



# TEST CASES FOR CALIBRATION AND VALIDATION OF OCM 2 IMAGES IN COASTAL WATERS OF SOUTHERN ITALY

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# *The Remote Sensing Group*

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**The Remote Sensing Group (RSG)** of the Physics Department of the Polytechnic of Bari (Italy) is active in the field of remote sensing for Earth Observation (EO).

RSG has been involved in Earth Observation projects funded by national and international space agencies and institutions (Italian Space Agency, ESA, NASA, ENEA, European Commission).

RSG consists of two professors and a dozen of senior and young researchers. The research and production activities are also supported by a Polytechnic of Bari spin-off company (GAP s.r.l.) established in 2006 by the staff of RSG.

## *The fields of the research*

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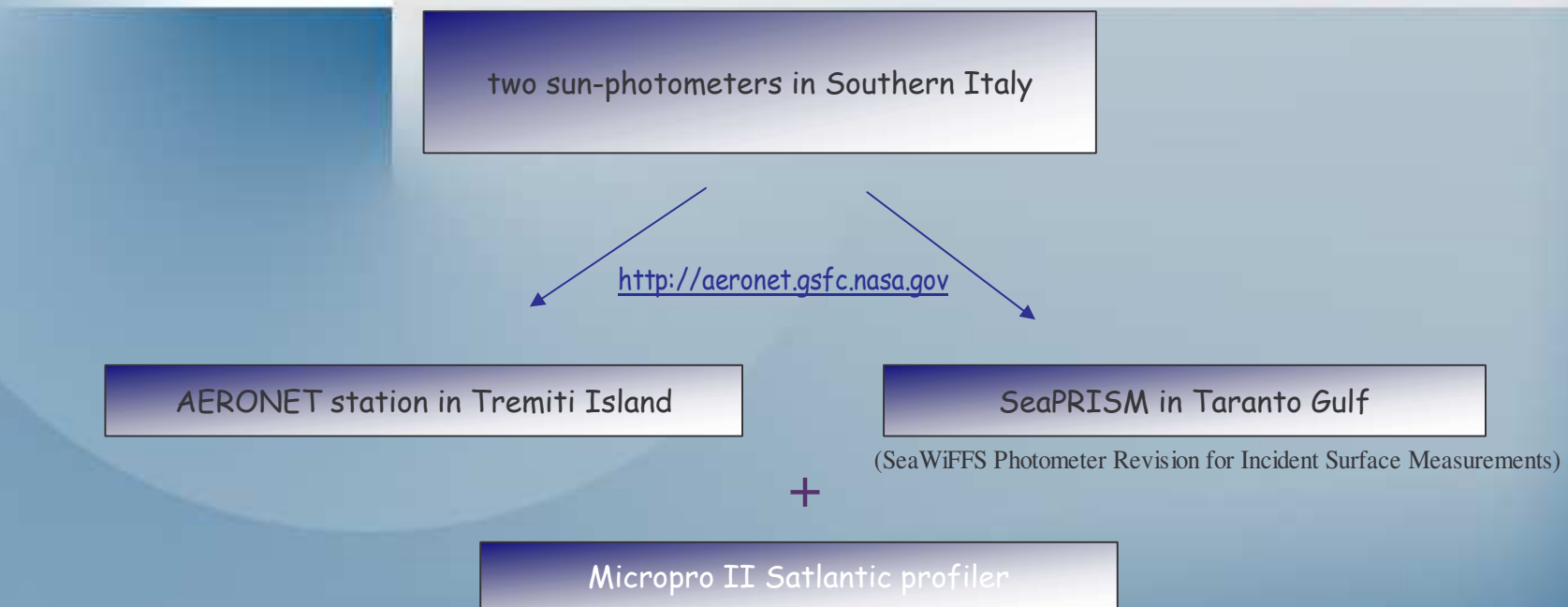
The fields of the **research areas** of RSG are:

