Multitemporal observations of extreme met-ocean conditions from Envisat ASAR and Copernicus Optical parameters

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OUTLINE

- Introduction
- Overview of GMES/COPERNICUS and EO products
- Test Case: 'Added value EO products for Extreme event'
  - Extreme event characterization:
  - - Copernicus EO
  - - Modeling
  - - WMS implementation

Introduction

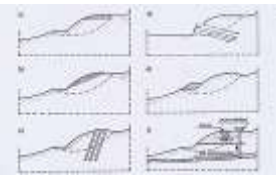
Context: For the decision and policy makers knowledge about coastal, response to variations in external conditions and the degree to which a system is able to cope with adverse effects, is mandatory. In order to consolidate and improve existing monitoring approaches in Europe and help to identify and address gaps in currently available data and information, specific tools to support decisions are available from the context of EO and GMES/Copernicus.

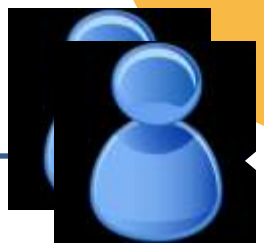
Purpose: Test Case presented shows how added value products for coastal analysis can be obtained by integrating COPERNICUS core observation products with other EO data and *insitu* measurements. Observing coastal dynamics means observing complex ecosystems with multi parameter interaction and their time- (long-term visions) and space- dependent dynamics. Appropriate governance (multi-purpose) and a sustainable approach requires the implementation of durable, repeatable and self-sustainable infrastructures as well as coaxes of infrastructures.

ESA ONGOING ROLES AND PARTNERSHIPS

- ESA is developing new satellite missions called **Sentinels** specifically for the operational needs of the GMES/Copernicus program.
- The Sentinel missions are based on a **constellation of satellites** to fulfill revisit and coverage requirements from environmental monitoring and provide a unique set of observations for **GMES/Copernicus Services.**
- The operational availability of ESA Sentinel satellites has been central in the 2013 FP7 space work programme to support space based applications such as Copernicus.
- EU funding schemes have and will strongly support topics aimed at delivering **new and innovative products, processes and services,** with particular attention on the investments in the Sentinel satellites.
- The simulations of future Sentinel data are on the way and they represent a challenge for scientists, since accurate technical specifications would be needed.

Downstreaming and Support to Decision Process





Integration layer
GMES Services
Non GMES Services

Publication layer

COASTS: The interface between Land/Sea Scape

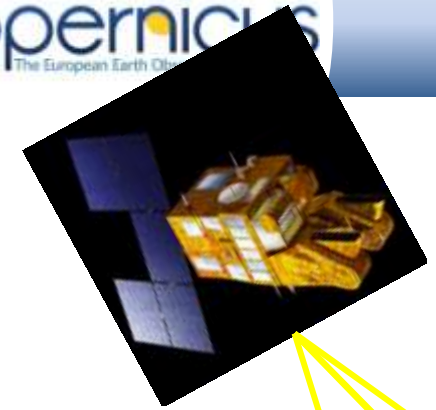
- Field Radiometry
- Algorithm development and research
- Spectral mixing analysis
- SAR processing

ESA remote Segment +
Data in situ acquisition

Preprocessing modules
(archive search&new acquisition)

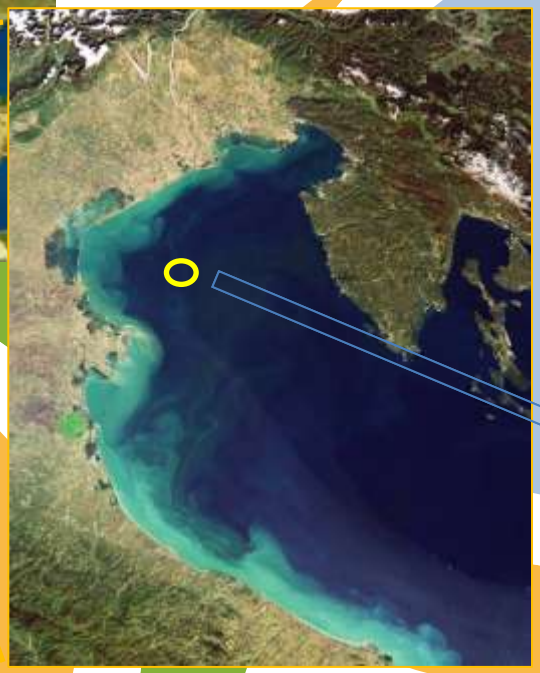
From Space Systems to **non EO expert** End Users

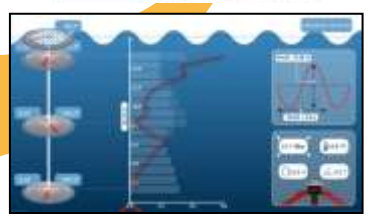
In situ Coordination



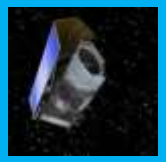
The strategy of combining high and very high resolution spectral measurements in a multisensory and multi resolution analysis. This includes different ways of data fusion to assimilate spectral and spatial variability in complex coastal mapping and modeling.

