

Report for the year 2015 and future activities

SOLAS ITALY

compiled by: Chiara Santinelli

Please note that this report has two parts!

Part 1: reporting of activities in the period of January 2015 – December 2015

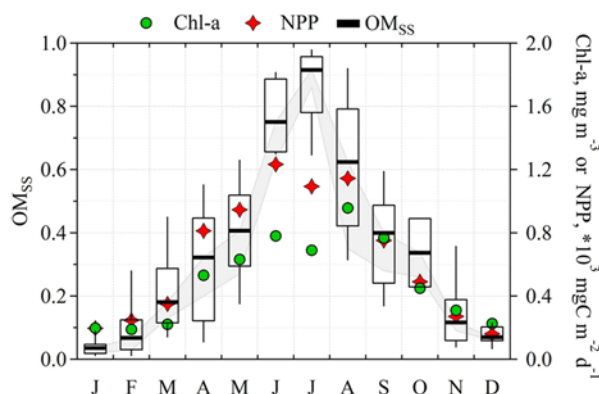
Part 2: reporting on planned activities for 2016 to 2018/19.

PART 1 - Activities from January 2015 to December 2015

1. Scientific highlight

Connecting marine productivity to sea-spray via nanoscale biological processes: Phytoplankton Dance or Death Disco?

Bursting bubbles at the ocean-surface produce airborne salt-water spray-droplets, in turn, forming climate-cooling marine haze and cloud layers. The reflectance and ultimate cooling effect of these layers is determined by the spray's water-uptake properties that are modified through entrainment of ocean-surface organic matter (OM) into the airborne droplets. In the newly published paper (O'Dowd et al., 2015), we presented new results illustrating a clear dependence of OM mass-fraction enrichment in sea spray (OM_{SS}) on both phytoplankton-biomass, determined from Chlorophyll-a (Chl-a), and Net Primary Productivity (NPP). The correlation coefficient for OM_{SS} as a function of Chl-a increased from 0.67 on a daily timescale to 0.85 on a monthly timescale. An even stronger correlation was found as a function of NPP, increasing to 0.93 on a monthly timescale. We suggest the observed dependence is through the demise of the bloom, driven by nanoscale biological processes (such as viral infections), releasing large quantities of transferable OM, comprising cell debris, exudates and other colloidal materials. This OM, through aggregation processes, leads to enrichment in sea-spray, thus demonstrating an important coupling between biologically-driven plankton bloom termination, marine productivity and sea-spray modification with potentially significant climate impacts. The Figure shows the seasonal variability of OM_{SS} at Mace Head and its relation with Chl-a and NPP.

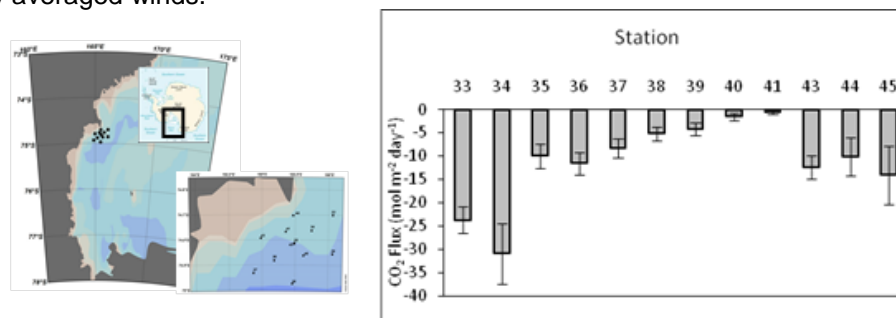


OM_{SS}, NPP and Chl-a annual cycle. Bold lines represent median concentrations, boxes- 25–75% percentile and whiskers demonstrate 10–90% percentile. Grey area represents a reduction in primary OM_{SS} due to possible secondary OM contribution to total organics. The secondary OM contribution was derived from data presented in Ceburnis et al. (2014) and ranges from 22% to 74% depending on the month.

O'Dowd, C.D., D. Ceburnis, J. Ovadnevaite, J. Bialek, D. B. Stengel, M. Zacharias, U. Nitschke, S. Connan, M. Rinaldi, S. Fuzzi, S. Decesari, M. C. Facchini, S. Marullo, R. Santoleri, A. Dell'Anno, C. Corinaldesi, M. Tangherlini and R. Danovaro, Connecting marine productivity to sea-spray via nanoscale biological processes: Phytoplankton Dance or Death Disco? Scientific Reports, Volume 5, 14 October 2015, Article number 14883.