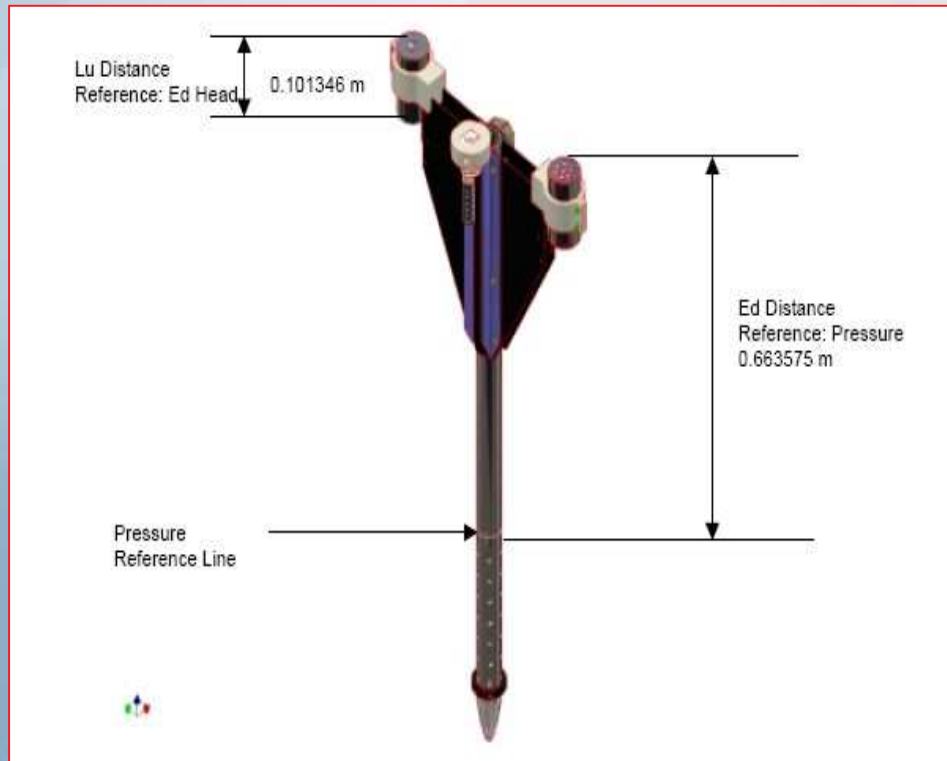
- › the study of the pollution of the sea coastal waters, using optical and Infrared (IR) sensors mounted on satellites
- › the processing of data acquired by Synthetic Aperture Radars (SAR)
- › the development and exploitation of meteorological models that are of crucial importance in analysis and forecasting of weather conditions associated with various types of environmental hazards
- › the development of tools useful to optimize the execution of those EO applications with a high demand of Memory and Computational resources.

## *projects.....*

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..... 2008: The team was involved in the research project funded by MIUR (Ministero dell'Istruzione, dell'Università e della Ricerca): "**IMCA - Integrated Monitoring of Coastal Areas**". Among others, the objective of the IMCA project is to study and develop a procedure to monitor water quality in coastal zones using satellite data integrated with in situ data.





Satlantic Micropro II



AERONET (*Aerosol Robotic Network*)

## *proposal*

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The activity related to the present proposal is intended to validate atmospheric correction methods on OCM2 data to determine water leaving reflectances in coastal zones, and EO techniques to retrieve bio-optical parameters in coastal zones, integrating OCM2 images with MODIS, MERIS and in situ data.

