PRODUCT USER MANUAL

For Black Sea Waves Reanalysis Product

BLKSEA_MULTIYEAR_WAV_007_006

Issue: 3.1

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RECORD TABLE

Issue	Date	§	Description of Change	Author	Validated By
1.0	04.02.2018	all	First version for V4 EIS	O. Krueger, A. Behrens, J. Staneva, S. Ciliberti	
1.1	21.01.2019	all	General revision and addition of static files description	R. Lecci, A. Behrens, J. Staneva	C. Derval
2.0	10.09.2020	all	New product name with new dataset. New template	R. Lecci, A. Behrens, J. Staneva, M. Ricker	C. Derval
2.1	15.01.2021	all	Addition of interim dataset	R. Lecci	C. Derval
3.0	29.11.2022	all	Quality improvement; Upstream data change; Dataset renaming	R. Lecci, J. Staneva, M. Ricker, A. Behrens	Copernicus Marine Product management
3.1	30.11.2023	all	Additional dataset; time series extension to 1950; addition of LATEMAR max. variables	R. Lecci, M. Ricker, J. Staneva, A. Behrens	

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GLOSSARY AND ABBREVIATIONS

BLK	Black Sea
CF	Climate Forecast (convention for NetCDF)
CLS	Collecte Localisation Satellites
CMAP	CPC Merged Analysis of *Precipitation*
CMS	Copernicus Marine Service
CTD	Conductivity Temperature Depth
DAC	Dynamic Atmospheric Correction
ECMWF	European Centre for Medium-Range Weather Forecasts
EOF	Empirical Orthogonal Function
FAQ	Frequently Asked Question
FTP	File Transfer Protocol
Hereon	Helmholtz-Zentrum Hereon (former HZG)
HZG	Helmholtz-Zentrum Geesthacht
Meridional Velocity	South to North component of the horizontal velocity vector
MFC	Monitoring and Forecasting Centre
NEMO	Nucleus 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	Copernicus Marine 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
Zonal Velocity	West to East component of the horizontal velocity vector

I INTRODUCTION

I.1 Summary

This document is the user manual for the Copernicus Marine multi-year reanalysis product **BLKSEA_MULTIYEAR_WAV_007_006**. An archive of reanalysis since 01/01/1950 is available on the Copernicus Marine 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 4 datasets:

- **cmems_mod_blk_wav_my_2.5km_PT1H-i** containing 1-hourly instantaneous values for all the variables
- **cmems_mod_blk_wav_myint_2.5km_PT1H-i** containing interim 1-hourly instantaneous values for all the variables
- **cmems_mod_blk_wav_my_2.5km-climatology_PT1M-m** containing a monthly climatology for significant wave height and Tm02 period
- **cmems_mod_blk_wav_my_2.5km_static** containing the coordinates, mask and bathymetry

The product is published on the Copernicus Marine dissemination server after automatic and human quality controls. Product is available on-line and disseminated through the Copernicus Marine Information System. Files downloaded are in NetCDF format.

The reanalysis system is described in the Quality Information Document (QUID).

Disclaimer: The quality of the product may vary during the proposed time series depending on the possible update of the system.

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

I.2 History of changes

Date	Description of changes and impacted product
Sept 2020	Change of product name including new datasets. New template.
Jan 2021	Addition of interim dataset
Nov 2022	Quality improvement; Upstream data change; Dataset renaming
Nov 2023	Additional dataset; Temporal extension; File format change

II DESCRIPTION OF THE PRODUCT SPECIFICATION

II.1 General Information

Product Line	BLKSEA_MULTIYEAR_WAV_007_006	
Geographical coverage	27.25°E → 42.00°E ; 40.50°N → 47.00°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 Maximum crest trough wave height (Hc,max) Height of the highest crest	
Product Type	**Reanalysis**	**Interim**
Update frequency	Once a year	Every month
Available time series	Since 1950 up to the previous year	Since the last day of Reanalysis up to the previous month
Target delivery time	NA	20th of each month at 12UTC
Temporal resolution	cmems_mod_blk_wav_my_2.5km_PT1H-i: 1-hourly instantaneous cmems_mod_blk_wav_myint_2.5km_PT1H-i: interim 1-hourly instantaneous cmems_mod_blk_wav_my_2.5km-climatology_PT1M-m: monthly means	
Horizontal resolution	About 2.5 km (1/40° zonal resolution, 1/40° meridional resolution)	