Physical and biological forcing of mesoscale variability in the carbonate system of the Ross Sea (Antarctica)

Data analysis of the surface water carbonate system properties, collected in the 2014 PNRA cruise in the Ross Sea, document substantial spatial heterogeneity and complexity of the system and the magnitude of the CO₂ flux at a horizontal length scale of about 10 km, emphasizing the importance of mesoscale events to regional biogeochemistry of the Southern Ocean. The investigated coastal region overall acted as a sink of CO₂, with respect to the measured atmospheric CO₂ with fluxes ranging from -0.5 ± 0.4 to -31.0 ± 6.4 mmol m⁻² d⁻¹. The CO₂ flux was controlled primarily by phytoplankton activity rather than physical forcing, which, on the other hand, created the favorable conditions for the phytoplankton growth. This is confirmed by the fact that the greatest air-sea CO₂ disequilibrium ($\Delta p\text{CO}_2$) occurred at those stations where O₂ supersaturation (112–113%) and high pH values (8.42) were recorded. Nevertheless, as wind speed is the main driver of the air-sea flux, together with the $\Delta p\text{CO}_2$, the lowest fluxes were calculated for those stations characterized by the weaker hourly averaged winds.



Calculated CO₂ flux (mol m⁻² day⁻¹) in the coastal area of the Ross Sea (Antarctica) investigated by the RoME Project during the austral summer 2014

Rivaro, P., Ianni, C., Langone, L., Ori, C., Aulicino, G., Cotroneo, Y., Saggiomo, M., Mangoni, O., Physical and biological forcing of mesoscale variability in the carbonate system of the Ross Sea (Antarctica) during summer 2014. *Journal of marine system*, <http://dx.doi.org/10.1016/j.jmarsys.2015.11.002>, 2015.

2. Activities/main accomplishments in 2015 (projects, field campaigns, events, model and data intercomparisons, capacity building, international collaborations, contributions to int. assessments such as IPCC, interactions with policy makers or socio-economics circles, etc.)

1. EVENTS

- **IMBER** (Integrated Marine Biogeochemistry and Ecosystem research) **IMBIZO IV** workshop on Marine and human systems: Addressing multiple scales and multiple stressors was held from October 26th to 30th 2015, at OGS, Trieste, Italy

2. CRUISES

- **COSIMO** 2015, R/V URANIA (CNR), April 10th to 29th 2014, CNR-ISAC, Roma (Chief scientist, Dr. F. Falcini). Main goals of the cruise: (1) Characterization of bio-optical properties of the Adriatic Sea; (2) Extension of the Mediterranean Sea in situ bio-optical dataset for the support of marine biological parameter estimates using satellite data; (3) Validation of regional algorithms for the estimates of marine chlorophyll and primary production from satellite data; (4) Development of new regional algorithms for the estimates of chlorophyll, primary production, chromophoric dissolved organic matter (CDOM) and phytoplankton species from satellite data.
- **MARINE STRATEGY** 2015, R/V MINERVA2 (CNR) November 4th to 22nd 2015, DTA-CNR. Main goals of the cruise: (1) fill up knowledge gaps on biological parameters in Mediterranean areas; (2) Monitoring plankton in offshore environments (MSFD, Activity 1.7); (3) monitoring the physical and chemical variables and nutrients (MSDF: activity 1.3). Assessment Areas: South Adriatic and Ionian Seas.
- **ARCA** 2015, R/V TEISTEN, June 16th to 29th 2015, CNR-IAMC, Messina (Chief scientist, Dr. M. Azzaro). Main goals of the cruise: (1) Study of microbial and chemical parameters in

the surface microlayer of the Kongsfjorden (Svalbard); (2) automatization of the sampling process in extreme conditions (e.g. in proximity of a glacier) with a specifically developed automatic water multisampler.

- **CEFA/PNRA** 2015, pack ice hole and rubber dinghy, October 2015-January 2016, CNR-IAMC, Messina. Main goals of the field campaign: (1) monitoring the evolution of microbial communities living in the coastal surface layer of Terra Nova Bay (Antarctica); (2) assessing the biogeochemical signatures in a changing environment.
- **ESAW-1**, Evolution and spreading of Southern Adriatic Waters, Eurofleet2, R/V BIOS DVA (Croatia), December 10th-15th 2015, OGS Trieste (Chief Scientist: V. Kovacevic). Main goals of the cruise: (1) to study the hydrographic and biogeochemical properties (with a special focus to carbon) along two shore to shore sections (Gargano – Split and Bari Dubrovnik) and in the Mid Adriatic depression, in winter.
- **AdritLTER1** 2015, R/V Dallaporta, march 8th to 15th 2015, CNR-ISMAR (Chief scientist: M. Bastianini). Main goals of the cruise: (1) determination of spatial variability of carbonate system properties, other chemical parameters (DO, DIN, DIP, SiO₂), and phytoplankton in a shelf region, highly sensitive to ocean acidification (2) maintenance of instruments and sensors on buoys.
- **PEGASO**, RV Hesperides (Spain). CNR-ISAC, together with C-CAPS NUIG (Centre for Climate and Air Pollution Studies, Natinal University of Ireland Galway, Ireland) and ICM-CSIC (Institut de Ciències del Mar, Barcelona, Spain), participated to a scientific cruise in the Southern Ocean. The main aim of the cruise was to understand how marine biota affects the chemical composition and climate-relevant properties of marine aerosol, with particular attention to sea spray. During the cruise (January-February 2015), a series of bubble bursting experiments were performed following the approach of Facchini et al (2008) and O'Dowd et al. (2015), setting the measurements over high biologically active seawaters. In detail, measurements were located in the region between South Georgia Island and the Antarctic Peninsula, over four distinct phytoplankton blooms identified from satellite data (see details of the cruise in Figure 1).