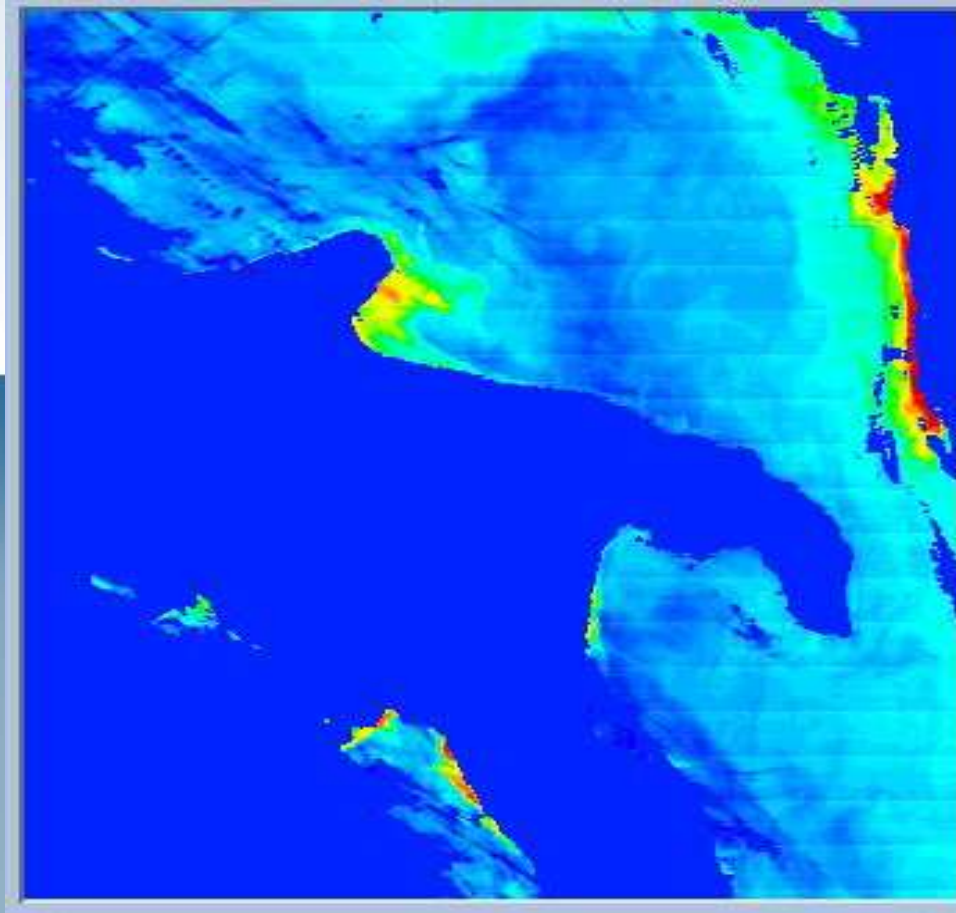
## *background*

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The group has developed several algorithms using passive remote sensing sensors (MERIS and MODIS), to retrieve water leaving reflectances, sea surface temperature and bio-optical parameters.

# Water leaving reflectance

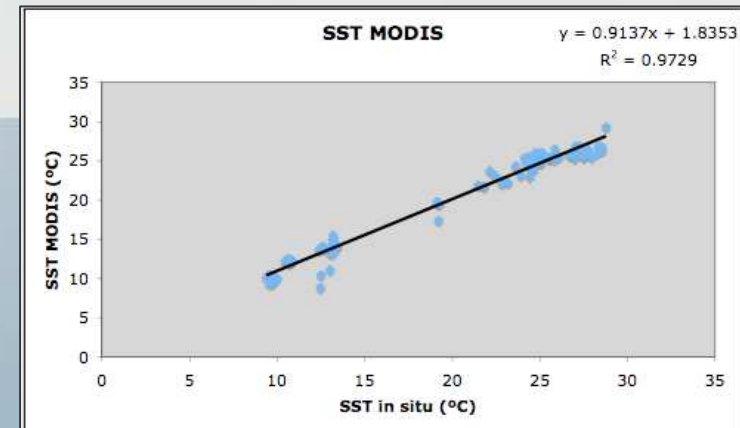
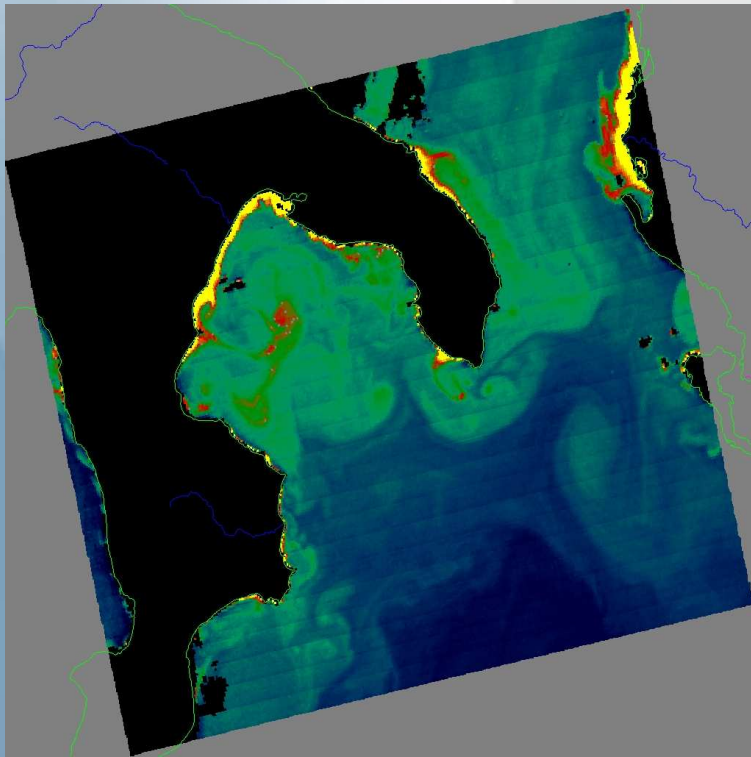
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# *SST (sea surface temperature)*

