



JERICO-NEXT Malta Summer School 2018

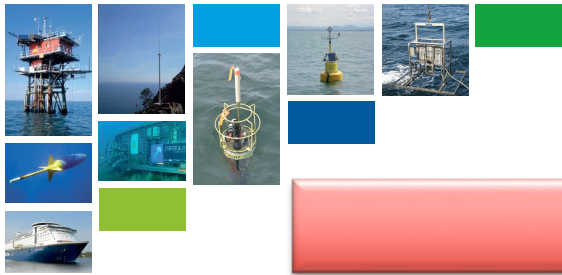
Operational Oceanography for Blue Growth

11th July 2018

CMEMS

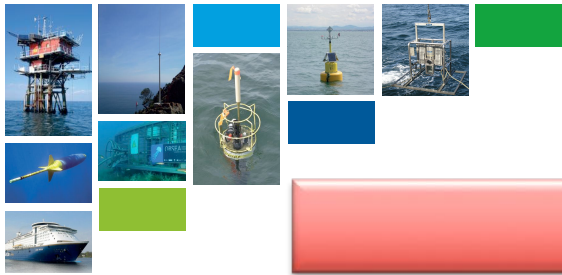
Satellite and Model products

R. Lecci – F. Palermo



Outline

- Download of CMEMS products
- CMEMS products:
 - Satellite
 - Models
- Practical Applications:
 - Environmental Monitoring
 - Means
 - Anomalies
 - STD
 - Correlations
 - Time series:
 - SOI
 - SSTA
 - Detrending
 - Filtering
 - Interpolation

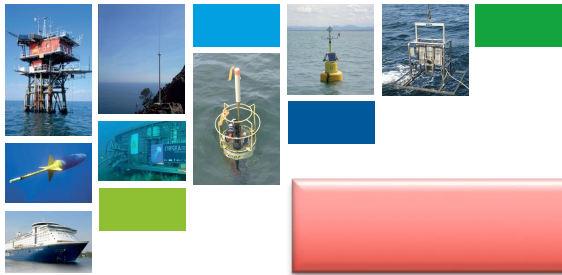


Download of CMEMS products

Register, for free,
on
<http://marine.copernicus.eu>

Services available without registration

- To discover the catalogue of products
- To get in-depth information on products
- To view products
- To access information on products quality
- To get news about products & services
- To use technical FAQs
- To learn latest improvements on products
- To exchange and share on an interactive web-based forum meant for current or future CMEMS users, for scientists implied in ocean knowledge, for CMEMS partners and more generally for the whole CMEMS community.



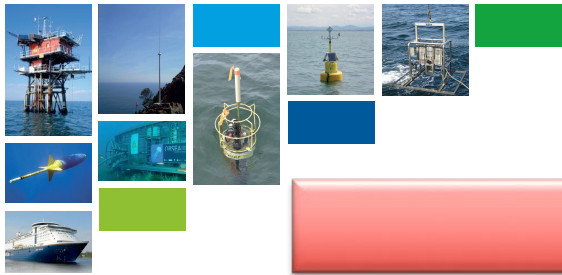
Download of CMEMS products

The screenshot shows the Copernicus Marine Environment Monitoring Service (CMEMS) website. At the top, the logo and name are displayed, along with the tagline "Providing PRODUCTS and SERVICES for all marine applications". A navigation menu includes "ABOUT US", "MARKETS & BENEFITS", "NEWS", "SCIENCE & MONITORING", "TRAINING & EDUCATION", and "SERVICES PORTFOLIO". A search bar is located in the top right corner.

The main content area is titled "ACCESS YOUR OCEAN INFORMATION" and features a world map background. Below the map, there are several interactive buttons: "OCEAN PRODUCTS" (with a description: "Ocean product catalogue, to download or visualize data across more than 50 variables, including historic, current and forecasted data."), "OCEAN MONITORING INDICATORS" (with a description: "Essential variables monitoring the health of the ocean"), "OCEAN STATE REPORT" (with a description: "Extensive annual analysis on the state of the ocean over nearly 20 years and severe/notable annual events"), "DATA" (highlighted with a red arrow), "TRENDS", and "EXPERTISE".

