

Product portfolio and data access

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Copernicus Marine Environment Monitoring Service

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www.copernicus.eu



INTRODUCTION OF USE CASE

• Use case:

User

Uptake

- We want to download temperature data along the Greek coast for fishery activities!
- We will show you how to access and download this data from CMEMS: The Copernicus Marine Environmental Monitoring Service
- Objectives of this info-session:
 - Presentation of the CMEMS website,
 - Browsing CMEMS online catalogue and type of products
 - Focus on the Mediterranean sea, in particular Greece
 - How to access and download data from the CMEMS service through the online portal
 - How to visualise the downloaded product





CMEMS Overview

Monitoring

- Copernicus Marine Service: <u>http://marine.copernicus.eu/</u>
- Implemented by Mercator Océan
- Data Policy: full, free and open access
- CMEMS is the one stop shop for all the Copernicus marine data :
 - T+, Salinity, Current, Wind, Sea ice, Sea level, Biology, Chemistry, _ Chlorophyl ... and soon waves!





CMEMS product: Mediterranean Sea

Marine Monitoring

In our Use case, that means:

- Select the area and the parameter of interest : "Mediterranean sea" and "Temperature"
- Select your product: « Mediterranean sea physics analysis and forecast »
- Various criteria:
 - Overview, Variables, Characteristics (geographical coverage, spatial resolution, vertical coverage, temporal resolution ...) → Opportunity to download them in .pdf or .xml formats
- Documentation :
 - Product user manual
 - Quality information document





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CMEMS product: Download the product

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Statistics derived from targeted products

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INTRODUCTION OF USE CASE

- Module dedicated to users concerned by the effect of Climate Change on the Ocean
- 2 objectives :
 - How to access specific products;
 - How to download the free software Panoply for the visualization of data;
 - How to download targeted products.
- The Use case:
 - Visualize long-term trends for sea level change, sea ice extent and ocean colour in the Arctic ocean





The CMEMS web site: Access

- Go to the website of the Copernicus Marine Environment Service: <u>http://marine.copernicus.eu</u>
- Registration process :
 - Read the Service Commitments and License
 - Complete the registration (user details, type of your organization, organization details, areas of relevance etc..)
 - Service Level Agreement acceptance
 - Click on send
- Look your mailbox \rightarrow an email of the CMEMS Service Desk with
 - Your Login and Password
 - First information
 - Links to video tutorials











CMEMS targeted products: Access

• Access the specific products:

Presentation of the **targeted products** Select a product and check associated documents:

- Product user manual describing how the product has been built and example of format of the dataset;
- **Quality information document** indicating the validation procedure









CMEMS targeted products: Sea level trends

- Use case : get information about Sea level trends over Europe
 - Go to the specific scientific developments page
 - Find and select the product Sea level trends over Europe
 - Download the product
 - Visualize the product with Panoply





Marine

CMEMS targeted products: Sea ice extent

- Use case: get information about Sea ice extent trends over Arctic Ocean
 - Go to the specific scientific developments page
 - Find and select the product
 - Choose the mode for download (NetCDF or Zip file)
 - Download a temporal subset (NetCDF) and visualize with Panoply:
 first demo





Marine

CMEMS targeted products: Sea ice extent

- Sea ice extent trends over Arctic Ocean: second demo
 - Go to the specific scientific developments page
 - Find and select the product
 - Choose the mode for download (NetCDF)
 - Download the Python script download function and procedure: second demo
 - Modify the relevant parts of the Python command line







Examples of tools for sea situational awareness using CMEMS data



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Sea Situational Awareness: Why? For whom?

Marine Monitoring

There are a number of activities at sea and along the costs in which the use of marine data is essential...





Sea Situational Awareness: where to find data?

Marine Monitoring

...but where do we find data we need for these activities?

Online catalogue on http://marine.copernicus.eu/services-portfolio/access-to-products/





Data: CMEMS products

We can search and download a product of interest, selecting the geographical area, the type of product (analysis, reanalysis) and variable

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ARE THERE TOOLS & APPLICATIONS ALREADY USING CMEMS DATA?