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The standard algorithm to determine SST has been modified for coastal waters



RMSE 2% comparable with the error of ocean waters

## *background*

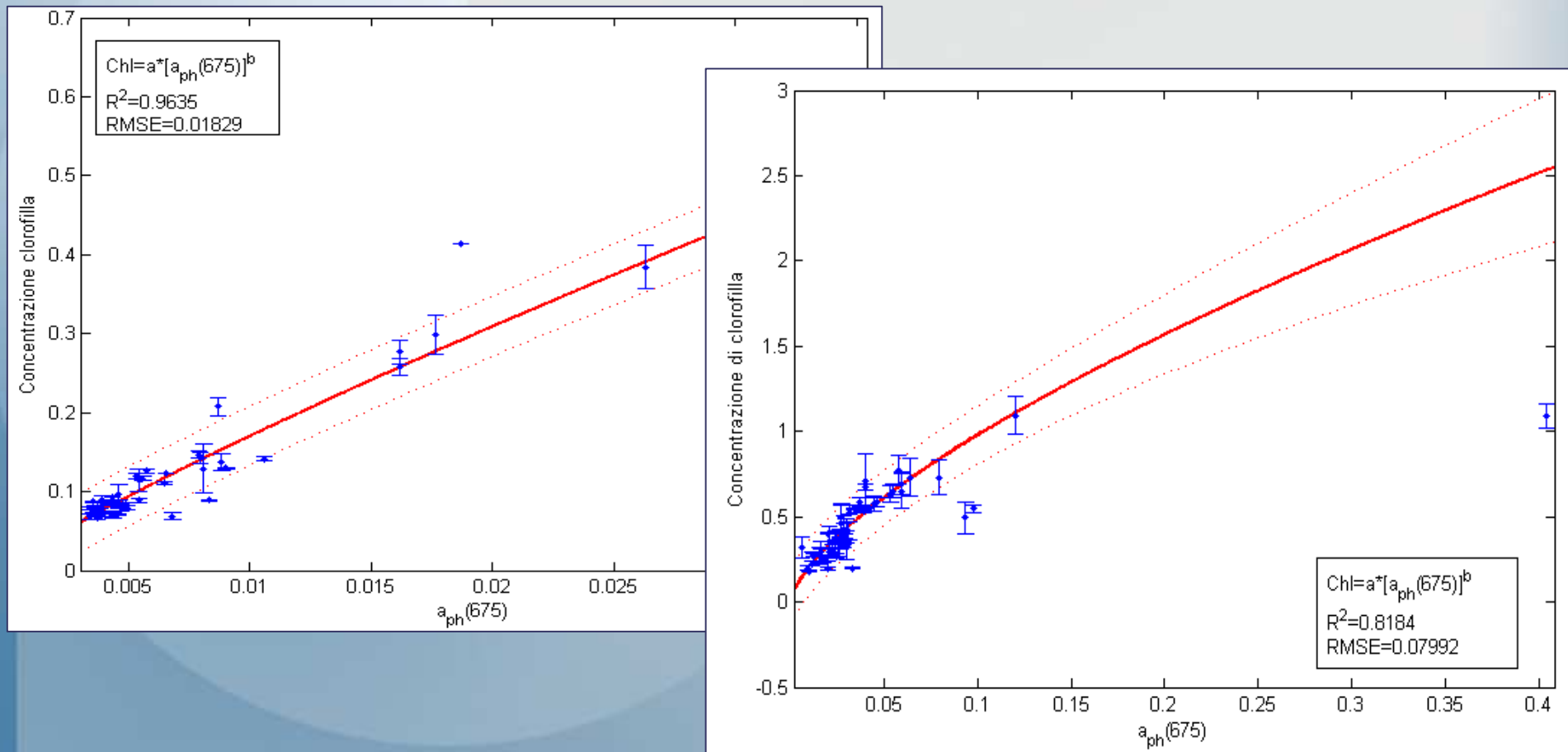
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The absorption coefficient, once corrected for clear water signature, could be used directly as an indicator of the *chlorophyll concentration* (ratio between 410nm and 490nm) (Bricaud et al., 1981; Bukata et al.,1995).

