

## Report for the year 2016 and future activities

### SOLAS 'Italy'

compiled by: 'Chiara Santinelli'

*This report has two parts:*

- **Part 1:** reporting of activities in the period of January 2016 – Jan-Feb 2017
- **Part 2:** reporting on planned activities for 2017/2018 and 2019.

*The information provided will be used for reporting, fundraising, networking, strategic development and updating of the live web-based implementation plan.*

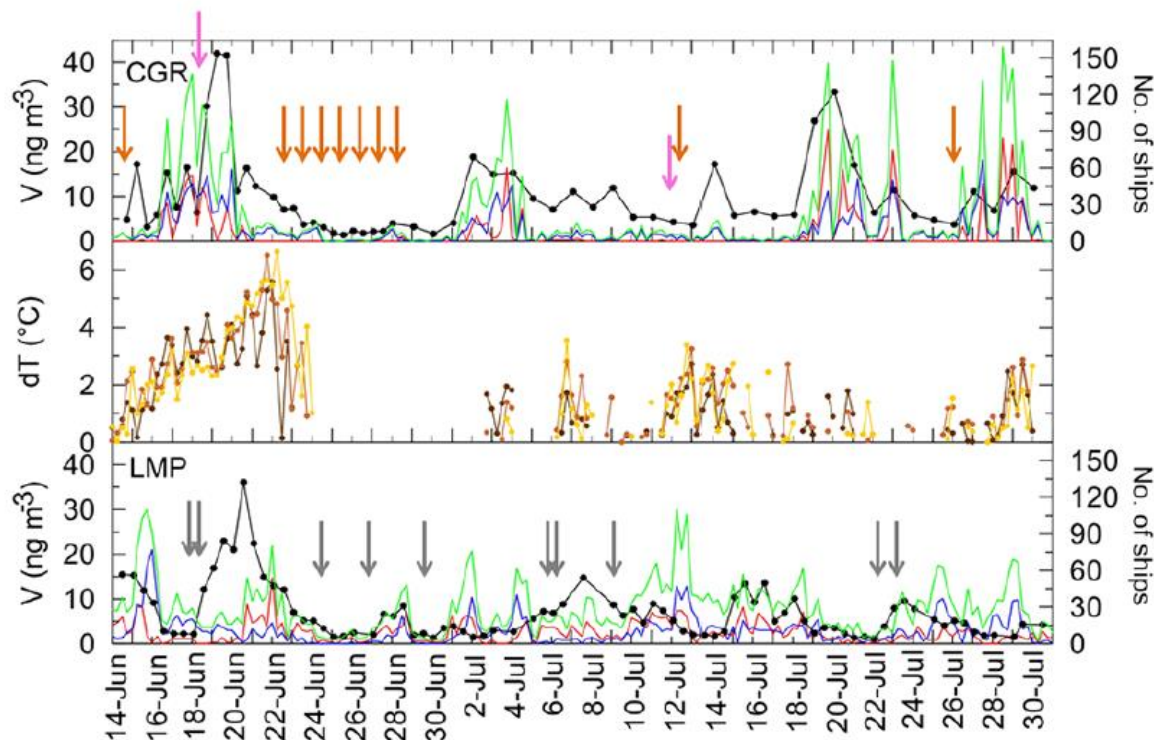
**IMPORTANT:** May we remind you that this report should reflect the efforts of the SOLAS community in the entire country you are representing (all universities, institutes, lab, units, groups, cities)!

#### PART 1 - Activities from January 2016 to Jan/Feb 2017

##### 1. Scientific highlight

#### CONSTRAINING THE SHIP CONTRIBUTION TO THE AEROSOL OF THE CENTRAL MEDITERRANEAN

PM10 (Particulate Matter with aerodynamic diameters lower than 10  $\mu\text{m}$ ) aerosol samples were collected during summer 2013, 12 h time resolutions, within the framework of the Chemistry and Aerosol Mediterranean Experiment (ChArMEx) at two sites located north (Capo Granitola) and south (Lampedusa Island) of the main Mediterranean shipping route in the Strait of Sicily. The evolution of soluble V and Ni concentrations (typical markers of heavy fuel oil combustion) was related to meteorology and ship traffic intensity in the Strait of Sicily, using a high-resolution regional model for calculation of back trajectories. The combination of the analyses based on chemical markers (in particular rare earth elements, which help distinguishing between refinery and ship emissions), air mass trajectories and ship routes allows us to unambiguously identify the large role of the ship source in the Strait of Sicily. Based on the sampled aerosols, ratios of the main aerosol species arising from ship emission with respect to V were estimated with the aim of deriving a lower limit for the total ship contribution to PM10. The estimated minimum ship emission contributions to PM10 were 2.0  $\mu\text{g}/\text{m}^3$  at Lampedusa and 3.0  $\mu\text{g}/\text{m}^3$  at Capo Granitola, corresponding with 11 and 8.6% of PM10, respectively.