Test Case: COASTAL MARINE– NORTHERN ADRIATIC SEA





Offshore Adriatic Sea, marine resources and multiuse platforms



Earth Observation DATA

COPERNICUS PRODUCTS

MODELS

Optical

SAR

Data & Products Assimilation

COPERNICUS PRODUCTS

Non COPERNICUS products

Data Processing

Assessment of products quality using *in-situ* data

- SST
- KD490
- TSM
- CHL
- WIND

Spatial series of maps

Temporal series of maps

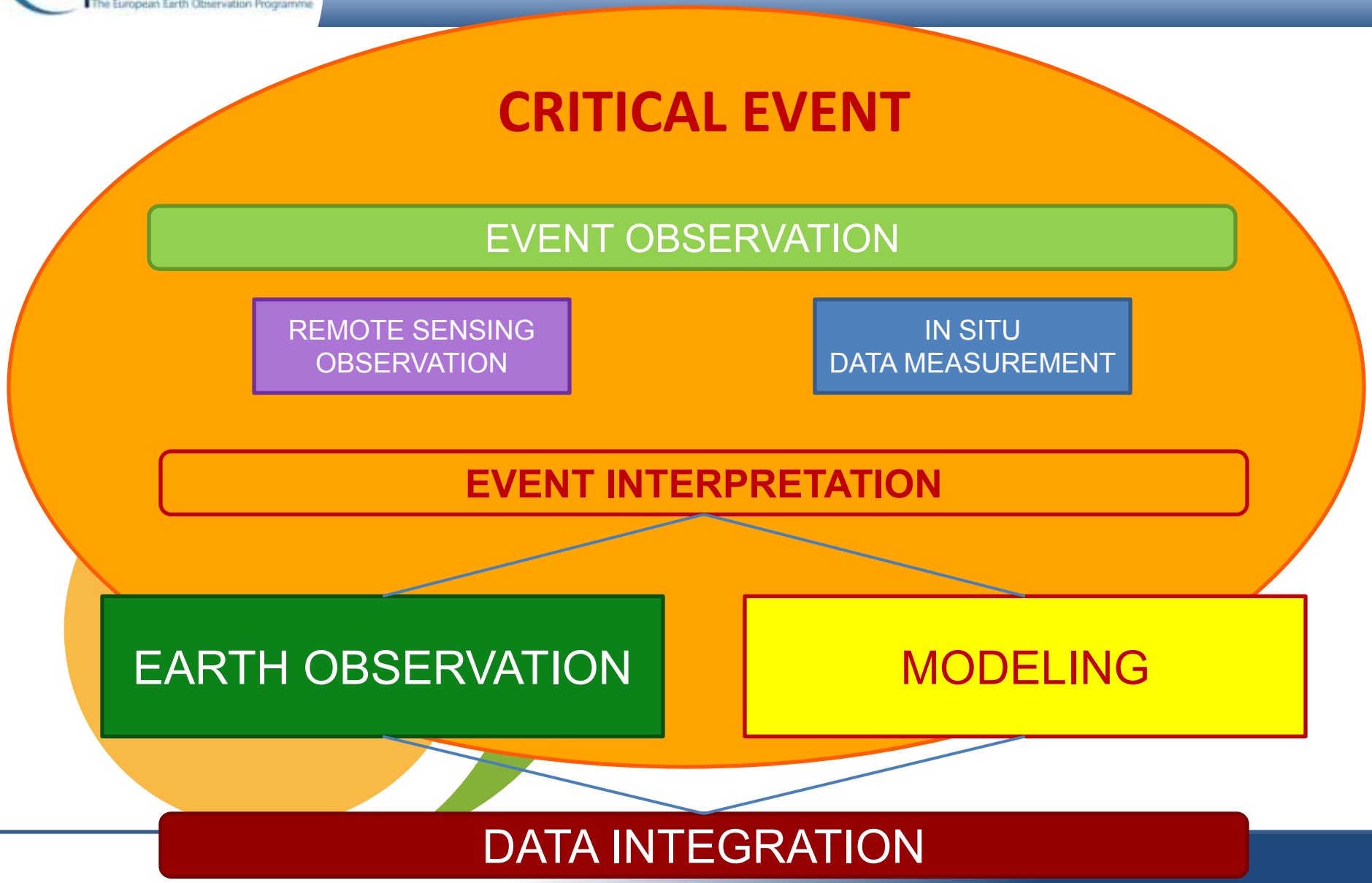
- Waves
- Currents

DATABASE

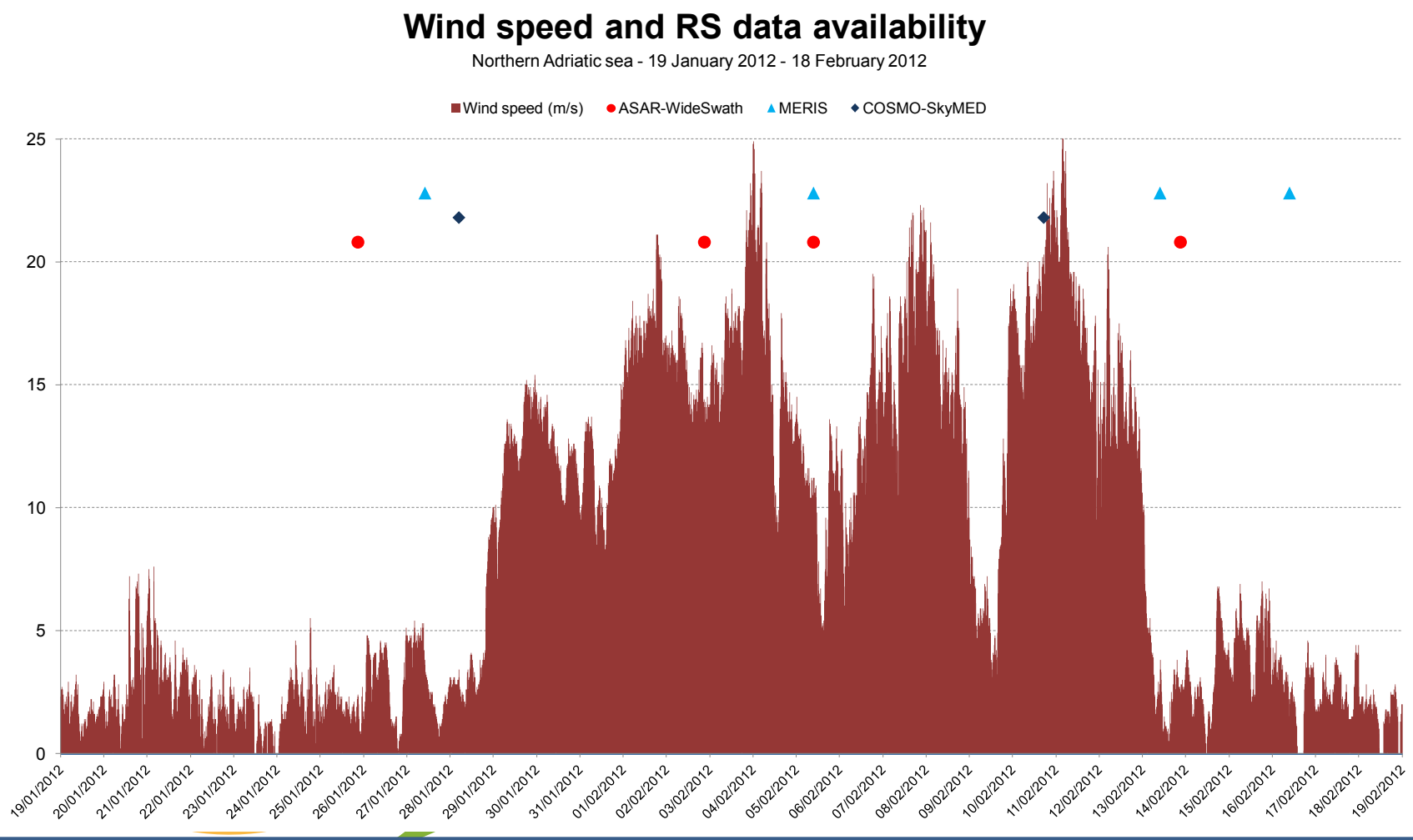
ADDED VALUE PRODUCTS

DSS

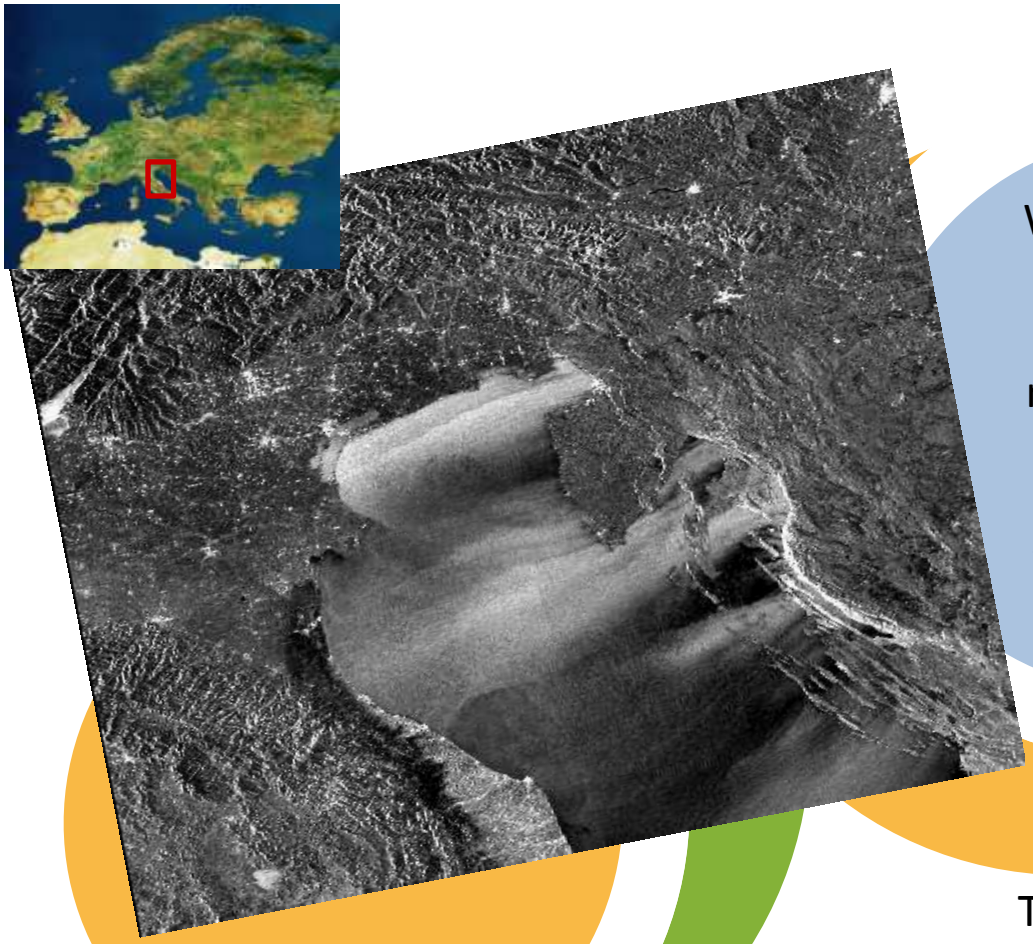
Different approaches for critical event interpretation



Evaluating Remote Sensed data availability during Bora events in winter 2012



RS data processing from SAR

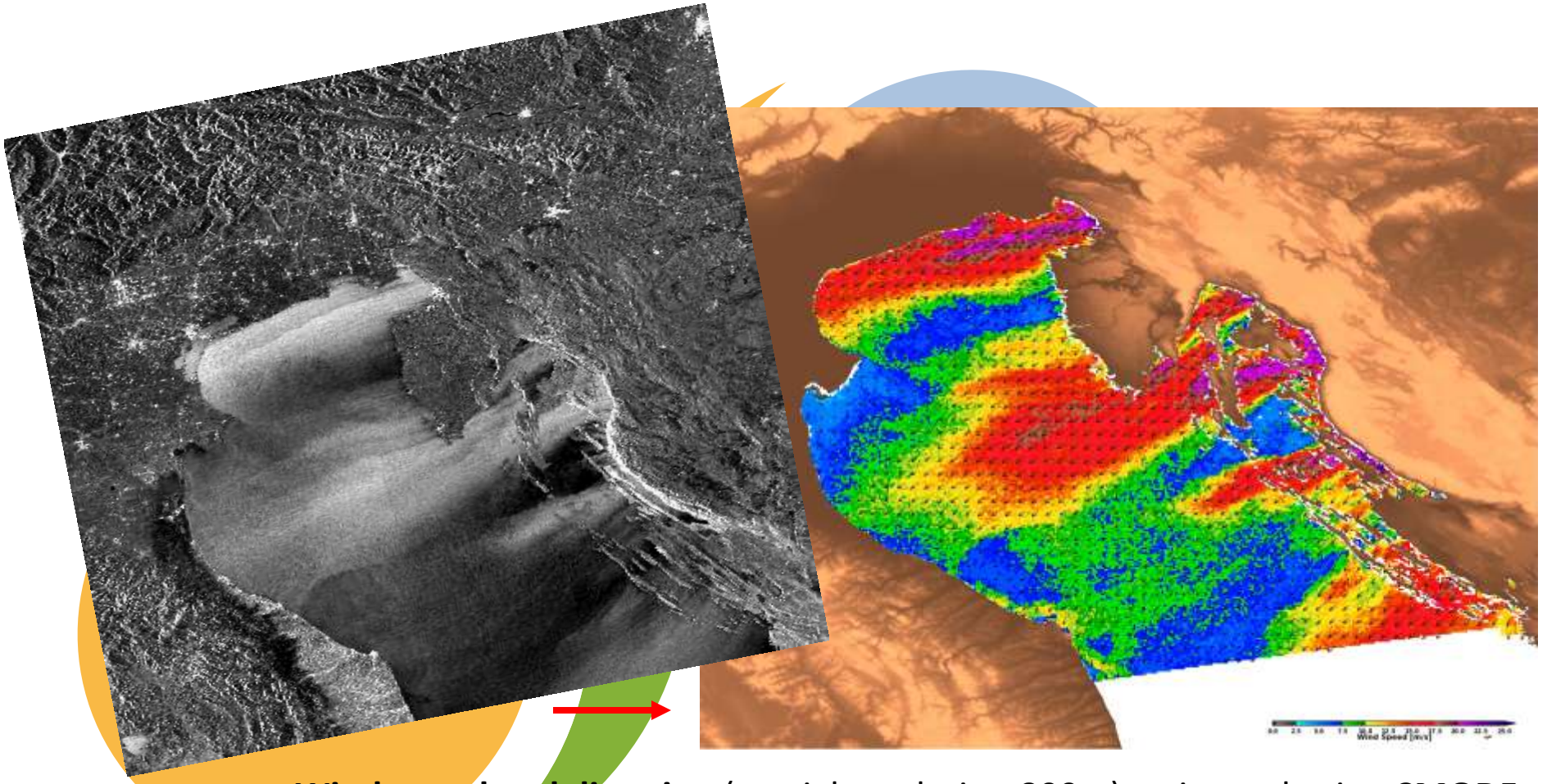


Wind field (intensity and direction) over sea surface can be estimated from Synthetic Aperture Radar (SAR) remotely sensed data, onboard satellite platforms.

There are different retrieval algorithms (XMOD, CMOD5), due to different sensor charactheristics.

Spatial resolution of output products can be 300m to 1000m.
Temporal resolution is depending on the acquisition platform, 4 to 16 days, and it is not affected by cloud coverage.

Estimated Wind field from medium resolution SAR ASAR Wide-Swath Mode

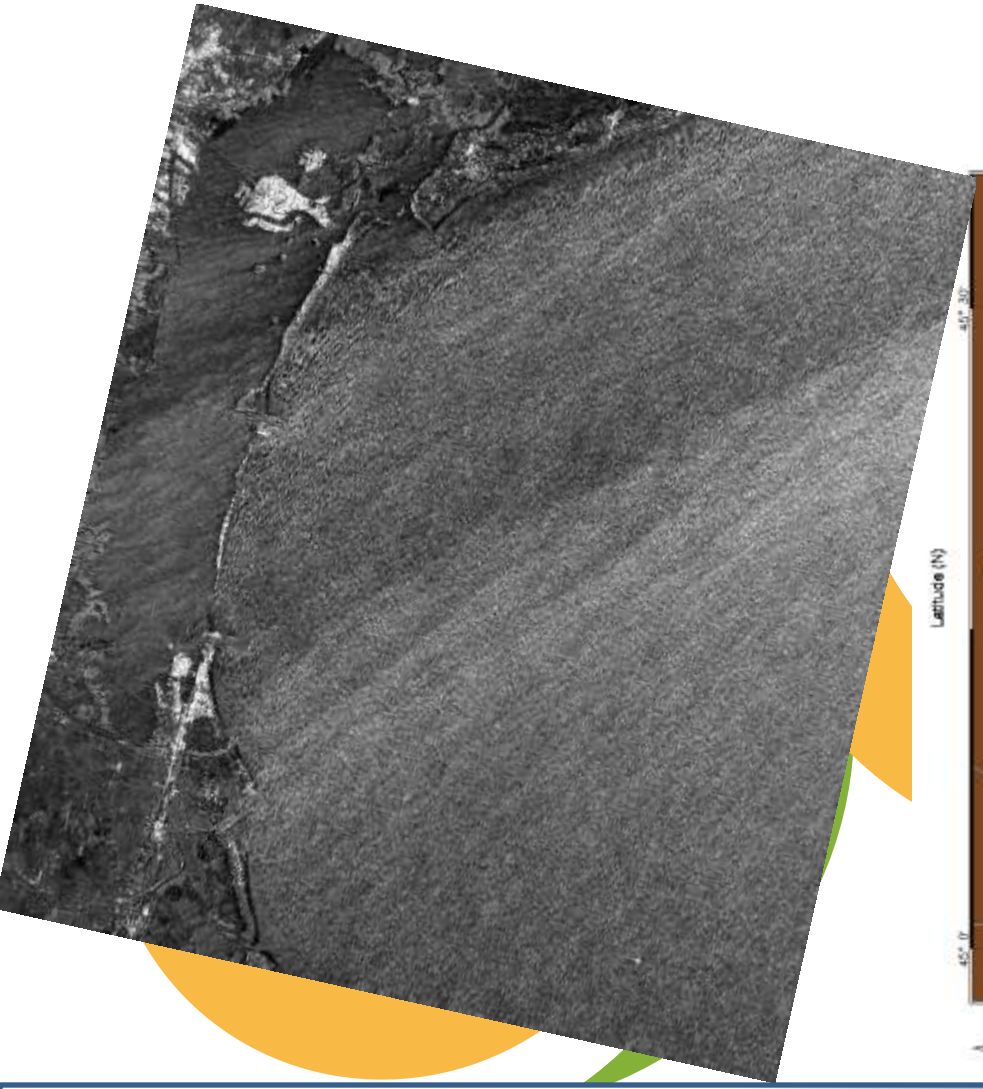


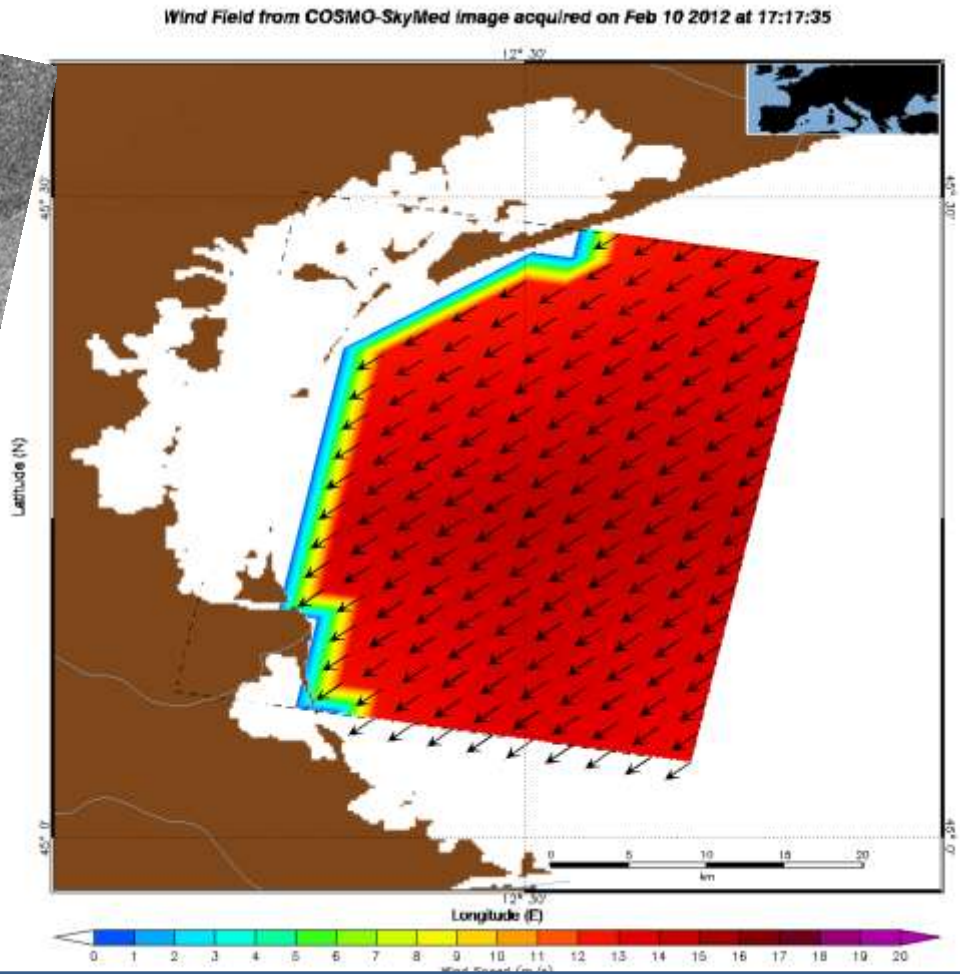
Wind speed and direction (spatial resolution 800m) estimated using **CMOD5** algorithm from **ENVISAT ASAR** Wide Swath acquired on 02/02/2012

