PRODUCT USER MANUAL

For Mediterranean Sea Waves Analysis and Forecasting Product

MEDSEA_ANALYSIS_FORECAST_WAV_006_017

Issue: 1.3

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Issue	Date	§	Description of Change	Author	Validated By
1.0	25/01/2018	all	Initial version	G. Korres, M. Ravdas, A. Zacharioudaki, A. Chalkiopoulos, D. Denaxa, R. Lecci	
1.1	21/01/2019	all	New template and addition of new datasets	R. Lecci, D. Denaxa	
1.2	06/12/2019	all	- Release of forecast cycle at 00:00 UTC - Change of product's dataset name	R. Lecci, D. Denaxa	
1.3	03/04/2020	all	Revision of timeseries temporal coverage	R. Lecci, D. Denaxa	

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GLOSSARY AND ABBREVIATIONS

CF	Climate Forecast (convention for NetCDF)
CMEMS	Copernicus Marine Environment Monitoring Service
ECMWF	European Centre for Medium-Range Weather Forecasts
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
Med/MED	Mediterranean
MFC	Monitoring and Forecasting Centre
MFS	Mediterranean Forecasting System
NetCDF	Network Common Data Form
NOAA	National Oceanic and Atmospheric Administration
NWP	Numerical Weather Prediction
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)
PU	Production Unit
SL	Sea Level
SLA	Sea Level Anomaly
SSH	Sea Surface Height
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

WAM	Third generation Wave Prediction Model

I INTRODUCTION

I.1 Summary

This document is the user manual for the CMEMS analysis and forecast product **MEDSEA_ANALYSIS_FORECAST_WAV_006_017**. It provides aggregated analyses updated daily with 10-day forecast. A rolling archive of analysis 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:

- **med00-hcmr-wav-an-fc-h** containing 1-hourly instantaneous values for all the variables

- **MEDSEA_ANALYSIS_FORECAST_WAV_006_017-statics** containing the coordinates, mask and bathymetry

It is updated as follows every day:

- the time series (analysis from the previous day and 10 days forecast) is updated at the end of the operational production process
- old obsolete forecasts are deleted from the server

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 analysis and forecasting system is described in the Quality Information Document (QUID): http://cmems-resources.cls.fr/documents/QUID/CMEMS-MED-QUID-006-017.pdf .

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

I.2 History of changes

21.01.2019	New hourly datasets and general revision
06.12.2019	- Changing forecast cycle from 12:00 UTC to 00:00 UTC - Changing product's dataset name - Correction of valid_min & valid_max attributes in Netcdf variables
03.04.2020	Revision of timeseries temporal coverage

II PRODUCT DESCRIPTION

II.1 General Information about products

Product name	MEDSEA_ANALYSIS_FORECAST_WAV_006_017		
Geographical coverage	18.125°W → 36.2917°E; 30.1875°N → 45.9792°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		
	Analysis		**Forecast**
Update frequency	daily		daily
Available time series	last two years up to real-time		10-days forecast
Target delivery time	Daily at 20:00 UTC		Daily at 20:00 UTC
Temporal resolution	1-hourly instantaneous		1-hourly instantaneous
Delivery mechanisms	Subsetter	DGF	FTP
Horizontal resolution	1/24 °		
Number of vertical levels	surface only		
Format	NetCDF CF1.6		