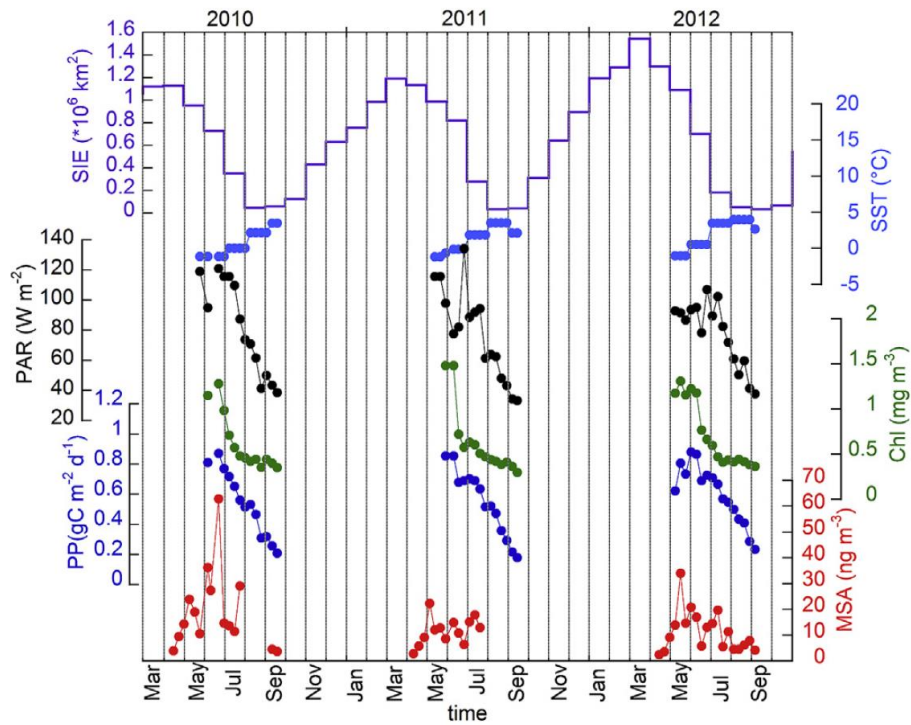


Time series of Vanadium concentration (black line with dots) and number of ships affecting the air masses sampled at Capo Granitola (upper panel) and Lampedusa (lower panel). Green, red and blue lines indicate, respectively, the total number of ships and the number of merchant (i.e. cargo and tanker) and fishing vessels. The time evolution of the temperature inversion index ( $dT$  in the figure) at three different locations in the Strait of Sicily is shown in the middle panel; brown, red and yellow curves show the behaviour at three sites in the Strait. The orange arrows identify samples classified as crustal, based on the La-Ce-V concentration; pink and gray arrows identify samples with Lanthanum to Cerium ratio  $> 1$ , possibly influenced by refineries.

Becagli, S, Anello F, Bommarito C, Cassola F, Calzolari G, Di Iorio T, di Sarra A, Gómez-Amo J L, Lucarelli F, Marconi M, Meloni D, Monteleone F, Nava S, Pace G, Severi M, Sferlazzo D M, Traversi R, Udisti R, 2017, Constraining the ship contribution to the aerosol of the Central Mediterranean, *Atmospheric Chemistry and Physics*, 17, 2067–2084, DOI: 10.5194/acp-17-2067-2017

