Marine Monitoring

- Example of use of CMEMS products to support public health and Water Quality
  - TELESPAZIO and Rivages Pro Tech (SUEZ): monitoring water quality

- Which CMEMS products are useful to support public health and Water Quality
  - Zoom on ocean model products
  - Zoom on Satellite Sea Surface Temperature
  - Zoom on Satellite Ocean Colour
  - Zoom on *In Situ* products

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EarthLab for coastal services – The case of water quality monitoring – Turbid Plumes

CMEMS DEMONSTRATION COASTAL - IBI

Contract 32-DEM2-L4
Until 30 September 2019

Authors: **S.Capo** Telespazio France, **M.Delpey** RivagesProTech SUEZ

Copernicus Marine Week, Serving Users and Society, Sept 27 2017

European Commission

Copernicus

Implemented by MERCATOR OCEAN
OCEAN FORECASTERS

Water Quality monitoring

MARKET SECTOR

Major challenge of managing coastal water quality, especially in urbanized areas with large raining events and high with large raining events and high dense summer period

Water Quality monitoring - turbid plumes - using ocean color tools, merged with 2DH and 3D numerical modelling and ground truth observations **with partner RPT Suez**

END USERS

We target end users such as local and regional stakeholders, councils, Department, Regions as well as private companies (nearshore industries)
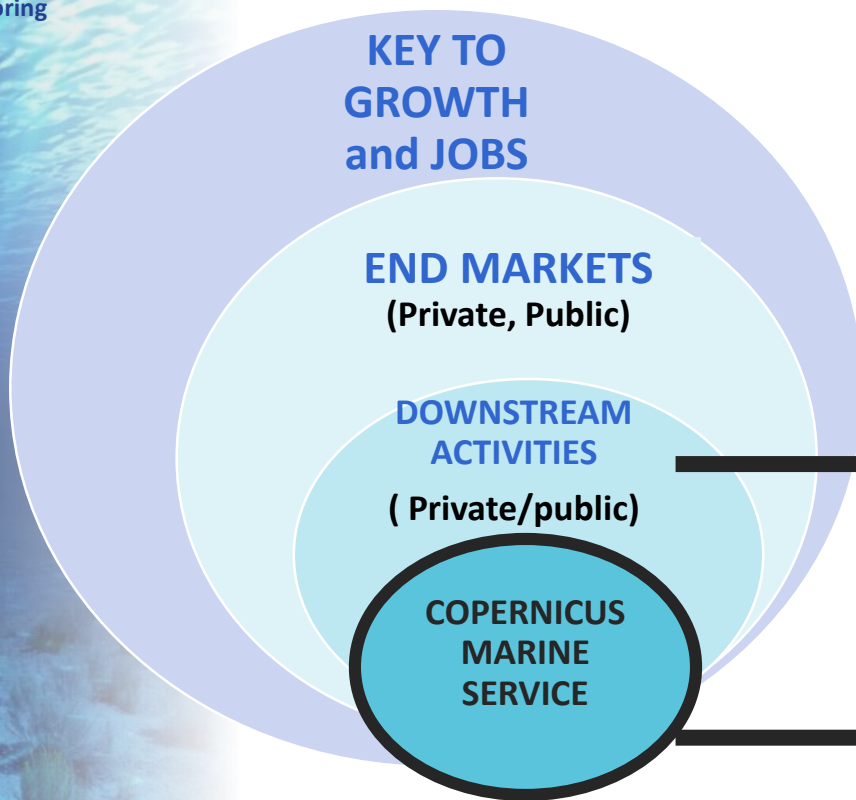
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http://marine.copernicus.eu/markets/use-cases/

KEY TO GROWTH and JOBS

END MARKETS
(Private, Public)

DOWNSTREAM ACTIVITIES

(Private/public)

COPERNICUS MARINE SERVICE

CMEMS USERS
(value added)

DIRECTLY(free)

