Challenges in Observing the Coastal Ecosystem

Ghada El Serafy

10.01.2018

This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 641762

SPACED: Using Earth Observations to Protect Natural Landscapes

Brussels, Belgium : 10-01-2018

What is the Coastal Ecosystem

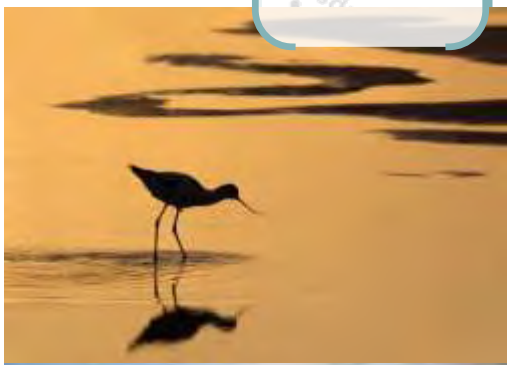
Extend along 1.6 million km and are the interface and bridge between the marine and terrestrial domains, thereby lending themselves easily influenced by both

Highly productive region supporting a wide range of flora and fauna and also serving as breeding and nursery grounds for many marine species

Dynamic system constantly undergoing changes which can be the subject of rapid and brutal changes due to severe events

Source of great biological diversity and supporting zone for many terrestrial and marine biota

Provides security and flood protection for coastal communities and is a critical component of food security and provisioning not only for coastal communities, but on a global stage.



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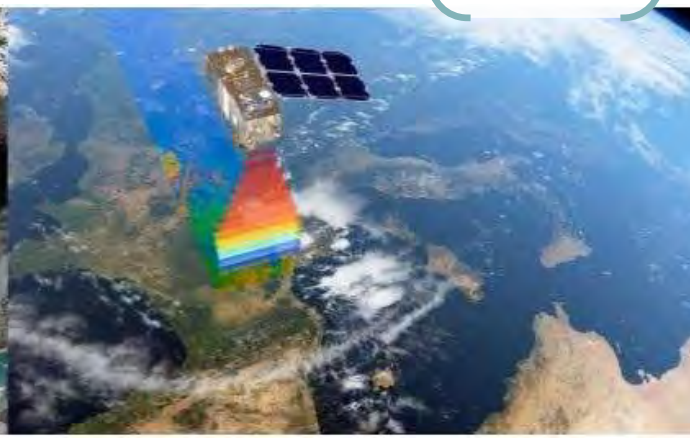
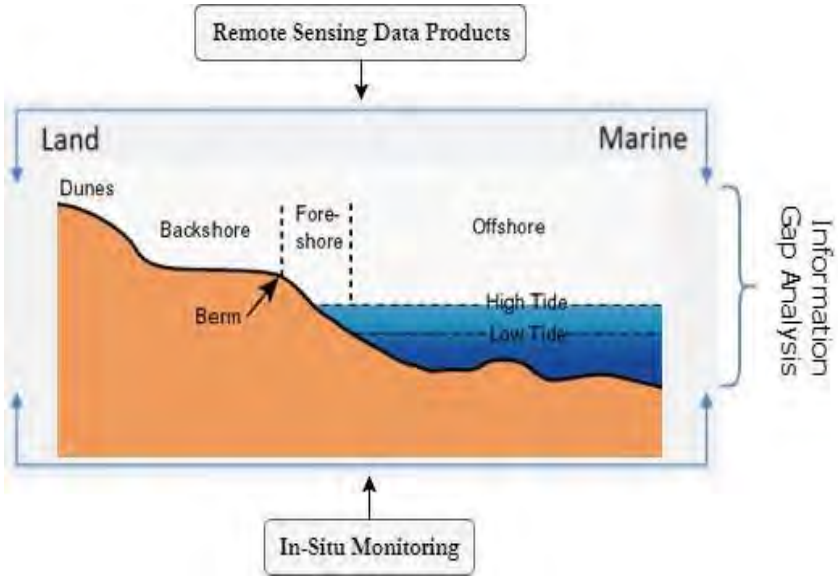
Coastal Monitoring Requirements





Ecologically Relevant Variables

- Vegetation Indices
- Sea and Air Temperatures
- Algae and Phytoplankton
- Sediment Characteristic & Turbidity
- Land Cover and Land Use



Challenges

- Required Spatial and Temporal Resolution
- Consistent and Complete Images
- Combining of Data Sources
- Uncertainty and Errors
- Ease of Access and Interpretation need of services

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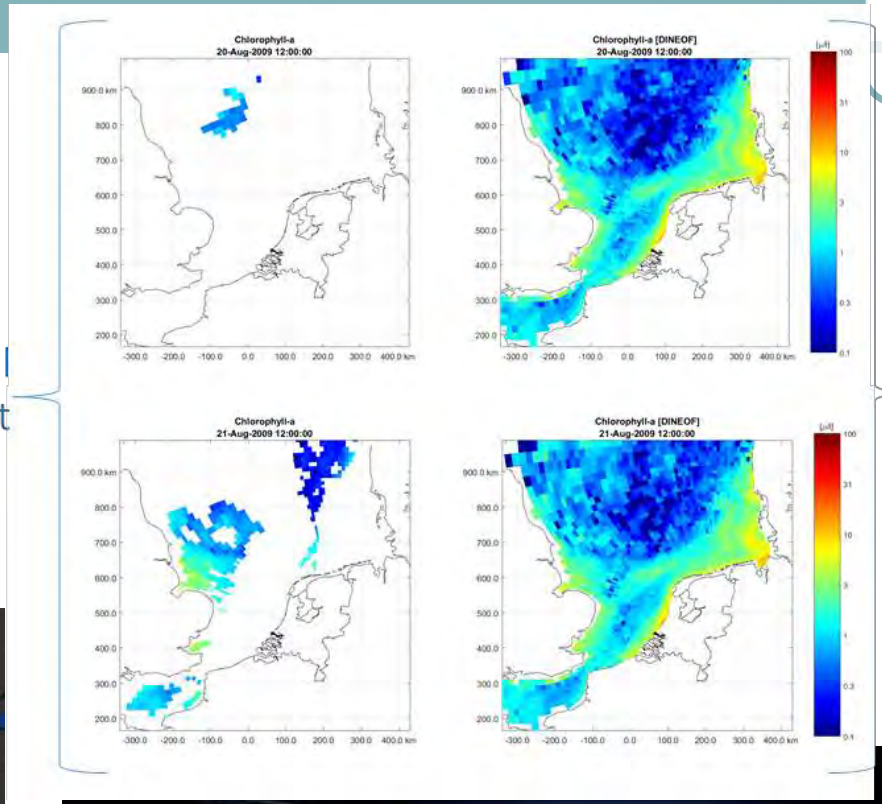
Remote Sensing Limitations