### RELATIONSHIPS LINKING PRIMARY PRODUCTION, SEA ICE MELTING, AND BIOGENIC AEROSOL IN THE ARCTIC

The relationships linking methanesulfonic acid (MSA), satellite-derived chlorophyll a (Chl-a), and oceanic primary production (PP) in the Arctic, are investigated. MSA was determined in PM10 samples collected at the two Arctic sites of Ny Ålesund (Svalbard islands) and Thule (Greenland) in 2010-2012. Chl-a peaks in May in the Barents Sea and in the Baffin Bay, and has maxima in June in the Greenland sea; PP follows the same seasonal pattern of Chl-a, although the differences in absolute values of PP during the blooms are less marked than for Chl-a. MSA shows a better correlation with PP than with Chl-a. The source intensity (expressed by PP) is able to explain more than 30% of the MSA variability. The other factors explaining the MSA variability are taxonomic differences in the phytoplankton assemblages, and transport processes from the *dimethylsulfide* source areas to the sampling sites. The sea ice dynamic plays a key role in determining MSA concentration in the Arctic, and a good correlation between MSA and *sea ice melting (SIM)* and between MSA and *marginal ice zone (IF-MIZ)* is found for the cases attributable to bloom of diatoms in the MIZ. Such relationships suggest that PP is related to sea ice melting and to the extension of marginal sea ice areas, and that these factors are the main drivers for MSA concentrations at the considered Arctic sites.

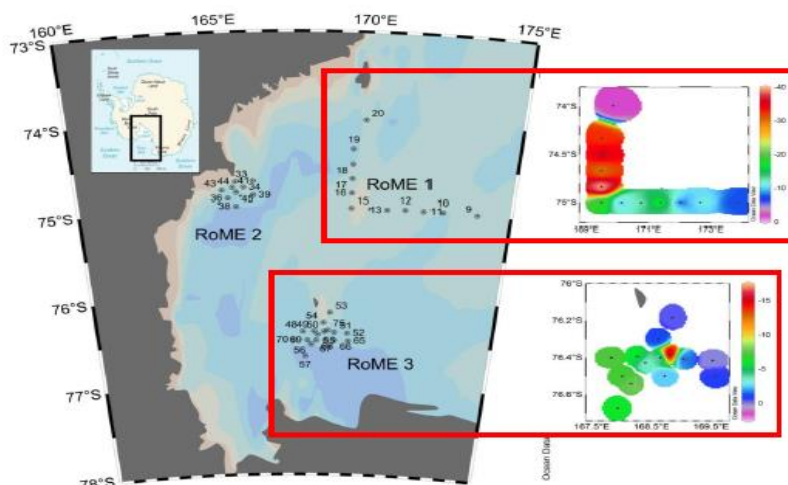


Three-year evolution of sea ice coverage area (SIE, monthly average), sea surface temperature (SST), photosynthetic active radiation (PAR), Chlorophyll a (Chl-a), primary production (PP) calculated for the Baffin Bay, and MSA at Thule. SST, PAR, Chl-a and PP and MSA are calculated as 8-day averages.

Becagli S, Lazzara L, Marchese C, Dayan U, Ascanius S E, Cacciani M, Di Biagio C, Di Iorio T, di Sarra A, Eriksen P, Fani F, Frosini D, Meloni D, Muscari G, Pace G, Severi M, Traversi R, Udisti R, 2016, Relationships linking primary production, sea ice melting, and biogenic aerosol in the Arctic, *Atmospheric Environment*, 136, 1-15, DOI: 0.1016/j.atmosenv.2016.04.002

### MESOSCALE VARIABILITY IN THE CARBONATE SYSTEM CHEMISTRY AND CO<sub>2</sub> AIR-SEA FLUXES OF THE ROSS SEA (ANTARCTICA) SHELF AREA

Data on mesoscale variability in the carbonate system chemistry and CO<sub>2</sub> air-sea fluxes observed in the Ross Sea (Antarctica) shelf area during austral summer 2013-14 were presented at the XXXIV SCAR Meeting. Carbonate system properties showed significant differences at a mesoscale level depending on both physical properties and biological activity, which was the main cause for the observed pH and  $\Omega_{Ar}$  variability. The investigated areas acted overall as a sink of CO<sub>2</sub>, with fluxes ranging from  $-0.4 \pm 0.4$  to  $-39.0 \pm 6.4$  mmol m<sup>-2</sup> d<sup>-1</sup>. The large range of the CO<sub>2</sub> flux is due both to the spatial variability of pCO<sub>2</sub> in surface sea water and to wind speed irregularity experienced during the survey.