CONTEXT

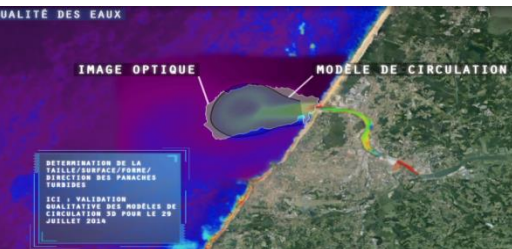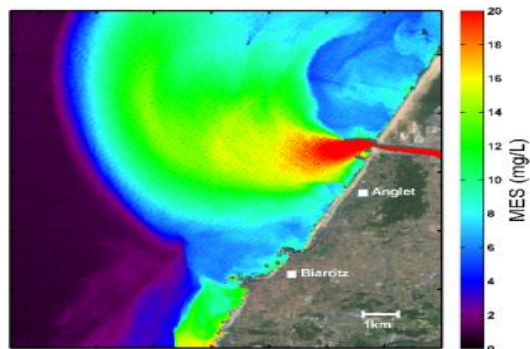**Preserving the coastal water quality:**

Economic and demographic drivers over the coastline (building activities 3times higher, 7 M +50% within 2040) and increasing tourism

APPLICATION

- Follow the dispersion and fate of the fine sediment River.
- Follow dispersion and fate of fecal bacteria

COPERNICUS MARINE
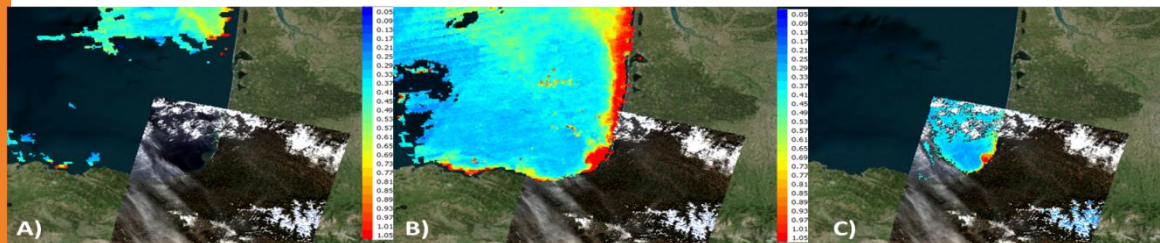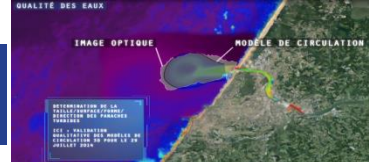
We use CMEMS products from:
- Model
- Satellite
- In situ

We use products in:
- Real time, and delayed time for event re-analysis

We use products in various areas:
IBI, MED

Main Parameters :
Currents, temperature, salinity, Optical properties and CHL

HOW DO WE USE CMEMS PRODUCTS?

Dynamical downscaling is the key for obtaining high-resolution (HR) refined models from lower resolution CMEMS models output (forcing conditions and/or boundary conditions), both for Satellite imagery and model suite. In situ data are use to validate HR models outputs and satellite marine optics derived products.

WHICH BENEFIT FOR US?
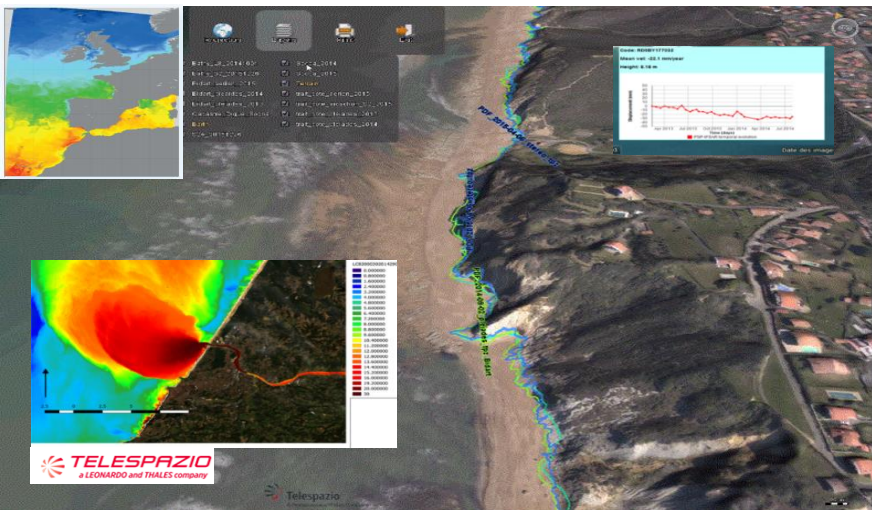
Robust and accurate inputs