- Fixed temporal and spatial resolution of data
- Optical sensors cannot penetrate clouds
- Sensor degradation and recalibration requirements
- Images retrieved in strips requiring composites



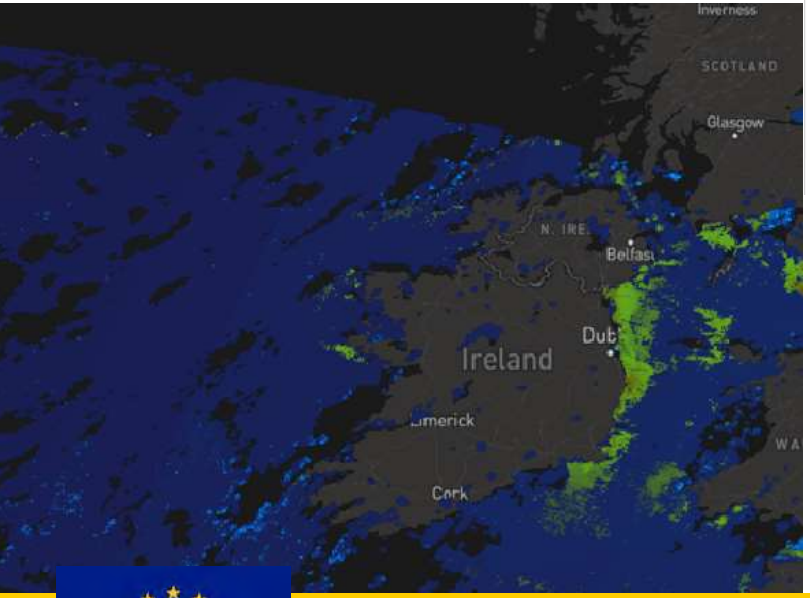


Photo : ESA

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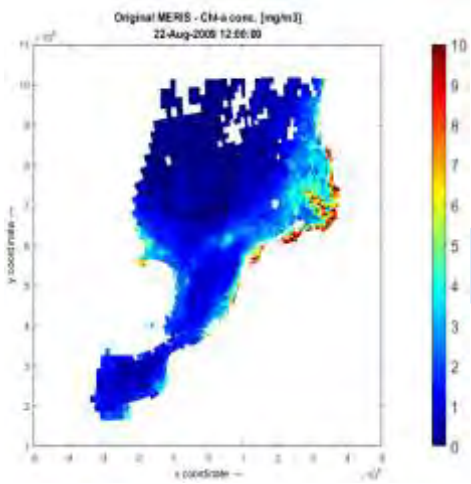
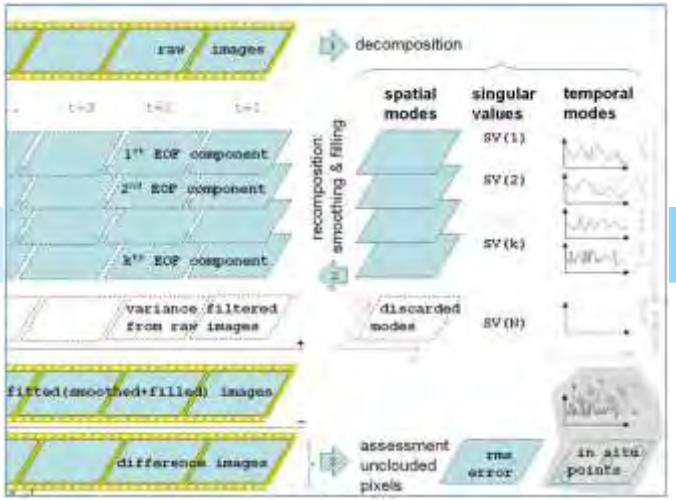
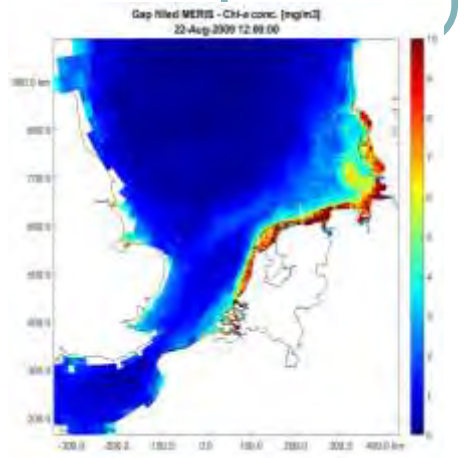
Remote Sensing Limitations