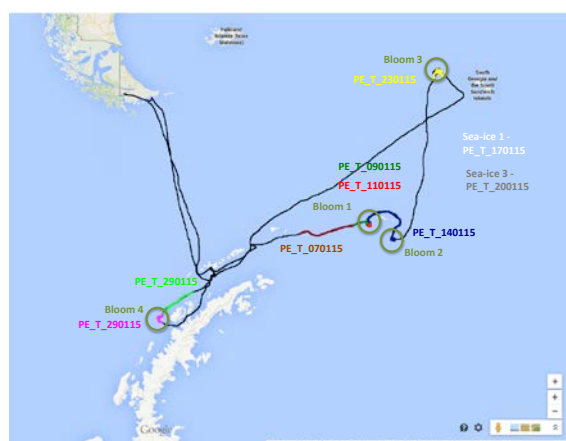


Figure 1. PEGASO cruise route. Colored segments indicate the regions where sea spray production and characterization experiments were performed. The four blooms identified from in-situ and satellite measurements are indicated by the green circles.

3. ON-GOING ACTIVITIES AND MAIN RESULTS

Marine aerosol characterization campaign at Mace Head

Facchini M.C, Rinaldi M., Paglione M., S. Sandrini, F. Belosi, G. Santachiara, A. Donateo, D. Contini (CNR-ISAC)

CNR-ISAC participated in the joint BACCHUS – Air-Sea Lab marine aerosol characterization campaign, held at Mace Head (Ireland) during August 2015. The aim of the campaign was to characterize the aerosol-cloud interaction in the North Atlantic Marine Boundary Layer (MBL).

The advanced in situ and remote sensing aerosol-cloud characterization instrumentation, running continuously at Mace Head research station, was integrated by observations carried on by CNR-ISAC, focusing particularly on marine cloud condensation nuclei (CCN) and ice nucleating particles (INP) emission and formation processes.

INP measurements

Offline deposition and condensation freezing INP analysis have been performed by Langer dynamic developing chamber (Santachiara et al., 2010), for the determination of their atmospheric concentration in the PM1 and PM10 size ranges. These measurements allow the investigation of INP particles in the marine boundary layer and of the role of biogenic organic matter associated to sea spray particles in determining the INP properties of primary particles produced from the ocean surface, testing the recent hypothesis by Wilson et al. (2015). Figure 1 presents an overview of the INP concentration determined at -22°C , as a function of the size range and of the water saturation ratio (Sw).

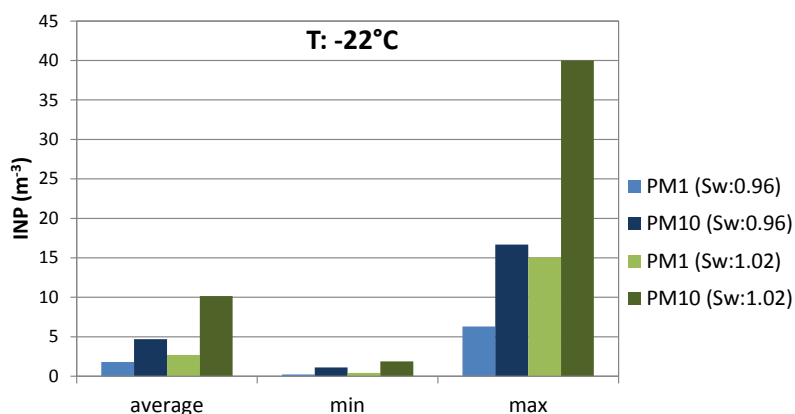


Figure 1. Overview of the INP concentrations observed at Mace Head during the August 2015 campaign.

Aerosol flux measurements by Eddy Covariance

Aerosol flux measurements by eddy covariance, combining high time resolution aerosol mass spectrometer (HR-ToF-AMS), condensation particle counter (CPC) and optical particle counter (OPC) measurements performed during the campaign in collaboration with C-CAPS NUIG and NERC (Edinburgh, UK) provide new information on the emission of marine aerosols particles potentially acting like CCN and INP in the (MBL).

Measurements were carried out using a micrometeorological flux system based on the Eddy Covariance (EC) method. The system was placed on the tallest Mace Head tower at 22 m height (Figure 2).



Figure 2. a) Micrometeorological Tower on the measurement observatory of Mace Head. b) Sonic anemometer and CPC inlet coupled in eddy covariance configuration.