By downloading CMEMS products, modelling can focus on downscaling processes, enriched with imagery validation outputs, we can provide more accurate near real-time and forecast service

Efficiency

Public policies can account for quantitative and qualitative model validation, near-real time correction and more accurate daily forecast (Day+1). The service is an efficient recommendation and Decisional Support Tool (DST) for the optimization of beach closure...
And much more economic issues (MPA, marine litters, fishing, shellfish farming, eutrophication..)

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Marine Monitoring

✓ **In Situ data**

    ✓ **See online tutorial:http://marine.copernicus.eu/tutorials**

✓ **Satellite Observations**

    ✓ **Satellite Sea Surface Temperature**

    See online tutorial:

    http://marine.copernicus.eu/tutorials/cmems-sea-surface-temp-satellite/

    ✓ **Satellite Ocean Colour**

    See online tutorial:
    http://marine.copernicus.eu/tutorials/cmems-ocean-colour-satellite/

✓ **Ocean Models**

    See online tutorial:
    http://marine.copernicus.eu/tutorials/cmems-ocean-model/

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Marine Monitoring

Ocean Models transform the continuous ocean into a discreet ocean with:

- discreet spatial grid
- discreet time steps

Ocean Models describe the ocean properties using **physical and biogeochemical relationships called the <u>primitive equations</u>.**

The primitive equations describe **the sum of the forces applied to the ocean, the conservation of properties and the equation of state of the ocean.**

To apply primitive equations to the Ocean M
that can be applied to the gridded discreet oce

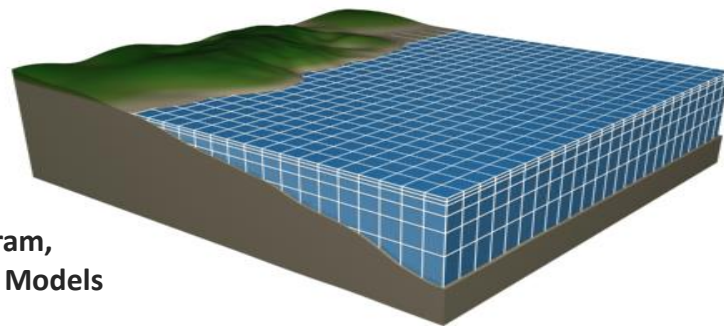**Fig Credits: The COMET Program, Mesoscale Ocean Circulation Models**

Marine Monitoring

Ocean Models simulate sea water properties:

- **In 3 dimensions** (from surface to bottom, displayed on a 3D grid)

- Through a period of time:

  - A reanalysis of the past (CMEMS provides with 20 years in the past).
  - An analysis of the current conditions.
  - And continue into the future to provide a forecast. CMEMS provides with **10-day forecast.**

As a summary, one of the Ocean Models characteristics is that they simulate sea water properties in 3D with 10-Day forecast when satellite data only provide with 2D coverage without any forecast.