Number of vertical levels	Surface only
Format	NetCDF CF1.6
Delivery mechanisms	Subsetter FTP

II.2 Details of datasets

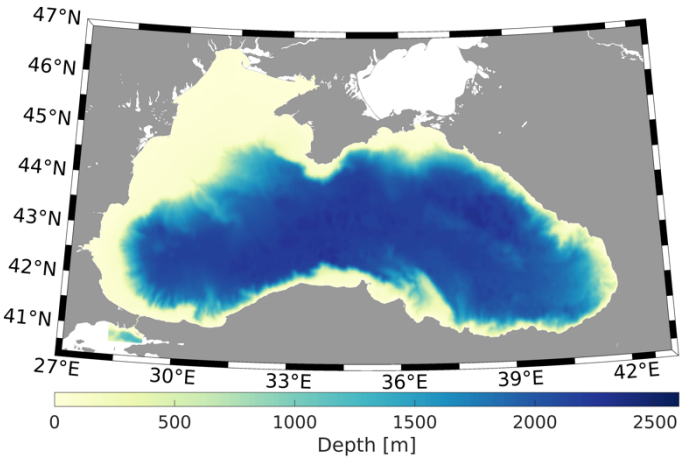
BLACKSEA_MULTIYEAR_WAV_007_006
Datasets: • **cmems_mod_blk_wav_my_2.5km_PT1H-i** contains 1-hourly instantaneous values for all the variables • **cmems_mod_blk_wav_myint_2.5km_PT1H-i** contains the interim 1-hourly instantaneous values for all the variables • **cmems_mod_blk_wav_my_2.5km-climatology_PT1M-m** contains a monthly climatology for significant wave height and Tm02 period • **cmems_mod_blk_wav_my_2.5km_static** contains the static fields for the system: coordinates, mask, and bathymetry **Variables name in the NetCDF file and Unit: Long_name & Standard_name**
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 [ms-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
VCMX [m] Maximum crest trough wave height (Hc,max) sea_surface_wave_maximum_height
VMXL [s] Height of the highest crest sea_surface_wave_maximum_crest_height
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

Table 2: List of the datasets and variable names and unit for the BLKSEA_MULTIYEAR_WAV_007_006 product

II.3 Production System Description

Domain Resolution and grid Geographic coverage	BLKSEA (27.25°E → 42.00°E; 40.50°N → 47.00°N) 1/40°; regular grid; 591 x 261 This product is composed by wave parameters at 1/40° horizontal resolution (approx. 2.5km) covering the Black Sea. 
Model Version Production unit Period of validation	▪ WAM Cycle 6 ▪ Helmholtz-Zentrum Hereon, Germany ▪ 15.01.2002–31.12.2021
Atmospheric forcing	1-h, 0.25° horizontal-resolution ERA5 reanalysis 10m-above-sea-surface winds from the European Centre for Medium-Range Weather Forecasts (ECMWF)
Boundary forcing	N/A
Assimilation scheme	Sequential optimal interpolation
Assimilated observations	Significant wave height and wind speed
Initial conditions (spin-up process)	Initial 2-d-wave spectrum generated via fetch law from local wind field
Bathymetry	GEBCO 30sec interpolated on the model grid

BLKSEA_MULTIYEAR_WAV_007_006 timeseries extension is performed once a year. The interim datasets are instead updated every month M to cover M-1, following the processing chain as represented in the figure below. Every year Y, at a corresponding EIS or end of production, we will add 1 month of BLK-REA Interim in operational model (light green with dashed line); once a year (usually in Nov, highlighted in red), the BLK-WAV REA will be extended up to Y-1 before the EIS (dark green), replacing the previous Interim update and then the BLK-WAV REA Interim will be calculated to cover the period between the end of the timeseries extension and the starting of the Interim update.