On the right side, there is a "SHORT-CUT TO SERVICES" sidebar with links for "REGISTER NOW!", "SCIENTIFIC QUALITY", "ONLINE TUTORIALS", and "COLLABORATIVE FORUM". Below this is a "LATEST NEWS FLASH" section with a date of "2018 26 JUN." and a headline: "CMEMS-8057 SEACE_ARC_SEACE_LL_NRT_5 product delayed on 2018-06-25 RESOLVED".

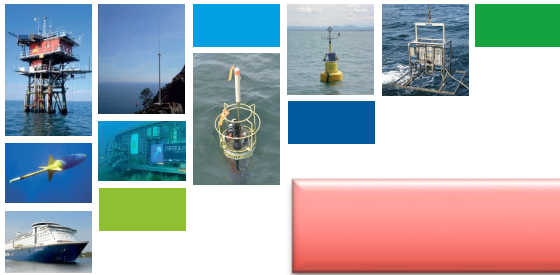
At the bottom, there is a section titled "OUR OCEAN STATE REPORT AWARDED THE DENNY MEDAL" with a "READ MORE" button and a photograph of two people receiving an award.



Download of CMEMS products

The screenshot shows the Copernicus Marine Environment Monitoring Service (CMEMS) website interface. At the top, there is a navigation bar with the European Commission logo and the text "COPERNICUS MARINE ENVIRONMENT MONITORING SERVICE". Below this, there are several menu items: ABOUT US, MARKETS & BENEFITS, NEWS, SCIENCE & MONITORING, TRAINING & EDUCATION, SERVICES PORTFOLIO, and a "SHORT-CUT TO SERVICES" dropdown. The main content area is titled "YOUR SEARCH" and displays search results for "Ocean products". A red arrow points to the "DATA" button in the search filters. The search results show two product entries:

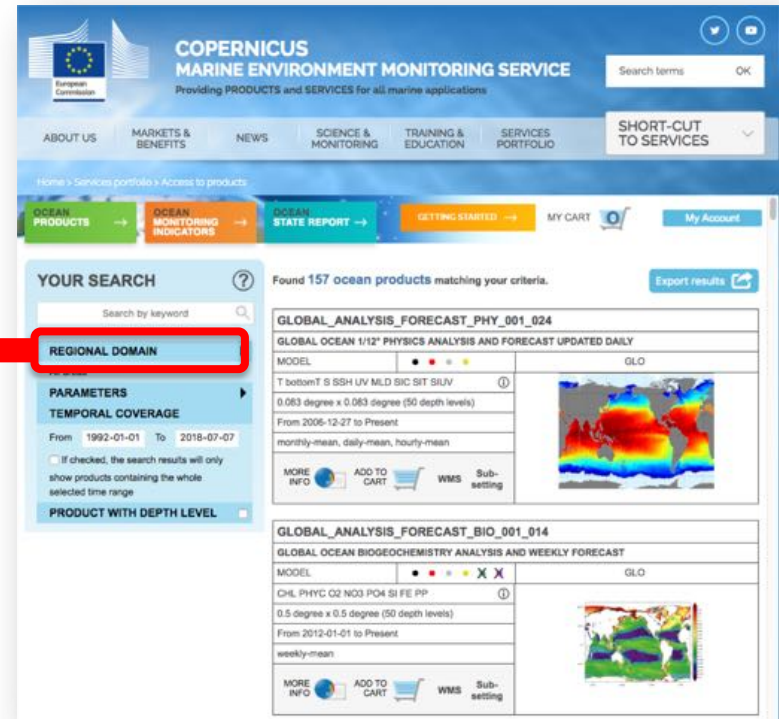
- GLOBAL_ANALYSIS_FORECAST_PHY_001_024**
GLOBAL OCEAN 1/12° PHYSICS ANALYSIS AND FORECAST UPDATED DAILY
MODEL: GLO
T bottomT B SSH LV MLD SIC SIT SILV
0.063 degree x 0.063 degree (50 depth levels)
From 2006-12-27 to Present
monthly-mean, daily-mean, hourly-mean
- GLOBAL_ANALYSIS_FORECAST_BIO_001_014**
GLOBAL OCEAN BIOGEOCHEMISTRY ANALYSIS AND WEEKLY FORECAST
MODEL: GLO
Chl PHYC O2 NO3 PO4 Si FE PP
0.5 degree x 0.5 degree (50 depth levels)
From 2012-01-01 to Present
weekly-mean

