time, lat, lon) ;
		VMDR:standard_name = "sea_surface_wave_from_direction" ;
		VMDR:long_name = "Mean wave direction from (Mdir)" ;
		VMDR:units = "degree" ;
		VMDR:_FillValue = 1.e+20f ;
		VMDR:valid_min = 0.f ;
		VMDR:valid_max = 360.f ;
		VMDR:missing_value = 1.e+20f ;
		VMDR:Coordinates = "time lat lon" ;
	float VHM0_WW(time, lat, lon) ;
		VHM0_WW:standard_name = "sea_surface_wind_wave_significant_height" ;
		VHM0_WW:long_name = "Spectral significant wind wave height" ;
		VHM0_WW:units = "m" ;
```

```
		VHM0_WW:_FillValue = 1.e+20f ;
		VHM0_WW:valid_min = 0.f ;
		VHM0_WW:valid_max = 20.f ;
		VHM0_WW:missing_value = 1.e+20f ;
		VHM0_WW:Coordinates = "time lat lon" ;
	float VHM01_WW(time, lat, lon) ;
		VHM01_WW:standard_name = "sea_surface_wind_wave_mean_period" ;
		VHM01_WW:long_name = "Spectral moments (0,1) wind wave period" ;
		VHM01_WW:units = "s" ;
		VHM01_WW:_FillValue = 1.e+20f ;
		VHM01_WW:valid_min = 1.f ;
		VHM01_WW:valid_max = 20.f ;
		VHM01_WW:missing_value = 1.e+20f ;
		VHM01_WW:Coordinates = "time lat lon" ;
	float VMDR_WW(time, lat, lon) ;
		VMDR_WW:standard_name = "sea_surface_wind_wave_from_direction" ;
		VMDR_WW:long_name = "Mean wind wave direction from" ;
		VMDR_WW:units = "degree" ;
		VMDR_WW:_FillValue = 1.e+20f ;
		VMDR_WW:valid_min = 0.f ;
		VMDR_WW:valid_max = 360.f ;
		VMDR_WW:missing_value = 1.e+20f ;
		VMDR_WW:Coordinates = "time lat lon" ;
	float VHM0_SW1(time, lat, lon) ;
		VHM0_SW1:standard_name                                                    =
"sea_surface_primary_swell_wave_significant_height" ;
		VHM0_SW1:long_name = "Spectral significant primary swell wave height" ;
		VHM0_SW1:units = "m" ;
		VHM0_SW1:_FillValue = 1.e+20f ;
		VHM0_SW1:valid_min = 0.f ;
		VHM0_SW1:valid_max = 20.f ;
		VHM0_SW1:missing_value = 1.e+20f ;
		VHM0_SW1:Coordinates = "time lat lon" ;
	float VTM01_SW1(time, lat, lon) ;
		VTM01_SW1:standard_name = "sea_surface_primary_swell_wave_mean_period" ;
		VTM01_SW1:long_name = "Spectral moments (0,1) primary swell wave period"
;
		VTM01_SW1:units = "s" ;
		VTM01_SW1:_FillValue = 1.e+20f ;
		VTM01_SW1:valid_min = 1.f ;
```