Source: ESA, Soprano CLS

Estimated Wind field from high resolution SAR COSMO-SkyMED

Wind Field (Direction and velocity)



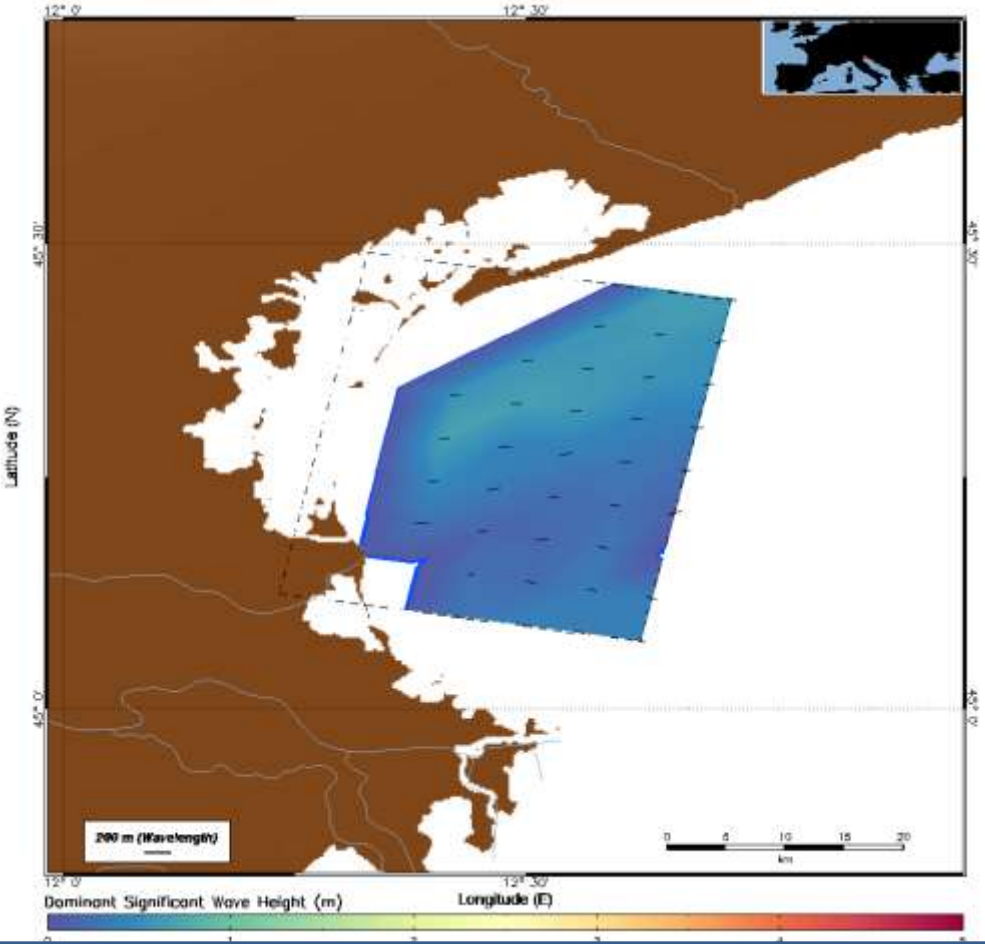


Software GWW e-GEOS

Estimated Waves from high resolution SAR COSMO-SkyMED

CosmoSkyMed High resolution

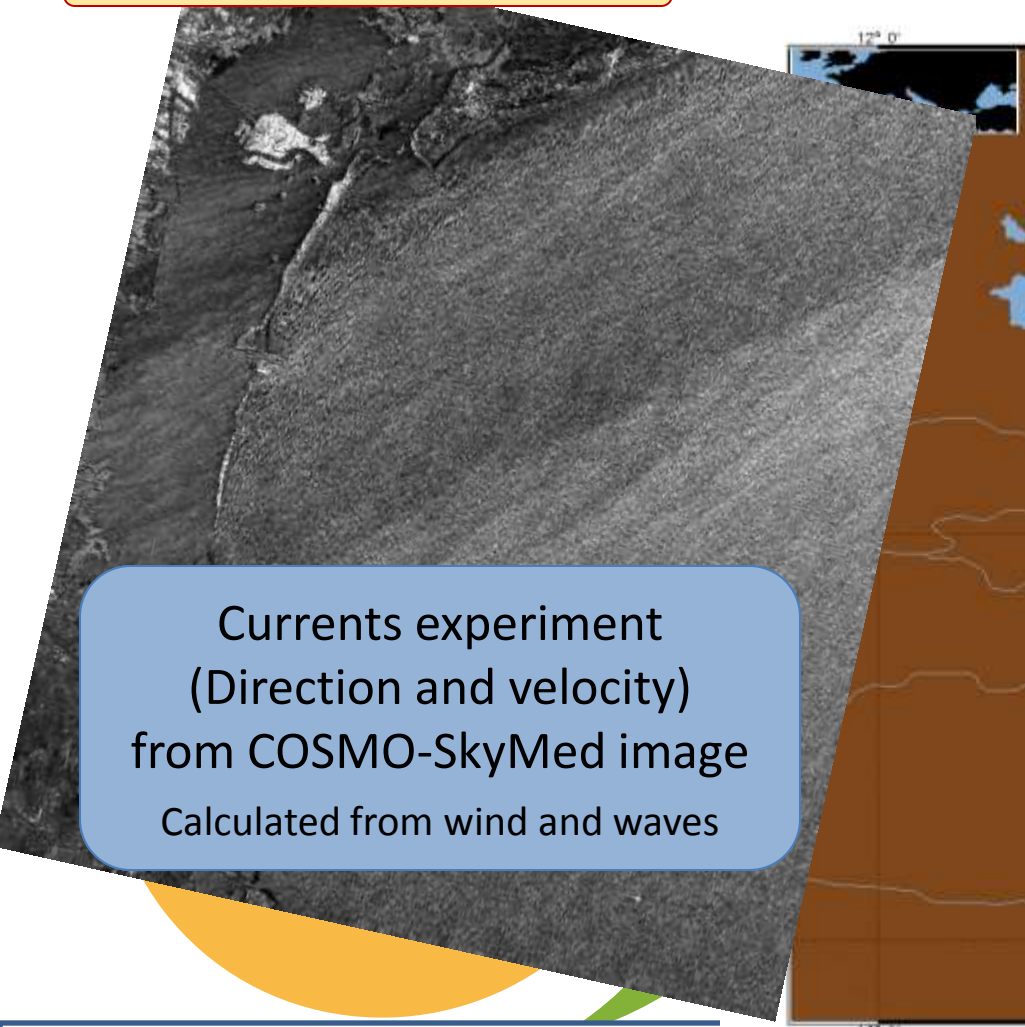
Wave Field (Significant Wave Height and Wave Lenght)



Software GWW e-GEOS

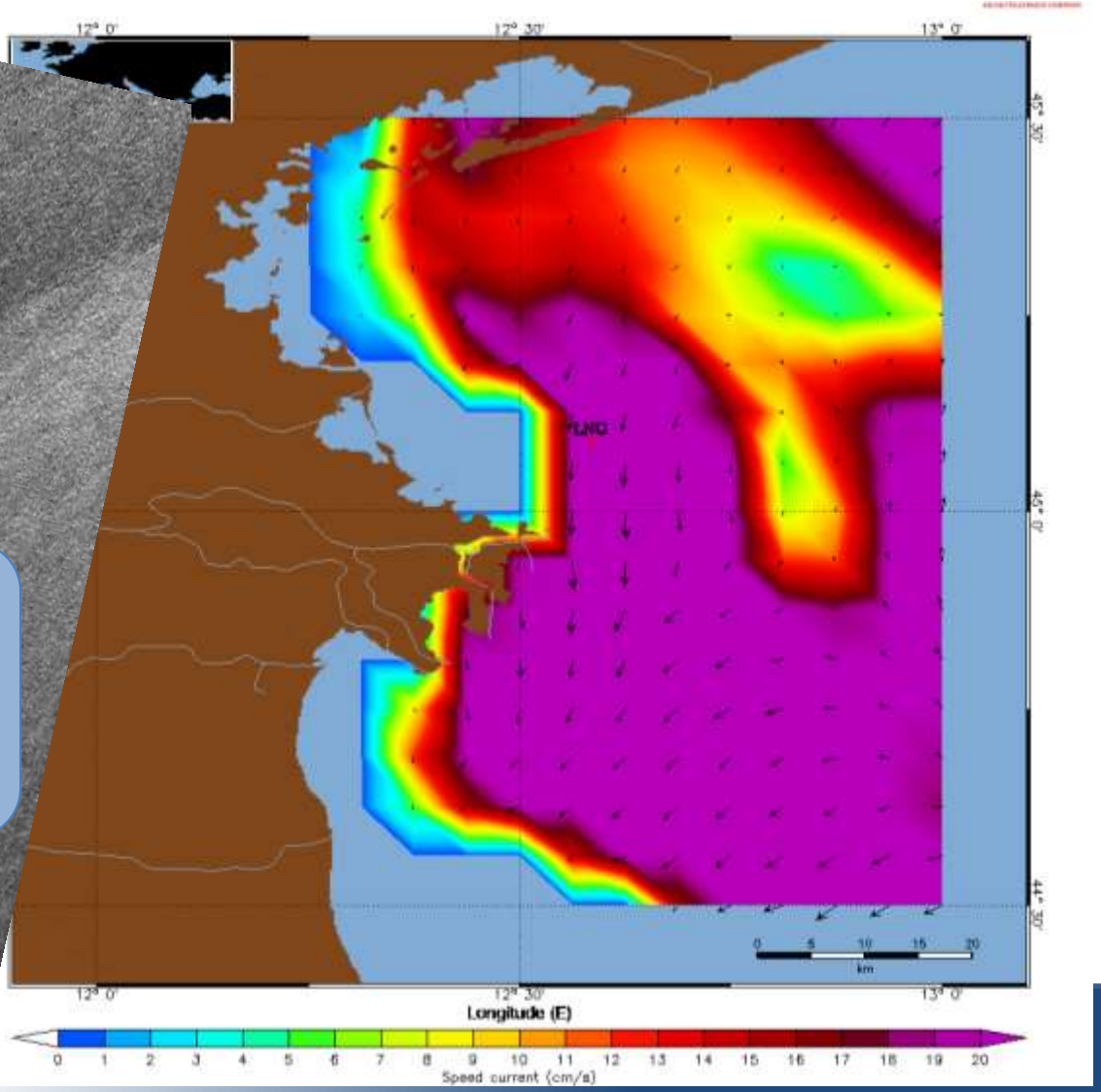
Estimated Currents field from high resolution SAR COSMO-SkyMED