Marine Monitoring
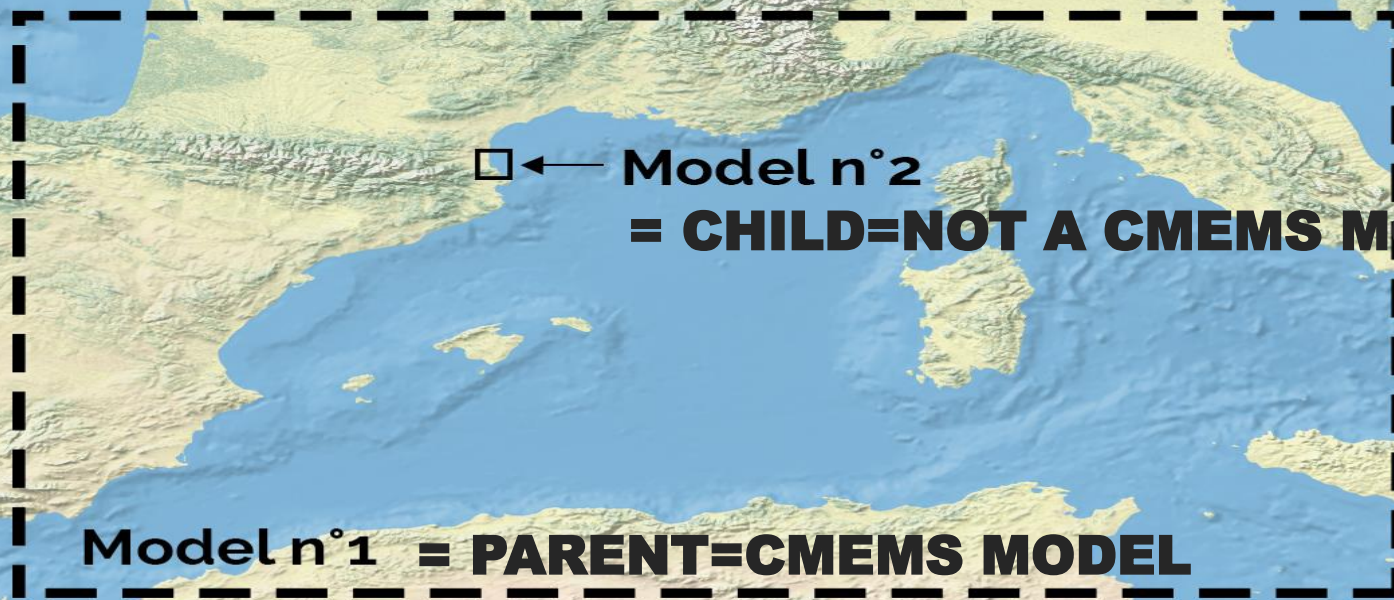
CMEMS model products can be used :

- as input data for coastal models: downscalling, nesting
- As forcing of an other kind of models:
    - ecosystem models
    - sediment transport models
    - Oil drift model
    - Plastic drift model
    - Any pollutant drift model

Model n°2 = CHILD=NOT A CMEMS MODEL

Model n°1 = PARENT=CMEMS MODEL

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Marine Monitoring

- **SATELLITE SEA SURFACE TEMPERATURE (SST) is measured by a sensor called « radiometer » on board of several satellites.**

- **CMEMS Satellite SST is obtained by Microwave (MW) and/or Thermal Infrared radiometers (IR).**

Marine
Monitoring

In order to avoid confusion between various SST at different depth, CMEMS SEA SURFACE TEMPERATURE Satellite products provide with the following information:

- **SEA SURFACE TEMPERATURE (SST):**

  - Foundation SST (SST at a depth of about 10 meters,
  i.e. **not influenced by diurnal cycle**) (all SST products except one)

  - Skin SST (SST at a depth of about 10 micrometers,
  i.e. **influenced by diurnal cycle**) (only 1 product
 SST_GLO_SST_L4_NRT_OBSERVATIONS_**010_014**)

Marine Monitoring

SEA SURFACE TEMPERATURE Satellite products over the GLOBAL Ocean and all European Seas are sorted into 2 categories:

- **Gridded with gaps - Sea Surface Temperature L3 - Real Time and Reprocessed**
  SST_(AREA)_SST_L3_(NRT)or(REP)_OBSERVATIONS_010_XXX

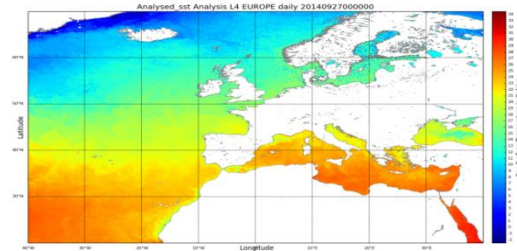Adjusted_sea_surface_temperature Supercollated L3S EUROPE daily 20140927000000
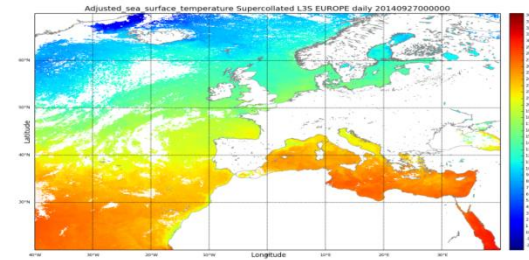
- **Gridded gap-free - Sea Surface Temperature L4 - Real Time and Reprocessed**

  SST_(AREA)_SST_L4_(NRT)or (REP)_OBSERVATIONS_0010_XXX

Analysed_sst Analysis L4 EUROPE daily 20140927000000

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Marine Monitoring

- **SATELLITE OCEAN COLOUR** is measured by a sensor called « **spectrometer** » on board of several satellites.