*Estimated CO<sub>2</sub> flux (mmol m<sup>-2</sup> d<sup>-1</sup>) in RoME 1 and RoME 3 mesoscale experiment.*

P. Rivaro, L. Langone, C. Ianni, F. Giglio, G. Alicino, Y. Cotroneo, G. Spezie, M. Saggiomo, O. Mangoni. Mesoscale variability in the carbonate system chemistry and CO<sub>2</sub> air–sea fluxes of the Ross Sea (Antarctica) shelf area. XXXIV Scientific Committee on Antarctic Research (SCAR) meeting, Kuala Lumpur, 20-30 August 2016.

## 2. Activities/main accomplishments in 2016 (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. AIR-SEA LAB MEDITERRANEAN CAMPAIGN

*Facchini M.C., Rinaldi M., Gobbi G.P., Bonasoni P., Contini D., Argentini S., Belosi F., Calidonna C.R., Di Sarra A., Fossum K., O'Dowd C.D. and the AIR-SEA LAB research team.*

The campaign was held during April 2016 and involved five different measurement sites at coast locations in Southern/Central Italy (Civitavecchia, Lecce, Lamezia Terme, Capogranitola and Lampedusa – in collaboration with ENEA). The aim of the campaign was to characterize aerosol properties and sources and the aerosol-cloud interaction in the central Mediterranean region, as a comparison term for the clean North Atlantic marine boundary layer (MBL), which was investigated during the first year of the Project. Measurement sites were chosen in order to cover different conditions of balance between natural and anthropogenic aerosol sources, from Civitavecchia, which is the most polluted site, to Capo Granitola, which represents the background conditions of the central Mediterranean basin. The Air-Sea Lab partner C-CAPS NUIG (National University of Ireland Galway) participated to the campaign. A list of the main characteristics of the sampling sites and a brief description of the scientific activity carried on at each site can be find below.

- **Civitavecchia Porto.** Civitavecchia hosts an intensive traffic of ferries, plus a continuous traffic of cruise ships. 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 (PM<sub>10</sub>, NO<sub>2</sub>, etc.), Civitavecchia shows a larger mortality and morbidity with respect to the regional average. Aerosol optical properties and chemical composition measurements were carried on through online and offline techniques. PM oxidative potential was evaluated by the DTT (Dithiothreitol) assay, in order to investigate the relationship between PM-induced generation of reactive oxygen species (ROS) and PM composition.
- **Lecce.** The CNR-ISAC Environmental-Climate 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). Online aerosol physical characterization (aerosol number concentration, distribution and fluxes, aerosol mass) and offline chemical characterization (OC-EC and ions) were carried on during the campaign.

- **Lamezia Terme.** Lamezia Terme (LT) is a 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 Saharan dust. Online aerosol physical characterization (aerosol number concentration and distribution, aerosol mass) and offline chemical characterization (OC-EC and ions) were carried on during the campaign.
- **Capogranitola.** Capogranitola (CG) is a marine background site in the Strait of Sicily, representative of background conditions in the central Mediterranean Sea, potentially influenced by ship traffic. For the campaign the routine measurements program active at the I-AMICA observatory (meteo, aerosol scattering, equivalent black carbon, PM10 and PM 2.5 aerosol mass, particle number size distribution (0.28-10  $\mu\text{m}$ ), O<sub>3</sub>, SO<sub>2</sub>, NO<sub>x</sub>, CO<sub>2</sub>, CO, CH<sub>4</sub> and H<sub>2</sub>O surface concentration) was integrated by high resolution time of flight aerosol mass spectrometer (HR-ToF-AMS), cloud condensation nuclei (CCN) counter and ice nucleating particles (INP) measurements, providing a complete characterization of the main aerosol physico-chemical properties.
- **Lampedusa.** Lampedusa is a marine background site and its routine aerosol characterization program were made available through the external collaboration with ENEA and University of Florence.

## 2. AMERIGO VESPUCCI CRUISE

*Rinaldi M., Zanca N., Busetto M., Cristofanelli P., Paglione M., Bonasoni P., Facchini M.C. – CNR-ISAC Bologna; Diliberto L., Ciampichetti S., Gobbi G.P. – CNR-ISAC Roma; Ielpo P. – CNR-ISAC Lecce*