Development of new technology devices for extreme polar environments: first "in situ" application of an automatic sampler in the Svalbard Islands

Zappalà G., Bruzzone G., Caruso G., Azzaro M. (CNR-IAMC; CNR-ISSIA)

Increased attention has recently been addressed to Arctic ecosystems due to the well-known impact of global warming on the northern polar region. Advanced technologies for marine monitoring are needed to monitor environmental changes, especially those related to ice melting. In the framework of the CNR ARCA project aimed at studying the hydrological cycle and its consequences on the climate in the boreal hemisphere, a first prototype of automatic equipment was specifically designed to perform discrete sampling of surface waters in the area close to the Kronebreen glacier, in the Svalbard Islands. This contribution reports the results of the first in situ application of this device to the study of heterotrophic bacterial distribution and functional metabolism. High enzymatic activity and abundance of culturable heterotrophic bacteria were observed close to the Kronebreen glacier. The extracellular enzymatic profiles of the bacterial isolates showed that lipids, proteins and organic phosphates play a major role in bacterial metabolism in this area of the Arctic Ocean.



Figure 1: The automatic vehicle (left) towing the multisampler (right)

Total atmospheric deposition of dissolved organic carbon (DOC) at the Lampedusa Island: preliminary results

Santinelli C. (CNR-IBF), Galletti Y. (CNR-IBF), Di Sarra G. (ENEA), Becagli S. (Univ. Florence)

The main goals of this project are: (1) to gain the first information on the total atmospheric deposition of dissolved organic matter (DOM) at the Lampedusa Island and (2) to gain some qualitative information about the composition of DOM through the analysis of the optical properties (absorption and fluorescence) of its chromophoric fraction (CDOM).

In March 2015, the first Italian total atmospheric deposition sampler for DOM was installed at the Station for Climate Observations "Roberto Sarao" ENEA, Lampedusa Island. Atmospheric depositions were collected between March 19th and December 2nd. DOC fluxes ranged between 0.07 and 1.81 mmol C m⁻² day⁻¹, with a marked variability (Fig. 1). These data are in the range of DOC atmospheric fluxes measured at Cap Ferrat in 2006 (0.04-1.2 mmol C m⁻² day⁻¹) and of total OC (TOC) in rainwater at the Creta Island (0.14 mmol C m⁻² day⁻¹). The EEMs of CDOM, in total deposition, showed 3 peaks (Fig. 2). (1) Peak A ($\lambda_{\text{ex}} = 250$ nm and $\lambda_{\text{em}} = 400$ -500 nm), that has been observed in many studies on marine DOM, in particular in coastal regions and is attributed to terrestrial humic-like substances. (2) Peak M ($\lambda_{\text{ex}} = 310$ -320 nm and $\lambda_{\text{em}} = 400$ -450 nm) showed lower levels of fluorescence intensity than peak A, and it was observed in all the samples. It was reported in previous studies and it could be due to the occurrence of marine as well as terrestrial humic-like substances. (3) Peak T ($\lambda_{\text{ex}} = 280$ nm and $\lambda_{\text{em}} = 340$ nm) is attributed to protein-like substances and it was not observed in all the samples.

These preliminary results suggest that atmosphere can be an important and up to now overlooked source of DOC and CDOM to the Med Sea.

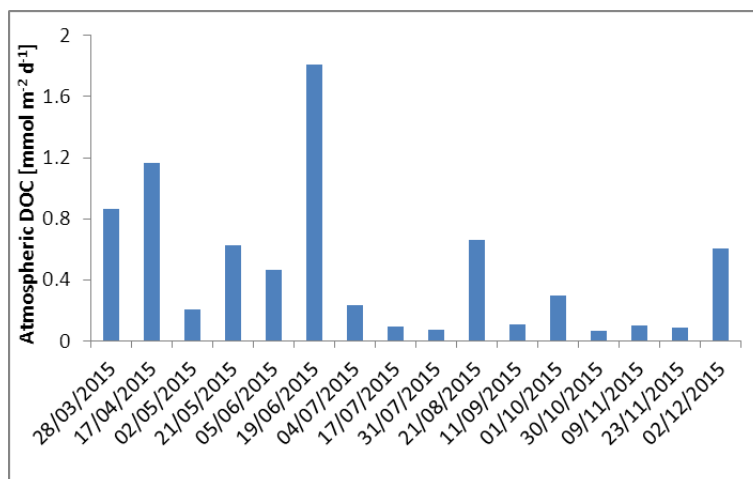


Figure 1. The DOC fluxes during the study period.

3. Top 5 publications in 2015 (only PUBLISHED articles) and if any weblinks to models, datasets, products, etc.

For journal articles please follow the proposed format:

Author list (surname and initials, one space but no full stops between initials), year of publication, article title, full title of journal (italics), volume, page numbers, DOI.