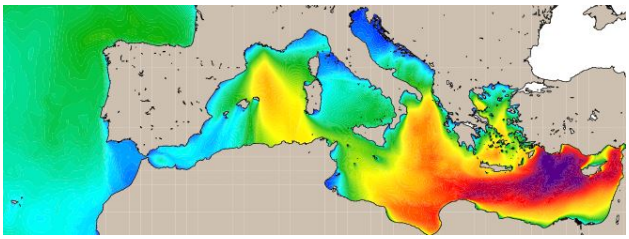
II.2 Details of the datasets

MEDSEA_ANALYSIS_FORECAST_WAV_006_017	
med00-hcmr-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
MEDSEA_ANALYSIS_FORECAST_WAV_006_017-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 wave component of the Mediterranean Forecasting System (Med-Waves) is a wave model based on WAM Cycle 4.6.2 with proper tuning and maximum spectral steepness limitation and it has been developed as a nested sequence of two computational grids (coarse and fine) to ensure that swell propagating from the North Atlantic (NA) towards the strait of Gibraltar is correctly entering the Mediterranean Sea (MED). The coarse grid covers the North Atlantic Ocean from 75°W to 10°E and from 70°N to 10°S in 1/6° resolution while the nested fine grid covers the Mediterranean Sea from 18.125°W to 36.2917°E and from 30.1875°N to 45.9792°N with a 1/24° (~4.6km) resolution. The Med-Waves modelling system resolves the prognostic part of the wave spectrum with 24 directional and 32 logarithmically distributed frequency bins and the model solutions are corrected by an optimal interpolation data assimilation scheme of along track satellite significant wave height observations. The system provides a Mediterranean wave analysis and 10 days Mediterranean wave forecasts updated daily.

Domain	MED (18.125° W 36.2917° E ; 30.1875° N 45.9792° N)
Resolution and grid	1/24°; regular grid; 1307 x 380
Geographic coverage	This product is composed by wave parameters at 1/24° horizontal resolution (approx. 4.6km) covering the Mediterranean Sea and extending up to -18.125°W into the Atlantic Ocean. 
Algorithm	WAM 4.6.2
Atmospheric forcings	ECMWF 10m-above-sea-surface winds (1/8 °, varying temporal resolution)
Assimilation scheme	Optimal interpolation
Assimilated observations	All available along-track satellite Significant Wave Height observations by CMEMS
Bathymetry	GEBCO

II.4 Processing information

The daily prediction system runs once per day (starting at 00:00 UTC) and it is scheduled to simulate 264 hours — 24 hours in the past (analysis) blending through data assimilation model results with available SWH satellite observations and 240 hours into the future (the forecast mode). 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.

The Mediterranean Sea model is forced by daily averaged surface currents obtained from CMEMS Med MFC at 1/24° resolution and the North Atlantic model is forced by daily averaged surface currents obtained from the CMEMS Global MFC at 1/12°. ECMWF sea ice remains constant during the forecast cycle. In the analysis part of the cycle, the system uses 6-hourly ECMWF analysis winds, daily averaged analysis currents, a daily analysis sea ice field and all available SWH along track

satellite observations from CMEMS SL TAC. At the end of the analysis mode a restart file is written that forms the basis (initial conditions) for the next cycle.