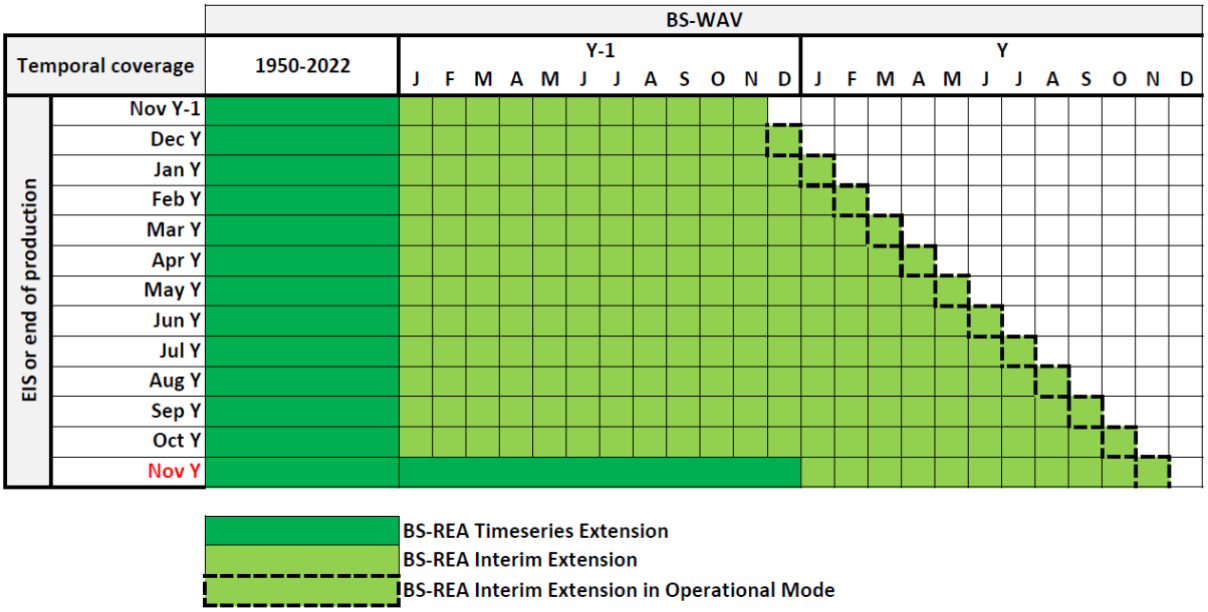


Figure 1: BLK-WAV production chain.

II.3.1.1 Observational Data

Observational data are assimilated into the system using the sequential optimal interpolation scheme. Presently the following data are assimilated:

- Altimetric significant wave height and wind speed observations from the Jason-1, Jason-2, and Jason-3 satellites provided by AVISO (https://www.aviso.altimetry.fr/en/home.html).

II.4 Grid

BLK-WAV analysis and forecast product is delivered on a regular grid (coinciding with the native model grid) covering the whole Black Sea at 1/40° resolution. The grid covers the geographical area 27.25°E → 42.00°E; 40.50°N → 47.00°N and its size is 591 x 261. All wave variables are provided at the same horizontal resolution (1/40°, approx. 2.4km)

II.5 Processing information

II.5.1 Update Time

The Black Sea Waves reanalysis has been initialized on the 1st of January 1950. The first month is considered as the period of model spin up and should be used with care.

The Black Sea Waves Interim dataset is updated monthly on the 20th (addition of the previous month).

II.5.2 Temporal extent of analysis and forecast stored on delivery mechanism

The product is available from 01/01/1950 until Y-1.

II.5.3 Time averaging

The fields are 1-hourly instantaneous at 00, 01, 02, …, 23 UTC.

