GOS

Consiglio Nazionale delle Ricerche

ISAC

GOS Global Ocean Satellite monitoring and marine ecosystem study

The role of ship based measurements in the satellite calibration and validation activities: the CNR experience

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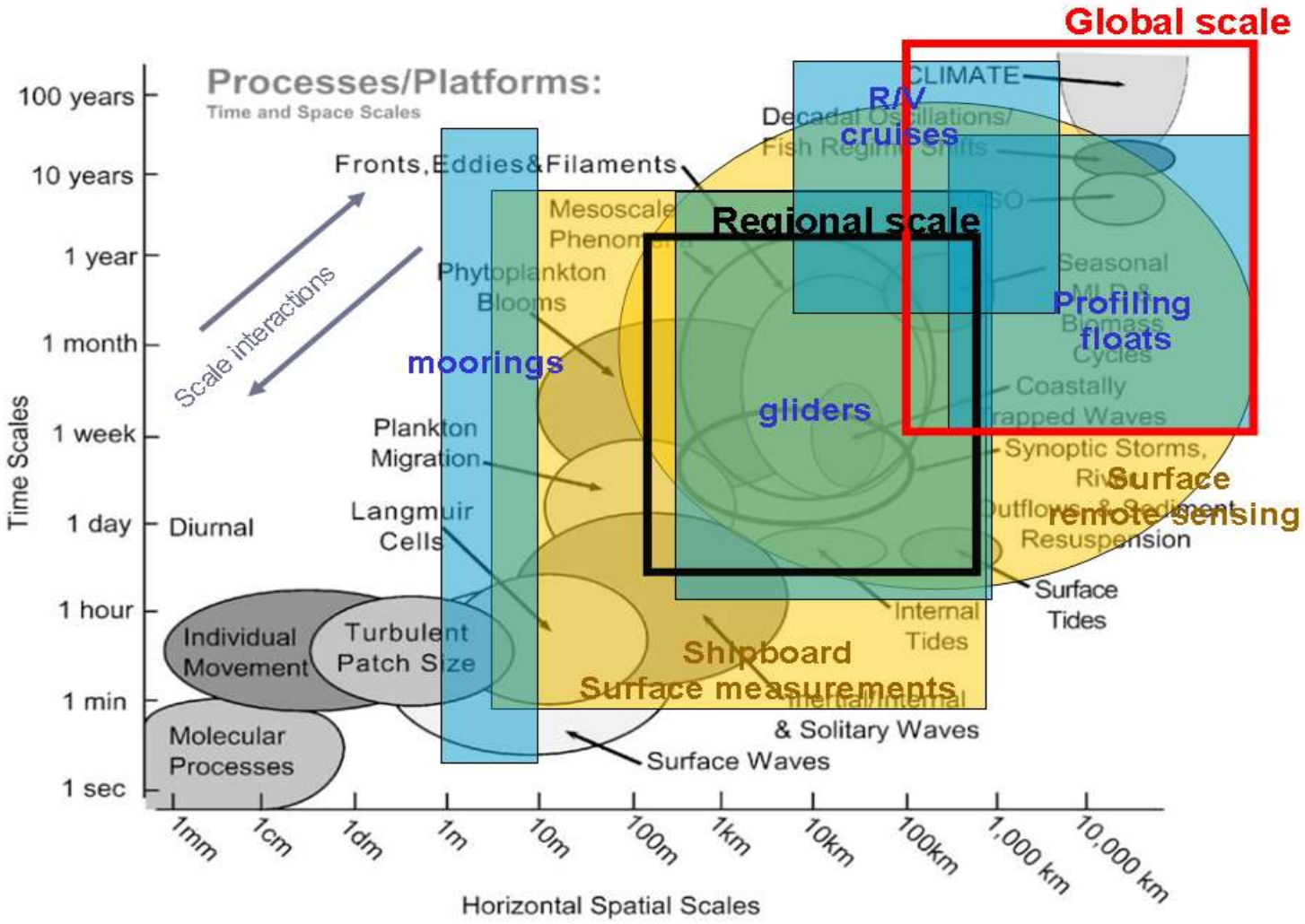
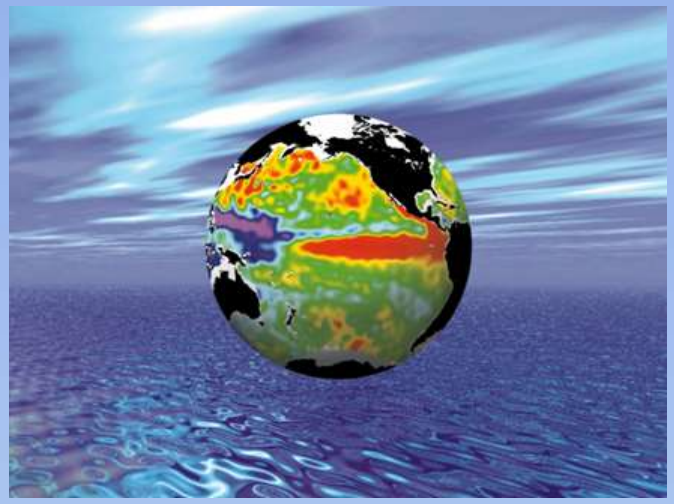
Ocean Processes & Observing Systems



Satellite Role in Ocean Monitoring & CNR mission

Satellite is an essential component of Ocean Observing System.
The only real avenue to **global coverage at high space and time resolution.** Satellite data **essential** to constrain ocean models, **used** for assimilation, forcing & validation.



Satellites provide key parameters: :

- Sea Surface Height
- Sea Surface Temperature
- Ocean Colour
- Sea Ice
- Winds

CNR objectives in the framework of the European Effort :

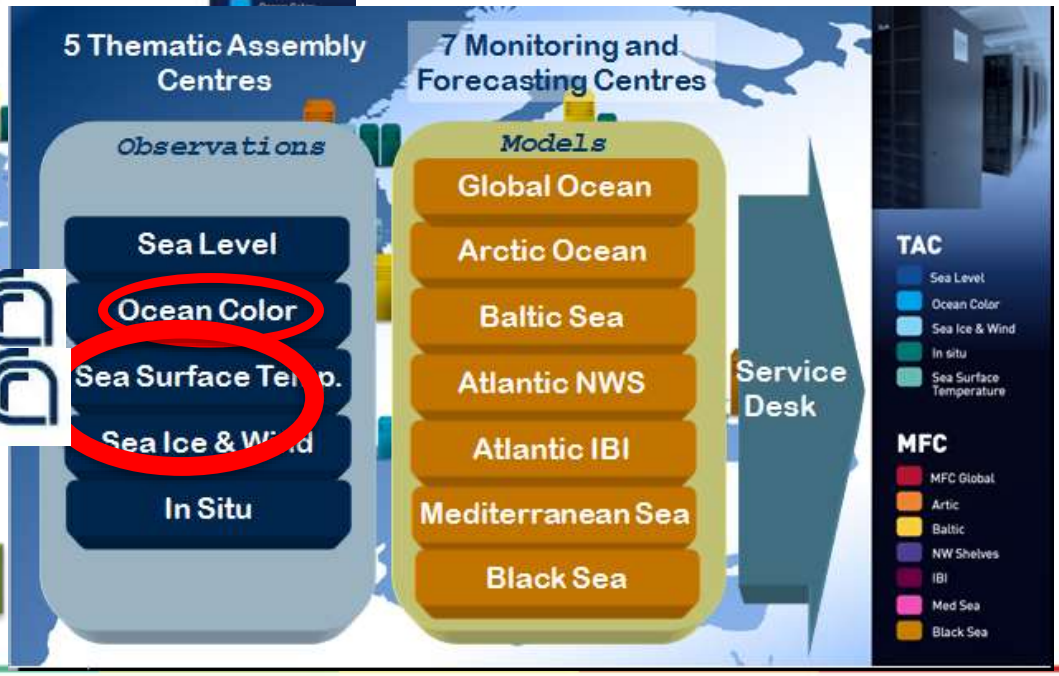
Operational: develop a satellite operational observing system able to provide high quality near real-time, long term, synoptic global observation of the ocean essential variable (EOV). Contribute to the European Copernicus Marine Enviromemental monitoring Service

Scientific: assess the marine ecosystem state and define the short and long term variability circulation and primary production

CMEMS:Copernicus Marine Environmental Service

Objective: European service providing every day information on **the physical and ecosystem state** of the **oceans** and **European** regional **seas**