Yes, there are some examples from different geographical areas:

- Examples of direct use of CMEMS data 1.
- 1. Examples of applications which make us of CMEMS data to provide additional/higher resolved data

... and many others can be found here, in the Benefits menu of CMEMS website





EXAMPLES OF USE OF CMEMS DATA: in the Baltic area

In January 2015, in Vordingborg Kommune (Vordingborg district) in Denmark, after a surge of pike deaths, an investigation showed the phenomenon to be related to high salinity levels. The Baltic Sea forecasts of the Copernicus Marine Service were used to obtain salinity measurements in the relevant waters.

http://marine.copernicus.eu/usecases/supporting-fishermen-in-thebaltic-sea-using-copernicus-marine-service-products/?idpage=125



Fig. 2 - Surface Salinity in inner Danish waters

Given that salinity is a precious indicator, the use of Baltic MFC products can be very useful to local authorities and fishermen about potential threats on pikes.





EXAMPLES OF USE OF CMEMS DATA: in the Artic area

ArkGIS (Arctic Geographical Information System) is a free, interactive mapping platform for people who need to understand biological and ecological aspects of the Arctic: from Arctic-related decision makers and stakeholders to a person merely wishing to learn and explore the Arctic landscape.

http://marine.copernicus.eu/usecases/the-arkgis-project-mapping-the-changing-arctic-landscape/?idpage=130



The Arctic ocean physics analysis and forecasts are used integrating CMEMS sea ice thickness analysis and forecast





EXAMPLE OF APPLICATIONS OF CMEMS DATA

Marine Monitoring

The **Weather4D** smartphone and tablet application aims to offer a navigation-oriented global weather forecast through an intuitive and user-friendly interface, in four dimensions (three spatial dimensions and time).

It provides information on precipitation, cloud cover, average wind speeds and gusts up to 10 metres above sea level, temperatures up to 2 metres above sea level, marine currents and waves.



http://www.weather4d.com/en/

Each day generates an average of 1 000 to 2 000 requests related solely to the data on **marine currents** provided by CMEMS, contributing to the increased awareness of these services amongst the general public







EXAMPLE OF APPLICATIONS OF CMEMS DATA

Marine Monitoring

SAMPA provides customized information for harbor decision making in environmental management, harbor safety and infrastructure operations. The SAMPA observing system is designed to provide a real time insight of oceanographic conditions in the Iberia-Biscay-Ireland Regional Seas, with special Focus in the Algeciras Bay. In the framework of SAMPA, new high resolution forecast models were developed (for atmosphere, waves and circulation) in order to improve the regional solutions.

> http://marine.copernicus.eu/usecases/from-cmems-core-services-to-highly-effectiveharbor-operations-monitoring-systems/?idpage=130





CMEMS products, and more specifically the IBI-MFC Near Real Time Ocean Forecast product, are used. The high resolution SAMPA forecast is a downscaling of the CMEMS IBI regional solution. Likewise, other observational products (i.e. the CMEMS Sea Surface Temperature products) are used for validation purposes.



The SAMPA circulation model: Grid and snapshot of currents.



EXAMPLES OF APPLICATIONS OF CMEMS DATA

Great Circle offers a meteorological support service to both skippers and race management. This consists of expert weather reports sent at regular intervals, as well as tools to help assess weather risks.

Squid is software that lets you download and view the GRIB weather files and does your routing (with the isochronic method). Squid can also display satellite images (visible imagery, infrared, water vapour and colour composite) and retrieve synoptic charts and observations (SYNOP, METAR and scatterometry).



http://www.greatcircle.be/







EXAMPLES OF APPLICATIONS OF CMEMS DATA

Monitoring

SeaConditions is designed to provide forecasts about the Mediterranean Sea via web and mobile devices to all users interested in detailed, updated, and customized information on sea and weather conditions.

Displayed on a Google map with over-imposed color shades and arrows, data provided by SeaConditions refer to a time-span of 5 days, with a time schedule of 3 hours for the first 3 days and of 6 hours for the second two.



www.SeaConditions.com

CMEMS physics products for the Mediterranean area (analysis, reanalysis and forecast) are used and visualized in SeaConditions





HOW TO BUILD YOUR OWN APPLICATION starting from CMEMS data to visualize marine data

What are the conditions to develop an application (portal and app) that can provide regional weather marine forecasts?