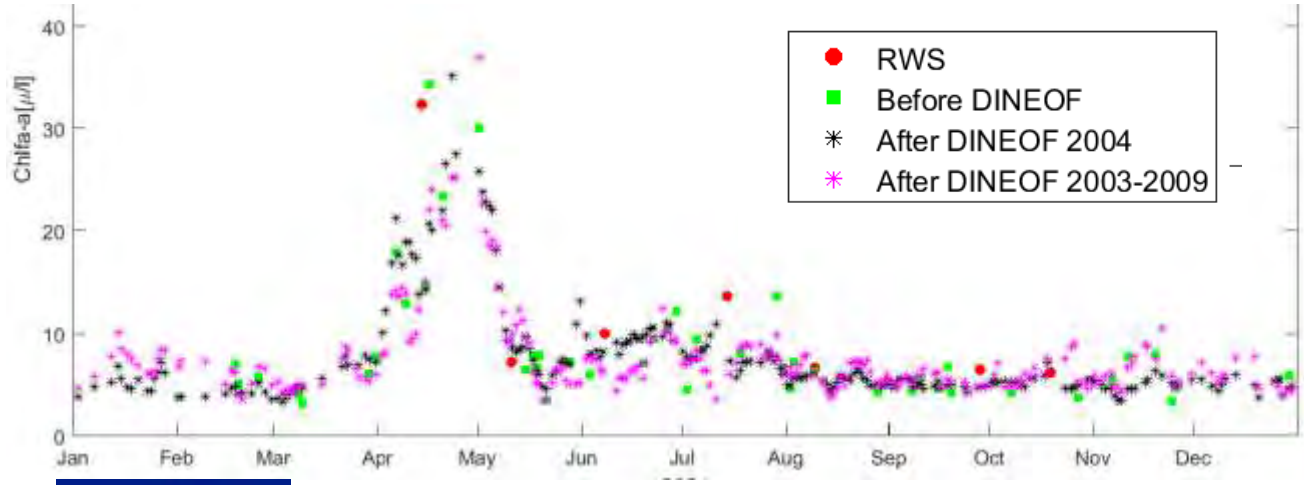
MERIS Chlorophyll-a data on 22/08/2009

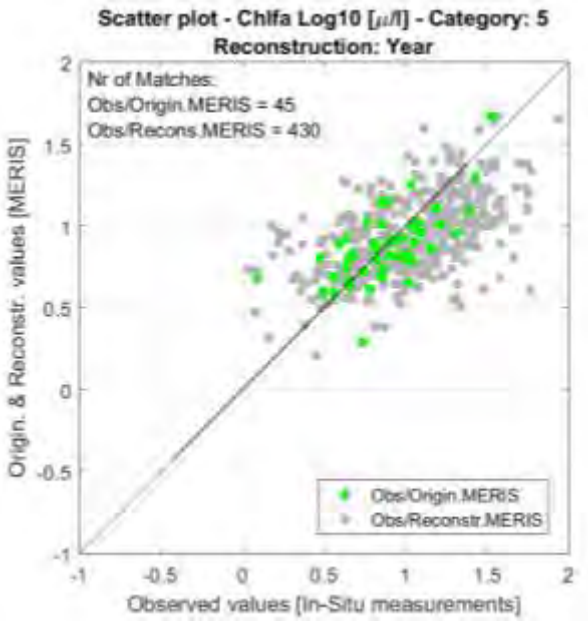


Schematization of DINEOF analysis



DINEOF gap-filled MERIS





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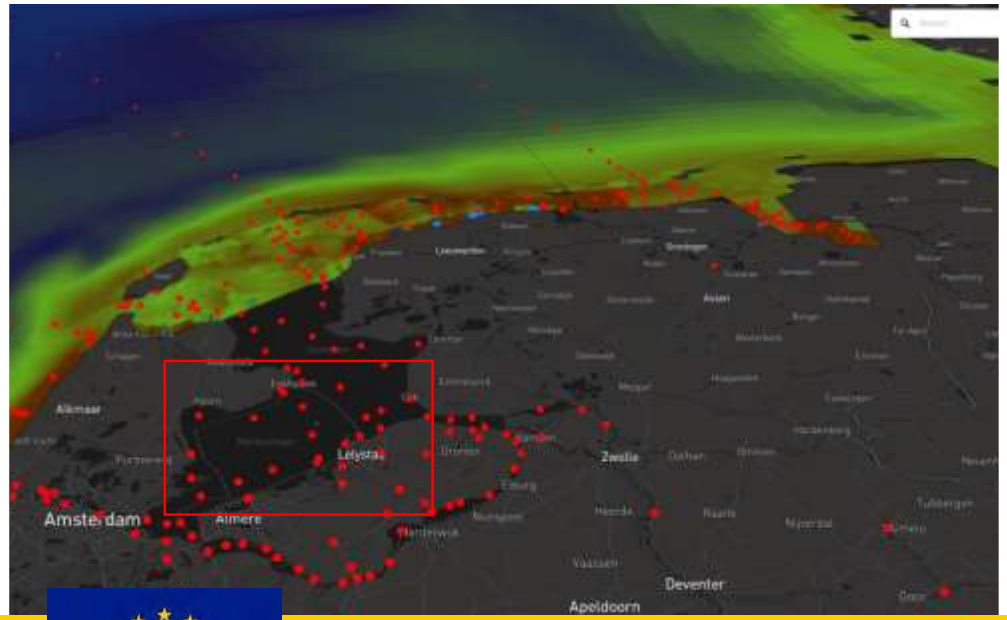
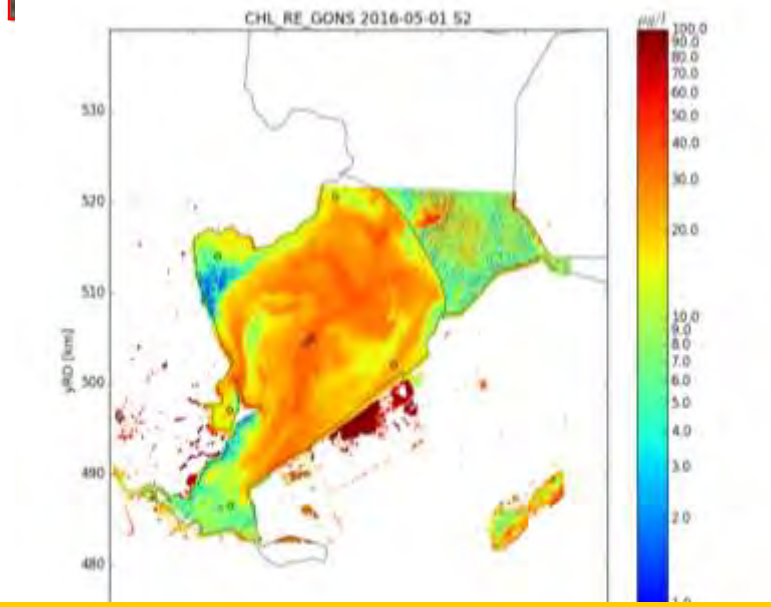
Remotely Sensed Data for Monitoring