The Air-Sea Lab Mediterranean intensive observation period was integrated with measurements performed by Air-Sea Lab partners on-board the Italian Navy Vessel “*Amerigo Vespucci*”, cruising around the Italian peninsula. This cruise was held under the framework of the CNR-Navy joint activity “Vespucci Dual Use” between May and June 2016 and allowed to extend the observations performed at the coastal stations during Air-Sea Lab, with both open sea and port measurements. The “Vespucci Dual Use” born by an agreement between CNR and the Italian Navy, aimed to monitor air quality among Italian coasts and the Mediterranean Sea by means of different observation techniques. *Amerigo Vespucci* sailed around the Italian peninsula (Fig. 1) and stopped in 12 Italian harbors, collecting measurements in Adriatic and Tyrrhenian Sea for roughly 2 months (<http://www.isac.cnr.it/it/content/la-ricerca-isac-sullamerigo-vespucci>). Instrumentation installed onboard by CNR-ISAC consisted in:

- 1) **Aerosol Chemical Speciation Monitor (ACSM):** for on-line measurements of fine particulate matter (PM1): ACSM routinely quantifies the atmospheric concentration of non-refractory submicron particulate matter components (organics, sulfate, nitrate, ammonium and chloride), with a time resolution of 30 minutes.
- 2) **Aethalometer (Magee A33):** the aethalometer measures aerosol absorption and provides an estimate of the BC concentration.
- 3) **Thermo 49c Ozone Monitor:** the instrument measures the atmospheric concentration of the gas ozone.
- 4) **Tecora ECO-Hi-Vol (PM1 aerosol sampler):** it collects aerosol for offline chemical characterization laboratory analyses.

With the advanced instrumentation set installed, it has been possible to achieve an almost complete chemical characterization of sub-micron aerosol particles (including the contribution of the absorbing species BC, which is an important short-lived climate agent and a tracer of combustion processes), monitoring at the same time the tropospheric photochemical processes through ozone trends. The detailed high resolution chemical characterization of OA allowed a detailed source apportionment through statistical analysis (positive matrix factorization, PMF). In particular, it was possible to apportion OA into a primary OA (HOA; hydrocarbon-like OA) from fossil combustion and a secondary fraction (OOA, oxidized OA), originating from chemical reactions in the atmosphere.

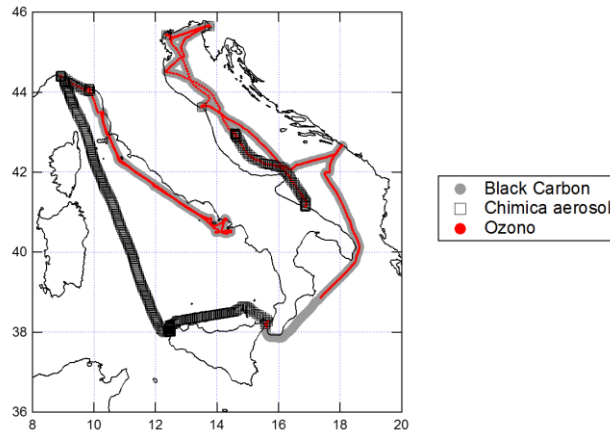


Figure 1: Route of the Amerigo Vespucci cruise around Italy with data coverage of the CNR-ISAC atmospheric chemistry instrumentation.

### 3. INP PARAMETRIZATION FOR THE NORTH ATLANTIC OCEAN

Rinaldi M., Belosi F., Paglione M., Sandrini S., Facchini M.C. – CNR-ISAC Bologna; Santoleri R. – CNR-ISAC Roma; Ovadnevaite J., O’Dowd C.D. – CCAPS-NUIG Galway

The relation between Ice Nucleating Particles (INP) in the marine boundary layer (MBL) and oceanic biological activity has been investigated through INP measurements performed by CNR-ISAC during the joint AIR-SEA-Lab/BACCHUS campaign at Mace Head (August 2015). The driving hypothesis is that marine biogenic organic matter can modify the ice nucleating properties of sea-spray (Wilson et al., 2015). The correlation between chlorophyll-a and INP observed at Mace Head was investigated, as a function of the delay time between the Chl-a and aerosol time series, following the approach of Rinaldi et al. (2013).