- Depending of the sea water constituents, 3 categories of colours can be observed: **Chlorophyll-a, Non Algal Suspended Matter, Colour Dissolved Organic Matter.**

Marine Monitoring

CMEMS OCEAN COLOUR Satellite products provide with the following information:

- ## CHLOROPHYLL-A CONCENTRATION
  - Chlorophyll-a concentration is a measure of phytoplankton's biomass integrated over the euphotic zone
  - In Open Ocean, Chlorophyll-a uncertainity is influenced by phytoplankton's variability (Case I water).
  - In Coastal Water, Chlorophyll-a uncertainity maybe influenced also by Suspended Particulate Matter and Colour Dissolved Organic Matter (Case II water).
  - For each CMEMS Chlorophyll-A product, either the Case I or Case II algorithm is applied depending on the location (open ocean or coastal water).

- ## OPTICAL WATER PROPERTIES
  - Reflectances
  - Back scattering coefficient
  - Light attenuation coefficient
  - Absorption coefficient

Marine Monitoring

OCEAN COLOUR Satellite products over the GLOBAL Ocean and all European Seas are sorted into <u>2 categories</u>:

- **CHL: Chlorophyll-A**
  L3 or L4 - Real Time and Reprocessed
  OCEANCOLOUR_(AREA)_CHL_(L4)or(L3)_(NRT)or(REP)_OBSERVATIONS_009_XXX

- **OPTICS: Optical Water Properties (as Turbidity…)**
  L3 or L4 - Real Time and Reprocessed

  OCEANCOLOUR_(AREA)_OPTICS_(L4)or(L3)_(NRT)or (REP)_OBSERVATIONS_009_XXX

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- In-situ observations are <u>on-site local measurements</u> of sea water properties.

- They are obtained using ad-hoc <u>on-site</u> sensors on board of various platforms like buoys and ships for example.