- Required In-Situ data for product validation & algorithm calibration
- Seasonality issue : data acquisition, in-situ availability, cloudiness, and trending
- Point source of in-situ versus spatially explicit for remotely sensed





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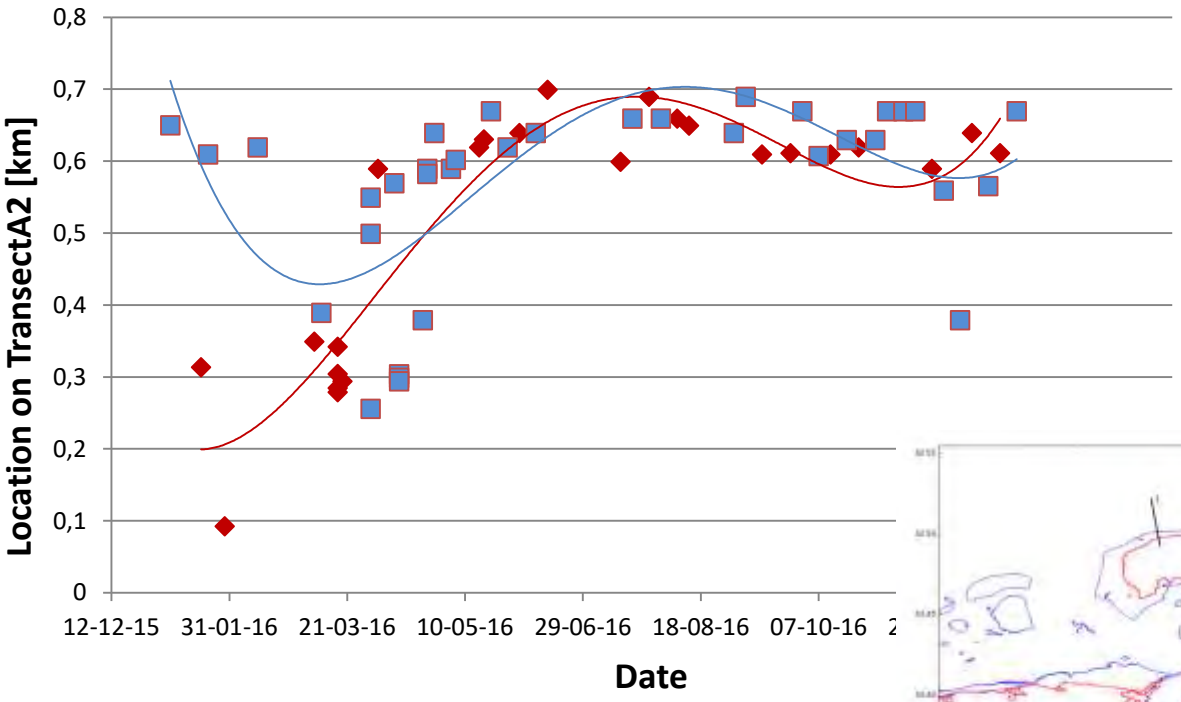
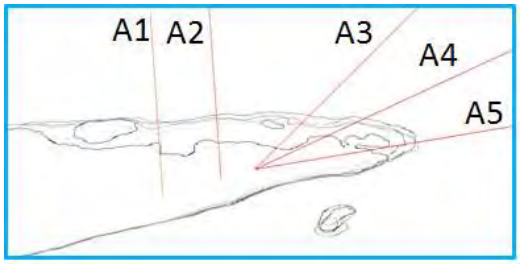
Remotely Sensed Data for Shoreline Detection

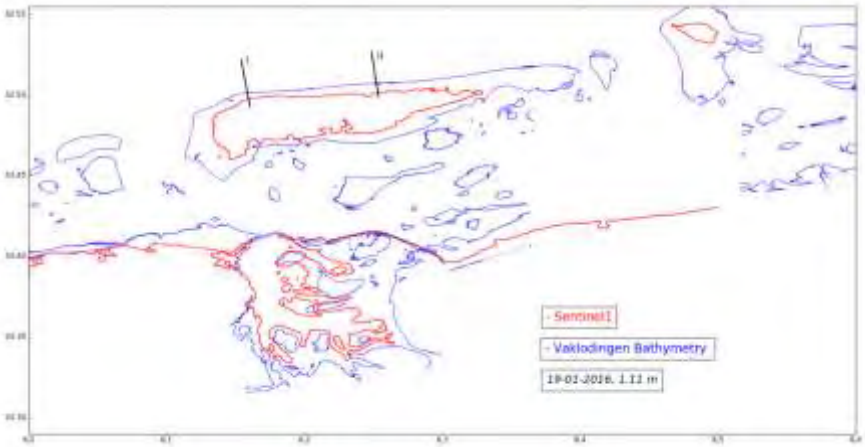
Shoreline Change Detection –high resolution images at regular intervals

Intersection points in 2016 for high [red] and low [blue] tide on transect A2





High Tide
Low Tide
Poly. (High Tide)
Poly. (Low Tide)



- High and Low tide with respect to reference
- Difference represents Seasonal variation
- Timing of the satellite overpasses

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Data Fusion to enhance data sets

Downstream service with products based on Sentinel data for spatial information on foreshore and floodplain characteristics, such as morphology, sediment characteristics and vegetation properties.