CosmoSkyMed High resolution



Currents experiment
(Direction and velocity)
from COSMO-SkyMed image

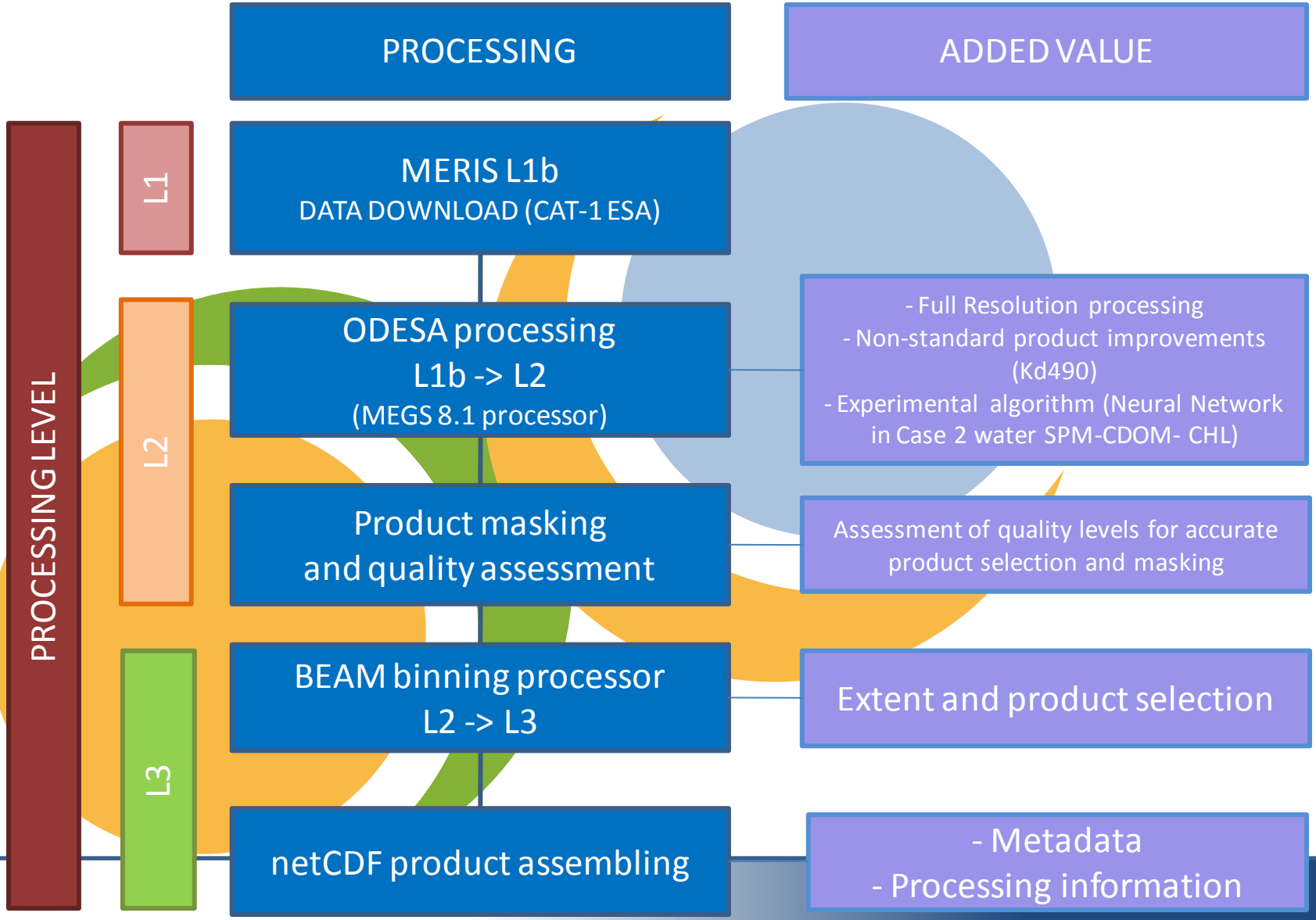
Calculated from wind and waves



Software GWW e-GEOS

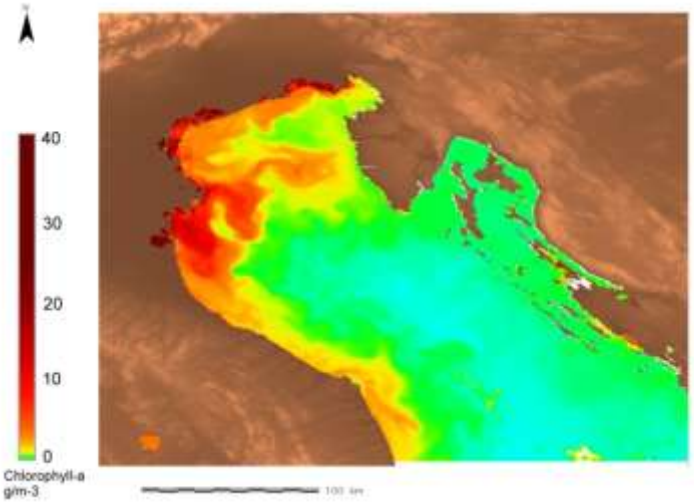
RS data processing from optical sensors

MERIS full resolution processing chain

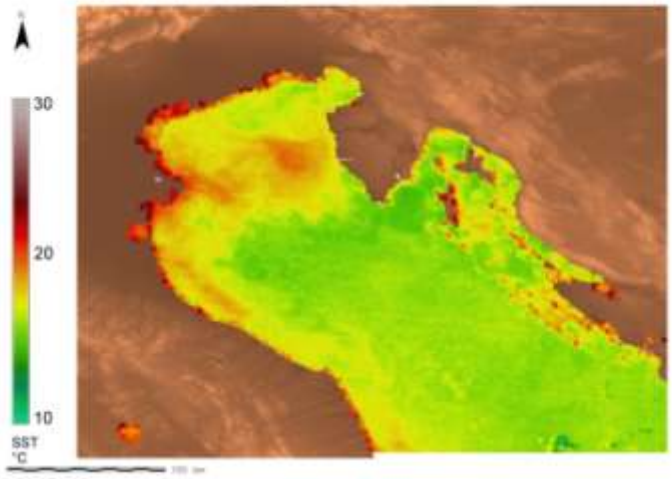


RS data processing from optical sensors

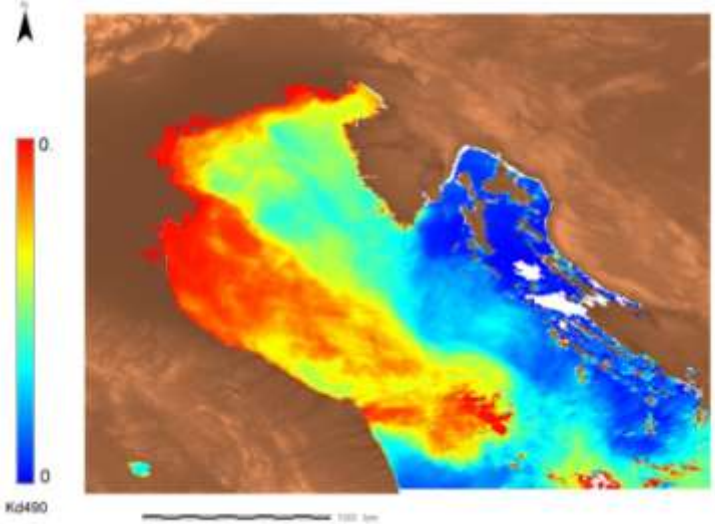
Chlorophyll-a



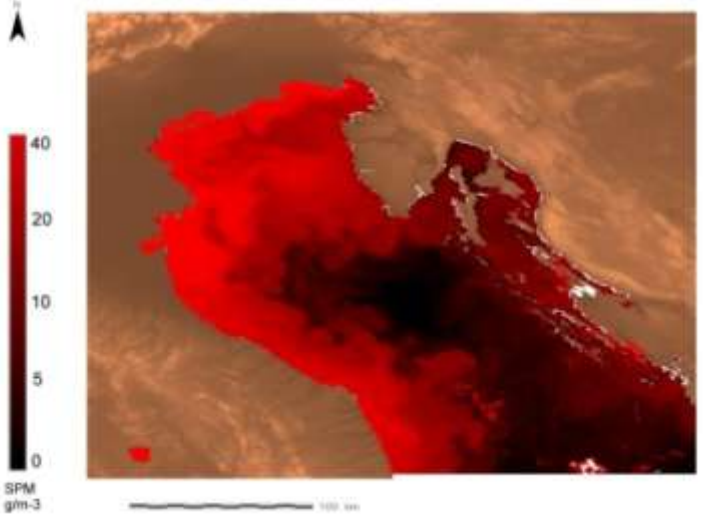
Sea Surface Temperature



Diffuse attenuation coefficient (KD) for downwelling irradiance at 490 nm

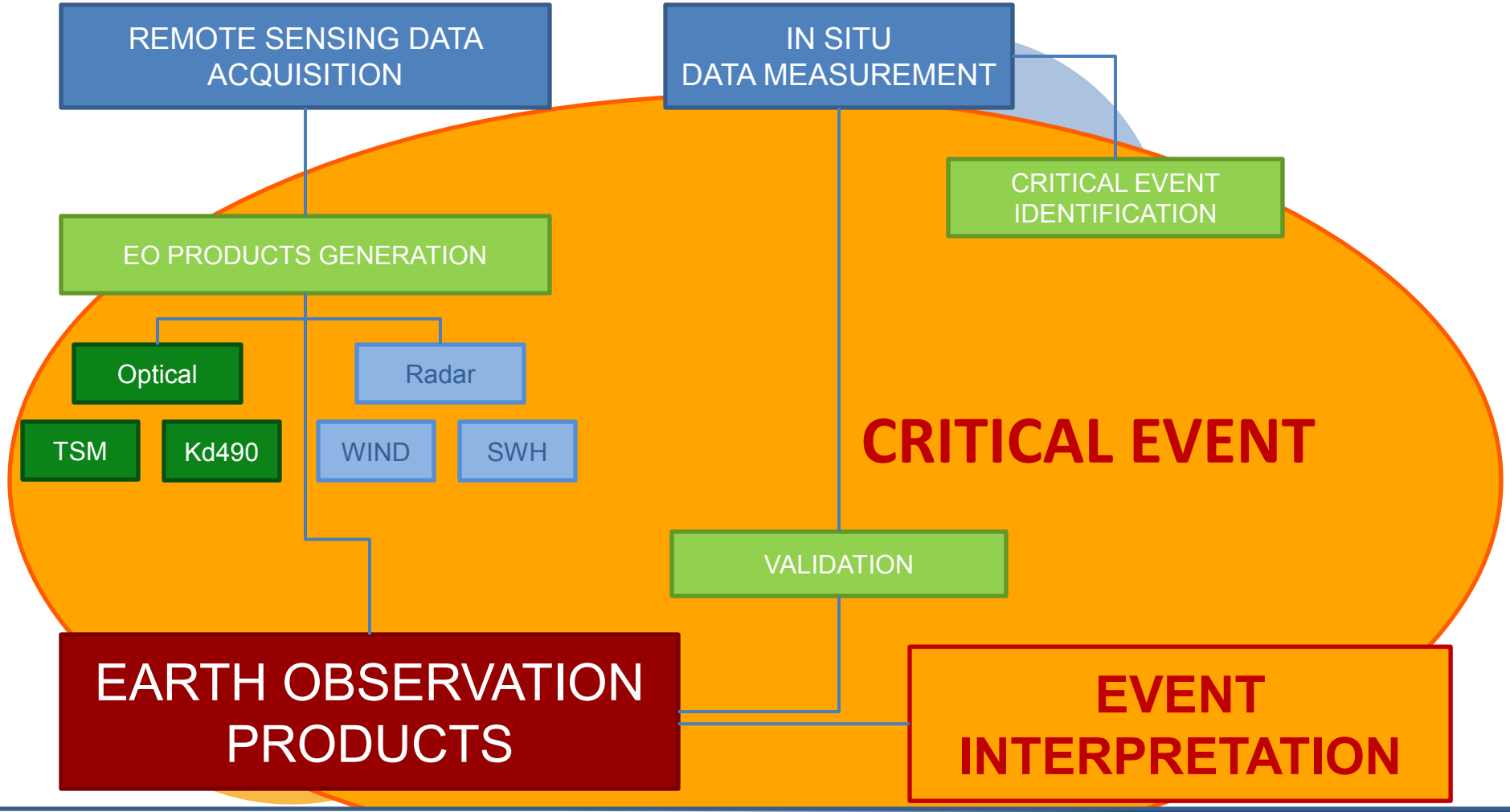


Suspended Particulate Matter

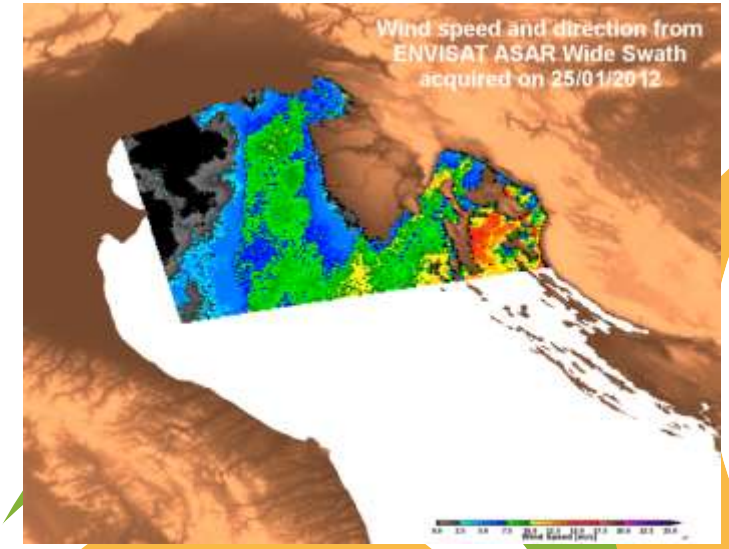


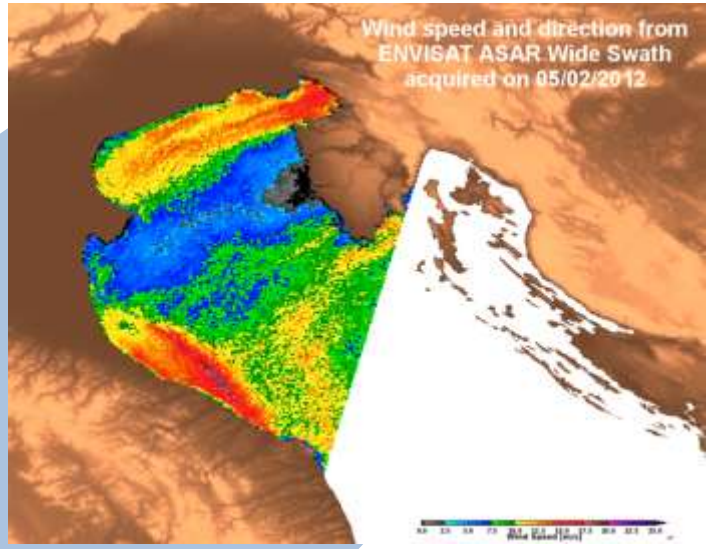