14 MAIN OPERATORS
for the main service functions

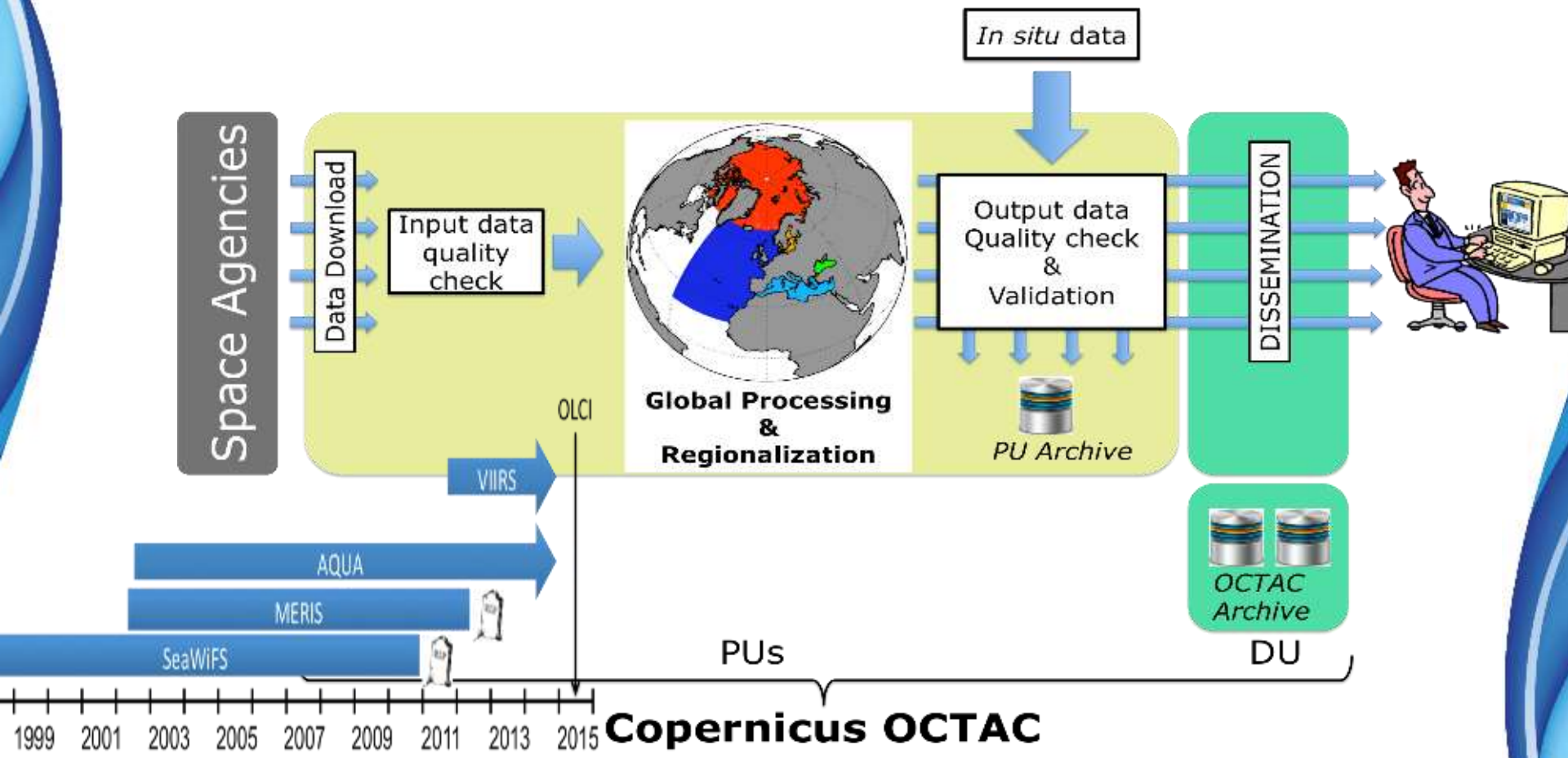


4 THEMATIC ASSEMBLY CENTRES:

7 MONITORING AND FORECASTING CENTRES

CNR leading OCTAC & contributing to OSITAC

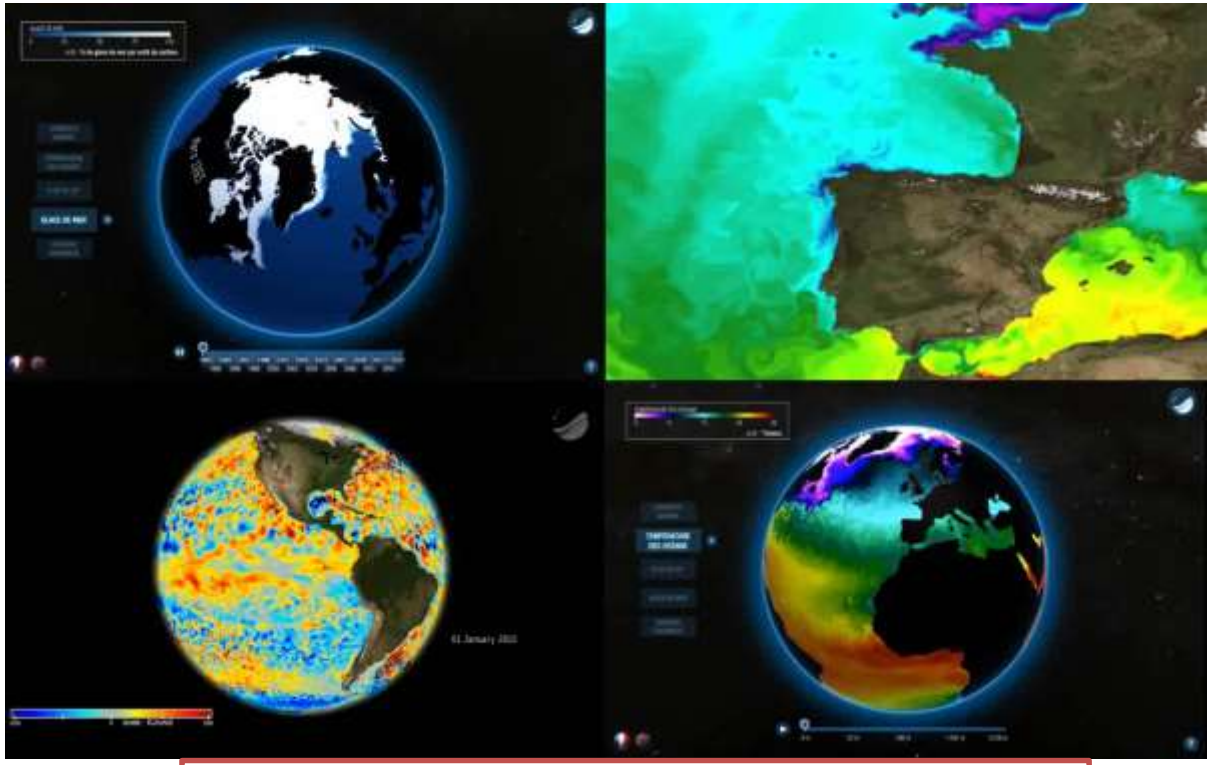
CMEMS OC TAC: Architecture



CNR leads the OCTAC, European Ocean Colour component within the CMEMS. CMEMS provide NRT and reprocessed OC data **global ocean** and the **European Regional Sea**. **Product quality information available for all products. The product accuracy assessment strongly depends on high quality in situ data.**