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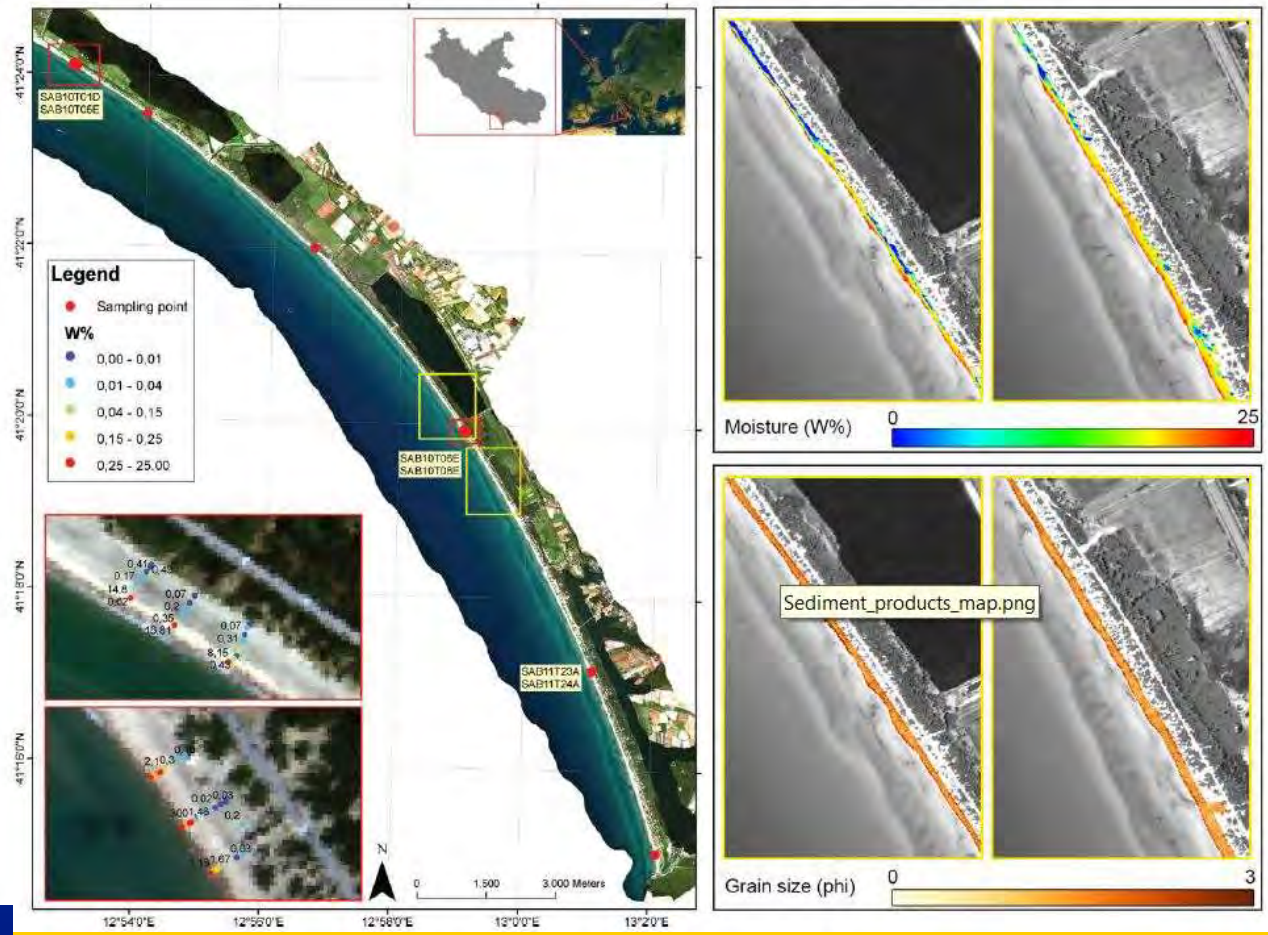
Data Fusion to enhance data sets

ISPRA : Integration of in-situ data in Linear Spectral Mixing Analysis (LSMA) for the onshore coastal sediment characterization. Sediment moisture and grain size estimated by integrating in situ measurement on beach sampling points with airborne MIVIS hyperspectral data.