The backscattering coefficients in the near-infrared (760nm, 870nm) are excellent indicators of the *total suspended matter or sediment loading*(Loisel and Morel, 1998).

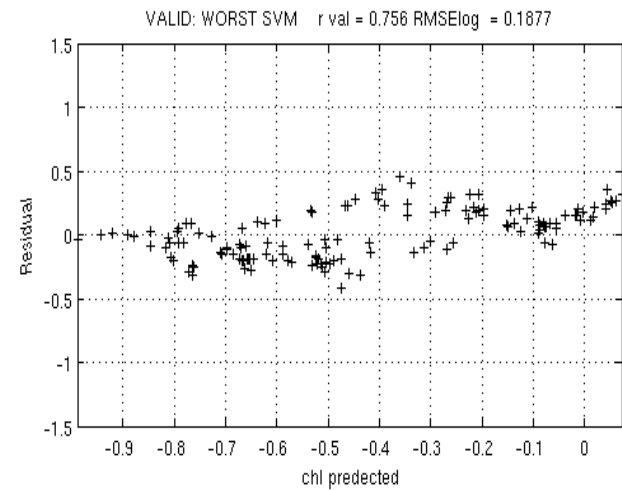
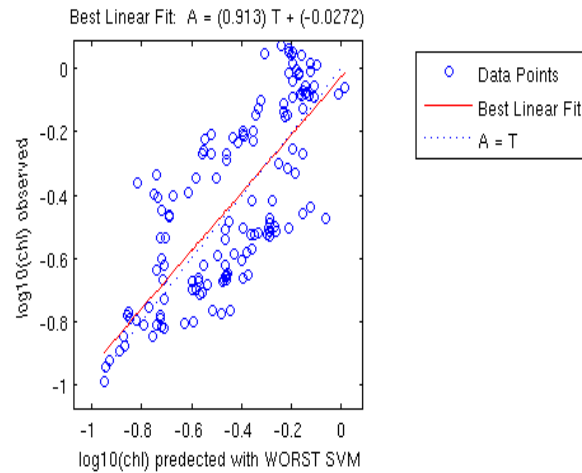
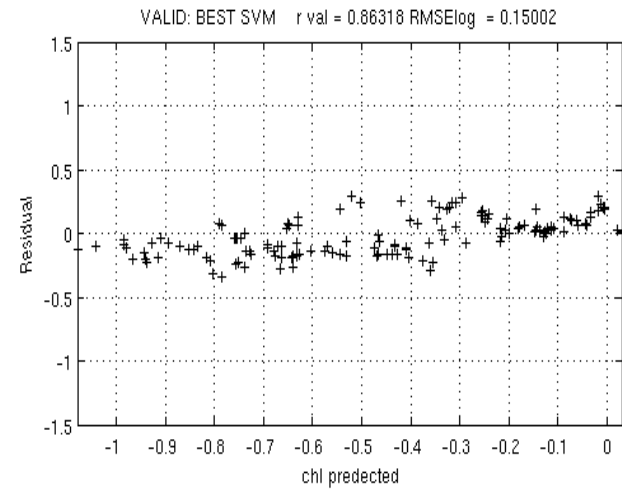
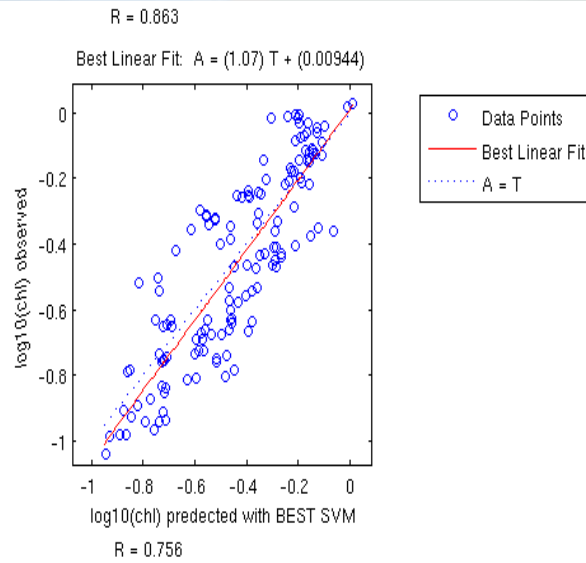
Based on spectral absorption and backscattering coefficients, we can extend the retrieval of chlorophyll to the estimates of sediment content and algae or pollutant concentrations for the study area.