- In-situ observations are made locally. CMEMS In-Situ TAC gathers them into ONE data base, hence providing a <u>global picture</u> based on the integration of thousands of <u>local data</u>.
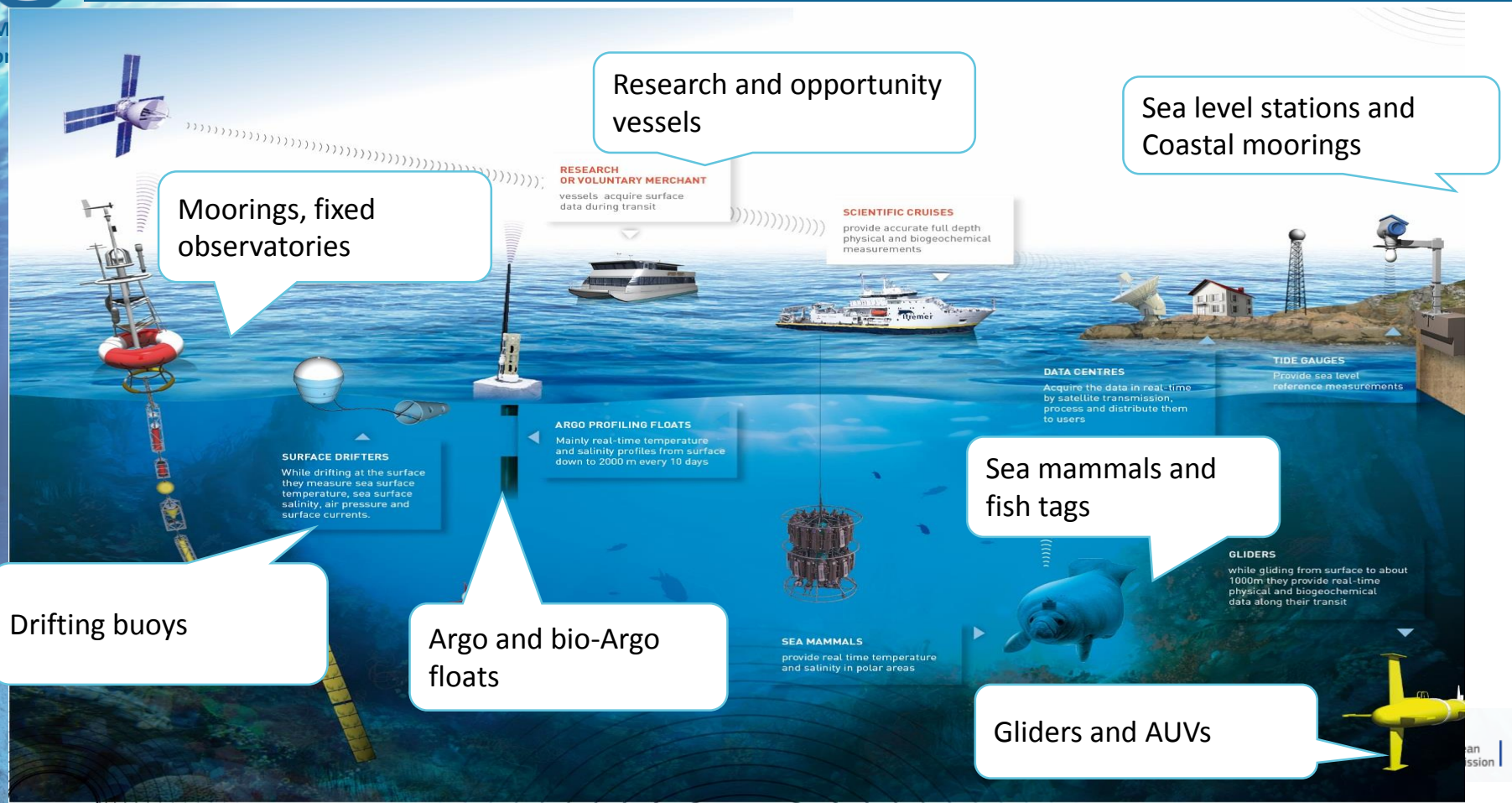
- Many organizations outside of CMEMS acquire in-situ data.

- CMEMS's job is not to acquire in-situ data. It is rather to gather and integrate them into ONE DATA BASE.

- « Gathering data » from outsider organisations requires strong mutual agreements.

- « Integrating data » into ONE data base requires strong format standard definition and quality control procedures.

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Research and opportunity vessels

Sea level stations and Coastal moorings

Moorings, fixed observatories

Drifting buoys

Argo and bio-Argo floats

Sea mammals and fish tags

Gliders and AUVs

Marine Monitoring

Different use of CMEMS data:

➔ **Use CMEMS data (model, in situ, satellite) as is**
Direct use of CMEMS regional products (such as Temperature, Chlorophyll, nutrients).

➔ **Use CMEMS model data as Boundary Conditions/forcing conditions to higher resolution models /imagery algorithm**
CMEMS products as input data for coastal models: downscalling, or forcing to other kind of models   (ecosystem models, sediment transport models, oil-plastic-any pollutant drift model…)

Marine Monitoring

CMEMS data can be used

- 2.5.1 as a Forcing/boundary conditions for modelling (CMEMS MODEL)
- 2.5.2 as a Forcing for satellite image processing (CMEMS SATELLITE)
- 2.5.3 as validation for coastal model and imagery (CMEMS INSITU)

CONTACT US

Marine Monitoring

JOIN THE COPERNICUS MARINE SERVICE COMMUNITY

Web portal
marine.copernicus.eu

Service Desk's email
servicedesk.cmems@mercator-ocean.eu

Collaborative Forum
http://forum.marine.copernicus.eu/

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MercatorOcean

Linkedin CMEMS partnership Meeting place
https://www.linkedin.com/groups/8243515

Tutorials on CMEMS YouTube channel
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