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Combining Models with Remote Sensing

Utilization of Spectral signatures of sediment fraction sizes along with PAR Remote Sensing Values and MPB model predictions in order to train an algorithm (Random Forest) to ascertain and predict future values based on Water Quality and Climate predictions

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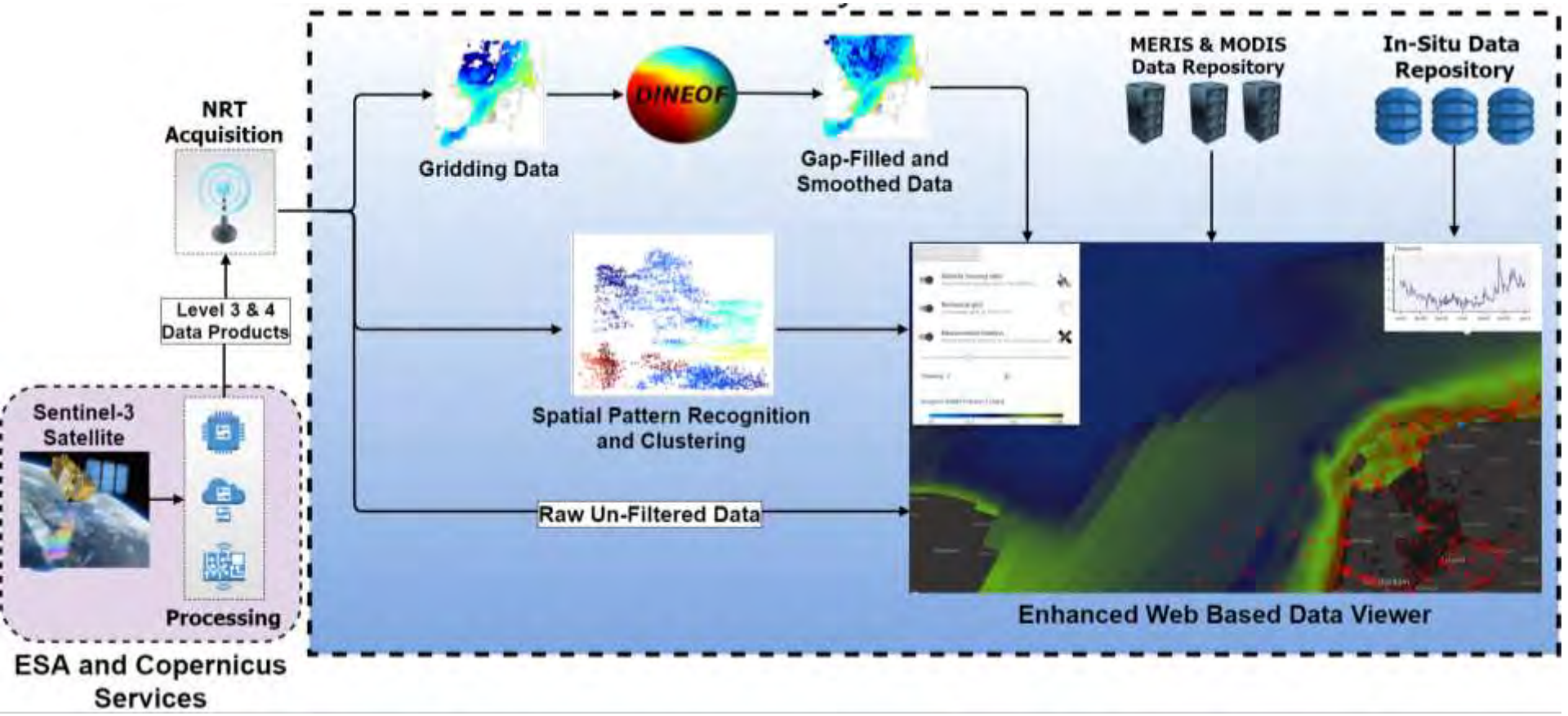
Combined Observatory Data Chain



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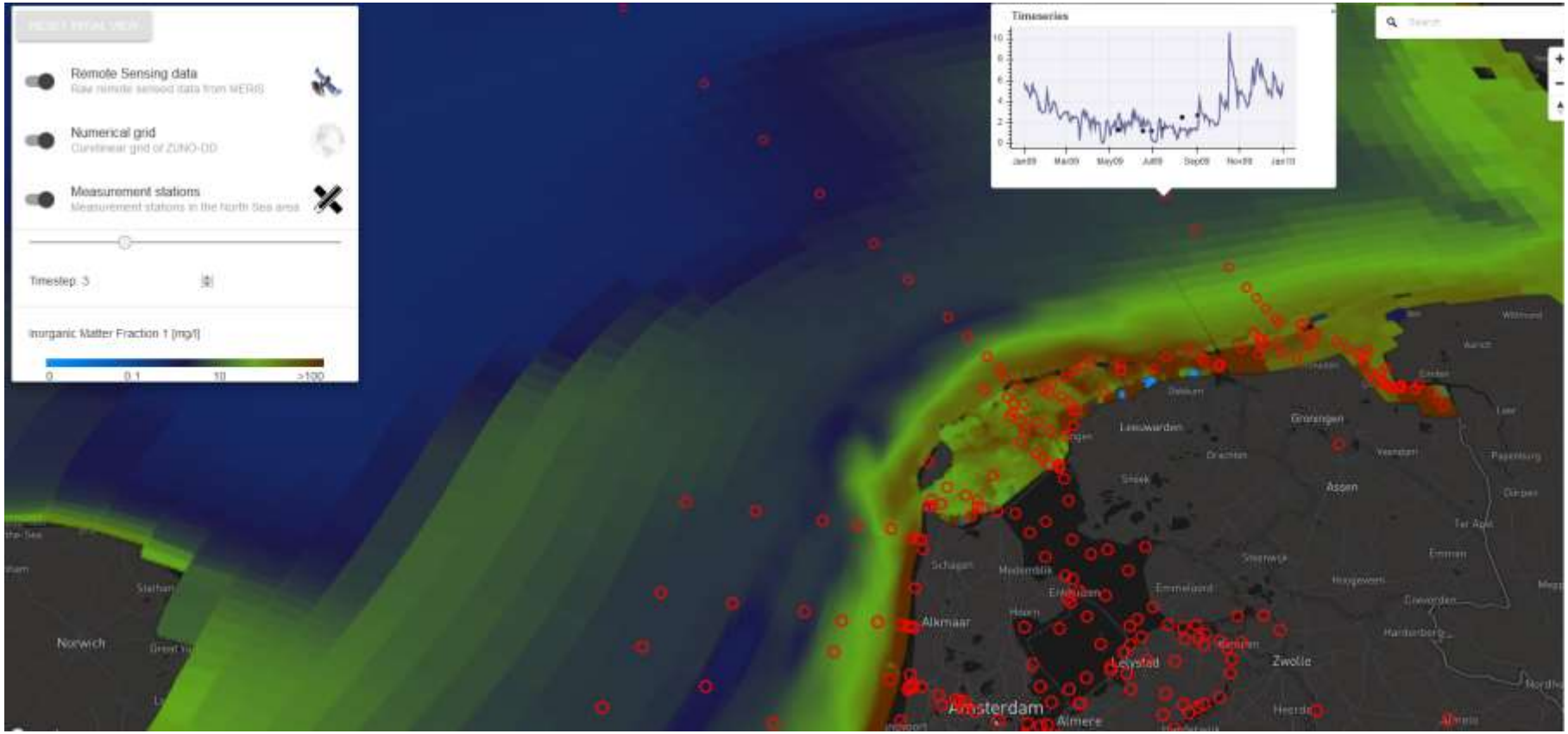