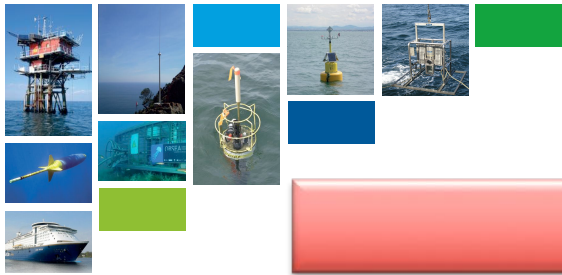


Download of CMEMS products

The interactive catalogue allows users to select products according to:

- **7 geographical areas :**
 - GLOBAL Ocean,
 - ARCTIC Ocean,
 - BALTIC Sea,
 - Atlantic-European North West Shelf-Ocean,
 - Atlantic-European South West Shelf-Ocean,
 - MEDITERRANEAN Sea,
 - BLACK Sea.
- **Parameters:**
 - Temperature,
 - Salinity,
 - Currents,
 - Sea Ice,
 - Sea Level,
 - Wind,
 - Ocean Optics,
 - Ocean Chemistry,
 - Ocean Biology,
 - Ocean Chlorophyll.
- **Time Coverage:**
 - FORECAST,
 - NEAR REAL TIME,
 - MULTI-YEAR,
 - TIME INVARIANT products (either from OBSERVATIONS or MODELLING).
- **Models or Observations** (Satellite or InSitu)
- **Grid type**
- **Time span**
- **Vertical coverage**
- **Processing Level**
- **Temporal resolution**



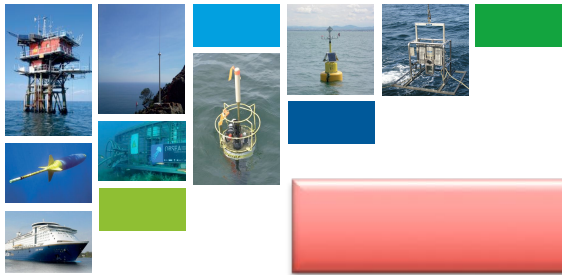


Download of CMEMS products

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 - Sea Ice,
 - Sea Level,
 - Wind,
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 - Ocean Chemistry,
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- **Models or Observations** (Satellite or InSitu)
- **Grid type**
- **Time span**
- **Vertical coverage**
- **Processing Level**
- **Temporal resolution**





Download of CMEMS products

COPERNICUS MARINE ENVIRONMENT MONITORING SERVICE
Providing PRODUCTS and SERVICES for all marine applications

Home > Services portfolio > Access to products

YOUR SEARCH Found 157 ocean products matching your criteria.

GLOBAL_ANALYSIS_FORECAST_PHY_001_024
GLOBAL OCEAN 1/12° PHYSICS ANALYSIS AND FORECAST UPDATED DAILY

MODEL: GLO
T bottomT S SSH UV MLD SIC SIT SILV
0.083 degree x 0.083 degree (50 depth levels)
From 2006-12-27 to Present
monthly-mean, daily-mean, hourly-mean

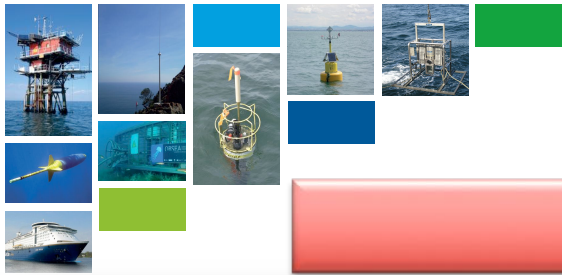
GLOBAL_ANALYSIS_FORECAST_PHY_001_024

GLOBAL OCEAN 1/12° PHYSICS ANALYSIS AND FORECAST UPDATED DAILY

Metadata provided by CMEMS
Credits: E.U. Copernicus Marine Service Information

DOWNLOAD PRODUCT

- ✓ CHOOSE A DATASET
- GLOBAL-ANALYSIS-FORECAST-PHY-001-024
 - GLOBAL-ANALYSIS-FORECAST-PHY-001-024-HOURLY-T-U-V-SSH
 - GLOBAL-ANALYSIS-FORECAST-PHY-001-024-MONTHLY
 - GLOBAL-ANALYSIS-FORECAST-PHY-001-024-STATICS