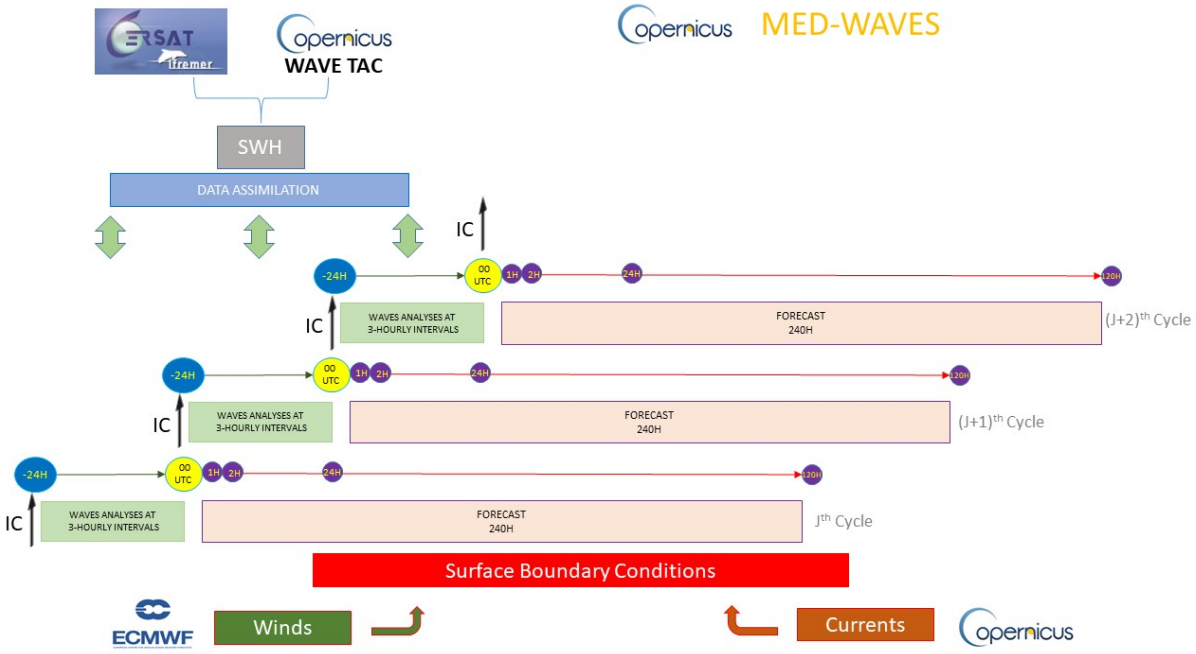


Figure 1 Scheme of the production chain MEDSEA_ANALYSIS_FORECAST_WAV_006_017

MEDSEA_ANALYSIS_FORECAST_WAV_006_017 product temporal coverage: for the hourly fields, every day J is available a time series over the last two years to the day J+10. The last ten days of the time series are forecast fields, while the remaining days are analysis. Every day, the time series is updated with one day of analysis and ten days of forecast.

Production Day	FC Cycle	Day	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Monday	**1**	**Mo**	A	F	F	F	F	F	F	F	F	F	F							
Tuesday	1	Tu	A	A	F	F	F	F	F	F	F	F	F	F						
Wednesday	1	We	A	A	A	F	F	F	F	F	F	F	F	F	F					
Thursday	1	Th	A	A	A	A	F	F	F	F	F	F	F	F	F	F				
Friday	1	Fr	A	A	A	A	A	F	F	F	F	F	F	F	F	F	F			
Saturday	1	Sa	A	A	A	A	A	A	F	F	F	F	F	F	F	F	F	F		
Sunday	1	Su	A	A	A	A	A	A	A	F	F	F	F	F	F	F	F	F	F	
Monday	**2**	**Mo**	A	A	A	A	A	A	A	A	F	F	F	F	F	F	F	F	F	F

A	Aggregated time-series of hourly analysis
A	Analysis 1hr instantaneous
F	Forecast 1hr instantaneous

Figure 2 Example of aggregated product

II.4.1 Update Time

The product is updated daily at 20:00 UTC.

II.4.2 Time coverage

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

II.4.3 Time averaging

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

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

MEDSEA_ANALYSIS_FORECAST_WAV_006_017 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: med00-hcmr-wav-an-fc-h_1303461772348.nc

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

MEDSEA_ANALYSIS_FORECAST_WAV_006_017 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}-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)
- **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 MEDSEA_ANALYSIS_FORECAST_WAV_006_017 product.

Table 1 Description of the nomenclature for MEDSEA_ANALYSIS_FORECAST_WAV_006_017

valid date	YYYYMMDD
freq flag	h (hourly)
producer	HCMR
config	MEDWAM3
region	MEDATL
parameter	WAVE
bul date	bYYYYMMDD
product type	an (analysis) fc (forecast)
file version	06.00

Example for a forecast file:

`20181227_h-HCMR--WAVE-MEDWAM3-MEDATL-b20181227_fc-sv06.00.nc.`

This file contains the hourly instantaneous fields of the wave parameters listed analytically in Table 2, from 00:00 UTC of the 27th of December 2018 to 23:00 UTC of the 27th of December 2018.