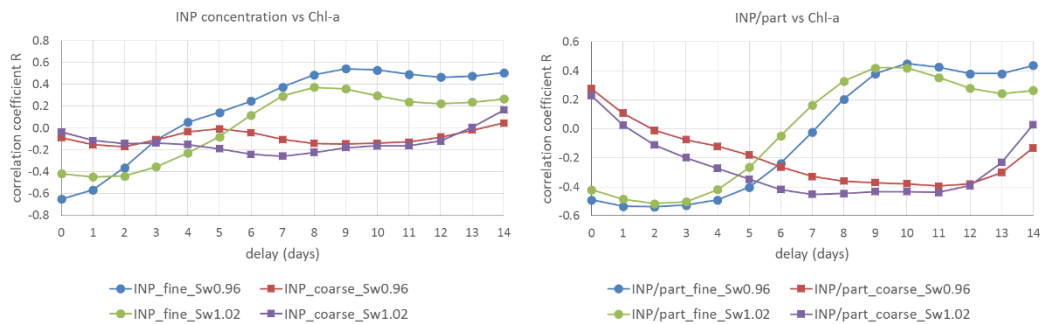


Figure 1: Correlation between Chl-a and INP concentration (left) and Chl-a and INP/part (right) as a function of the delay time between the time series.

The Figure 1 shows that the correlation is dependent on the delay time between the Chl-a and INP time series, with a significant correlation (95% confidence interval) obtained after 8-10 days. This behavior is similar to that observed by Rinaldi et al. (2013) for the enrichment of OM in sea-spray aerosol. The Figure also shows that sub-micron and super-micron INP have very different relations with marine biological activity. Sub-micrometer INP appear more related to biological activity, as expected considering that marine OM is mainly enriched in fine sea-spray (e.g., Facchini et al., 2008; Quinn et al., 2014). This demonstrates that a reliable parametrization for marine INP, based on proxies of the oceanic biological activity and meteorological parameters, for large scale and earth system models, can be achieved. For improving the parameterization, a better space and time data coverage is desirable.

Facchini M. C. et al., *Geophys. Res. Lett.*, 35, L17814, 2008.

Quinn P. K. et al., *Nature Geoscience*, 7, 2014.

Rinaldi M. et al., *J. Geophys. Res.*, 118, 1–10, 2013.

#### 4. ARCA project, Svalbard Islands (May 2016)

Azzaro M., Caruso G., Maimone G., Caroppo C., Decembrini F., Azzaro F., La Ferla R. - CNR-IAMC Messina; Miserocchi S., Giglio F. - CNR-ISMAR Bologna; Madonna A., Bonamano S., Piermattei V., Marcelli M. - Laboratory of Experimental Oceanology and Marine Ecology, University of Tuscia, Roma

In the framework of the rewarding Project "ARCA" (ARctic: present Climatic change and pAst extreme events, 2014-2016), coordinated by the Italian National Research Council (Department of Earth System Science and Environmental Technologies) and focusing on climate changes in the Ny Ålesund area, an oceanographic cruise was performed in May 2016 in the Svalbard Islands. The scientific team included the Institute for Coastal Marine Environment (IAMC)-CNR Messina and Taranto, the Institute for Marine Sciences (ISMAR)-CNR Bologna and the Laboratory of Experimental Oceanology and Marine Ecology, Department of Ecological and Biological Sciences (DEB), University of Tuscia, Civitavecchia (Rome). Water samples were collected from a total of 7 surface stations (station 4-5-6-7-8-14 and 23), located along a transect, for the determination of the following parameters: phytoplankton abundance, total bacterioplankton abundance, respiratory activity, nutrients, chlorophyll-a, chromophoric Dissolved Organic Matter (c-DOM), Particulate Organic Carbon (POC) and Total Suspended Matter (TSM), extracellular enzymatic activity and culturable heterotrophic bacterial abundance. Station 4 was also sampled at different depths (surface, 5, 25, 50, 75 and 100 meters). Measurements and data elaboration are still in course.

#### 5. Estimating chlorophyll from continuous fluorescence measurements in North Adriatic (Emilia-Romagna coast) to validate satellite remotely-sensed observations

Ravaioli M., - CNR-ISMAR, Bologna; Riminucci F., -Consorzio-proambiente; Bohm E., Santoleri R. - CNR-ISAC, Roma

Continuous fluorescence-derived total chlorophyll measurements are being collected offshore Rimini at the E1 Buoy and south of Po river Delta at the S1-GB site in the framework of cooperative research that see a collaboration between ISAC and ISMAR CNR institutes. This activity aims at constructing a chlorophyll database useful to improve the remote sensing observations. Sensor fluorescence measurements are first validated with in situ sea water sampling as close as possible to the Fluorescence optical sensor followed by lab analysis carried out by ISMAR. This incremental database is aimed at getting reliable fluorescence-derived chlorophyll based on validation points corresponding to each of in situ measurement campaign (i.e. ENV-ADRI-LTER-7 and ENV-ADRI-LTER-8).