Download of CMEMS products

GLOBAL OCEAN 1/12° PHYSICS ANALYSIS AND FORECAST UPDATED DAILY

Metadata provided by CMEMS
Credits: E.U. Copernicus Marine Service Information

BACK TO SEARCH

ADD TO CART

VIEW PRODUCT

DOWNLOAD PRODUCT

INFORMATION DOCUMENTATION SERVICES NEWS FLASH

1 Select your dataset

GLOBAL-ANALYSIS-FORECAST-PHY-001-024
 GLOBAL-ANALYSIS-FORECAST-PHY-001-024-HOURLY-T-D-V-SSH
 GLOBAL-ANALYSIS-FORECAST-PHY-001-024-MONTHLY
 GLOBAL-ANALYSIS-FORECAST-PHY-001-024-STATICS

2 Select and apply your filters

GLOBAL-ANALYSIS-FORECAST-PHY-001-024

DATA ACCESS OPTION

DATASET FILTERS

GEOGRAPHICAL AREA

Click to download 3

Intersection between product coverage and area defined by user: **Product coverage.**

TIME RANGE

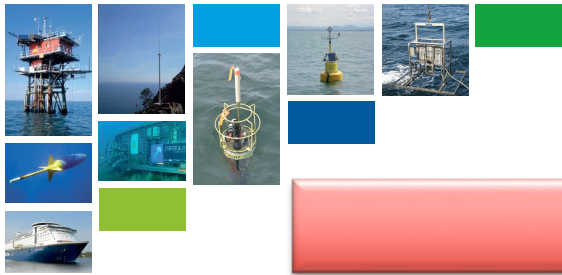
START DATE: 2018-07-06 12:00:00
 END DATE: 2018-07-08 12:00:00

DEPTH

START DEPTH: 0.493
 END DEPTH: 0.4942

VARIABLES (Uncheck All)

DOWNLOAD	NAME	DESCRIPTION	STANDARD NAME	UNITS
<input checked="" type="checkbox"/>	thetao	Temperature	sea_water_potential_temperature	degree_C
<input checked="" type="checkbox"/>	bottomT	Sea floor potential temperature	sea_water_potential_temperature_at_sea_floor	degree_C



Download of CMEMS products

Users are offered different on-line downloading options:

- To download the whole product.
- To extract and download only a part of a product (per area, per variable, for a period of time, some depths).
- To download automatically by using scripts (python) for a regular use.

According to chosen product, various download mechanisms are available:

- **SUBSETTER**: HTTPS protocol, allow to subset on (areas/ depth/ time/ variable), available for 75% of the products
- **DIRECTGETFILE**: HTTPS protocol, download the whole file with a time selection, available for 40% of the products
- **FTP**: FTP protocol, download the whole file, available for 85% of the products

The requested data is downloaded in Netcdf format

Python command line and Motu Client to launch a download request

```

VIEW SCRIPT
PURPOSE:
This section introduces the script download function: a multi-platform command line matching your data
extraction (also referred as data selection or data query), which can be executed from the shell of your system
(Windows/MacOS/Linux) thanks to a Python package called "motuclient".
It's intended for both Beginners and Expert users and is particularly useful to automate retrieval of
NearRealTimeForecast data production and to optimize heavy requests such as long timeseries.

REQUIREMENTS:
• Python (2.7.0 to 2.7.13) (https://www.python.org/downloads/)
• Motuclient (1.5.00 or higher) (http://marine.copernicus.eu/?q=what-are-the-motu-and-python-requirements?
&page=100)

TEMPLATE COMMAND (cut, paste and edit):

python <PATH_TO_MOTUCLIENT_DIR>/motu-client.py --user <USERNAME> --pwd <PASSWORD>
--motu http://nrt.cmems-sr.eu/motu-web/Motu --service-id
GLOBAL_ANALYSIS_FORECAST_PHY_001_024-TDS --product-id global-analysis-forecast-
phy-001-024 --longitude-min -180 --longitude-max 179.916671329297 --latitude-min
-80 --latitude-max 90 --date-min "2018-07-08 12:00:00" --date-max "2018-07-08
12:00:00" --depth-min 0.493 --depth-max 0.4942 --variable sbctso --variable
bottom --variable so --variable eos --variable uo --variable vo --variable mlots
--variable slomco --variable slthick --variable usl --variable vsi --out-dir
<OUTPUT_DIR> --out-name <OUTPUT_FILENAME>

Please replace <VALUE> according to your preferences.
If any value contains a special character, then encapsulate it as follows:
• On *nix/MAC OS, you must use the single quote, otherwise it may expand specific characters.
[... ] --pwd 'MyP@ssw0rd2' [...]
• On Windows OS, you must use the double quote, because single quotes are treated literally.
[... ] --pwd "MyP@ssw0rd2" [...]

If you use an HTTP proxy, add the following options:
[... ] --proxy-server <PROXY_SERVER_URL>:<PROXY_PORT_NUMBER>
If your proxy-server requires authentication, add the following options:
[... ] --proxy-user <PROXY_USERNAME> --proxy-pwd <PROXY_PASSWORD>
    
```