L3 binned Geophysical parameters from ENVISAT MERIS and MODIS Terra data acquired on 08/05/2011
Source: ISPRA

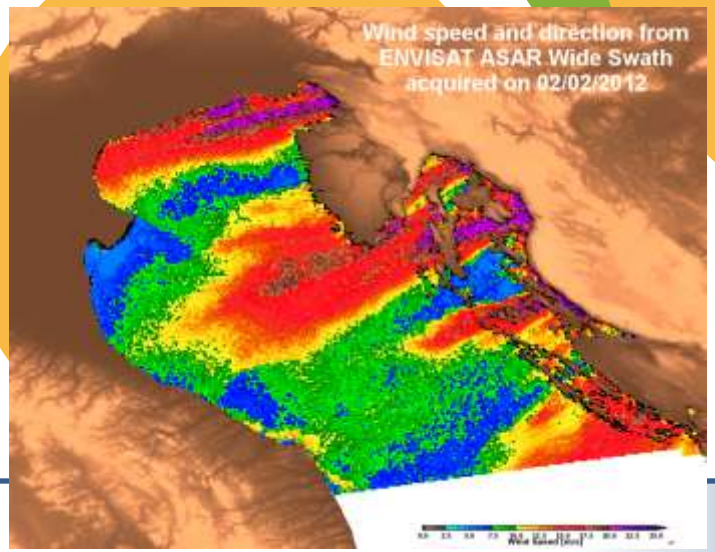
Interpreting critical events using Earth Observation products

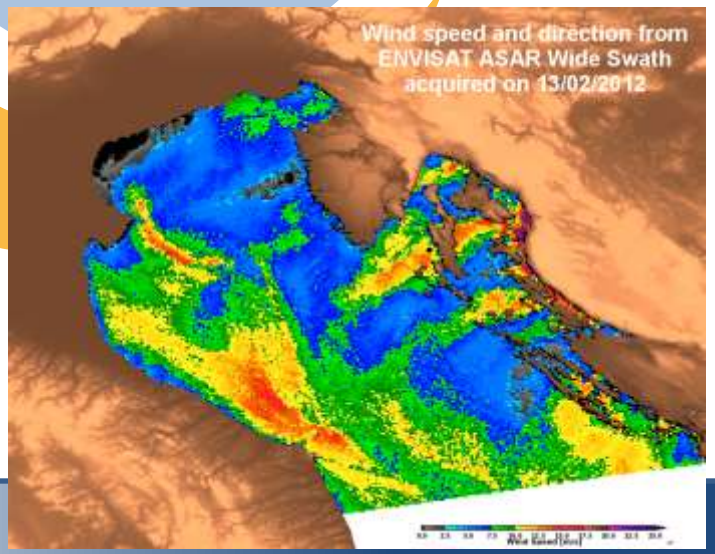


Estimated Wind intensity during Bora events in winter 2012



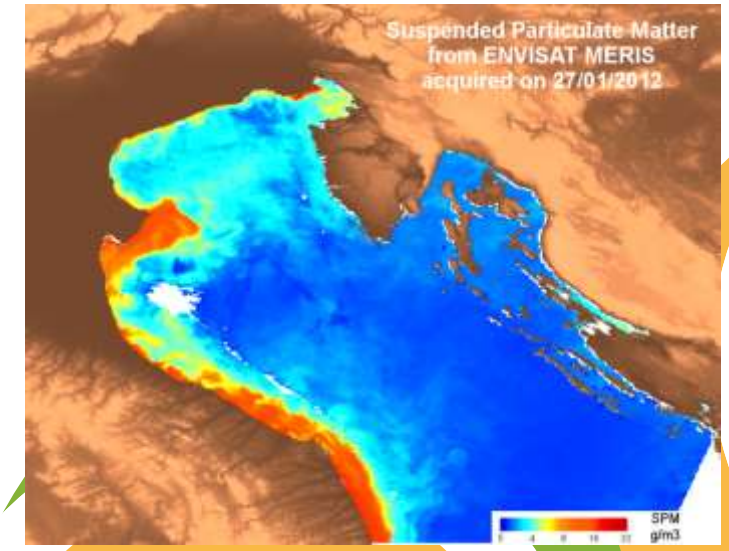


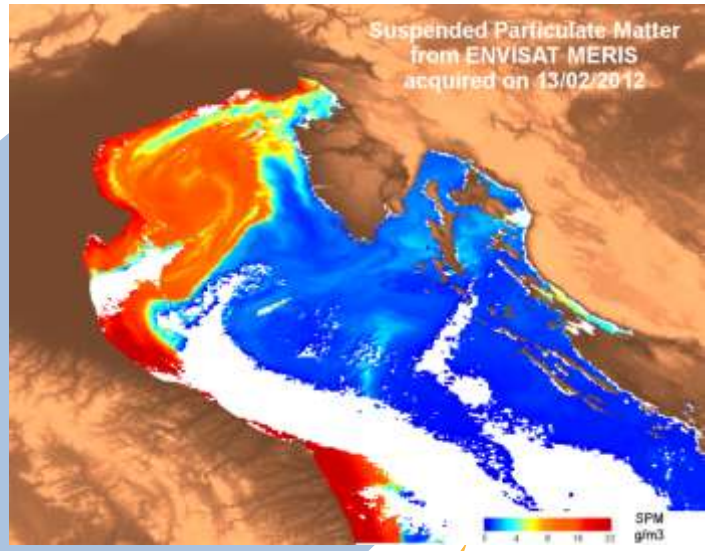


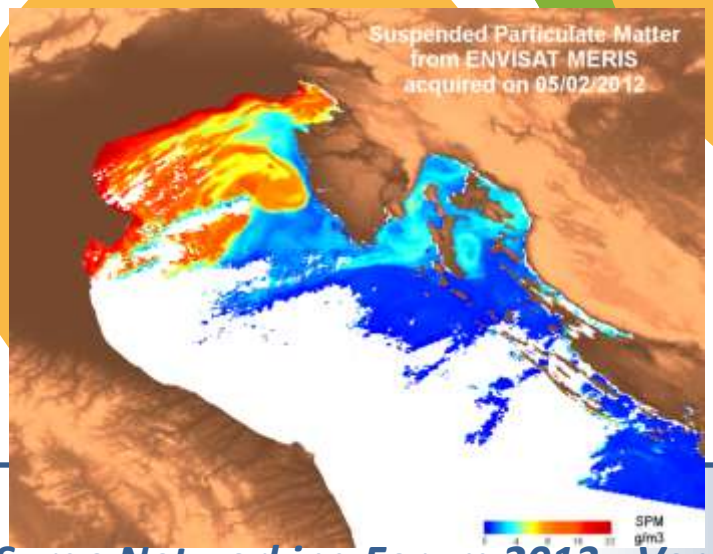


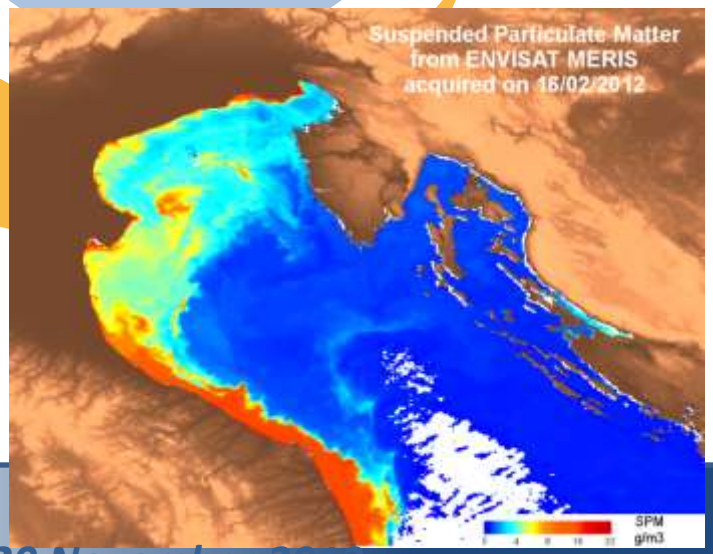
Source: Soprano CLS

Estimated Suspended Particulate Matter during Bora events in winter 2012



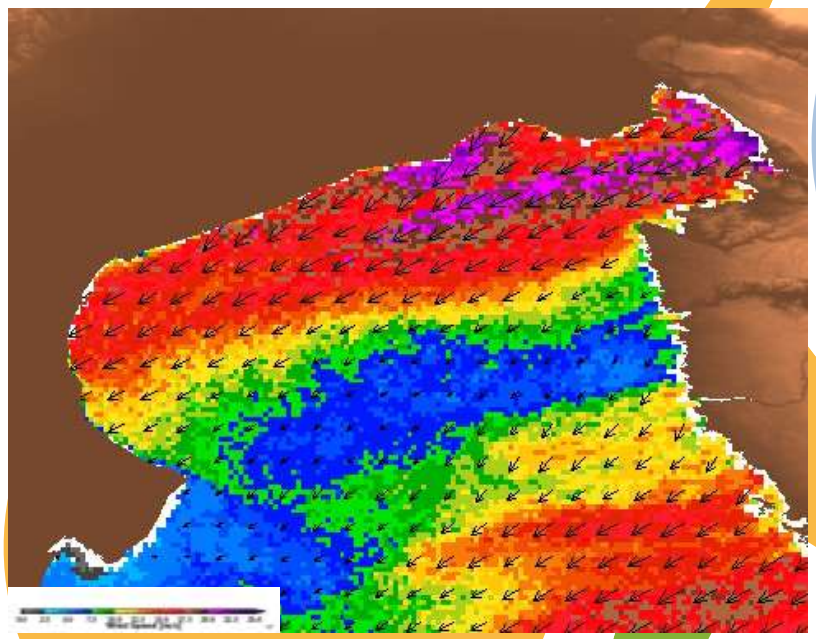




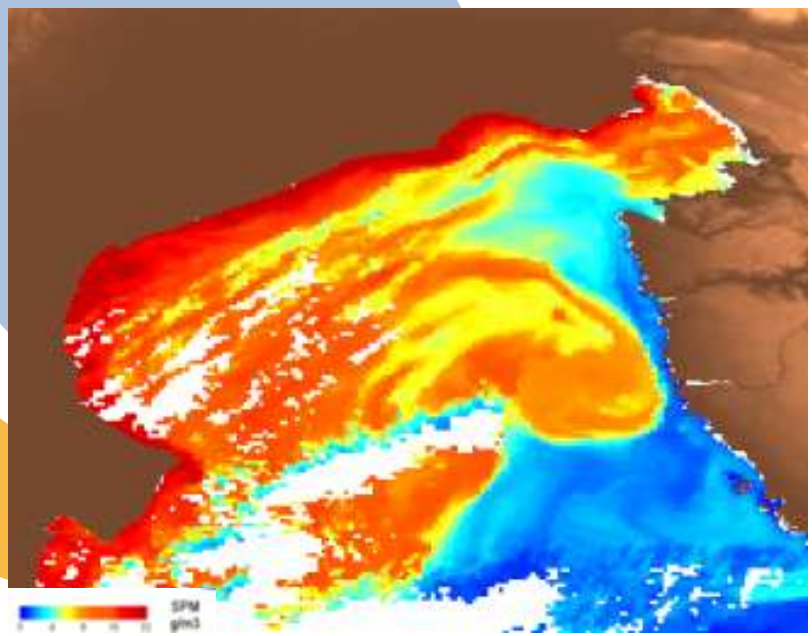


Source: ISPRA

Comparing Earth Observation products estimated from different sensor acquired contemporary during Bora events in winter 2012