#### 1. Total atmospheric deposition of dissolved organic matter (DOM) at the Lampedusa Island

Galletti Y., Santinelli C., - CNR-IBF, Pisa; di Sarra A. – ENEA, Roma; 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 19<sup>th</sup> 2015 and November 3<sup>rd</sup> 2016 for DOC concentrations and for absorption and fluorescence of CDOM. The concentration of metals was measured in the same samples.

Measured DOC fluxes ranged between 0.07 and 1.81 mmol C m<sup>-2</sup> day<sup>-1</sup>, 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<sup>-2</sup> day<sup>-1</sup>) and of total OC (TOC) in rainwater at the island of Crete (0.14 mmol C m<sup>-2</sup> day<sup>-1</sup>). Assuming this range valid for the whole basin, a total input of 0.4-4.3·10<sup>12</sup> g C year<sup>-1</sup> can be estimated. Two periods were characterized by high DOC fluxes (> 1.20 mmol C m<sup>-2</sup> day<sup>-1</sup>). A good linear relationship between DOC, metals and nutrients was found when the samples with the highest DOC concentration were excluded, suggesting a different origin of DOC in these two periods. The study of the air mass back trajectories in the period of the sampling suggests the effect of different sources, terrestrial and marine, from the Atlantic Ocean to Northern Europe, from the UK to the Sahara Desert.

The Parallel Factorial Analysis (PARAFAC) applied to the fluorescence excitation emission matrixes (EEMs), validated a seven-component model. The seven groups of fluorophores were identified by comparison with the literature, and included humic-like and protein-like materials. In addition, one component may be due to the presence of a mixture of PAHs (Polycyclic Aromatic Hydrocarbons) with other organic material. Similar components were observed in the open ocean (Jorgensen et al., 2011), in a previous study on dust inputs on alpine lakes (Mladenov et al., 2011) and more recently in aerosol particles collected at the polar region (Fu et al., 2015).

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

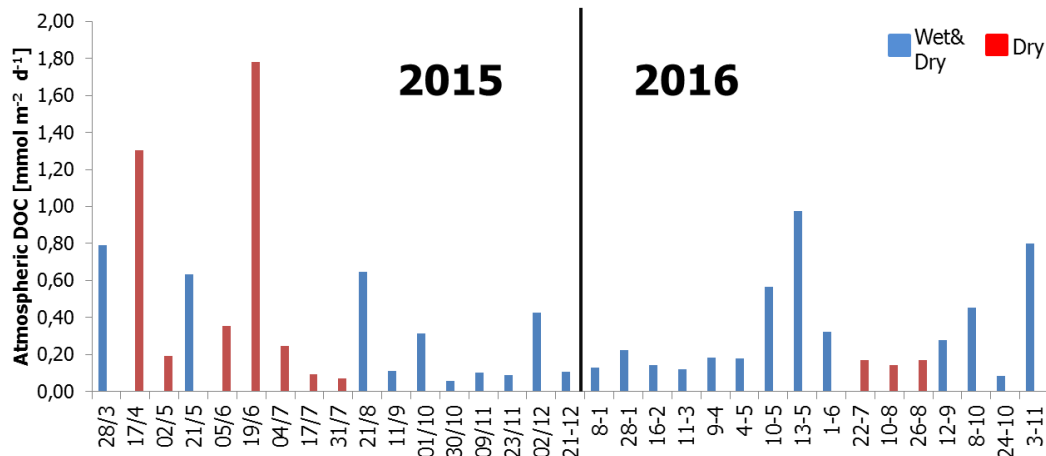


Figure 1. DOC fluxes during the study period.