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	FILE NAME	DIMENSION [MB]
med00-hcmr-wav-an-fc-h	{date1}_h-HCMR--WAVE-MEDWAM3-MEDATL-b{date2}_an-sv06.00.nc {date1}_h-HCMR--WAVE-MEDWAM3-MEDATL-b{date2}_fc-sv06.00.nc	145
MEDSEA_ANALYSIS_FORECAST_WAV_006_017-statics	MED-MFC_006_017_${field}.nc	0.938

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 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 2 Dimensions and variables included in the files NetCDF of MEDSEA_ANALYSIS_FORECAST_WAV_006_017

DIMENSIONS	VARIABLES

	NAME	DIMENSIONS	TYPE
lon=1307 lat=380 time=24	lon	lon	float
	lat	lat	float
	time	time	int
	VHM0	time,lat,lon	short
	VTPK	time,lat,lon	short
	VTM10	time,lat,lon	short
	VTM02	time,lat,lon	short
	VMDR	time,lat,lon	short
	VHM0_WW	time,lat,lon	short
	VTM01_WW	time,lat,lon	short
	VMDR_WW	time,lat,lon	short
	VHM0_SW1	time,lat,lon	short
	VHM0_SW2	time,lat,lon	short
	VTM01_SW1	time,lat,lon	short
	VTM01_SW2	time,lat,lon	short
	VMDR_SW1	time,lat,lon	short
	VMDR_SW2	time,lat,lon	short
	VPED	time,lat,lon	short
	VSDX	time,lat,lon	short
	VSDY	time,lat,lon	short