Wind Speed and direction

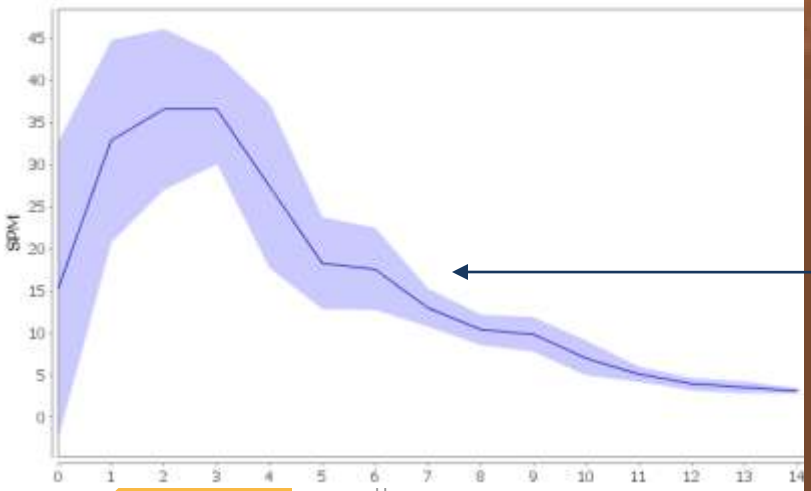


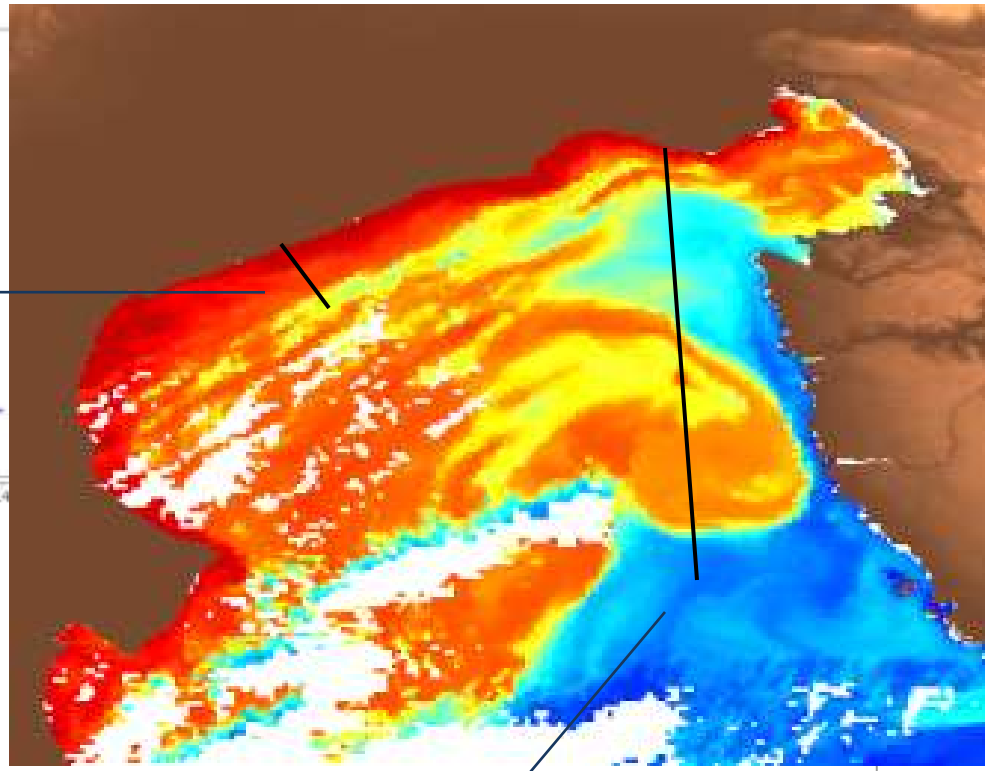
Suspended Particulate Matter

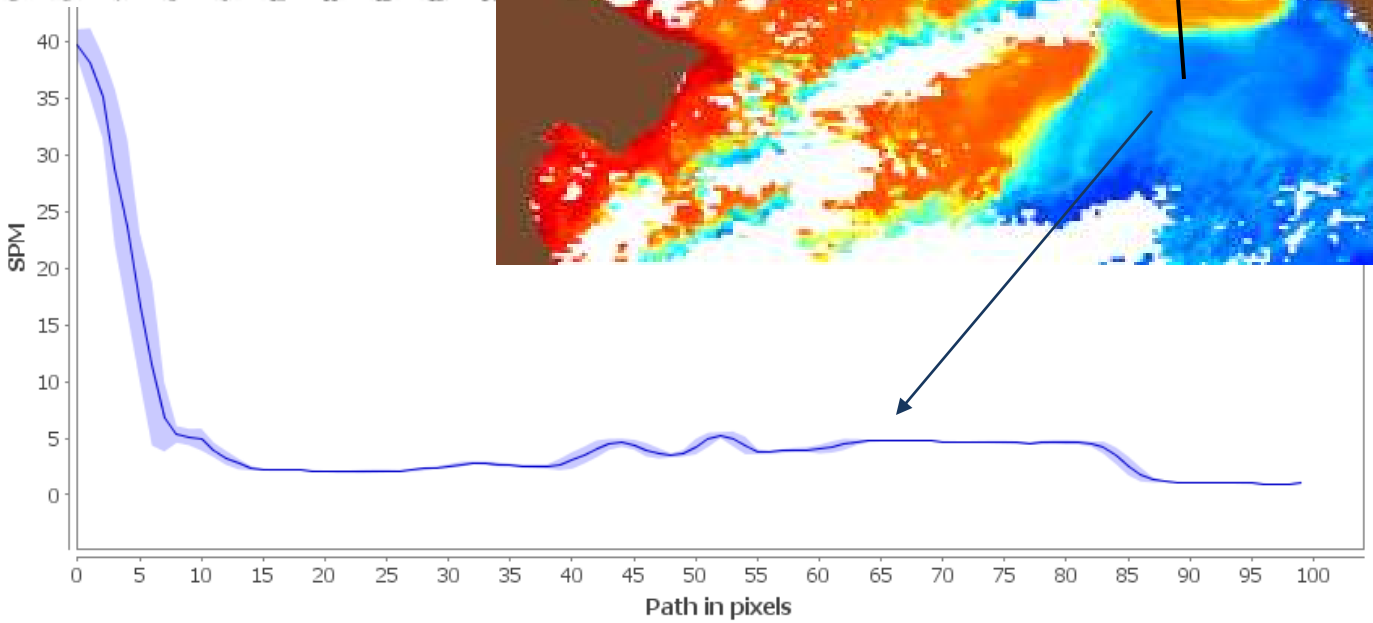
Data acquired on 02/02/2012
Source: Soprano CLS, ISPRA

Analysing Earth Observation product

Suspended Particulate Matter

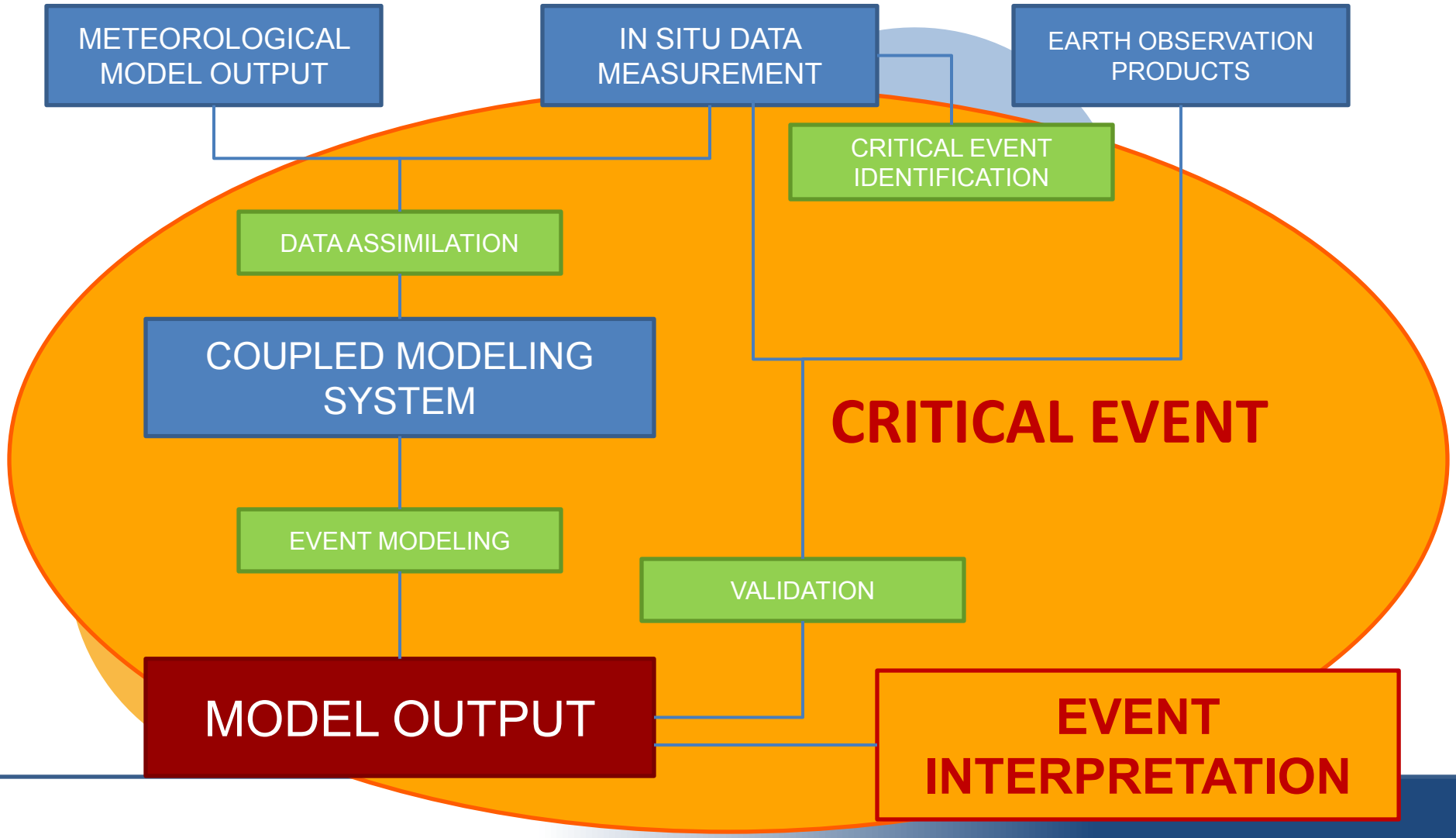






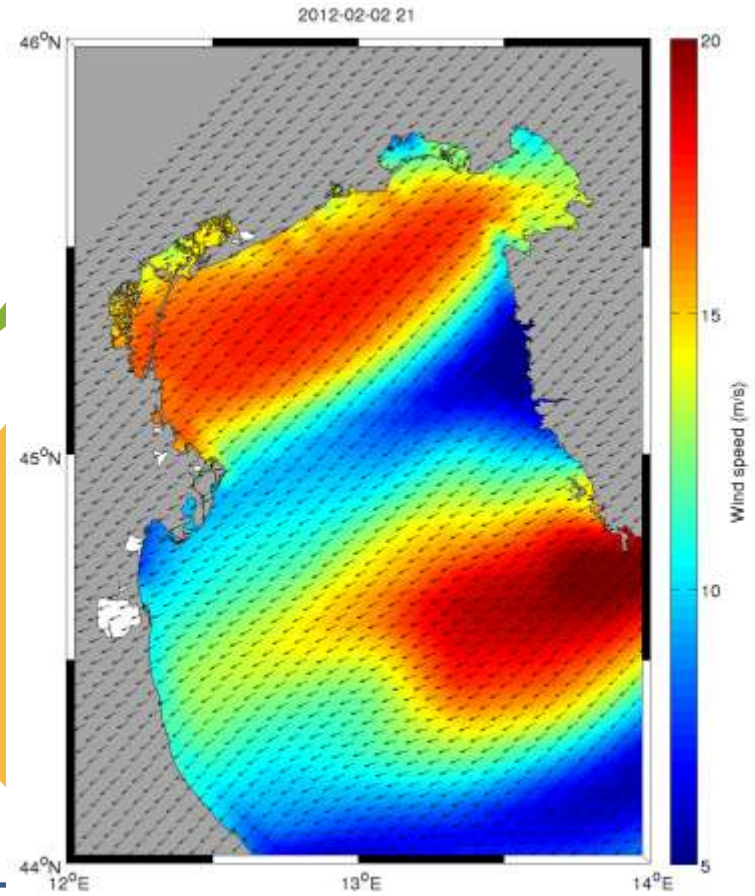
Data acquired
on 02/02/2012
Source: ISPRA