- ✓ **Specialized personnel**: modellers, oceanographers, computer engineers
- Tools: oceanographic models, atmospheric models at higher resolutions making use of CMEMS data

Computing facilities/capabilities: processing power, storage power, data

protection, internet connection

C. Strung







HOW TO BUILD YOUR OWN APPLICATION starting from CMEMS data to visualize marine data

What are the main steps?

- 1. Develop higher resolution models
- 2. Construct the operational chain, which downloads relevant data (including from CMEMS) and integrate them in the modelling tools
- 3. Develop the user interface, web portal and/or app
- 4. Integrate all the previous aspects together

Let's see how it worked in the example of SeaConditions for the Mediterranean Sea









HOW TO BUILD YOUR OWN APPLIC ATION starting from CMEMS data to visualize marine data: SeaConditions example

The **operational chain** is used ti processing the input data from different sources, including CMEMS











HOW TO BUILD YOUR OWN APPLICATION starting from CMEMS data to visualize marine data: SeaConditions example

Can the same approach be used in other regions?

Yes, it can!

The main architecture can be the same, but the data used can be selected from CMEMS according to the area of interest

BLACK SEA PHYSICS ANALYSIS AND FORECAST

Numerical-Model, Currents, Salinity, Temperature, Sea-Level, Near-Real-Time, Forecast, Black-Sea

The physical component of the Black Sea Forecasting System (BS-Currents) is a hydrodynamic model implemented over the whole Black Sea basin. The model horizontal grid resolution is 1/36° in zonal resolution (127° in medidional resolution (a. 3 km) and has 31 unevenly spaced vertical levels. The hydrodynamics are supplied by the Nucleus for European Modeling of the Ocean (NEMO, v3.4). The model solutions are corrected by the variational assimilation (based on a 3DVAR scheme), originally developed for the Mediterranean Sea and later extended for the global ocean. The observations assimilated in the BS-Currents includes insitu profiles, along-track sea level anomalies (SLA) and gridded sea surface temperature (SST) provided by Copernicus TACs.

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BLKSEA_ANALYSIS_FORECAST_PHYS_007_00





The Operational Mercator global ocean analysis and forecast system at 1/12 degree is providing 10 days of 30 global ocean forecasts updated shilly. The time series start on December 27, 2006 and is aggregated in time in order to reach a two full year's time series sliding window. This product includes daily mean files of temperature, salinity, currents, sea level, mixed layer depth and ice parameters from the top to the bottom over the global ocean. It also includes hourly mean surface fields for sea level height, temperature and currents.

Numerical-Model, Sea-Level, Currents,

Forecast, Global-Ocean

Temperature, Sea-Ice, Salinity, Near-Real-Time,

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

ATLANTIC - EUROPEAN NORTH WEST SHELF - OCEAN BIOGEOCHEMISTRY ANALYSIS AND FORECAST

Numerical-Model, Ocean-Chemistry, Ocean-Chlorophyll, Ocean-Biology, Ocean-Optics, Near-Real-Time, Forecast, North-West-Shelf-Seas

The Forecasting Ocean Assimilation Model 7rm Allantic Margin model FOAM MM/D is a coupled hydroynamicecosystem model, nested in a series of one-way nests to the Met Office global ocean model. The hydroynamics are supplied by the Nucleus for European Modelling of the Ocean (NEMO) with the 30Var NEMOVAR system used for the assimilation of sea surface temperature data. This is coupled, <u>0. bn</u> _ Longean Regional Sea b

GLOBAL_ANALYSIS_FORECAST_PHY_001_024





NORTHWESTSHELF_ANALYSIS_FORECAST_BI





Ocean current forecast for routing activities

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INTRODUCTION OF USE CASE

- CMEMS Products can be
 - The objectives :
 - Choose a product displaying ocean current and temperature forecast for the next days;
 - Refine the **area of interest**;
 - Visualize **maps of ocean currents** for a particular day from the CMEMS portal services;
 - Visualize **animation** of current prediction for the next 1 to 5;
 - Download ocean current and/or temperature data for a particular day over the defined area
 - Use Panoply software to create visualization (maps and animations) from numerical data
 - The Use case:
 - Visualize ocean current forecast in the context of routing and security services





