New chlorophyll-*a* concentration retrieving Algorithm Based on fidUcial referenCe measurements of ocean COlour

NABUCCO

- Principal Investigator (Name/Surname): Dr. Aristomenis Karageorgis
- Scientific Area: Environment and energy
- Scientific Field: Climate change
- Scientific Subfield: Observations and remote sensing
- Projects' Duration (in months): 36
- Total Budget (€): 191 998
- Host Institution: **Hellenic Centre for Marine Research, Institute of Oceanography**

- Collaborating Organizations:

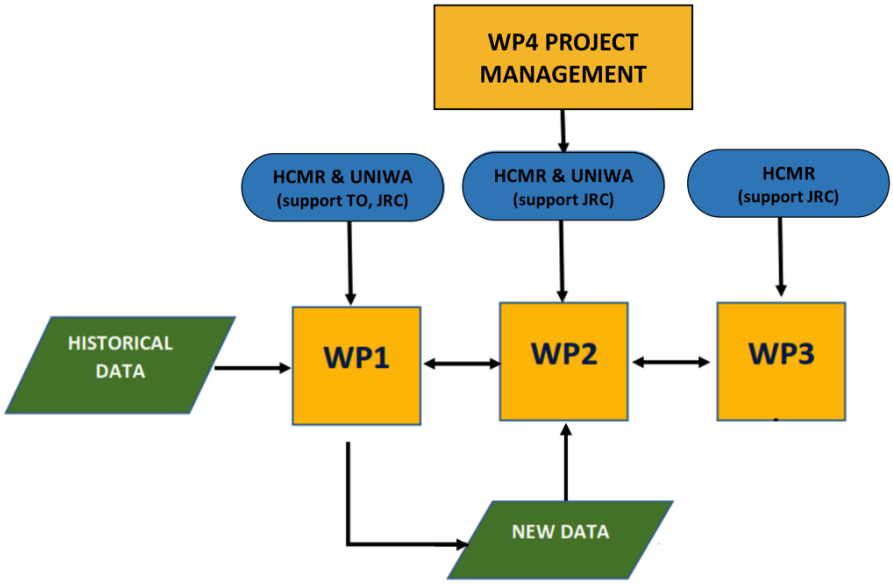
(1) Laboratory of Optical Metrology, University of West Attica (partner)
(2) European Commission – DG Joint Research Centre, Italy (support)
(3) Tartu Observatory, Tartu University, Estonia (support)

The concept

Ocean colour is an essential climate variable (ECV) that has revolutionized biological oceanography. It is used as a central element in assessing the health and productivity of marine ecosystems and the role of oceans in the global carbon cycle. However, there are still substantial systematic and unresolved errors in the estimation of its key parameters, i.e. water leaving radiance and chlorophyll-a (Chl-a), making such an application of ocean colour particularly challenging in the ultra-oligotrophic waters of the E. Mediterranean, that also comprise most of the Hellenic pelagic territorial waters. Thus, the NABUCCO project aims at working towards resolving this problem by studying the optical properties of seawater in the oligotrophic Cretan and NW Levantine Seas, improving their SI-traceability and uncertainty evaluation and thereby deriving an appropriately accurate regional Chl-a retrieval algorithm. Fiducial reference measurements (FRM) are recognized as necessary for satellite ocean colour calibration and validation and state-of-the-art ocean colour radiometry because without traceability and uncertainty information we cannot know how trustworthy or accurate ocean colour measurements are. The implementation of NABUCCO will: develop state-of-the-art optics calibration facilities at the host institution (HCMR); collect together existing and new in situ FRM from oceanographic research cruises; apply