Interpreting critical events using Models

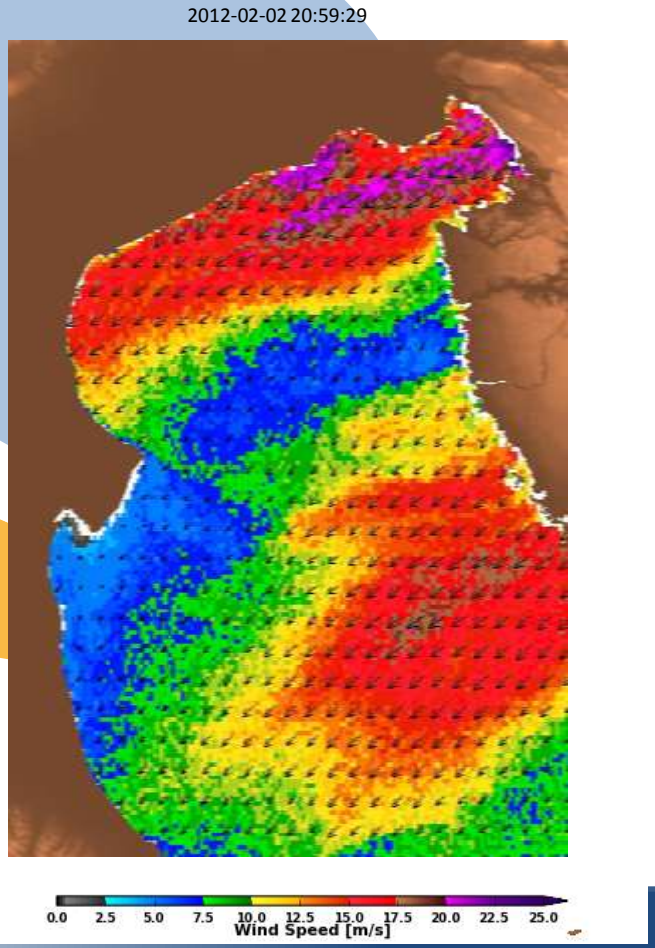


Comparing estimation of wind field from model and Earth Observation

Wind field estimated from COSMO-I7 model



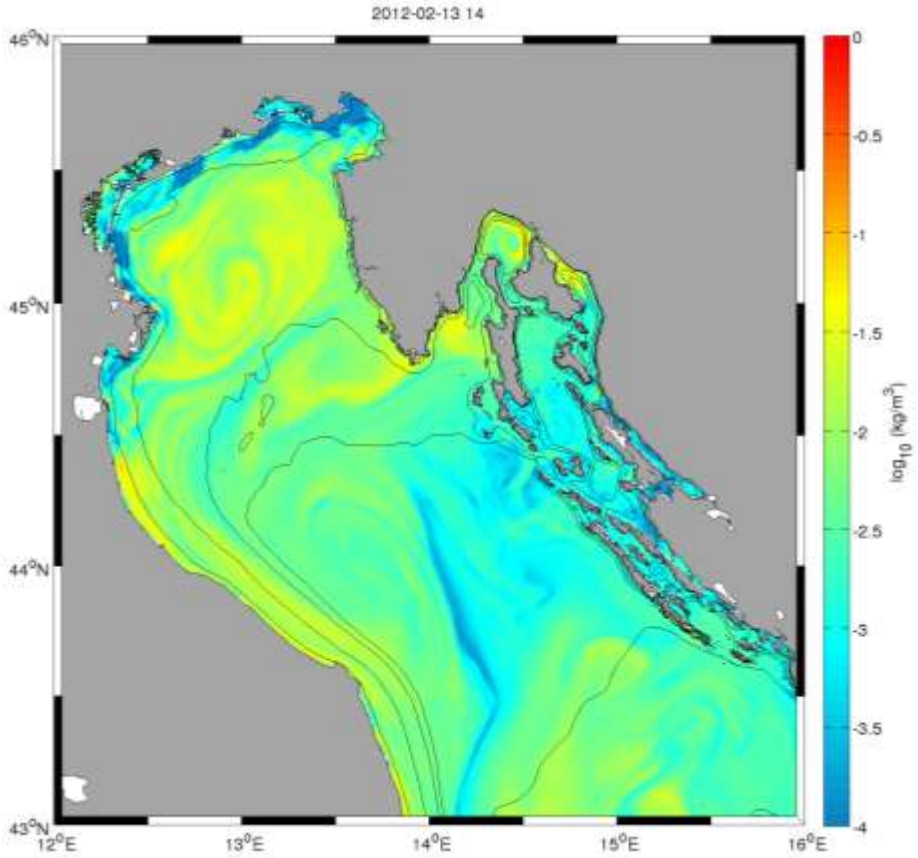
Wind field estimated from ASAR WSM



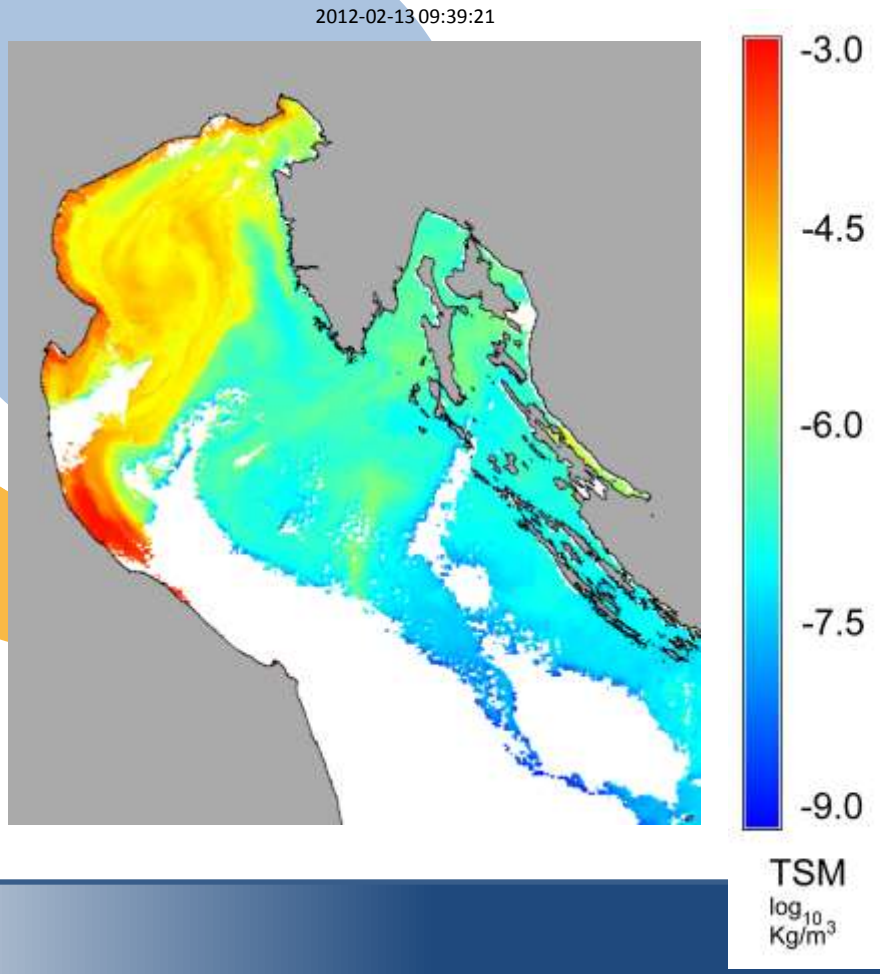
Data acquired on 02/02/2012
Source: Soprano CNR-ISMAR, CLS

Comparing estimation of suspended sediment from model and Earth Observation

Suspended Sediment Concentration (SSC) estimated by ROMS-SWAN



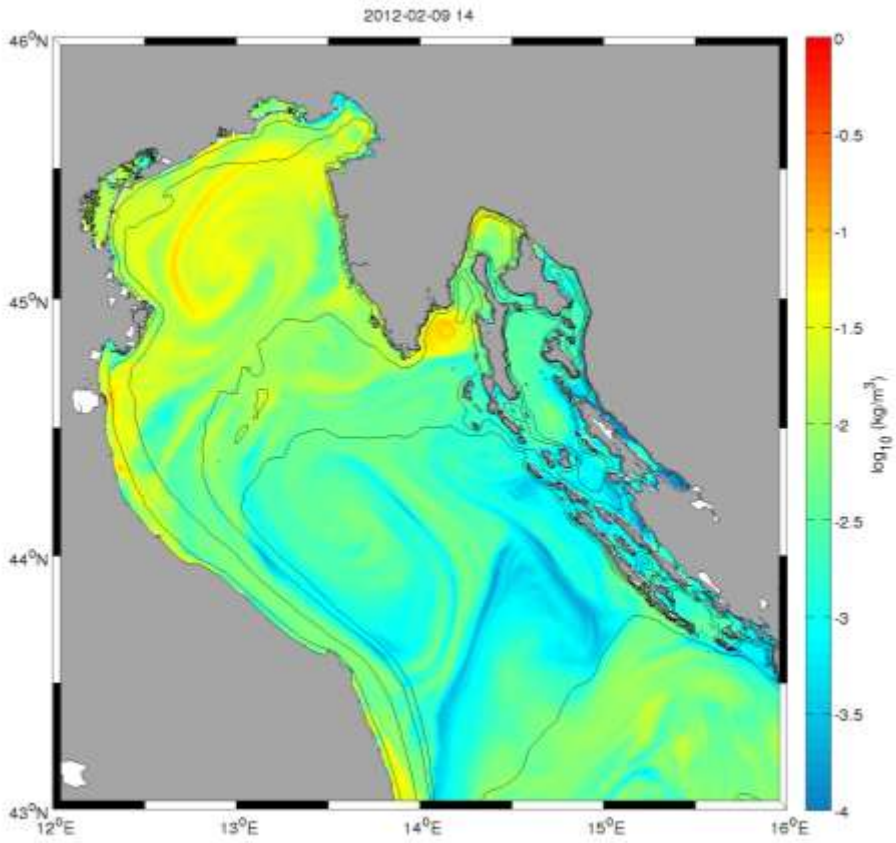
Total Suspended Matter (TSM) estimated from ENVISAT MERIS