For 20180101_h-HCMR--WAVE-MEDWAM3-MEDATL-b20180102_an-sv06.00.nc:

```
netcdf \20180101_h-HCMR--WAVE-MEDWAM3-MEDATL-b20180102_an-sv06.00 {
dimensions:
        time = UNLIMITED ; // (24 currently)
        latitude = 380 ;
```

```
        longitude = 1307 ;
variables:
        float latitude(latitude) ;
                latitude:standard_name = "latitude" ;
                latitude:units = "degrees_north" ;
                latitude:long_name = "latitude" ;
                latitude:axis = "Y" ;
                latitude:valid_min = 30.1875f ;
                latitude:valid_max = 45.97917f ;
                latitude:step = 0.042f ;
        float longitude(longitude) ;
                longitude:standard_name = "longitude" ;
                longitude:units = "degrees_east" ;
                longitude:long_name = "longitude" ;
                longitude:axis = "X" ;
                longitude:valid_min = -18.125f ;
                longitude:valid_max = 36.29167f ;
                longitude:step = 0.042f ;
        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" ;
                time:step = 3600 ;
        short VHM0(time, latitude, longitude) ;
                VHM0:scale_factor = 0.001f ;
                VHM0:add_offset = 0.f ;
                VHM0:_FillValue = -32767s ;
                VHM0:missing_value = -32767s ;
                VHM0:long_name = "Spectral significant wave height (Hm0)" ;
                VHM0:standard_name = "sea_surface_wave_significant_height" ;
                VHM0:coordinates = "time latitude longitude" ;
                VHM0:units = "m" ;
                VHM0:valid_min = 0s ;
                VHM0:valid_max = 30000s ;
                VHM0:type_of_analysis = "spectral analysis" ;
                VHM0:WMO = 100 ;
        short VTPK(time, latitude, longitude) ;
                VTPK:scale_factor = 0.001f ;
```

```
                VTPK:add_offset = 0.f ;
                VTPK:_FillValue = -32767s ;
                VTPK:missing_value = -32767s ;
                VTPK:long_name = "Wave period at spectral peak / peak period (Tp)"
;
                VTPK:standard_name                                              =
"sea_surface_wave_period_at_variance_spectral_density_maximum" ;
                VTPK:coordinates = "time latitude longitude" ;
                VTPK:units = "s" ;
                VTPK:valid_min = 0s ;
                VTPK:valid_max = 32000s ;
                VTPK:type_of_analysis = "spectral analysis" ;
                VTPK:WMO = 204 ;
        short VTM10(time, latitude, longitude) ;
                VTM10:scale_factor = 0.001f ;
                VTM10:add_offset = 0.f ;
                VTM10:_FillValue = -32767s ;
                VTM10:missing_value = -32767s ;
                VTM10:long_name = "Spectral moments (-1,0) wave period (Tm-10)" ;
                VTM10:standard_name                                             =
"sea_surface_wave_mean_period_from_variance_spectral_density_inverse_frequency_mome
nt" ;
                VTM10:coordinates = "time latitude longitude" ;
                VTM10:units = "s" ;
                VTM10:valid_min = 0s ;
                VTM10:valid_max = 32000s ;
                VTM10:type_of_analysis = "spectral analysis" ;
                VTM10:WMO = 201 ;
        short VTM02(time, latitude, longitude) ;
                VTM02:scale_factor = 0.001f ;
                VTM02:add_offset = 0.f ;
                VTM02:_FillValue = -32767s ;
                VTM02:missing_value = -32767s ;
                VTM02:long_name = "Spectral moments (0,2) wave period (Tm02)" ;
                VTM02:standard_name                                             =
"sea_surface_wave_mean_period_from_variance_spectral_density_second_frequency_momen
t" ;
                VTM02:coordinates = "time latitude longitude" ;
                VTM02:units = "s" ;
                VTM02:valid_min = 0s ;
                VTM02:valid_max = 32000s ;
                VTM02:type_of_analysis = "spectral analysis" ;
```

```
                VTM02:WMO = 221 ;
        short VMDR(time, latitude, longitude) ;
                VMDR:scale_factor = 0.01f ;
                VMDR:add_offset = 180.f ;
                VMDR:_FillValue = -32767s ;
                VMDR:missing_value = -32767s ;
                VMDR:long_name = "Mean wave direction from (Mdir)" ;
                VMDR:standard_name = "sea_surface_wave_from_direction" ;
                VMDR:coordinates = "time latitude longitude" ;
                VMDR:units = "degree" ;
                VMDR:valid_min = -18000s ;
                VMDR:valid_max = 18000s ;
                VMDR:type_of_analysis = "spectral analysis" ;
                VMDR:WMO = 200 ;
        short VHM0_WW(time, latitude, longitude) ;
                VHM0_WW:scale_factor = 0.001f ;
                VHM0_WW:add_offset = 0.f ;