The climatology contains monthly averaged fields. The period on which the climatology is based is given in the file name: date3: begin of the period, date4: end of the period (see also section IV.4).

III DOWNLOAD A PRODUCT

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

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

IV FILES NOMENCLATURE

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

BLKSEA_MULTIYEAR_WAV_007_006 files nomenclature when downloaded through the Copernicus Marine 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_nnnnnnnnnnnn.nc**

where:

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

Example: cmems_mod_blk_wav_my_2.5km_PT1H-i_1303461772348.nc

IV.2 Nomenclature of files when downloaded through the CMS Web Portal DirectGetFile or CMS FTP Service

BLKSEA_MULTIYEAR_WAV_007_006 files nomenclature when downloaded through the Copernicus Marine FTP service is based as follows:

{valid date}_{freq flag}-{producer}--{parameter}-{config}-{region}-{bul date}_{product type}-sv{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, hts = hourly time series, d = daily, m=monthly)
- **producer** is a short version of the Copernicus Marine production unit
- **config** identifies the producing system and configuration
- **region** is a six-letter code for the region
- **parameter** is a four-letter code for the parameter or parameter set from Standard BODC.
- **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 and sm for hindcast.

- **file version** is xx.yy where xx is the Copernicus Marine version (03, 04 or 05) and yy is an incremental version number

Table 3 shows the nomenclature for the BLKSEA_MULTIYEAR_WAV_007_006 product.

Table 3: Description of the nomenclature for BLKSEA_MULTIYEAR_WAV_007_006

valid date or period for climatology	YYYYMMDD
freq flag	h (hourly) m (monthly) cli (climatology)
producer	Hereon
config	BSeas4
region	BS
parameter	WAVE
bul date	bYYYYMMDD
product type	re (reanalysis) in (interim)
file version	08.00

Example for a reanalysis file of wave height:

`19500115_h-Hereon--WAVES-BSeas4-BS-b20230524_re-sv08.00.nc`

This file contains the 24 hourly instantaneous fields of the wave parameters of every hour from midnight (00:00 UTC) of the 15th January 1950 to 23:00 UTC of the 15th January 1950.

IV.3 Other information: mean centre of Products, land mask value, missing value

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.4 File size

DATASET NAME	FILE NAME	DIMENSION [MB]
cmems_mod_blk_wav_my_2.5km_PT1H-i	{date1}_h-Hereon--WAVE-BSeas4-BS-b{date2}_re-sv08.00.nc	86
cmems_mod_blk_wav_myint_2.5km_PT1H-i	{date1}_h-Hereon--WAVE-BSeas4-BS-b{date2}_in-sv08.00.nc	86
cmems_mod_blk_wav_my_2.5km-climatology_PT1M-m	{date3}-{date4}_cli-Hereon--WAVE-BSeas4-BS-b{date2}_re-sv08.00.nc	30
cmems_mod_blk_wav_my_2.5km_static	BS-MFC_007_006_${field}.nc	2

V FILE FORMAT

V.1 NetCDF

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 (http://www.unidata.ucar.edu/software/netcdf/) for more information, and to retrieve netCDF software package.

NetCDF data format 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.

The products are compliant with the NetCDF Climate and Forecast Convention CF-1.4 (see http://cf-pcmdi.llnl.gov/).

The BLKSEA_MULTIYEAR_WAV_007_006 product is distributed in netCDF4 format.