Copernicus Marine Enviromental Service

An integrated information



Registered users ~ 8000

OPERATIONAL OCEANOGRAPHY BUILT UPON MULTIPLE SOURCES OF INFORMATION

OBSERVATIONS AND MODELS

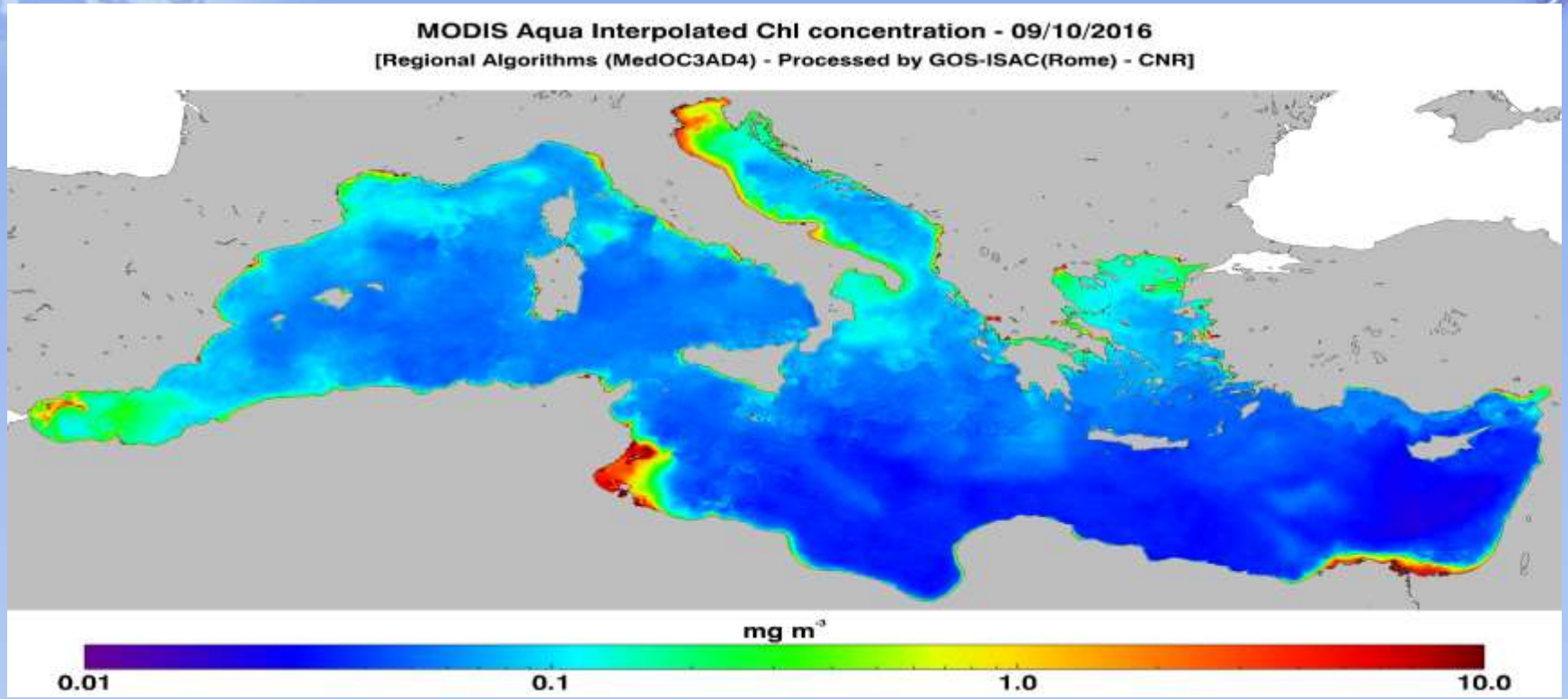
PHYSICS AND BIOGEOCHEMISTRY

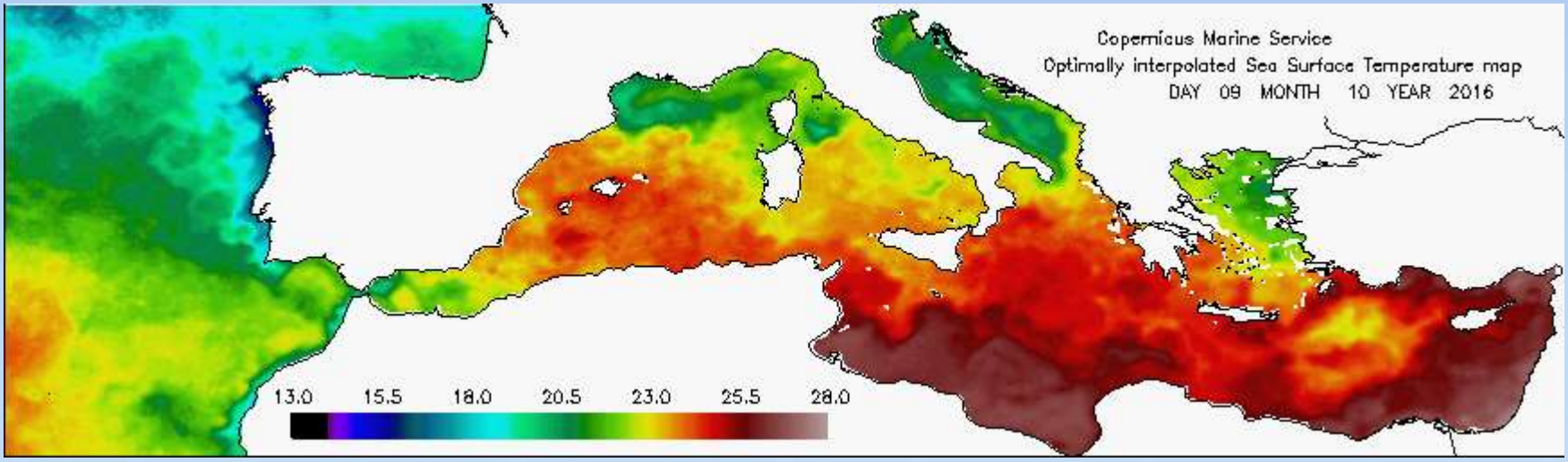
REAL-TIME AND REANALYSES

REANALYSES
10 to 45 years

REAL-TIME
Daily, hourly

FORECAST
2 to 10 days


MODIS Aqua Interpolated Chl concentration - 09/10/2016
[Regional Algorithms (MedOC3AD4) - Processed by GOS-ISAC(Rome) - CNR]
mg m-3
0.01
0.1
1.0
10.0


Copernicus Marine Service
Optimally interpolated Sea Surface Temperature map
DAY 09 MONTH 10 YEAR 2016
13.0
15.5
18.0
20.5
23.0
25.5
28.0

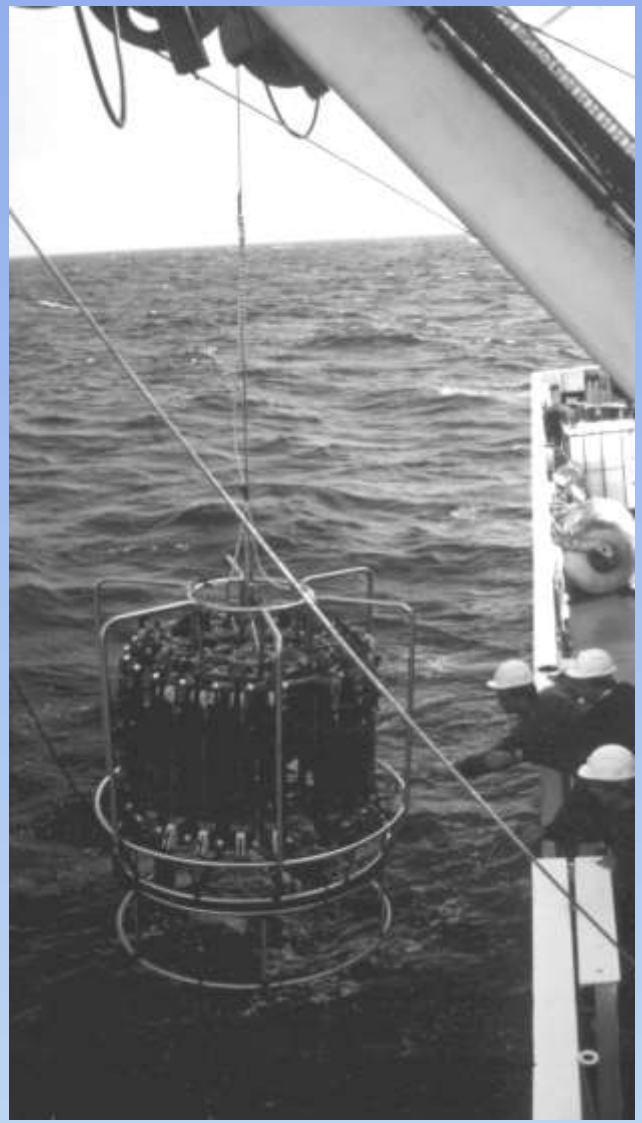
Satellite data calibration and Validation:

Remote sensing output is affected by:

- Instrument degradation;
- Calibration uncertainties;
- Errors/assumptions on retrieval model

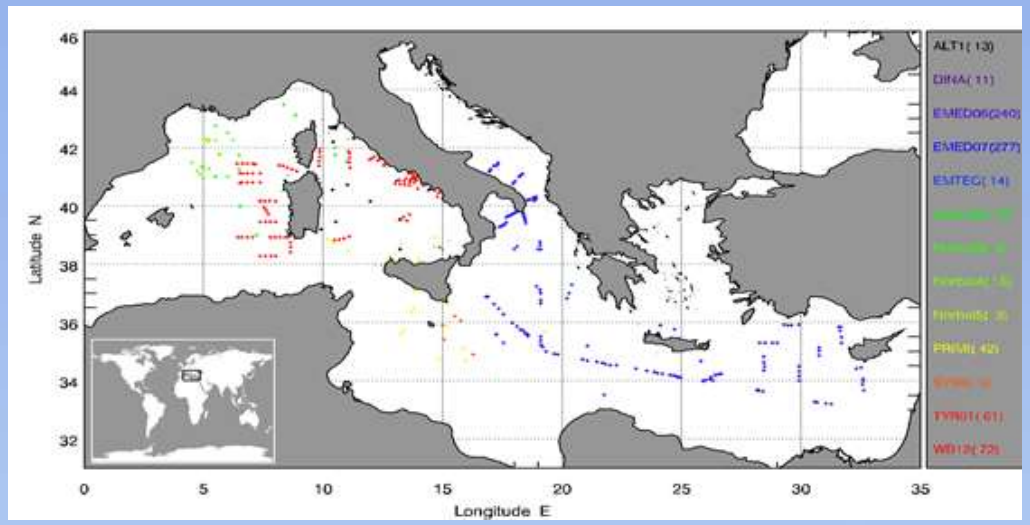
In situ data are necessary to ensure that satellite remotely sensed data are properly calibrated and validated.

Research Cruises are unique mean to acquire CAL/VAL measurements



In situ Fiducial Reference Measurements (FRM) are an essential for satellite mission calibration and validation Research Cruises are cruicial to acquire FRM.