1. Canepa E., Pensieri S., Bozzano R., Faimali M., Traverso P., Cavaleri L. (2015) The ODAS Italia 1 buoy: more than forty years of activity in the Ligurian Sea. *Progress in Oceanography*. Volume 135, June 2015, Pages 48–63. <http://dx.doi.org/10.1016/j.pocean.2015.04.005>
2. O'Dowd, C.D., D. Ceburnis, J. Ovadnevaite, J. Bialek, D. B. Stengel, M. Zacharias, U. Nitschke, S. Connan, M. Rinaldi, S. Fuzzi, S. Decesari, M. C. Facchini, S. Marullo, R. Santolero, A. Dell'Anno, C. Corinaldesi, M. Tangherlini and R. Danovaro (2015), Connecting marine productivity to sea-spray via nanoscale biological processes: Phytoplankton Dance or Death Disco? *Scientific Reports*, 5, 14883, doi: 10.1038/srep14883.
3. Rivaro P., Ianni, C., Langone, L., Ori, C., Aulicino, G., Cotroneo, Y., Saggiomo, M., Mangoni, O. (2015). Physical and biological forcing of mesoscale variability in the carbonate system of the Ross Sea (Antarctica) during summer 2014. *Journal of marine system*,

<http://dx.doi.org/10.1016/j.jmarsys.2015.11.002>, 2015

4. Zaccone R., G. Caruso, Azzaro M., M. Leonardi, G. Maimone, L.S., Monticelli, A. Cuttitta, B. Patti, R. La Ferla (2015). Seasonal changes on microbial metabolism and biomass in the euphotic layer of Sicilian Channel. *Mar Environ Res*, 112B: 20-32 special issue Mares. DOI: 10.1016/j.marenvres.2015.07.007
5. Celussi M., Gallina A.A., Ras J., Giani M., Del Negro P. 2015. Effect of sunlight on prokaryotic organic Carbon uptake and dynamics of photoheterotrophy relevant pigments in the Adriatic Sea, *Aquatic Microbial Ecology*, 74: 235–249. doi: 10.3354/ame01738.
6. Cossarini G. , Querin S., Solidoro C. 2015. The continental shelf carbon pump in the northern Adriatic Sea (Mediterranean Sea): Influence of wintertime variability. *Ecological Modelling* 314: 118–134.

PART 2 - Planned activities from 2016 to 2018/19

1. Planned major field studies and collaborative laboratory and modelling studies, national and international (incl. all information possible, dates, locations, teams, work, etc.)

- **April 2016. AIR-SEA LAB Project campaign.** P.I.: Maria Cristina FACCHINI. Main focus: characterization of the air quality & climate interactions in the Mediterranean Basin. The Air-Sea Lab partners C-CAPS NUIG and CNRS LaMP (France) will participate in the campaign. Measurements will be carried at 6 coastal sites representative of different pollution conditions in the Mediterranean (Fig. 1):
 - a. **Capogranitola.** Marine background site in the Strait of Sicily, potentially influenced by ship traffic.
 - b. **Civitavecchia Porto** (mobile lab). Civitavecchia hosts an intensive traffic of ferries linking Sardinia to the mainland, plus a continuous traffic of cruise ships stopping there to allow for tourist visits to Rome. Furthermore, the port is rapidly expanding to the north to host maritime commercial traffic of goods. At the end of this port, ~5km north of the city, there is a coal-powered power station. In spite of rather low levels of the standard pollutants (PM10, NO2, etc.), Civitavecchia shows a larger mortality and morbidity with respect to the regional average.
 - c. **Civitavecchia LACOST.** Micrometeorology, Radiative and energy balance, wind profiles, vertical velocity profile, atmospheric thermal structure, mixing layer height.
 - d. **Lecce.** The CNR-ISAC Environmental-Climatology Observatory, regional station of the Global Atmosphere Watch (GAW) network, is an urban background station in Lecce (40°20'8"N-18°07'28"E, 37 m asl) at about 4 km (SW) of the urban area. The site is located at about 30 km and 80 km from the most important industrial centers of the Puglia Region (Taranto and Brindisi).
 - e. **Lamezia Terme.** Coastal site in the Southern Tyrrhenian Sea, potentially influenced from East North-East direction by urban surrounding small villages anthropic activity and from South-West from Etna volcanoes emission and Saharian Dust.
 - f. **Lampedusa.** Marine background site. Lampedusa station will be available through the external collaboration with ENEA and University of Florence.

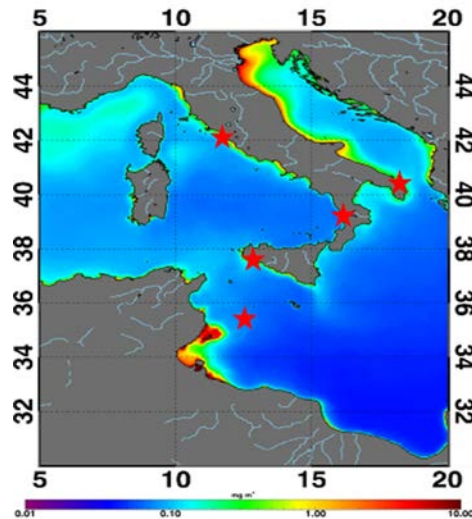


Figure 1. Sampling stations (red stars) during the Air-Sea Lab campaign in the Mediterranean Basin (April 2016). Colors refer to Chlorophyll concentration climatology over the Mediterranean Sea (1998-2009; Case I – Case II chlorophyll product derived by MedOC4 to SeaWiFS remote sensing reflectances)