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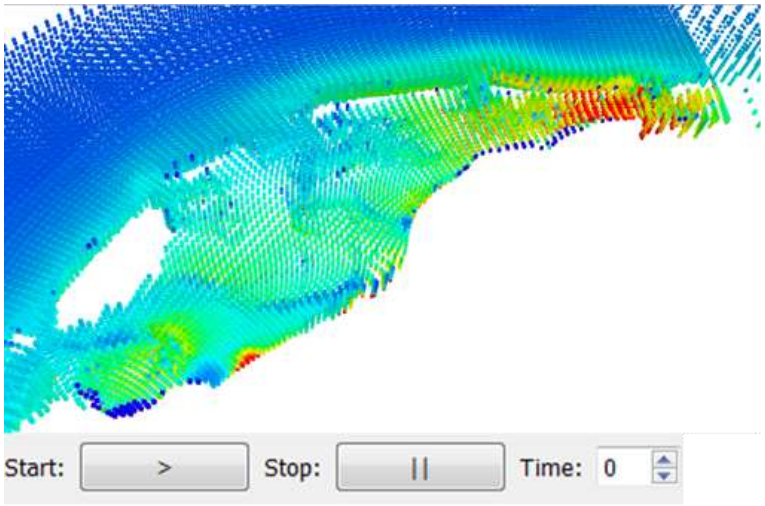
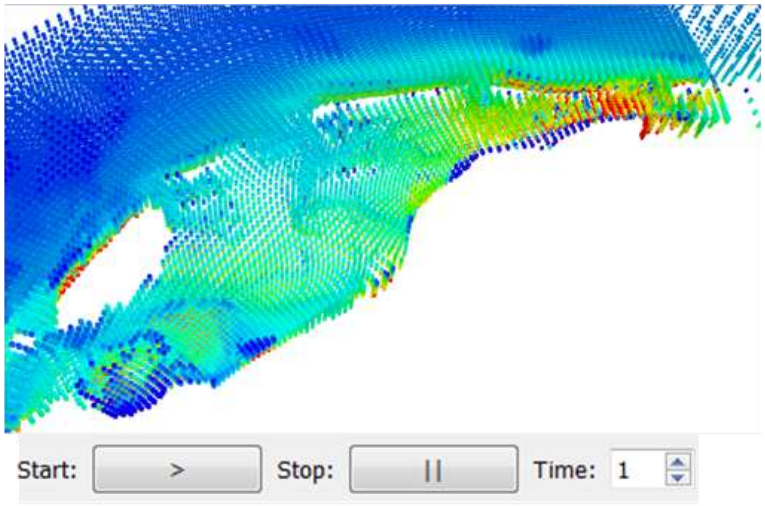
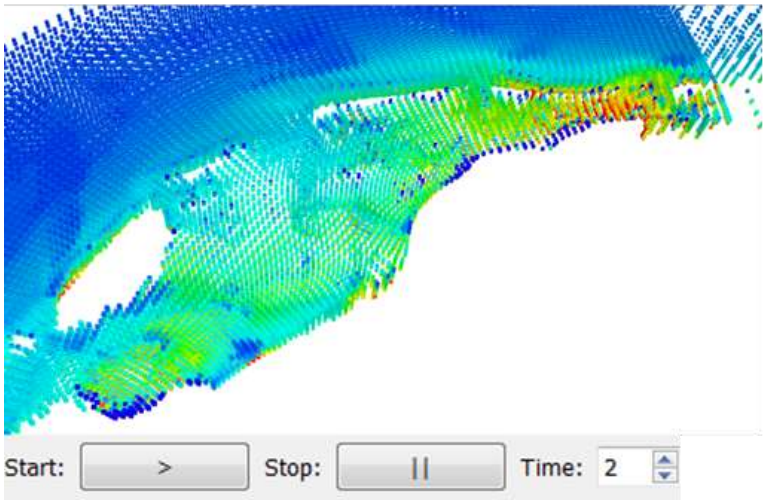
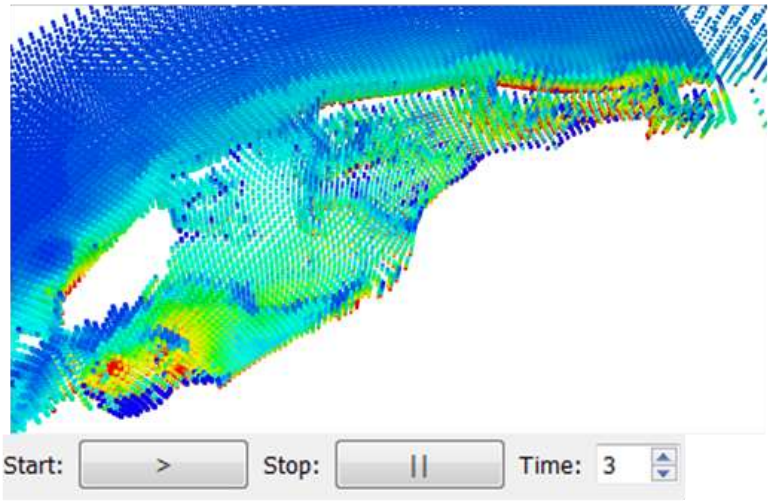
3-D Visualization of Uncertainty For Decision Makers