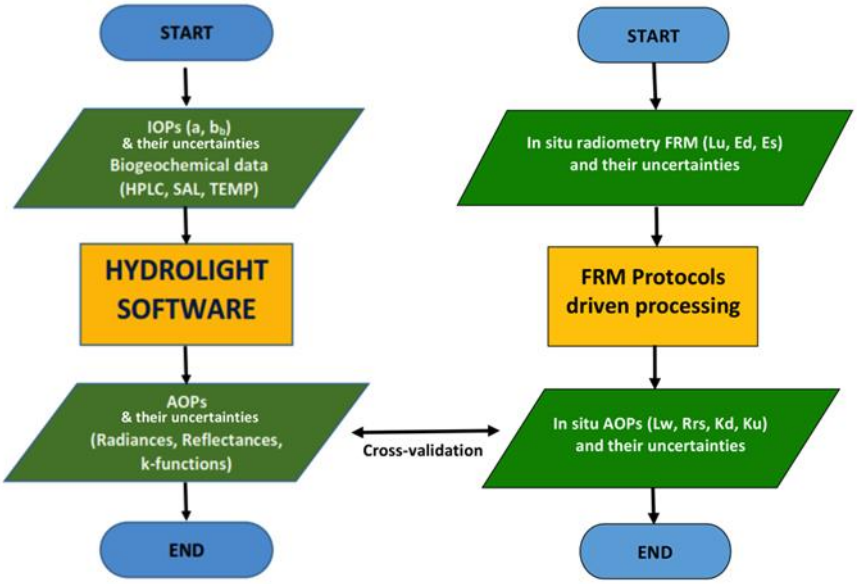
radiative transfer modeling to link these with satellite observations; and develop regionally tuned models and Chl-a retrieval algorithms for the E. Mediterranean. This will be strengthened by agreed collaboration with the UNIWA Laboratory of Optical Metrology in Greece, the marine optics laboratory of JRC and the calibration laboratories of Tartu Observatory in Estonia. NABUCCO will improve the quality and spatio-temporal resolution of ocean data products for the E. Mediterranean and significantly reduce the cost of data collection. Such an achievement will strongly support the national monitoring projects of Greece and in particular substantially improve marine ecosystem monitoring programs, management applications and services for the region.

Workflow and data analysis



WP1 constitutes the foundation of NABUCCO, which involves AOP and IOP measurements of the water column using well calibrated instruments with a full uncertainty budget, i.e. FRM. In order to achieve this for AOPs, state-of-the-art SI-traceable absolute radiometric calibrations that have uncertainty evaluation at each step are necessary. Therefore, in WP1 HCMR will develop its own optical facilities to perform absolute radiometric calibrations. WP1 work will also be carried out in collaboration with UNIWA optical metrology laboratory and thus give HCMR and Greece state-of-the-art ocean colour calibration facilities and expertise at the highest level for Europe and facilitate the best possible marine optics measurements of the E. Med for NABUCCO.

In **WP2** existing optical (multispectral and hyperspectral IOPs and AOPs) and biogeochemical (e.g. Chl-*a*, particulate matter, particulate organic carbon concentrations) data sets from previous research projects and new datasets from the cruises during NABUCCO will be collected, quality controlled and stored. The Hydrolight numerical model will be applied to estimate remote sensing reflectance from IOPs as will the FRM4SOC and IOCCG protocols.



WP3 focuses on the evaluation of existing and the development of new algorithms, to estimate Chl-a concentration from space products.

The research team

The PI (**Dr. A. Karageorgis**) has a long engagement in particle dynamics studies since the late 1990s and continued since 2011 with the study of IOPs in the E. Med and the Black Sea.

Dr. A.C. Banks is the HCMR expert in satellite oceanography, radiative transfer and marine optics, and an expert in fiducial reference measurements and ocean colour validation and calibration.

Dr. S. Psarra is a highly experienced marine biologist with a long record in Chl-a determination methods, phytoplankton ecology and ecosystem functioning, thus providing an excellent link between AOPs/light availability and Chl-a distribution patterns.

Mr. N. Spyridakis, MSc. is a skillful electronics engineer who will undertake most of the technical design and construction work. He is also experienced with the deployment of optical sensors and their calibration as part of his role as head engineer for the HCMR profiling optics suite and above water radiometry system.

Prof. P.G. Drakopoulos from University of West Attica (UNIWA) is Director of the Laboratory of Optical Metrology (LOM) and has a solid background in ocean optics and their applications as well as deep knowledge of theoretical aspects and modelling of AOPs and IOPs.

The team will also consist of 2 NABUCCO PhD students and 2 post-docs and be further strengthened by the agreed collaboration with the marine optics laboratory of JRC and the ocean colour radiometry calibration laboratories of Tartu Observatory in Estonia. Knowledge transfer and calibration visits to these state-of-the-art European facilities will be undertaken and give important training to the NABUCCO team, helping to bring the national expertise up to the highest possible level in FRM for NABUCCO and the future of ocean colour in Greece.