- **June 2016 PELAGIC MESOSCOSM EXPERIMENT in the Gulf of Naples.** P.I.: Christophe Brunet (SZN). The SZN in collaboration with many research institutes and Universities from Italy and Europe is organizing a Pelagic Mesocosm experiment in the Gulf of Naples in June 2016. The experiment will consist in the deployment of 6 mesocosms ($\approx 100 \text{ m}^3$ each, 3 m diameter and 15 m depth) in order to follow the ecosystem dynamics (almost end-to-end: from viruses to macrozooplankton) in response to macronutrient addition, with or without presence of microplastics. The six bags will be enriched by nutrients (nitrates, phosphate and silicates), and in three of them microplastics will be added. The aims of the experiment are:
 - (i) to induce a coastal bloom in order to investigate the ecosystem processes related to this event, such as succession, primary and secondary production, vertical fluxes, viral infection, grazing, biodiversity, changes in the chemistry of the water column and the biogeochemical cycles.
 - (ii) to study the impact of the microplastics in a coastal area, such as the vertical fluxes, the interactions with the biotope and the trophic food web, interactions with the marine chemistry (metals, dissolved organic matter).

The experiment will last 15 days. Many researchers will contribute to the whole data set retrieved from this first Italian Pelagic Mesocosm experiment. Many parameters will be analysed and complementary technical approaches will be used. For all biological compartments (virus, bacteria, phytoplankton, microzooplankton and macrozooplankton), the biodiversity will be studied through conventional taxonomic measurements together with molecular approaches, and the biochemistry, physiology and production will be also investigated. Physical (salinity, temperature) and chemical parameter will be measured in order to investigate organic matter (dissolved and particulated, polysaccharides, absorption and fluorescence of its chromophoric fraction) and metals dynamics. The outside control station will be used for assessing all the changes occurring in the water column following the fertilization with or without the enrichment in microplastics.

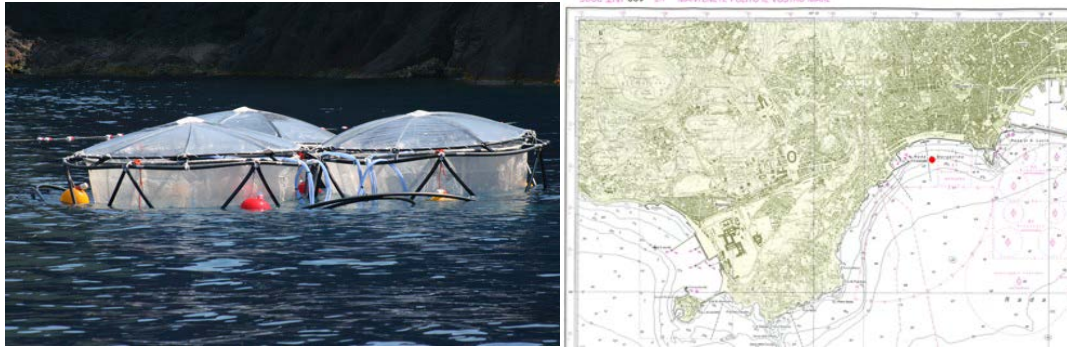


Figure 2: Above surface view of three pelagic mesocosms (used in the French DUNE project, Picture by C. Brunet, 2010), and the map of the inner part of the Gulf of Naples showing the position (red dot) of the mesocosms deployment in June 2016.

- **2017 Spring. AFRÒS CRUISE** in the Tyrrhenian Sea. Solas-Italy community and international partner. Main goals: Characterization of the main processes of sea spray formation; Biogeochemical and microbial characterization of surface water in relation to sea spray formation. To investigate carbon fluxes at the surface ocean-atmosphere interaction.
- **March 2015 - Ongoing** Total atmospheric deposition sampling at the Lampedusa Island, in collaboration with MIO, Marseille, France.
- **September 2016** Mineralization experiments to assess the impact of atmospheric deposition of inorganic nutrients and organic matter on marine biogeochemical cycle. In collaboration with MIO, Marseille, France. Project ADORE.
- **January-February 2016 - RoME Project activities** in the framework of the oceanographic cruise of Italian National Program of Research in Antarctica (XXXI Expedition). Main goals: (1) determination of spatial variability of carbonate system properties, other chemical parameters (DO, nutrients, iron), and phytoplankton in a shelf region of the Ross Sea impacted by mesoscale structures; (2) calculation of air-sea CO₂ fluxes, (3) maintenance of instruments and sensors on long-term moorings.
- **Summer 2016 MARINE STRATEGY 2016** Cruise. Main objectives: monitoring plankton in offshore areas (MSFD, Activity 1.7), monitoring physical-chemical variables and nutrients (MSDF: activity 1.3).
- **Summer 2016 or 2017 ARCA** project in the Kongsfjorden (Svalbard). Main objectives: monitoring superficial microlayer and bottom boundary layer.
- **ESAW-2**, Evolution and spreading of Southern Adriatic Waters, **Eurofleet2**, R/V BIOS DVA (Croatia), April 4th-12th 2016, OGS Trieste (Chief Scientist: V. Kovacevic). Main goals of the cruise: (1) to study the hydrographic and biogeochemical properties (with a special focus to carbon) along two shore to shore sections (Gargano – Split and Bari Dubrovnik) and in the Mid Adriatic depression, in the post-convection phase.