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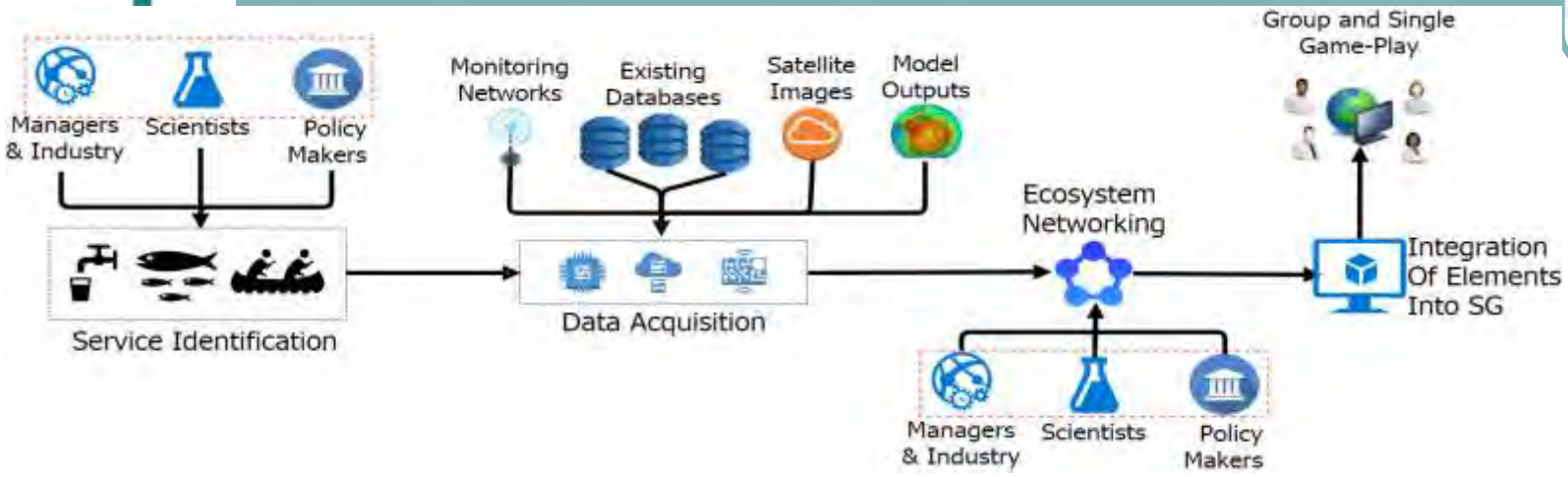
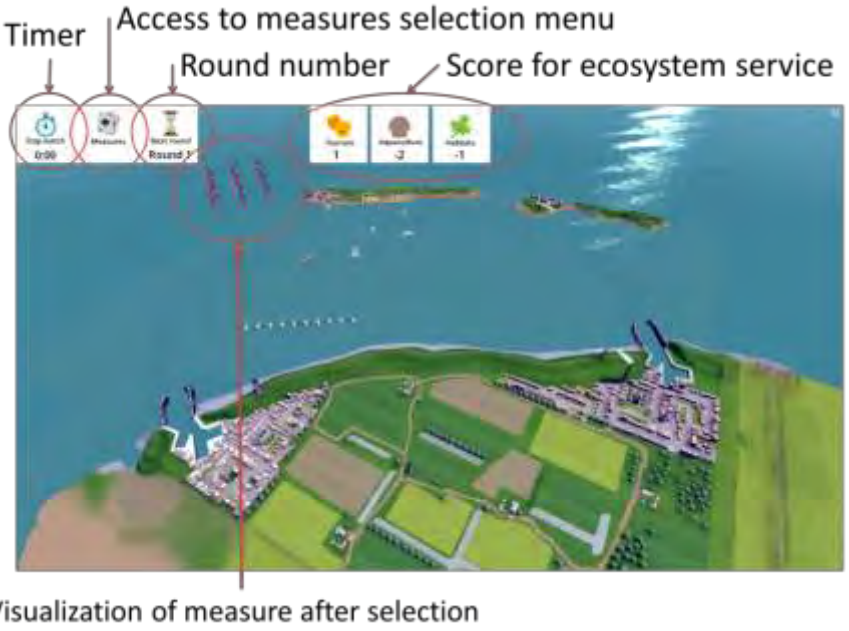
Serious Gaming





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Importance of Coastal Areas

Coasts are constantly under threat from human interference and climate change (coastal & Inland) and exploitation (ecosystem services) *Need of monitoring*

High detailed information (*spatial and temporal*) is needed to manage this threat and maximize the benefits

Many value-added services can be tailored to specific needs, resulting in new business and opportunities to mutually beneficial ends both for society and ecology.

Coastal zones are highly developed, the location of many dense urban and industrial zones representing a large societal investment and *requirement for guided planning* of said areas.

The location of many food provisioning resources that needs to be preserved requires *EO tools and add-value services for decision making*

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