```
		VTM01_SW1:valid_max = 25.f ;
		VTM01_SW1:missing_value = 1.e+20f ;
		VTM01_SW1:Coordinates = "time lat lon" ;
	float VMDR_SW1(time, lat, lon) ;
		VMDR_SW1:standard_name = "sea_surface_primary_swell_wave_from_direction"
;
		VMDR_SW1:long_name = "Mean primary swell wave direction from" ;
		VMDR_SW1:units = "degree" ;
		VMDR_SW1:_FillValue = 1.e+20f ;
		VMDR_SW1:valid_min = 0.f ;
		VMDR_SW1:valid_max = 360.f ;
		VMDR_SW1:missing_value = 1.e+20f ;
		VMDR_SW1:Coordinates = "time lat lon" ;
	float VHM0_SW2(time, lat, lon) ;
		VHM0_SW2:standard_name                                                =
"sea_surface_secondary_swell_wave_significant_height" ;
		VHM0_SW2:long_name = "Spectral significant secondary swell wave height"
;
		VHM0_SW2:units = "m" ;
		VHM0_SW2:_FillValue = 1.e+20f ;
		VHM0_SW2:valid_min = 0.f ;
		VHM0_SW2:valid_max = 20.f ;
		VHM0_SW2:missing_value = 1.e+20f ;
		VHM0_SW2:Coordinates = "time lat lon" ;
	float VTM01_SW2(time, lat, lon) ;
		VTM01_SW2:standard_name = "sea_surface_secondary_swell_wave_mean_period"
;
		VTM01_SW2:long_name  =  "Spectral  moments  (0,1)  secondary  swell  wave
period" ;
		VTM01_SW2:units = "s" ;
		VTM01_SW2:_FillValue = 1.e+20f ;
		VTM01_SW2:valid_min = 1.f ;
		VTM01_SW2:valid_max = 25.f ;
		VTM01_SW2:missing_value = 1.e+20f ;
		VTM01_SW2:Coordinates = "time lat lon" ;
	float VMDR_SW2(time, lat, lon) ;
		VMDR_SW2:standard_name                                                =
"sea_surface_secondary_swell_wave_from_direction" ;
		VMDR_SW2:long_name = "Mean secondary swell wave direction from" ;
		VMDR_SW2:units = "degree" ;
		VMDR_SW2:_FillValue = 1.e+20f ;
		VMDR_SW2:valid_min = 0.f ;
```

```
		VMDR_SW2:valid_max = 360.f ;
		VMDR_SW2:missing_value = 1.e+20f ;
		VMDR_SW2:Coordinates = "time lat lon" ;
	float VPED(time, lat, lon) ;
		VPED:standard_name = "sea_surface_wave_from_direction_at_spectral_peak"
;
		VPED:long_name = "Wave principal direction at spectral peak" ;
		VPED:units = "degree" ;
		VPED:_FillValue = 1.e+20f ;
		VPED:valid_min = 0.f ;
		VPED:valid_max = 360.f ;
		VPED:missing_value = 1.e+20f ;
		VPED:Coordinates = "time lat lon" ;
	float VSDX(time, lat, lon) ;
		VSDX:standard_name = "sea_surface_wave_stokes_drift_x_velocity" ;
		VSDX:long_name = "Stokes drift U" ;
		VSDX:units = "m/s" ;
		VSDX:_FillValue = 1.e+20f ;
		VSDX:valid_min = -1.f ;
		VSDX:valid_max = 1.f ;
		VSDX:missing_value = 1.e+20f ;
		VSDX:Coordinates = "time lat lon" ;
	float VSDY(time, lat, lon) ;
		VSDY:standard_name = "sea_surface_wave_stokes_drift_y_velocity" ;
		VSDY:long_name = "Stokes drift V" ;
		VSDY:units = "m/s" ;
		VSDY:_FillValue = 1.e+20f ;
		VSDY:valid_min = -1.f ;
		VSDY:valid_max = 1.f ;
		VSDY:missing_value = 1.e+20f ;
		VSDY:Coordinates = "time lat lon" ;
 // global attributes:
		:bulletin_type = "forecast" ;
		:institution = "Helmholtz Centre for Coastal Research - Geesthacht,
Germany" ;
		:source = "WAM Cycle 4.6" ;
		:contact = "servicedesk.cmems@mercator-ocean.eu" ;
		:references = "Please check in CMEMS catalogue the INFO section for
product BLKSEA_ANALYSIS_FORECAST_WAV_007_003 - http://marine.copernicus.eu" ;
		:comment = "Please check in CMEMS catalogue the INFO section for product
BLKSEA_ANALYSIS_FORECAST_WAV_007_003 - http://marine.copernicus.eu" ;
```

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:Conventions = "CF-1.0" ;
:bulletin_date = "20160402" ;
:field_type = "hourly_instantaneous_at_time_field" ;
:title = "Wave Products (2D) - Instantaneous Field "
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