2. Events like conferences, workshops, meetings, schools, capacity building etc. (incl. all information possible)

XXXIV SCAR (Scientific Committee on Antarctic Research) Meeting 2016 and Open Science Conference 23 to 26 August 2016. The theme of the conference will be "*Antarctica in the Global Earth System: From the Poles to the Tropics*" Kuala Lumpur, Malaysia, <http://scar2016.com/>

3. Funded national and international projects / activities underway (if possible please list in order of importance and indicate to which part(s) of the SOLAS 2015-2025 science plan the activity topics relate – including the themes on ‘SOLAS science and society’ and ‘Geoengineering’)

- **ADORE (2016)**. Atmospheric input of Dissolved ORganic mattEr to the Mediterranean Sea”, Italy-France exchange project funded in the framework of the Galileo program, Università Italo-Francese.
- **AIR-SEALAB (2014-2016)**. Aerosol-cloud interaction in marine areas. CNR funded Bilateral Project.
- **BACCHUS (2013-2016)**. Impact of Biogenic versus Anthropogenic emissions on Clouds and Climate: towards a Holistic UnderStanding. Funded by EU FP7. www.bacchus-env.eu/
- **CEFA/PNRA 2015 (2015-2016)** Coastal Ecosystem Functioning in a changing Antarctic ocean
- **EMODNet European Marine Observation and Data network (2013-2016)**. EMODNET aims to assemble fragmented and inaccessible marine data into interoperable, continuous and publicly available data streams for complete maritime basins. EMODNET is a long term marine data initiative from the European Commission Directorate-General for Maritime Affairs and Fisheries (DG MARE) underpinning its Marine Knowledge 2020 strategy. **EMODNET Chemistry**. Coordinator OGS-NODC. www.emodnet-chemistry.eu.
- **FIXO3 (2013-2017)**. The Fixed point Open Ocean Observatory network seeks to integrate European open ocean fixed point observatories and to improve access to these key installations for the broader community. OGS is leading the WP2 - Technological harmonization. www.fixo3.eu/wp2/
- **JERICO NEXT (2015-2019)**. Joint European Research Infrastructure network for Coastal Observatory – Novel European eXpertise for coastal observaTories. CNR-ISMAR is leading the the WP7. <http://www.jerico-ri.eu/>
- **PERSEUS (2012-2016)**. Policy-oriented marine Environmental Research in the Southern European Seas. EU FP7. www.perseus-net.eu
- **Rewarding ARCA (2014-2016)**. ARtico: cambiamento Climatico Attuale ed eventi estremi del passato, Supported by DTA-CNR.
- **RITMARE (2012-2017)**. Italian Flagship Project, supported by the Italian Ministry of Research and University. www.ritmare.it.

4. Plans / ideas for future projects, programmes, proposals national or international etc. (please precise to which funding agencies and a timing for submission is any)

Greenhouse gases and the oceans

Goals:

- To investigate organic carbon fluxes, mediated by microbes (the biological carbon pump and the microbial carbon pump), and their role in regulating ocean-atmospheric CO₂ exchanges, with particular regards to (i) the atmospheric CO₂ uptake by marine phototrophs, (ii) the heterotrophic transformation and mineralization of organic matter along the water column (iii) the role of POC and DOC in C sequestration in the ocean.
- To investigate the sea-surface microlayer and its microbial community.
- To quantify the relative contribution of physical and biological processes driving the summertime CO₂ air–sea fluxes in surface waters of the Ross Sea, Antarctica, in order to predict future changes in the carbonate system associated with climate change in this key area.
- To study photo-degradation processes and their role in CO₂ fluxes to the atmosphere.

Future Activities:

- An integrated air-sea observatory is under development in the central Med Sea at Lampedusa (35.5°N, 12.6°E). Existing observations, mostly dedicated to atmospheric parameters (see <http://www.lampedusa.enea.it>), will be complemented with air-sea exchange measurements on a buoy close to the atmospheric measurement site on the island. Measurements will include radiation budget, p(CO₂), oceanic optical properties, etc.
- Dissolved and particulate Lipopolysaccharides in surface layer and marine aerosol will be

investigated as a biomarker of bacterial biomass. Experiments will be developed in order to analyze bacterial metabolism and to assess the carbon budget (heterotrophic hydrolysis and respiration).