Mediterranean Ocean Color Bio-optical DATA SETS



Annual Mediterranean cruises for Satellite OC CAL/VAL:

organized by CNR-ISAC since 1997 in the framework of National and International Projects

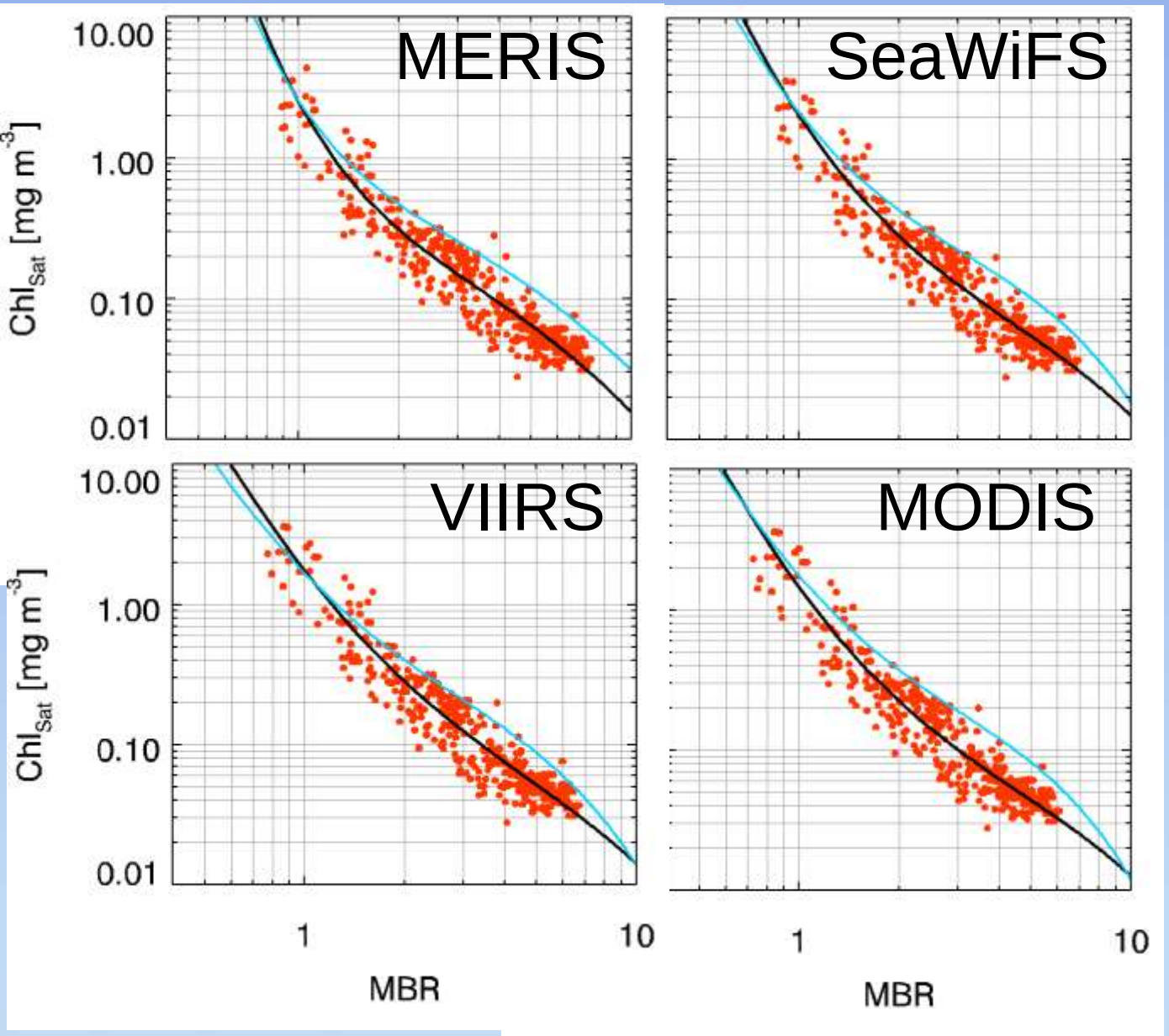
Bio-optical measurements:

769 in-water profiles of:

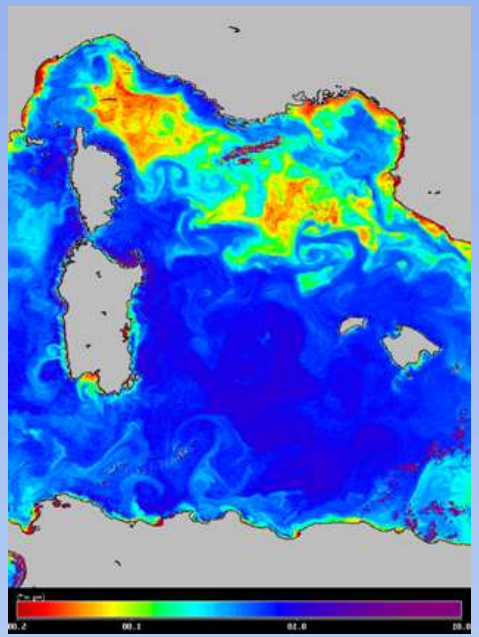
- downwelling irradiance (Ed)
- upwelling radiance (Lu)
- downwelling radiance (Eu)
- IOPs
- Chl profiles concurrently with in-water optical cast

FRM Bio-optical data: WMED-BIOOPT

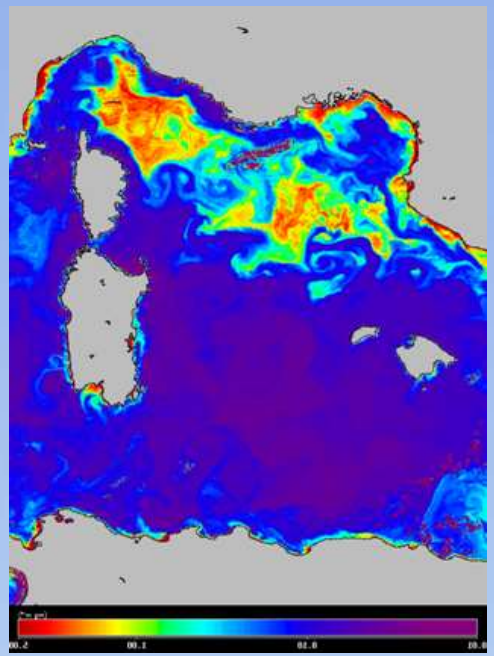
UNIQUE *in situ* dataset to develop sensor-specific algorithms for Mediterranean waters