                VHM0_WW:_FillValue = -32767s ;
                VHM0_WW:missing_value = -32767s ;
                VHM0_WW:long_name = "Spectral significant wind wave height" ;
                VHM0_WW:standard_name  =  "sea_surface_wind_wave_significant_height"
;
                VHM0_WW:coordinates = "time latitude longitude" ;
                VHM0_WW:units = "m" ;
                VHM0_WW:valid_min = 0s ;
                VHM0_WW:valid_max = 30000s ;
                VHM0_WW:type_of_analysis = "spectral analysis" ;
                VHM0_WW:WMO = 102 ;
        short VTM01_WW(time, latitude, longitude) ;
                VTM01_WW:scale_factor = 0.001f ;
                VTM01_WW:add_offset = 0.f ;
                VTM01_WW:_FillValue = -32767s ;
                VTM01_WW:missing_value = -32767s ;
                VTM01_WW:long_name = "Spectral moments (0,1) wind wave period" ;
                VTM01_WW:standard_name = "sea_surface_wind_wave_mean_period" ;
                VTM01_WW:coordinates = "time latitude longitude" ;
                VTM01_WW:units = "s" ;
                VTM01_WW:valid_min = 0s ;
                VTM01_WW:valid_max = 32000s ;
                VTM01_WW:type_of_analysis = "spectral analysis" ;
```

```
                VTM01_WW:WMO = 223 ;
        short VMDR_WW(time, latitude, longitude) ;
                VMDR_WW:scale_factor = 0.01f ;
                VMDR_WW:add_offset = 180.f ;
                VMDR_WW:_FillValue = -32767s ;
                VMDR_WW:missing_value = -32767s ;
                VMDR_WW:long_name = "Mean wind wave direction from" ;
                VMDR_WW:standard_name = "sea_surface_wind_wave_from_direction" ;
                VMDR_WW:coordinates = "time latitude longitude" ;
                VMDR_WW:units = "degree" ;
                VMDR_WW:valid_min = -18000s ;
                VMDR_WW:valid_max = 18000s ;
                VMDR_WW:type_of_analysis = "spectral analysis" ;
                VMDR_WW:WMO = 101 ;
        short VPED(time, latitude, longitude) ;
                VPED:scale_factor = 0.01f ;
                VPED:add_offset = 180.f ;
                VPED:_FillValue = -32767s ;
                VPED:missing_value = -32767s ;
                VPED:long_name = "Wave principal direction at spectral peak" ;
                VPED:standard_name                                                  =
"sea_surface_wave_from_direction_at_variance_spectral_density_maximum" ;
                VPED:coordinates = "time latitude longitude" ;
                VPED:units = "degree" ;
                VPED:valid_min = -18000s ;
                VPED:valid_max = 18000s ;
                VPED:type_of_analysis = "spectral analysis" ;
                VPED:WMO = "" ;
        short VHM0_SW1(time, latitude, longitude) ;
                VHM0_SW1:scale_factor = 0.001f ;
                VHM0_SW1:add_offset = 0.f ;
                VHM0_SW1:_FillValue = -32767s ;
                VHM0_SW1:missing_value = -32767s ;
                VHM0_SW1:long_name  =  "Spectral  significant  primary  swell  wave
height" ;
                VHM0_SW1:standard_name                                              =
"sea_surface_primary_swell_wave_significant_height" ;
                VHM0_SW1:coordinates = "time latitude longitude" ;
                VHM0_SW1:units = "m" ;
                VHM0_SW1:valid_min = 0s ;
                VHM0_SW1:valid_max = 30000s ;
```

```
                VHM0_SW1:type_of_analysis = "spectral analysis" ;
                VHM0_SW1:WMO = 202 ;
        short VTM01_SW1(time, latitude, longitude) ;
                VTM01_SW1:scale_factor = 0.001f ;
                VTM01_SW1:add_offset = 0.f ;
                VTM01_SW1:_FillValue = -32767s ;
                VTM01_SW1:missing_value = -32767s ;
                VTM01_SW1:long_name = "Spectral moments (0,1) primary swell wave
period" ;
                VTM01_SW1:standard_name                                         =
"sea_surface_primary_swell_wave_mean_period" ;
                VTM01_SW1:coordinates = "time latitude longitude" ;
                VTM01_SW1:units = "s" ;
                VTM01_SW1:valid_min = 0s ;
                VTM01_SW1:valid_max = 32000s ;
                VTM01_SW1:type_of_analysis = "spectral analysis" ;
                VTM01_SW1:WMO = 226 ;
        short VMDR_SW1(time, latitude, longitude) ;
                VMDR_SW1:scale_factor = 0.01f ;
                VMDR_SW1:add_offset = 180.f ;
                VMDR_SW1:_FillValue = -32767s ;
                VMDR_SW1:missing_value = -32767s ;
                VMDR_SW1:long_name = "Mean primary swell wave direction from" ;
                VMDR_SW1:standard_name                                          =
"sea_surface_primary_swell_wave_from_direction" ;
                VMDR_SW1:coordinates = "time latitude longitude" ;
                VMDR_SW1:units = "degree" ;
                VMDR_SW1:valid_min = -18000s ;