- The LTER time series of physical chemical and biological parameters in the Gulf of Trieste will continue in order to quantify the carbon cycle
- The LTER time series of physical chemical and biological parameters in Po river and Romagna coast will continue in order to validate satellite remotely-sensed observations and meteo-oceanographic forecast models (E1 and S1 systems).
- Carbonate system measurements will be integrated at E2M3A site, South Adriatic Sea
- The S1 system, now configured as an elastic beacon, will be implemented during 2017 with a 'yo-yo' device.
- An integrated air-sea observatory is already working in the North Adriatic Sea (PALOMA station: 35.5°N, 13.6°E) for 6 years. Existing observations (atm pCO₂, dissolved pCO₂ and oxygen) are dedicated to air-sea gas exchanges (CO₂ and O₂), with particular focus on ocean acidification. The observatory is part of GOA-ON and ICOS networks and contributes to ongoing and future projects (PERSEUS, JERICO and JERICO NEXT).
- Data collected in the Kongsfjorden, Svalbard Islands (Norway), in the framework of the project ARCA, will allow to explore the microbial assemblages and metabolism in an ocean-glacier melting site.
- To continue the pCO₂ continuous measurements (in seawater and in atmosphere) in the Adriatic Sea.
- Cruise with dedicated experiments

Atmospheric deposition and ocean biogeochemistry

Goals

- To estimate atmospheric input of DOM, macro and micro nutrient (P, N, Fe, Si, Ca, Al, K, etc) to the Med Sea
- To study biological lability of atmospheric organic matter
- To gain qualitative information on atmospheric organic matter
- To assess the role of Saharan dust on nutrients availability and biogenic marine activity
- To study atmospheric markers of the biogenic activity
- To assess the transport and diffusion processes in the ocean

Activities

- To continue collection of atmospheric deposition at Lampedusa in order to acquire information with a high temporal resolution.
- Mineralization experiments to investigate the impact of atmospheric deposition on surface DOM cycle
- To use lagrangian oceanography and applications of lagrangian techniques to biological oceanography and marine ecology

Marine ecosystems, aerosol and clouds: interactions and feedbacks

Goals:

- Investigate sources and formation processes of marine organic aerosols
- Investigate the relation between marine microbiology and the formation of primary and secondary organic aerosols over the oceans
- Characterize the main climate relevant properties of marine aerosols
- Investigate sea spray aerosols

Activities

- Investigation on the role of sea spray as ice nuclei (IN) through both atmospheric measurements and laboratory experiments held at Mace Head (Ireland) in cooperation with National University of Ireland
- Joint CNR-ISAC/NUIG/CSIC cruise in the Southern Ocean. An integrated activity on aerosol-cloud interaction in marine environments (Mediterranean and North Atlantic) is starting at CNR-ISAC under the framework of AIR-SEA Lab project in collaboration with

university of Galway.

- Sea-spray measurements from the CNR-ISMAR Acqua Alta platform in the Northern Adriatic Sea in collaboration with University of Toulon (France) *We are searching for financial support, e.g., we are going to apply to the JERICO NEXT TNA call*

Remote sensing of biogeochemical processes

Goals:

- Validation and development of new regional algorithms for the estimates of chlorophyll, primary production, chromophoric dissolved organic matter (CDOM) and phytoplankton species from satellite data.
- Advances in satellite retrieval of physical and biogeochemical processes and variables.
- Characterization of the marine Planetary Boundary Layer by continuous measurements of aerosol cross section from lidar/ceilometer. These measurements could be carried out either onshore or aboard cruise ships or R/V.
- Use of satellite data of Chlorophyll and in situ phytoplankton activity in the application of bio-optical models for the estimate of primary production.
- To understand how important is the impact of the diurnal variability of the Sea Surface temperature (SST), solar irradiance and PBL height on air-sea interaction processes.
- To evaluate, over one annual cycle, the impact of the diurnal SST cycle on the air-sea heat fluxes and to investigate if a relation exists between extreme diurnal warming events and intense meteorological phenomenon in coastal areas

Activities

- Acquisition of a time series of optical data in continuum by oceanographic platforms already installed in the Adriatic Sea (Buoy E1 and S1) and deployment with new optical instrumentation
- To combine different remote sensing techniques (satellite, radiometric and lidar measurements) and modelling
- Cruises with the use of ship radiometer, that also provides an accurate air temperature measurement.

5. Engagements with other international projects, organisations, programmes etc.

Comments

The Italian community is very active on SOLAS themes and in January 2015 a first meeting was organised in order to discuss about the best way to strengthen and increase the visibility of the SOLAS-Italy community.

Today SOLAS-Italy counts about 40 participants from more than 13 Institutions. Our key words are: interdisciplinarity, collaboration, cooperation and sharing of both infrastructures and resources. The first goal of this community is to be able to “speak the same language” between atmospheric and marine scientists going behind the sea-air frontier. We realized that there is a problem of communication, the same process is often defined differently from atmospheric and marine perspective.

In May 19th the SOLAS-Italy web site was launched <http://www.isac.cnr.it/solas/home>. We are excited to take on this new frontier-breaking challenge that will increase our knowledge and will give us the unique opportunity to better understand oceanographic and atmospheric processes in a global perspective, we would like to thank SOLAS for giving us this great opportunity.

We are looking for projects to support our activities as well as for international collaborations.