Impact of the use of regional vs. global algorithms to process satellite data

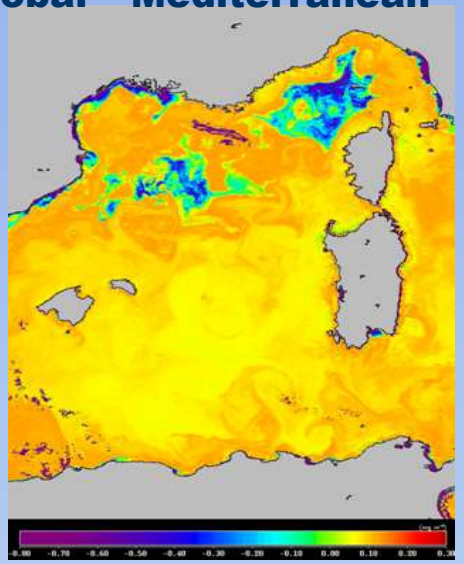


global algorithm used by space agency



Regional MED algorithm developed by CNR

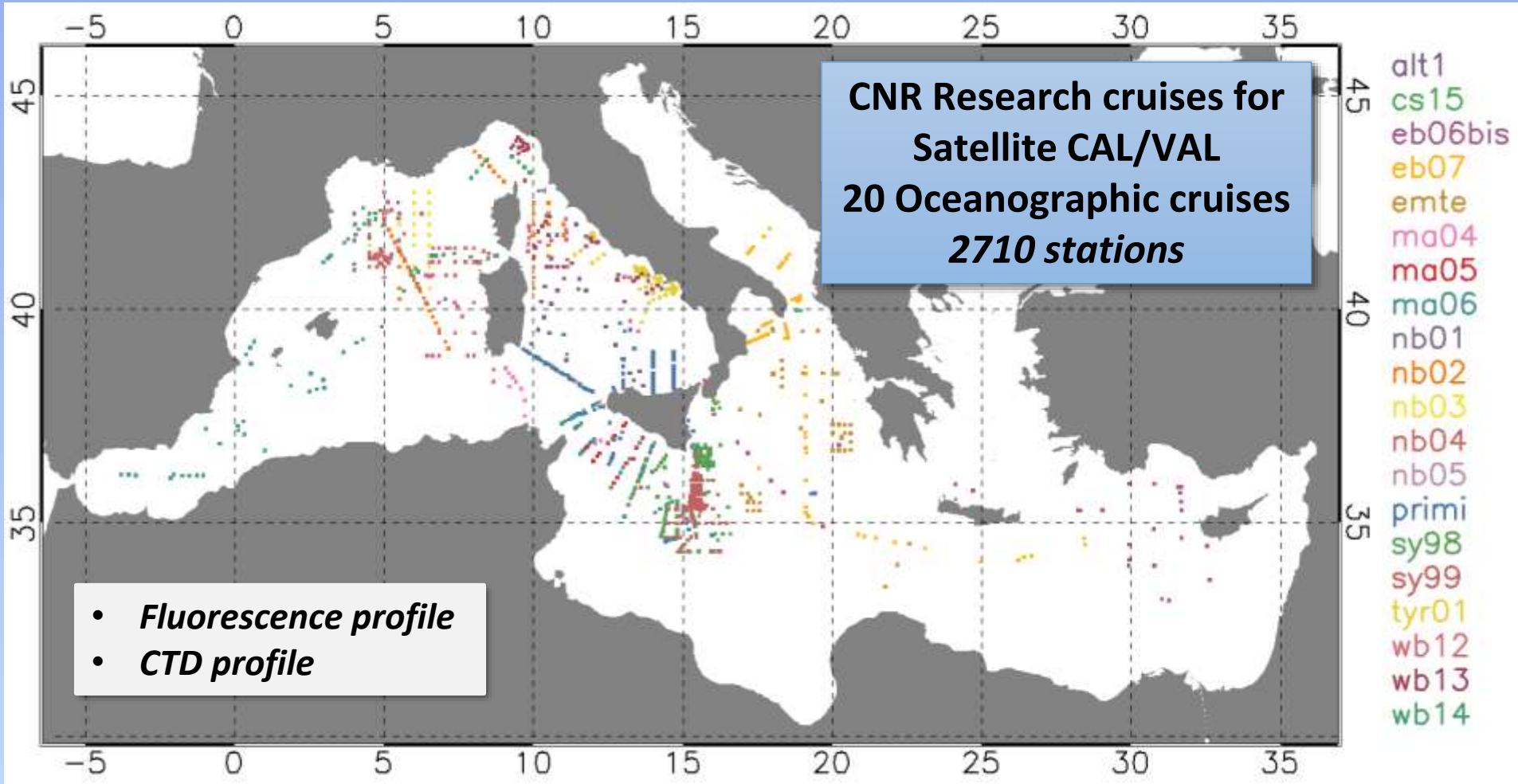
Global – Mediterranean



Up to 100% differences!

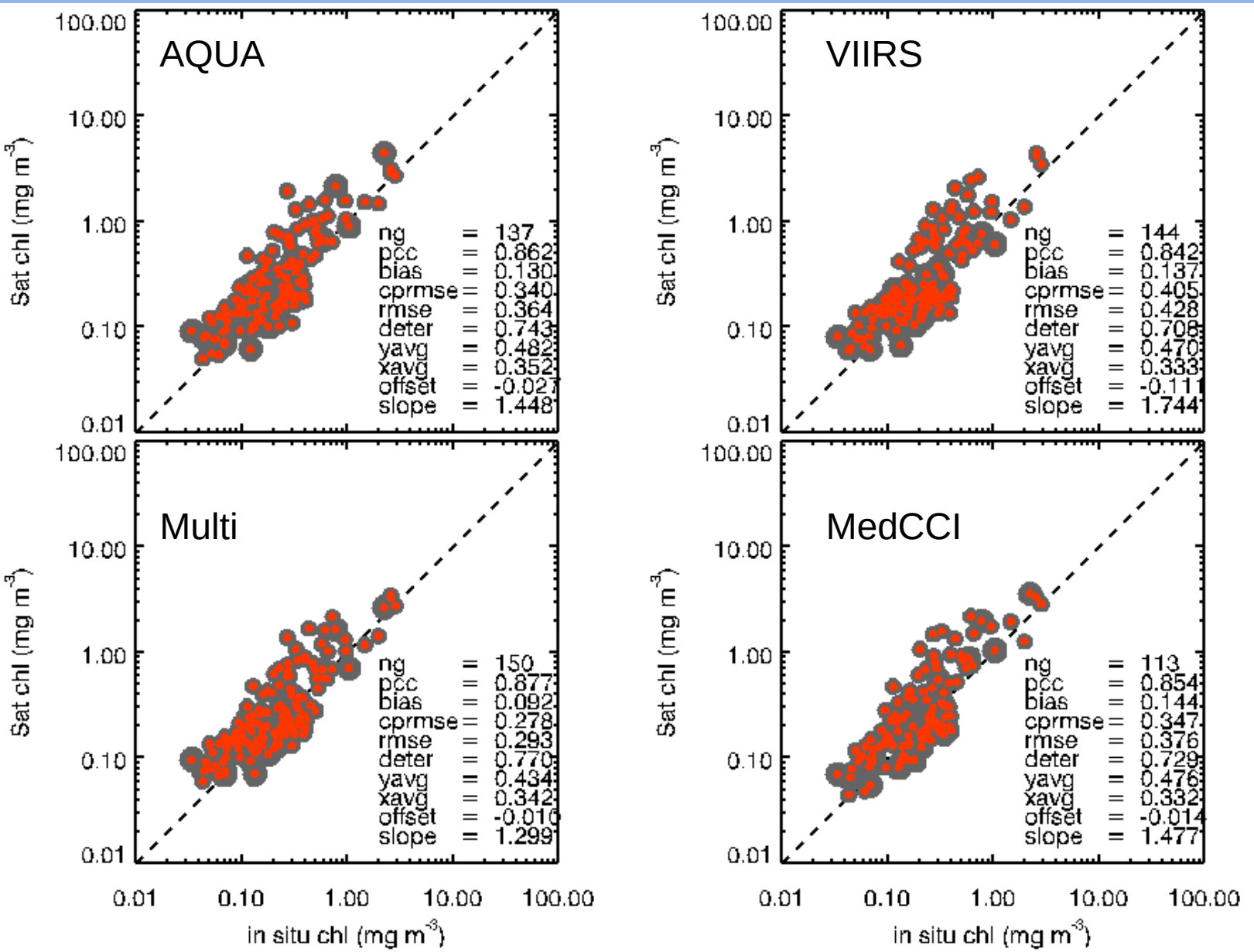
Used by CNR to produce Ocean colour products available from CMEMS

Chlorophyll Reference database



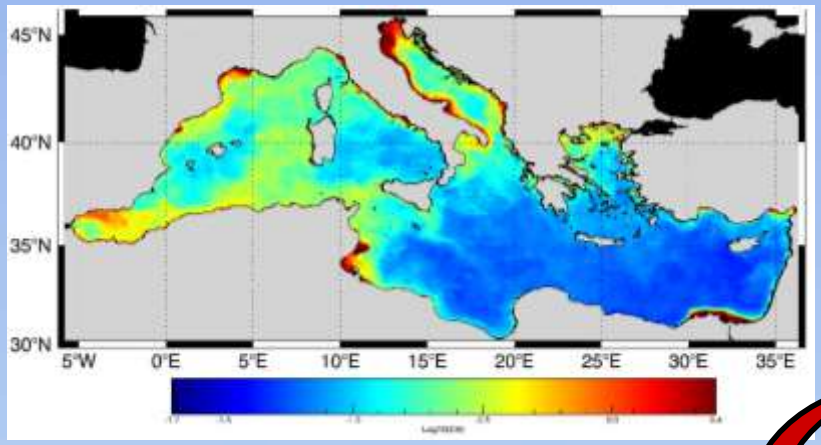
Since 2007 ISAC CNR organized annual Research cruise in collaboration with ENEA Zoological Station “Anton Dohrn” (SZN) to acquire in situ FRM chlorophyll data. This dataset is use to assess the quality of CMEMS products

Matchup & Statistics

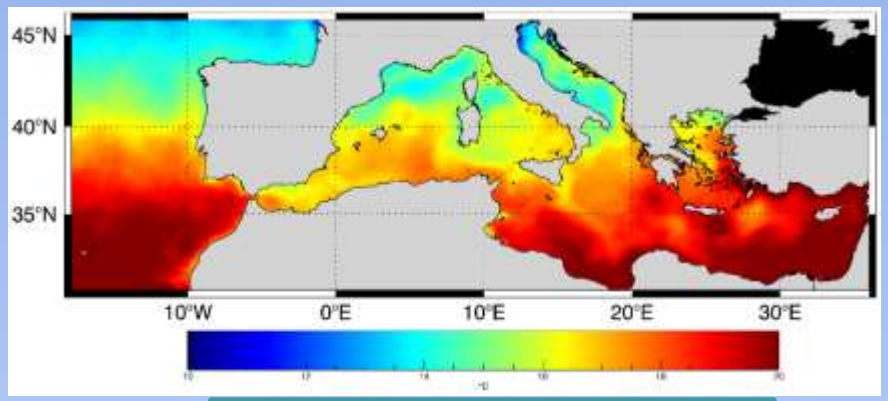


Synergic use of data

Ocean colour data
Satellite Surface chlorophyll a (Chl)