You can check the size of your request here

SUBSETTER

The following criteria are taken into account with subsetting:

- Geographical area
- Depth
- Time range
- Variables

VIEW SCRIPT

The maximum amount of data that can be downloaded is 1024 MB.

DOWNLOAD NETCDF FILE SUBSETTED BY ALL CRITERIA
3.731 MB

DIRECT GET FILE

The following criteria are taken into account with subsetting:

- Time range

VIEW SCRIPT

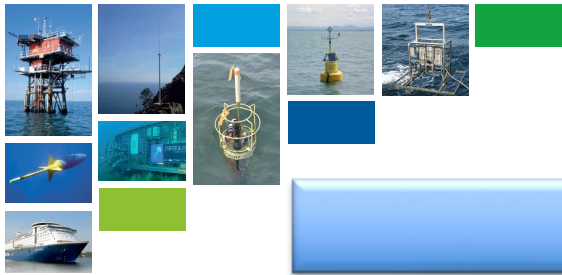
The maximum amount of data that can be downloaded is 1024 MB.

DOWNLOAD COMPRESSED NETCDF FILE SUBSETTED BY TIMERRANGE
147.347 MB

FTP

Filtering is not applicable for "FTP Access" (no criteria taken into account). You can connect to the FTP server with your Copernicus Marine Service credentials to select dataset files.

FTP ACCESS



CMEMS products

PARAMETER	MODEL			SATELLITE	
	20years in the past (surface to bottom of the ocean)	Today (surface to bottom of the ocean)	10-day forecast (surface to bottom of the ocean)	20years in the past (surface of the ocean only)	Today (surface of the ocean only)
Sea Surface Height	X	X	X	X	X
Temperature	X	X	X	X	X
Salinity	X	X	X		
Waves	X	X	X		
Currents/velocity	X	X	X		
Mixed Layer Depth	X	X	X		
Sea ice	X	X	X	X	X
Turbidity/Transparency				X	X
Reflectance				X	X
Nutrients	X	X	X		
Primary Production	X	X	X		
Oxygen	X	X	X		
Plankton	X	X	X		
Wind				X	X



Practical applications: satellite products

PARAMETER	MODEL			SATELLITE	
	20years in the past (surface to bottom of the ocean)	Today (surface to bottom of the ocean)	10-day forecast (surface to bottom of the ocean)	20years in the past (surface of the ocean only)	Today (surface of the ocean only)
Sea Surface Height	X	X	X	X	X
Temperature	X	X	X	X	X
Salinity	X	X	X		
Waves	X	X	X		
Currents/velocity	X	X	X		
Mixed Layer Depth	X	X	X		
Sea ice	X	X	X	X	X
Turbidity/Transparency				X	X
Reflectance				X	X
Nutrients	X	X	X		
Primary Production	X	X	X		
Oxygen	X	X	X		
Plankton	X	X	X		
Wind				X	X



Practical applications: model products

PARAMETER	MODEL			SATELLITE	
	20years in the past (surface to bottom of the ocean)	Today (surface to bottom of the ocean)	10-day forecast (surface to bottom of the ocean)	20years in the past (surface of the ocean only)	Today (surface of the ocean only)
Sea Surface Height	x	x	x	x	x
Temperature	x	x	x	x	x
Salinity	x	x	x		
Waves	x	x	x		
Currents/velocity	x	x	x		
Mixed Layer Depth	x	x	x		
Sea ice	x	x	x	x	x
Turbidity/Transparency				x	x
Reflectance				x	x
Nutrients	x	x	x		
Primary Production	x	x	x		
Oxygen	x	x	x		
Plankton	x	x	x		
Wind				x	x



MATLAB Practical Applications