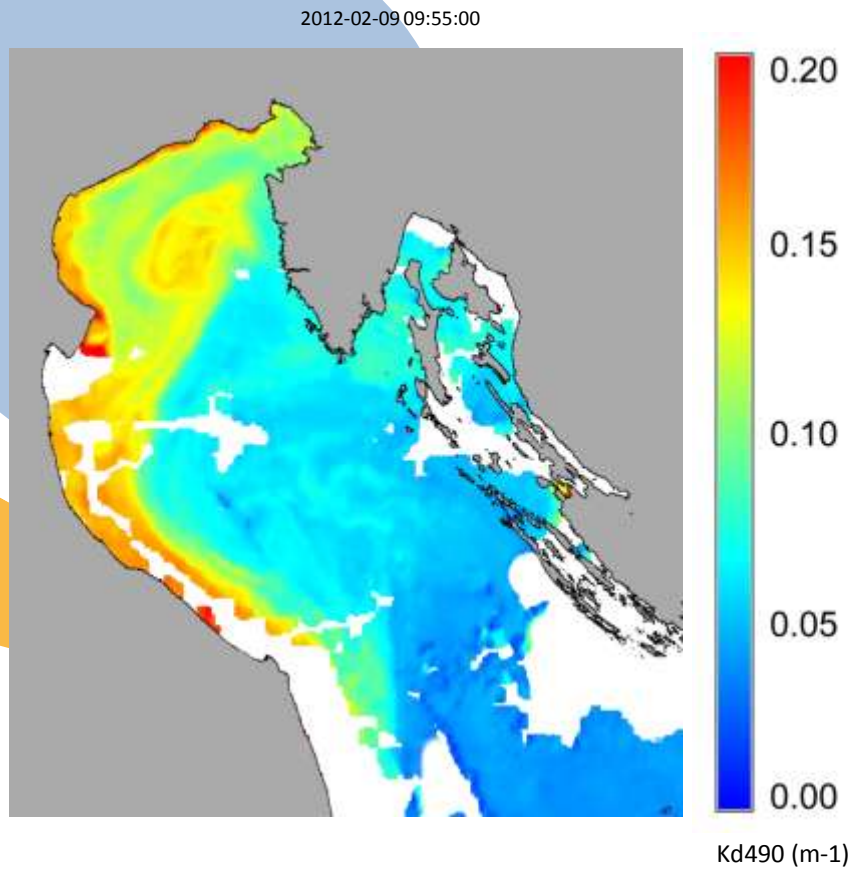
Source: CNR-ISMAR, ISPRA

Comparing estimation of suspended sediment from model and Earth Observation

Suspended Sediment Concentration (SSC) estimated by ROMS-SWAN

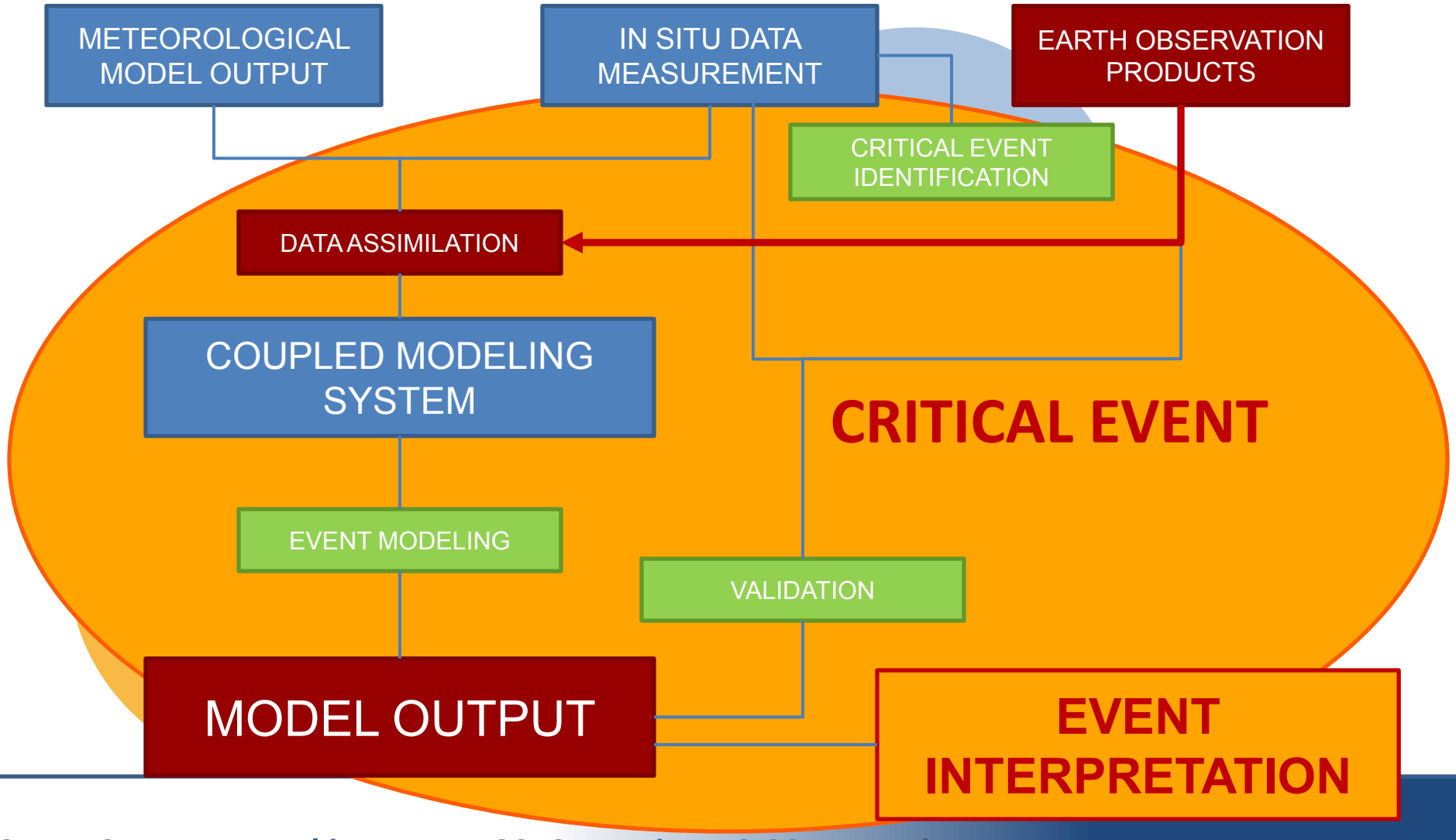


Diffuse Attenuation coefficient at 490nm (KD490) estimated from MODIS Terra

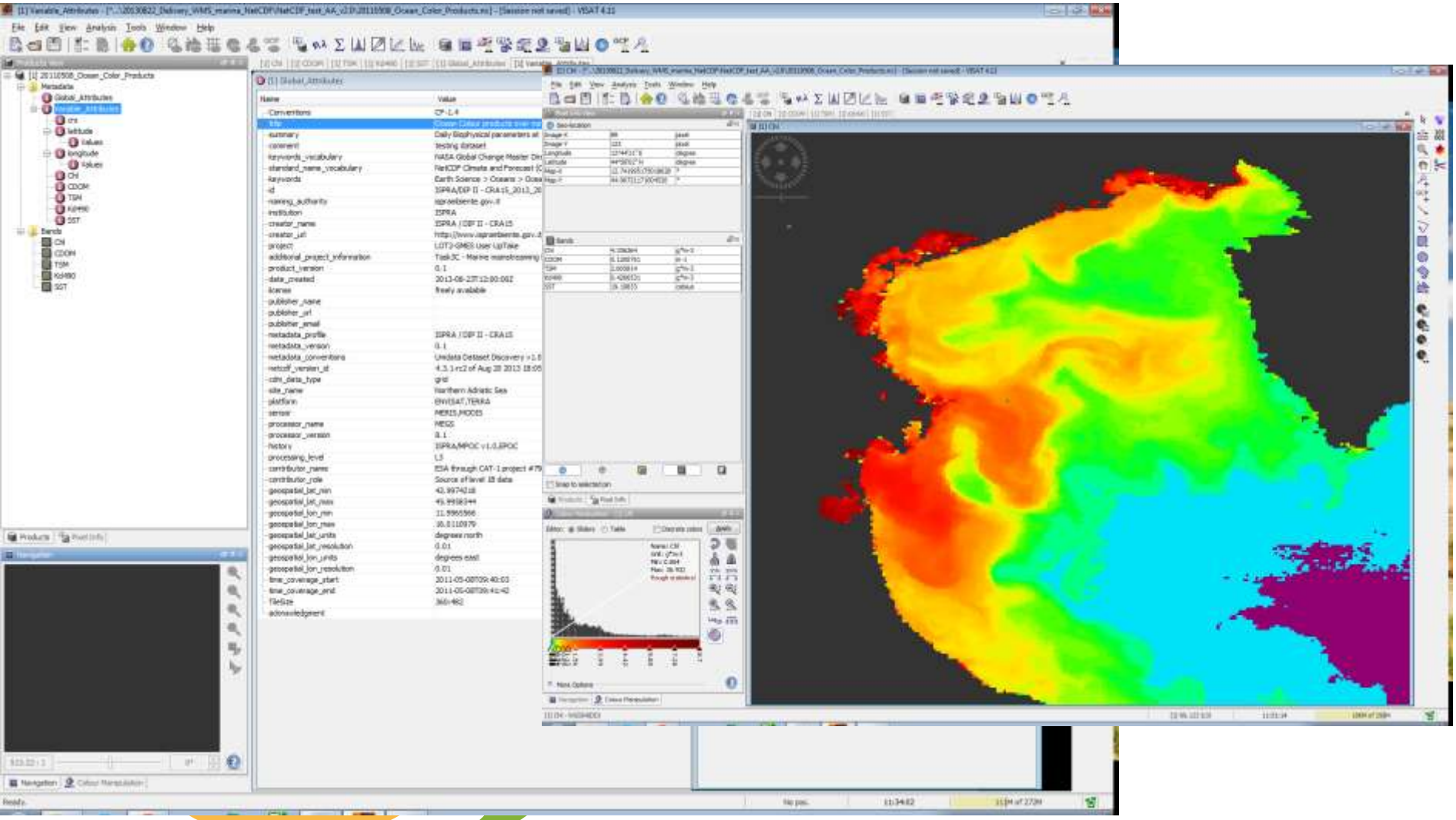


Source: CNR-ISMAR, ISPRA

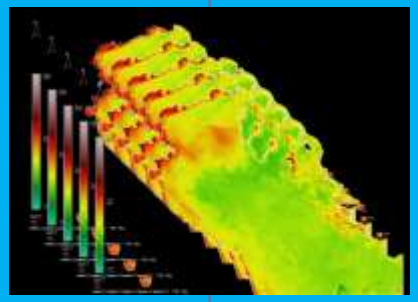
Combining two different approach: Earth Observation and Modeling



Value Added Products



Web Mapping Service



WMS

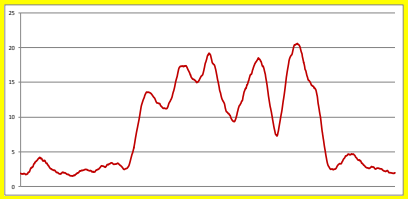
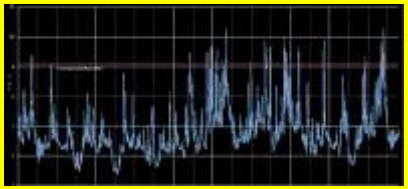
Product/Added value product
Product version
Coordinate Reference System
Spatial resolution
Platform/Sensor/Algorithm
Keyword
Long name/Standard name
Units
Scale factor
Fill value/missing value
Creator name/Creator URL/Creator contact
Publisher name/ Publisher URL/ Publisher contact

A Web Mapping Service (WMS) implemented to deliver products generated to supply the main and downstreaming of Copernicus Earth Observation products for coastal analysis. The deliverables will include series of maps based on existing MyOcean and GeoLand services integrated with Earth Observation and in-situ data with both biological and physical layers/indicators at different spatial and temporal scales.

Data assimilation sources

IN SITU DATA MEASUREMENT

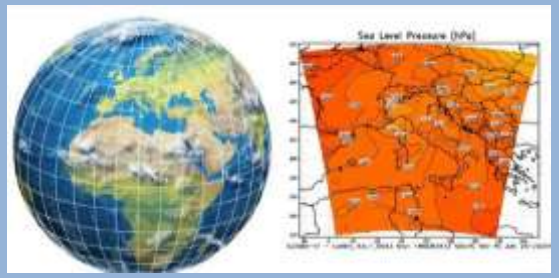


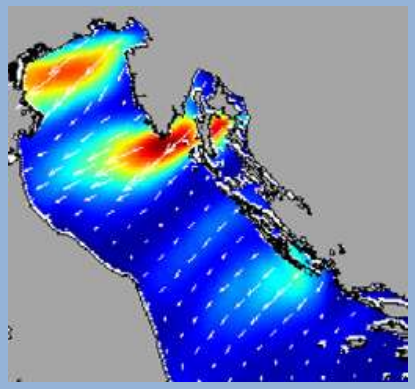




Strengths
- Continuous data acquisition
- Accurate measurement

Weaknesses
- Punctual data, not spatially distributed

METEOROLOGICAL MODELS

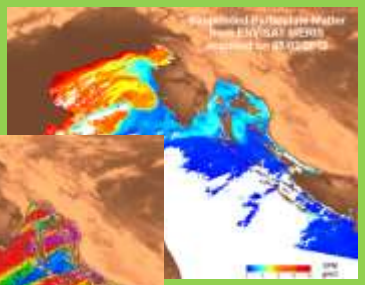
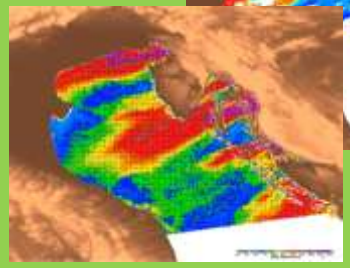




Strengths
- Spatially distributed data
- Continuous data acquisition

Weaknesses
- Modeled data, not measured
- Low spatial resolution

EARTH OBSERVATION PRODUCTS

Strengths
- Spatially distributed data
- High spatial resolution

Weaknesses
- Not continuous data acquisition
- Estimated data, not measured
- Cloud affected (optical sensors)

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ID - 7963 "Modelling uncertainties in coastal processes by means of innovative integration of remote sensing systems"
ID – 14945 "Monitoring boat anchoring pressure on Posidonia oceanica meadows through satellite SAR imagery"

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