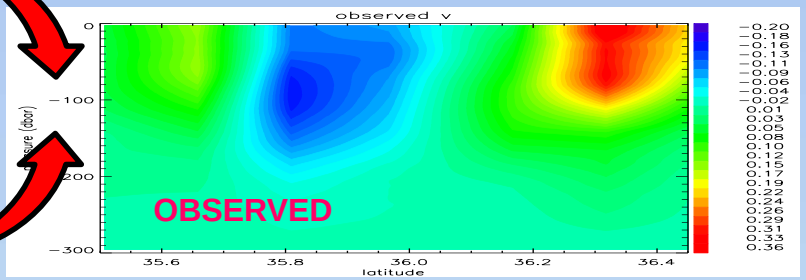


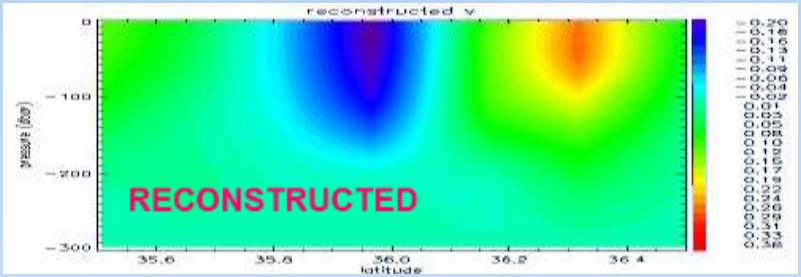
Satellite Sea Surface Temperature data



Machine Learning:

In situ data

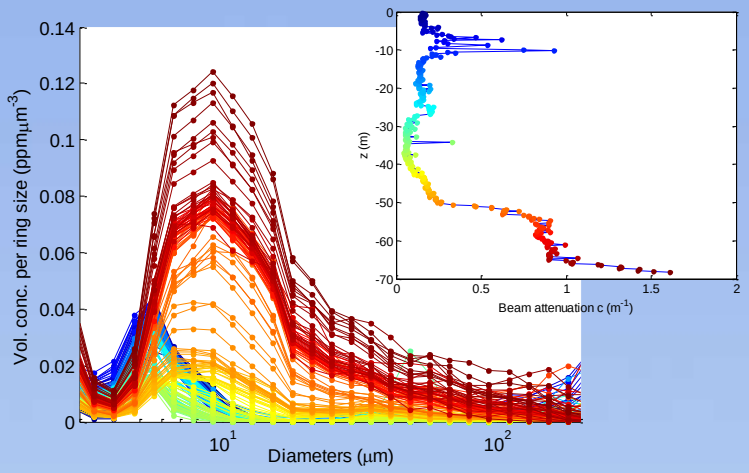


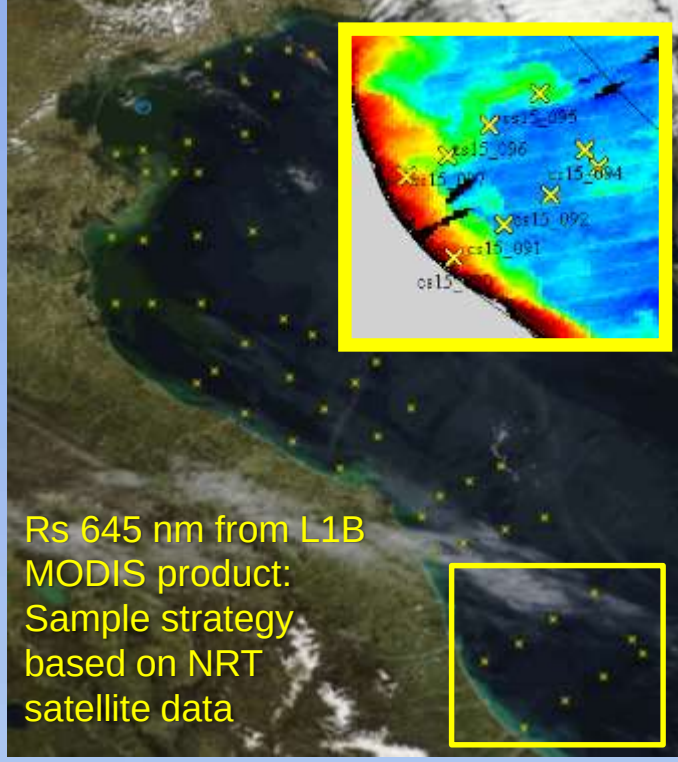


COSIMO 2015 Oceanographic Cruise

Objectives :

- *Regional algorithms for the TSM*
- *In situ mesurements for Cal/Val actvity (LISST and WetLab)*

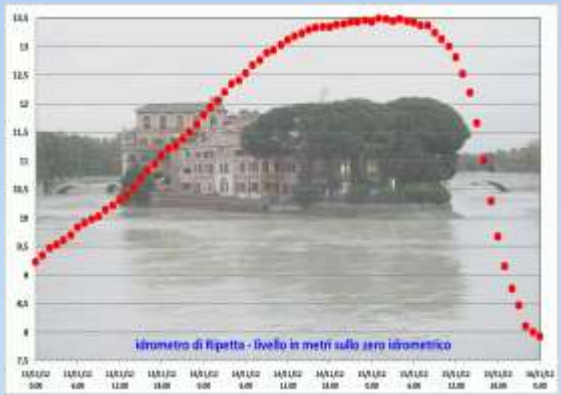


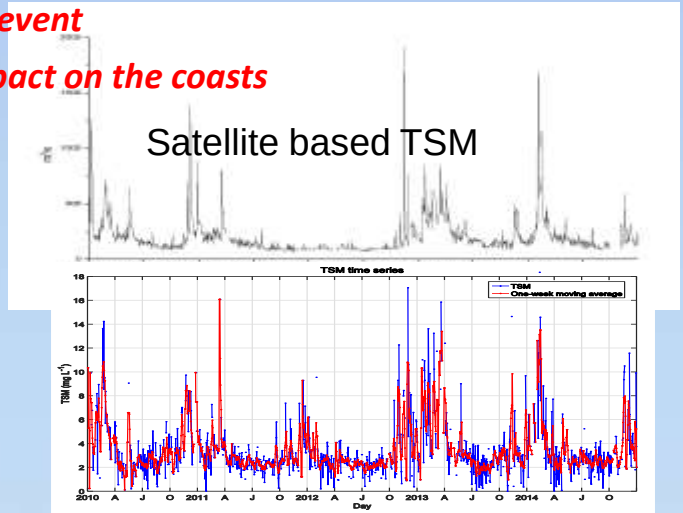


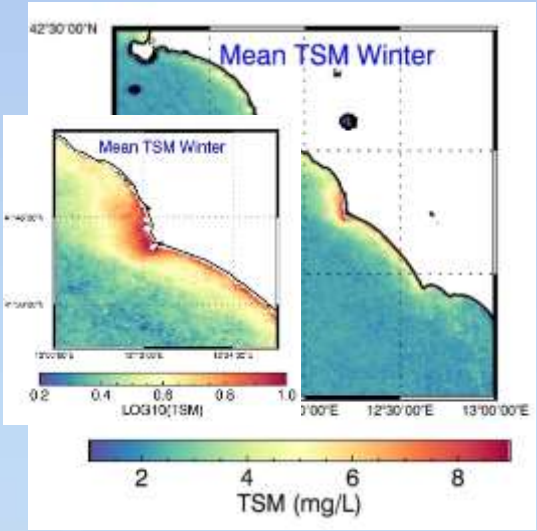
Variability of spatial patterns of total suspended matter during catastrophic flood

Objectives :

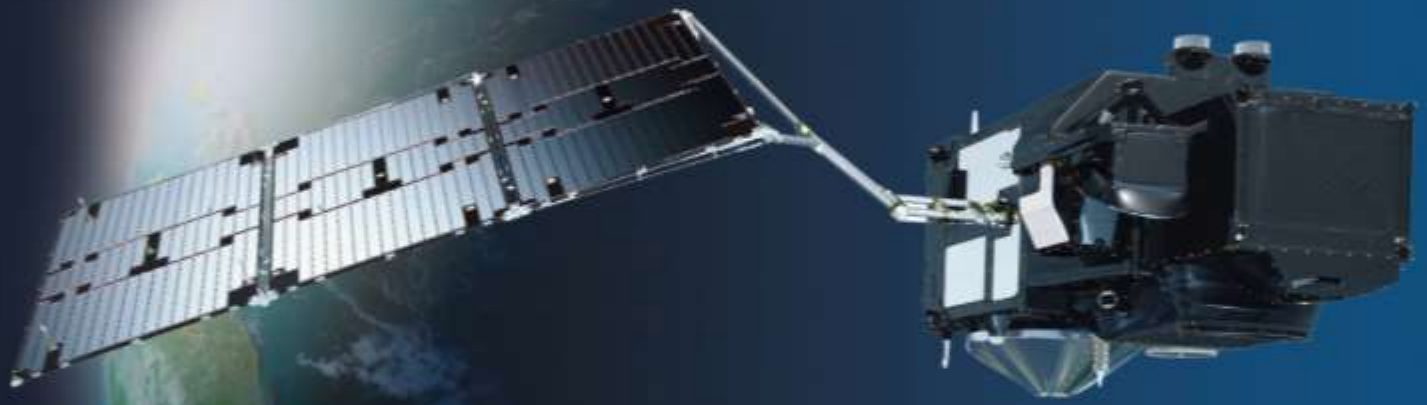
- *Quantify the TSM input from flood event*
- *Understand the geomorphologic inpact on the coasts*