V.2 Reader Software

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

- ✓ ncBrowse: http://www.epic.noaa.gov/java/ncBrowse/,
- ✓ NetCDF Operator (NCO): http://nco.sourceforge.net/
- ✓ IDL, Matlab, Panoply, GMT…

V.3 Structure and semantic of netCDF maps files

The model output files contain some additional fields in addition to the variables mentioned earlier. An example output NetCDF file header for cmems_mod_blk_wav_my_2.5km_PT1H-i is inserted below, with the additional fields in italic fonts.

netcdf \19500115_h-Hereon--WAVES-BSeas4-BS-b20230524_re-sv08.00 {
dimensions:
time = UNLIMITED ; // (24 currently)
lon = 591 ;
lat = 261 ;
variables:
float lon(lon) ;
lon:standard_name = "longitude" ;
lon:long_name = "longitude" ;
lon:units = "degrees_east" ;
lon:axis = "X" ;
lon:valid_max = 42.f ;
lon:valid_min = 27.25f ;
float lat(lat) ;
lat:standard_name = "latitude" ;
lat:long_name = "latitude" ;
lat:units = "degrees_north" ;
lat:axis = "Y" ;
lat:valid_max = 47.f ;
lat:valid_min = 40.5f ;
double time(time) ;
time:standard_name = "time" ;
time:long_name = "time" ;
time:units = "seconds since 1950-01-01 00:00:00" ;
time:calendar = "standard" ;
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 VTM01_WW(time, lat, lon) ;
VTM01_WW:standard_name = "sea_surface_wind_wave_mean_period" ;
VTM01_WW:long_name = "Spectral moments (0,1) wind wave period" ;
VTM01_WW:units = "s" ;
VTM01_WW:_FillValue = 1.e+20f ;
VTM01_WW:valid_min = 1.f ;
VTM01_WW:valid_max = 20.f ;
VTM01_WW:missing_value = 1.e+20f ;
VTM01_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 VPED(time, lat, lon) ;
VPED:standard_name = "sea_surface_wave_from_direction_at_variance_spectral_density_maximum" ;
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 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 = 0.f ;
VTM01_SW1:valid_max = 30.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 = 0.f ;
VTM01_SW2:valid_max = 30.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 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" ;
float VMXL(time, lat, lon) ;
VMXL:standard_name = "sea_surface_wave_maximum_crest_height" ;
VMXL:long_name = "Height of the highest crest" ;
VMXL:units = "m" ;
VMXL:_FillValue = 1.e+20f ;
VMXL:valid_min = 0.f ;
VMXL:valid_max = 30.f ;
VMXL:missing_value = 1.e+20f ;

VMXL:Coordinates = "time lat lon" ;
float VCMX(time, lat, lon) ;
VCMX:standard_name = "sea_surface_wave_maximum_height" ;
VCMX:long_name = "Maximum crest trough wave height (Hc,max)" ;
VCMX:units = "m" ;
VCMX:_FillValue = 1.e+20f ;
VCMX:valid_min = 0.f ;
VCMX:valid_max = 50.f ;
VCMX:missing_value = 1.e+20f ;
VCMX:Coordinates = "time lat lon" ;

// global attributes:
:bulletin_type = "reanalysis" ;
:institution = "Helmholtz-Zentrum Hereon, Germany" ;
:source = "WAM Cycle 6" ;
:contact = "servicedesk.cmems@mercator-ocean.eu" ;
:references = "Please check in CMEMS catalogue the INFO section for product BLKSEA_ANALYSISFORECAST_WAV_007_006 - http://marine.copernicus.eu" ;
:comment = "Please check in CMEMS catalogue the INFO section for product BLKSEA_ANALYSISFORECAST_WAV_007_006 - http://marine.copernicus.eu" ;
:conventions = "CF-1.6" ;
:bulletin_date = "20230524" ;
:field_type = "hourly_instantaneous_at_time_field" ;
:title = "Wave Products (2D) - Instantaneous Field" ;

VI REFERENCES

Quality Information Document (QUID):
https://catalogue.marine.copernicus.eu/documents/QUID/CMEMS-BS-QUID-007_006.pdf

Citation of the dataset:
Staneva, J., Ricker, M., & Behrens, A. (2022). Black Sea Waves Reanalysis (Copernicus Marine Service BS-Waves, EAS4 system) (Version 1) [Data set]. Copernicus Monitoring Environment Marine Service (CMEMS). https://doi.org/10.25423/CMCC/BLKSEA_MULTIYEAR_WAV_007_006_EAS4