                VMDR_SW1:valid_max = 18000s ;
                VMDR_SW1:type_of_analysis = "spectral analysis" ;
                VMDR_SW1:WMO = 107 ;
        short VHM0_SW2(time, latitude, longitude) ;
                VHM0_SW2:scale_factor = 0.001f ;
                VHM0_SW2:add_offset = 0.f ;
                VHM0_SW2:_FillValue = -32767s ;
                VHM0_SW2:missing_value = -32767s ;
                VHM0_SW2:long_name = "Spectral significant secondary swell wave
height" ;
                VHM0_SW2:standard_name                                          =
"sea_surface_secondary_swell_wave_significant_height" ;
                VHM0_SW2:coordinates = "time latitude longitude" ;
                VHM0_SW2:units = "m" ;
```

```
                VHM0_SW2:valid_min = 0s ;
                VHM0_SW2:valid_max = 30000s ;
                VHM0_SW2:type_of_analysis = "spectral analysis" ;
                VHM0_SW2:WMO = 203 ;
        short VTM01_SW2(time, latitude, longitude) ;
                VTM01_SW2:scale_factor = 0.001f ;
                VTM01_SW2:add_offset = 0.f ;
                VTM01_SW2:_FillValue = -32767s ;
                VTM01_SW2:missing_value = -32767s ;
                VTM01_SW2:long_name = "Spectral moments (0,1) secondary swell wave
period" ;
                VTM01_SW2:standard_name                                          =
"sea_surface_secondary_swell_wave_mean_period" ;
                VTM01_SW2:coordinates = "time latitude longitude" ;
                VTM01_SW2:units = "s" ;
                VTM01_SW2:valid_min = 0s ;
                VTM01_SW2:valid_max = 32000s ;
                VTM01_SW2:type_of_analysis = "spectral analysis" ;
                VTM01_SW2:WMO = 227 ;
        short VMDR_SW2(time, latitude, longitude) ;
                VMDR_SW2:scale_factor = 0.01f ;
                VMDR_SW2:add_offset = 180.f ;
                VMDR_SW2:_FillValue = -32767s ;
                VMDR_SW2:missing_value = -32767s ;
                VMDR_SW2:long_name = "Mean secondary swell wave direction from" ;
                VMDR_SW2:standard_name                                           =
"sea_surface_secondary_swell_wave_from_direction" ;
                VMDR_SW2:coordinates = "time latitude longitude" ;
                VMDR_SW2:units = "degree" ;
                VMDR_SW2:valid_min = -18000s ;
                VMDR_SW2:valid_max = 18000s ;
                VMDR_SW2:type_of_analysis = "spectral analysis" ;
                VMDR_SW2:WMO = 109 ;
        short VSDX(time, latitude, longitude) ;
                VSDX:scale_factor = 0.001f ;
                VSDX:add_offset = 0.f ;
                VSDX:_FillValue = -32767s ;
                VSDX:missing_value = -32767s ;
                VSDX:long_name = "Stokes drift U" ;
                VSDX:standard_name = "sea_surface_wave_stokes_drift_x_velocity" ;
                VSDX:coordinates = "time latitude longitude" ;
```

```
                VSDX:units = "m/s" ;
                VSDX:valid_min = -1000s ;
                VSDX:valid_max = 1000s ;
                VSDX:type_of_analysis = "spectral analysis" ;
                VSDX:WMO = 215 ;
        short VSDY(time, latitude, longitude) ;
                VSDY:scale_factor = 0.001f ;
                VSDY:add_offset = 0.f ;
                VSDY:_FillValue = -32767s ;
                VSDY:missing_value = -32767s ;
                VSDY:long_name = "Stokes drift V" ;
                VSDY:standard_name = "sea_surface_wave_stokes_drift_y_velocity" ;
                VSDY:coordinates = "time latitude longitude" ;
                VSDY:units = "m/s" ;
                VSDY:valid_min = -1000s ;
                VSDY:valid_max = 1000s ;
                VSDY:type_of_analysis = "spectral analysis" ;
                VSDY:WMO = 216 ;

// global attributes:
                :bulletin_type = "analysis" ;
                :institution = "Hellenic Centre for Marine Research (HCMR)-
Athens,Greece" ;
                :source = "MEDWAM3" ;
                :credit = "Copernicus Marine Environment Monitoring Service
(CMEMS)" ;
                :contact = "servicedesk.cmems@mercator-ocean.eu" ;
                :producer = "CMEMS-MED Monitoring and Forecasting Centre" ;
                :references = "Please check in CMEMS catalogue the INFO section for
product MEDSEA_ANALYSIS_FORECAST_WAV_006_017 - http://marine.copernicus.eu" ;
                :comment = "Please check in CMEMS catalogue the INFO section for
product MEDSEA_ANALYSIS_FORECAST_WAV_006_017 - http://marine.copernicus.eu" ;
                :Conventions = "CF-1.6" ;
                :area = "MED" ;
                :bulletin_date = "2018-01-02" ;
                :field_type = "hourly_instantaneous_at_time_field" ;
                :title = "Wave fields (2D) - Hourly Instantaneous" ;
}
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