Sentinel-3A Satellite

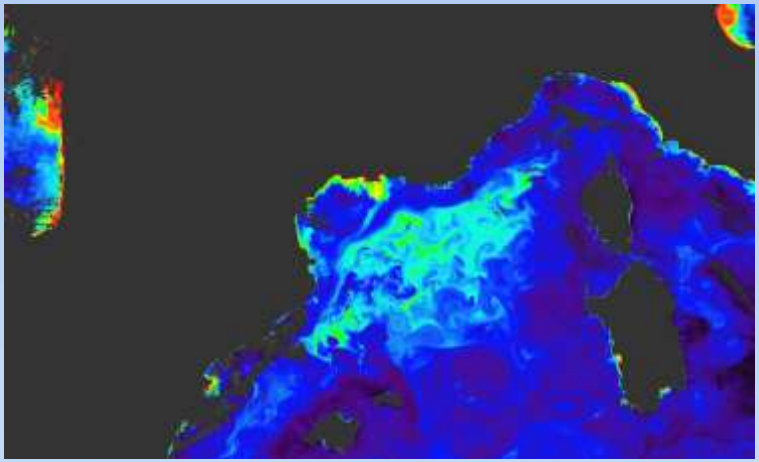


1. **Sea Surface Temperature**
2. **Ocean Colour**
3. **Altimetry**

Launched on 16 February 2016

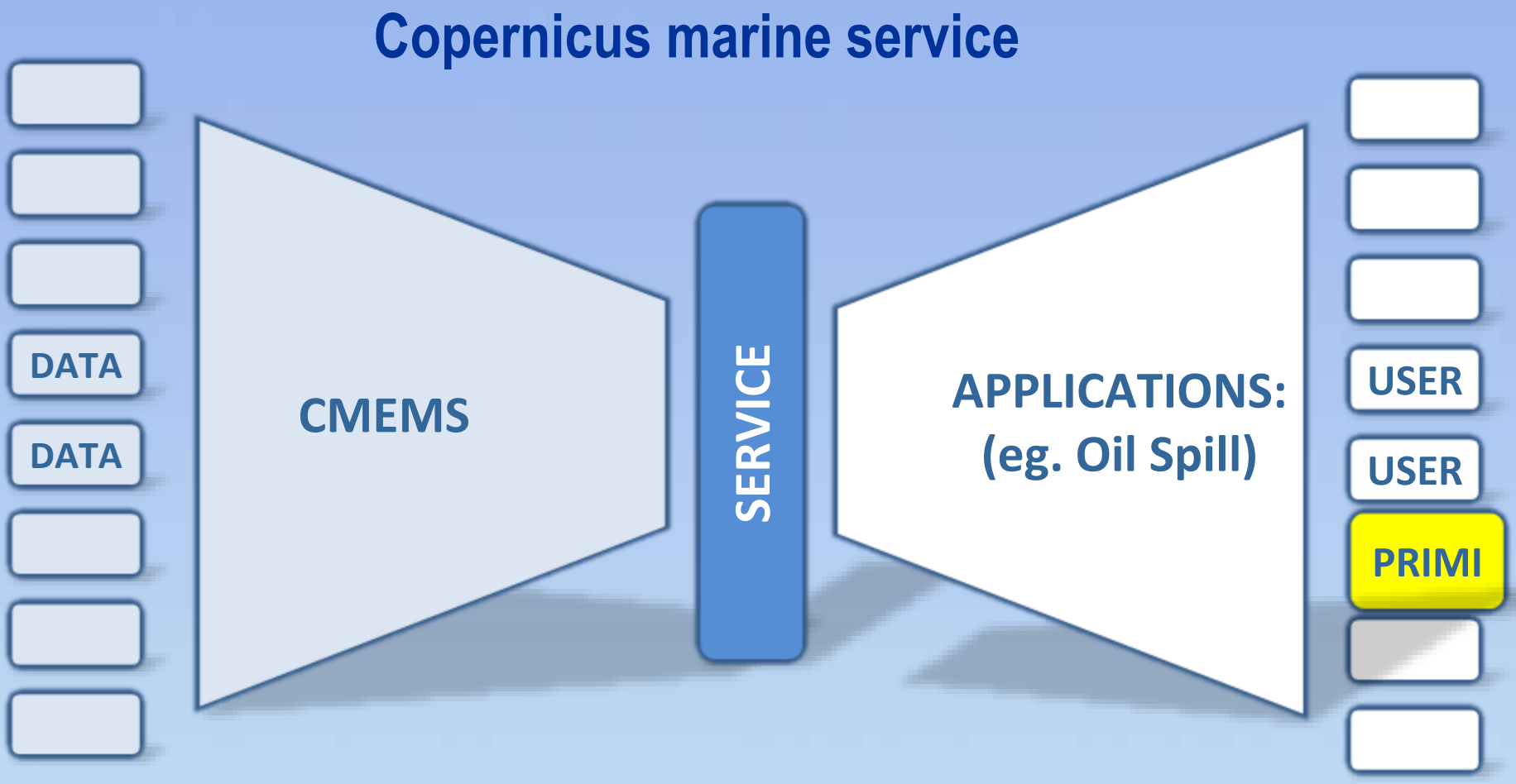
Sentinel 3

- **The Copernicus Programme** of the European Commission will **operate several satellite marine missions** to provide synoptic, global and regional aquatic bio-geochemistry information at unprecedented scales.
- **Sentinel-3A is the first operational mission in this context**.
- **The Sentinel-3** information will **empower policymakers, public authorities, the commercial sector and users worldwide** who will gain access to state-of-the art **operational Copernicus Marine** and **Climate Services using the measurement data**.



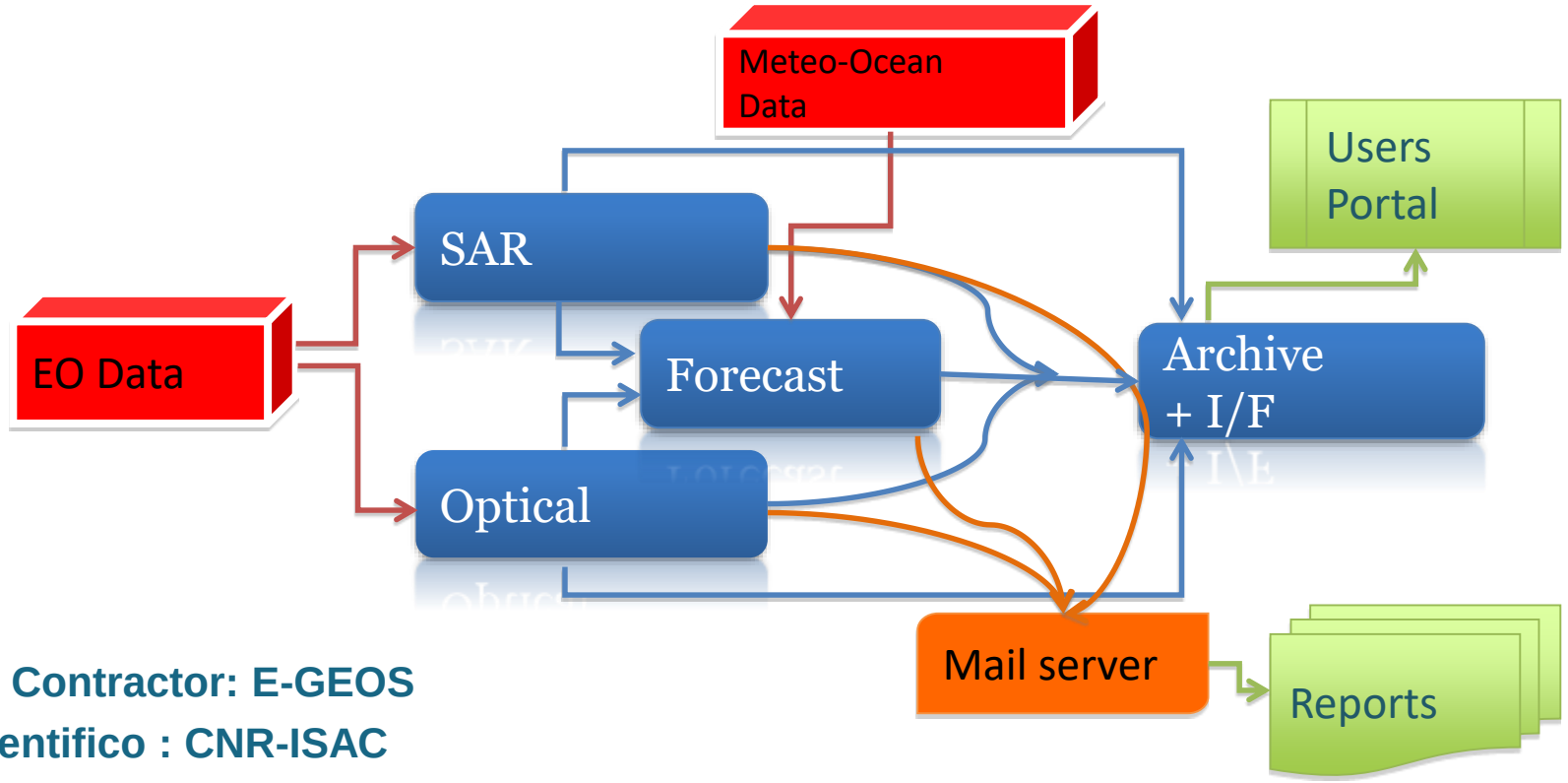
To contribute to Sentinel-3 CAL/VAL activities CNR carried out FRM measurements during this summer and planned a CAL/VAL Research cruise in 2017 as Italian contribution S3VT.