# example



Chlorophyll retrieved by the current method from MODIS vs Chlorophyll measured in Tremiti (on the left) and Taranto (on the right).

# chlorophyll



# Description of the project

- Algorithm development for atmospheric correction,
- Regional bio-optical algorithm development with special emphasis in case-II waters
- Inter-sensor data comparison and data merging.

Coastal zone are under pressure on account of increased anthropogenic activity on the coast, as a result of globalization. It is necessary to protect these coastal ecosystem to ensure sustainable development. This requires information on habitats, landforms, coastal processes, water quality, natural hazard on a repetitive basis.

Ocean color data from SeaWiFS and MODIS, provide information on biological aspects useful for fisheries and coastal ecosystems.

Nevertheless the same information can be achieved at a better spatial resolution with **OCM-2** data improving algorithms of atmospheric correction and inversion of bio-optical parameters.

IMCA project objective was the development of a prototype tool to monitor water quality in coastal zones, by periodic thematic maps produced integrating satellite and in situ data.

Of utmost importance in the project will be the use of **OCM-2** data that, with its spatial resolution, spectral domain, and revisiting time, is one of the most indicated sensor available to our purpose.

# *Objectives*

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- calibration and validation of atmospheric correction methods on OCM-2 data to retrieve water leaving reflectances in coastal zones;
- calibration and validation of EO techniques to retrieve bio-optical parameters in coastal zones.

# Study area

Three tests sites have been chosen within the IMCA project around Apulian Coast, in Southern Italy: **Taranto Gulf** (Ionian Sea), considered a very polluted area; **Tremite Islands** (Adriatic Sea, protected area), very clean area; **Gulf of Manfredonia** (Low Adriatic Sea), low polluted area with high sediments concentration.



Corner	Latitude	Longitude
Upper left	42.715619	13.471222
Bottom right	38.739292	19.600326

## *Type of data required*

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Level 1B, 1C and 2C LAC (Local Area Coverage) products of OCM (360m resolution);

Data from all seasons in order to better calibrate algorithms;

Estimate number of images one per week, almost 150 in three years.

**Standard LAC data products of OCM (360 m resolution):**

Level 1B LAC : Radiance product

Level 1C LAC : Geo-referenced (Radiometrically and geometrically corrected) product

Level 2C LAC : Geometrically corrected geo-physical parameters

Chlorophyll concentration product

Total Suspended Matter concentration product

Aerosol optical depth at 865 nm

Diffuse attenuation coefficient ( $K_d$ -490 nm)

# Methodology

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- The radiative transfer code the group is planning will use is the vectorial code **6s** (**SECOND SIMULATION OF A SATELLITE SIGNAL IN THE SOLAR SPECTRUM VECTOR CODE**), modified to take into account foam and glint contributions of the sea.

The **6S code** is a basic RT code used for calculation of lookup tables in the MODIS atmospheric correction algorithm. It enables accurate simulations of satellite and plane observation, accounting for elevated targets, use of anisotropic and lambertian surfaces and calculation of gaseous absorption. The code is based on the method of successive orders of scatterings approximations and its first vector version (6SV1), capable of accounting for radiation polarization.

- The code has been validated over Hawaii, with very good results.

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- Input: AOT and size distribution, information obtainable from AERONET stations or from wavelengths available with MODIS data. Thus, a new approach will be studied in order to correct OCM-2 bands coupled to MODIS data.
  - Once the water leaving radiance will be validated, a semi-analytical algorithm, will be calibrated and then validated to retrieve bio-optical parameters.
  - The validation will be carried out with the technical support of biologists and chemists of our University.
  - We are developing a parallel approach based on Support Vector Machines, which is giving very encouraging results in the retrieval of chlorophyll concentration and that will be applied on OCM-2 data.

## *Schedule*

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- A data acquisition phase will be followed by the atmospheric correction of data, by the radiative transfer code 6s, and the validation with the water leaving radiance from SeaPRISM.
- A data-processing to retrieve chlorophyll, suspended solids and yellow substance and a data ingestion phase, in which data will be inserted into a GIS environment will be checked against in situ measurements.
- The overall duration of the project is foreseen in 36 months, from the beginning of the mission till three years after the launch.

## *Expected results and possible uses*

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- Through the integration of remote sensing data with ground data, we intend to retrieve bio-optical parameters on coastal zones.
- This study is aimed at developing an approach which will increase the value and will promote the use of comparatively low-cost, wide area satellite data as input to a continuous monitoring system useful to environmental agencies.