The CMEMS web site: Access

- Go to the website of the Copernicus Marine Environment Service: <u>http://marine.copernicus.eu</u>
- Registration process :
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 - Complete the registration (user details, type of your organization, organization details, areas of relevance etc..)
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 - Click on send
- Look your mailbox \rightarrow an email of the CMEMS Service Desk with
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 - First information
 - Links for tutorials





CMEMS product: The registration process









CMEMS catalogue: selection

- Search for current forecast in the web catalogue:
- Identification of a regional modelling zone (MFC): IBI
- Select and access the corresponding product
- Use the provided tool for visualization (View Product)
 - **zoom** over a particular area of interest in the context of routing:

Gibraltar area

- visualize **maps of currents** for a particular day
- build an **animation** of forecasting currents







CMEMS : ocean current forecast

Marine Monitoring

- Use case : get information about currents in the area of Gibraltar for the next 5 days :
 - download of data
 - visualization of data

using Panoply



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Environmental Monitoring of Marine Renewable Energy farms

Copernicus User Uptake Information Sessions Renewable Energies / Marine

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INTRODUCTION OF USE CASE

- Module dedicated to users concerned by offshore projects : Marine Renewable Energy, but also Dredging, Oil&gas, etc.
- Marine Environmental Impact Assessment Studies (EIAS) and Marine Environmental Monitoring
- Objective :
 - Show the wealth of products available through CMEMS;
- The Use case:
 - Visualize products when you want to have a first level of data on a selected site





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CMEMS Information on a selected site

• Example in Mediterranean sea:

Marine

Monitoring

- There is a call for tender concerning offshore floating wind farm.
- One of the tenderer wish to browse CMEMS Catalogue to see which data could be used for his costs scenarios.
- After selection of Mediterranean sea: 29 products available!



Marine Monitoring

CMEMS products: Selection of products

- Global information on the Mediterranean Forecasting System available :
 - Spatial resolution: 1/16° (6-7km) + 72 vertical levels
- 2 types of products interesting for my purpose:
 - Reanalalysis: daily and monthly mean 1887 \rightarrow 2013

→Definitely consistent to process statistics aimed at refining the design basis of my project

- Analysis and Forecast:
 - Daily means from $1/1/2013 \rightarrow today+9 days$
 - Hourly means for the period 4 weeks to today+ 4 days

 \rightarrow Enable the analysis of diurnal variations

→interesting for dynamical downscaling (e.g modelling of extreme events)



CMEMS products: Environmental Monitoring Marine Monitoring Use case : Visualize information embedded in CMEMS website and/or download data – Maps Time series (currents, T°, salinity.) _ Vertical profiles (currents, T°, salinity, etc. — MEMS - MFS ; Lat : 44 "N : Lon : 9"30"W : 03/12/2015 15:30 UT 57 opernicus European

Marine Monitoring

CMEMS products: Environmental Monitoring

- Most interesting features :
 - Graphs or maps are available directly in CMEMS but you can also download
 - This information is absolutely necessary to assess environmental conditions of the selected site for:
 - Feed the Environmental Impact Assessment study
 - Refine design basis
 - Evaluate extreme conditions
 - Assess operability of Operation & Maintenance (O&M) of the offshore wind farm
 - Provide baseline reference data for future Environmental monitoring of the selected zone



Marine Monitoring

CMEMS products: Environmental Monitoring

• Why it is important?

- Operation & Maintenance represent 39% of the cost of an offshore wind farm
- CMEMS data respond to the ever-growing need for accurate data which is directly linked to Return On Investment Scenarii



Source: Offshore Wind Works http://offshorewind.works/cutting-cost-electricity-offshorewind/

Offshore wind O&M is *"set to become a two billion pound a year industry by 2025,"* Joe Phillips, Head of Strategy and Policy at DNV GL.