From Core Service to downstream Service



PRIMI Project: Validation of satellite oil spill detection and fate

PRIMI project, funded by the Italian Space Agency (ASI) has implemented an observation and forecast system to monitor marine pollution from hydrocarbon oil spills (OS) in the Italian Seas.



Prime Contractor: E-GEOS

PI Scientifico : CNR-ISAC

Partners: CNR (ISAC, IAMC, ISMAR), ENEA, INGV, Un. PO

Partners: ACS, FlyBy, INNOVA

PRIMI CRUISE OBJECTIVES

The main cruise objective was to visit oil slicks detected by the PRIMI SAR and Optical Observation Modules and whose displacement was predicted by the PRIMI Forecast Module, in order to validate PRIMI system during operation.

In particular:

1. To verify the accuracy of the oil slick detection by satellite
2. To verify the accuracy of the oil slick forecasting system
3. To release drifters into an oil slick and verify how they follow the slicks
4. To acquire in situ RADAR and LIDAR marine data in presence of oil spills
5. To collect oil spill water samples to analyze hydrocarbon composition, density and concentration
6. To acquire bio-ottical data of the area, for satellite algorithm validation (also in and out of OS)
7. To acquire surface mateo-marine data and R/V Urania navigation data for validation of SAR wind and ship detection products
8. To acquire hydrographic , biochemical and bilogical data of the area

PRIMI Cruise: INSTRUMENTATION

I-SPHERE: Iridium lagrangian drifters

LIDAR

Rosette Water Sampler (24 bottles) & CTD

ARGO lagrangian drifters

XBT

Drifter UNIBO

SATLANTIC optical profiler

RADAR IN SITU

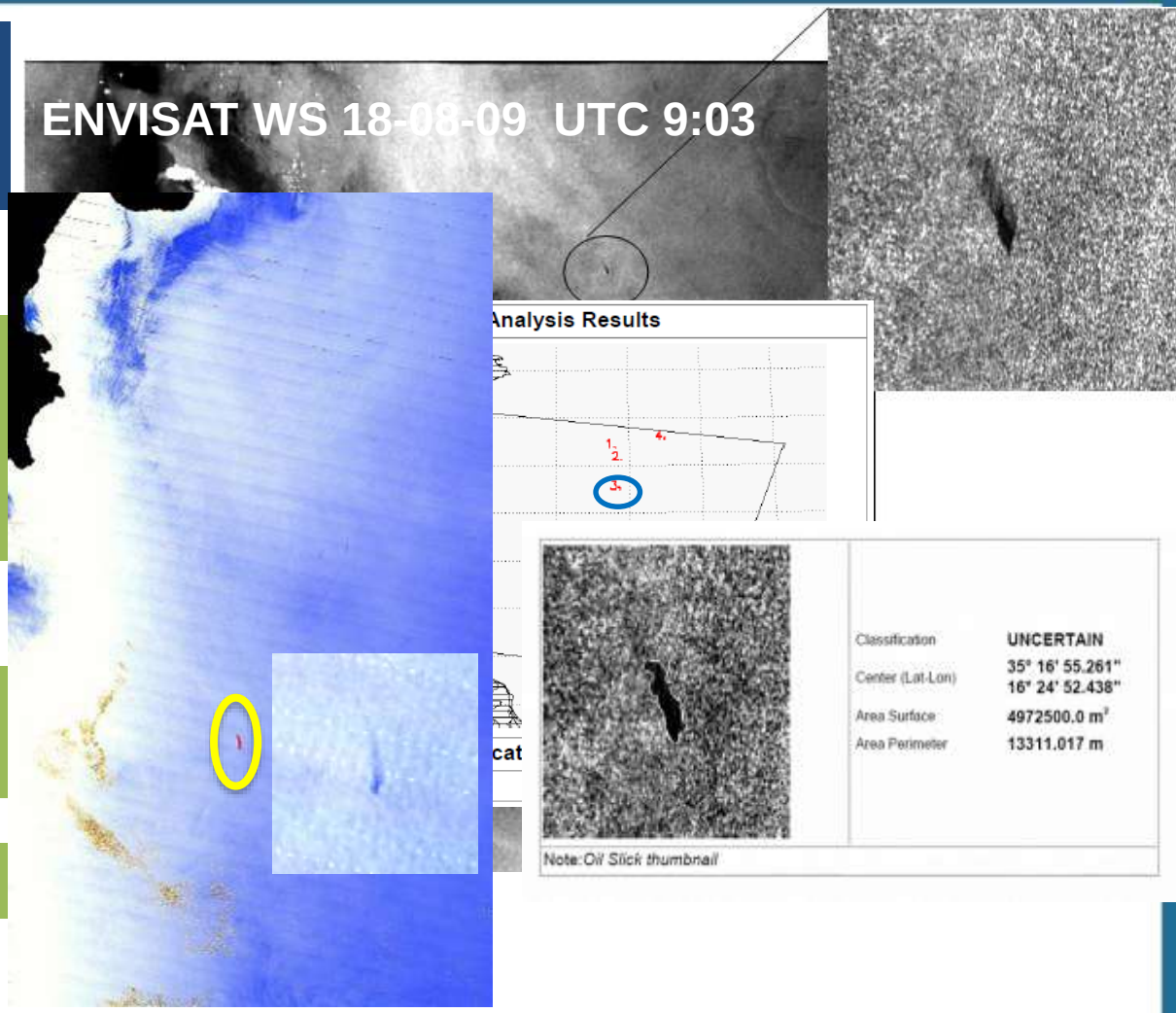
Oil Spill detection & Verification Strategy

SAR and VIS satellite processed in NRT by PRIMI system

OS SAR report received in NRT on board, within two hours from the satellite overpass

Selection of OS to be verify in situ

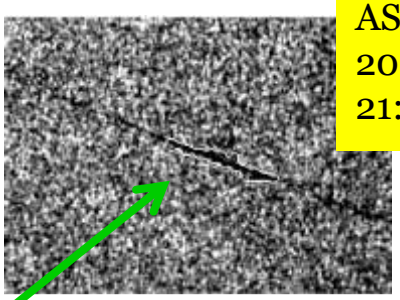
Check the OS in VIS images



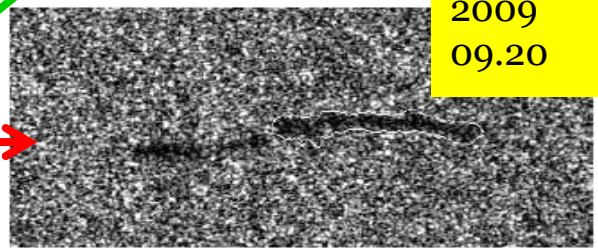
RV Ship move to the area in which the OS was detected and forecast of the OS board forecast of the oil spill drifi

PRIMI Cruise: OS of Aug. 26-27, 2009, Sicily Channel

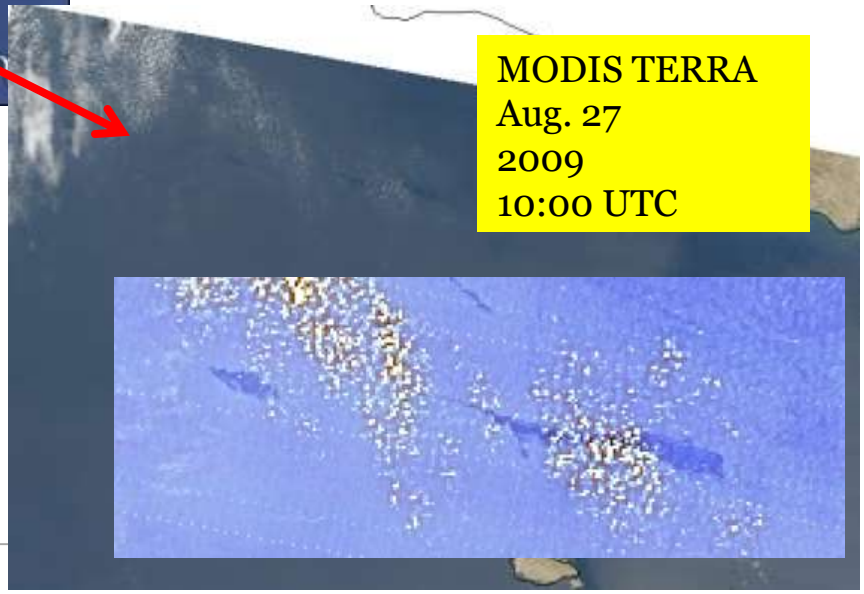
➢ Example: OS in situ location of a slick detected in two successive ENVISAT ASAR and MODIS images



ASAR Aug. 26
2009
21:05 UTC



ASAR Aug. 27
2009
09.20



MODIS TERRA
Aug. 27
2009
10:00 UTC

ow), prediction
reen), drifter
8

(tags at upper left).

2.0 and 2.3 g kg^{-1} of hydrocarbons were found in the samples


Thanks for the attention