### 3. Top 5 publications in 2016 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.

1. Ceburnis D, Rinaldi, M, Ovadnevaite J, Martucci, G, Giulianelli, L, O'Dowd, C D, 2016, Marine submicron aerosol gradients, sources and sinks, *Atmospheric Chemistry and Physics*, 16, 19, 12425-12439, DOI: 10.5194/acp-16-12425-2016.
2. Ingrosso G, Giani M, Comici C, Kralj M, Piacentino S, De Vittor C, Del Negro P., 2016, Drivers of the carbonate system seasonal variations in a Mediterranean gulf. *Estuarine, Coastal and Shelf Science*, 168, 58-70. doi:10.1016/j.ecss.2015.11.001
3. Jayarathne T, Sultana C M, Lee C, Malfatti F, Cox J L, Pendergraft M A, Moore K A, Azam F, Tivanski A V, Cappa C D, Bertram T H, Grassian V H, Prather K A, Stone E A., 2016, Enrichment of Saccharides and Divalent Cations in Sea Spray Aerosol During Two Phytoplankton Blooms. *Environmental Science & Technology*, 50 (21), 11511–11520. DOI: 10.1021/acs.est.6b02988
4. Piazzola J, Mihalopoulos N, Canepa E, Tedeschi G, Prati P, Bastianini M, Zampas P, Missamou T, Cavaleri L, 2016. Characterization of aerosols above the Northern Adriatic Sea: case studies of offshore and onshore wind conditions. *Atmospheric Environment*, 132, 153-162. <http://dx.doi.org/10.1016/j.atmosenv.2016.02.044>
5. Trisolino P, di Sarra A, Meloni D, Pace G, 2016, Determination of global and diffuse Photosynthetically Active Radiation from Multi-Filter Shadowband Radiometer (MFRSR), *Applied Optics*, 55, 8620-8626, DOI: 10.1364/AO.55.008280
6. Vincent J, Laurent B, Losno R, Bon Nguyen E, Roulet P, Sauvage S, Chevaillier S, Coddeville P, Ouboulmane N, di Sarra A G, Tovar-Sánchez A, Sferlazzo D, Massanet A, Triquet S, Morales Baquero R, Fornier M, Coursier C, Desboeufs K, Dulac F, Bergametti G, 2016, Variability of mineral dust deposition in the western Mediterranean basin and South-East of France, *Atmospheric Chemistry and Physics*, 16, 8749–8766, DOI: 10.5194/acp-16-8749-2016

### 4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2016? If yes, who? How did you engage?



## PART 2 - Planned activities from 2017/2018 and 2019

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

- 1. AIR-SEA LAB MEDITERRANEAN CAMPAIGN DATA ANALYSIS.** The data collected during the Mediterranean campaign described above will be elaborated in a joint effort between the partners of AIR-SEA LAB (CNR-ISAC and NUIG) in order to investigate the physico-chemical properties and origin of the background aerosol characterizing the Mediterranean basin. This is a hot topic both for air-quality issues among the Mediterranean countries and for climate change. Advanced meteorological and chemical transport models will allow the extension of in-situ observation at regional scale (Mediterranean basin).
- 2. CRUISE IN THE ROSS SEA (Antarctica) 30.12.2016-22.02.2017. CELEBeR Project** (CDW Effects on glacial mElting and on Bulk of Fe in the Western Ross sea) - P.I.: P. Rivaro; University of Genoa, University of Naples Federico II and Parthenope, CNR IAMC Messina.
- 3. The PAMELA Experiment** (Photosynthetic Actinic radiation Modulation Experiment at Lampedusa) will take place in Lampedusa, at the Station for Climate Observations (<http://www.lampedusa.enea.it>), from 15 May to 10 June, 2017. The participants are: ENEA, IBF/CNR, ISAC/CNR, Universities of Florence (Chemistry and Biology Departments), Rome (Physics Dep.) and Valencia (Dep.of Earth Physics and Thermodynamics, Spain), and PMOD (Switzerland). The experiment will be carried out in collaboration with Area Marina Protetta delle Isole Pelagie (<http://www.ampisolepelagie.it>).

The main objectives of the experiment are:

- investigate the role and effect of different factors, such as atmospheric and oceanic composition and optical properties, in modulating photosynthetically active radiation (PAR) actinic flux and irradiance, at the surface and underwater;
  - relate actinic flux and irradiance in the PAR spectral range;
  - study the behavior of the PAR actinic flux at the air-sea interface, from the atmosphere to underwater;
  - investigate the role of land and sea albedo on PAR;
  - investigate the role of PAR actinic flux in determining terrestrial and marine productivity;
  - investigate the photosynthetic performance of phytoplankton surface assemblages, through PAM fluorometry, and assess the light and/or nutrient limitation to their productivity.
  - Investigate the biological lability of atmospheric dissolved organic matter (DOM)
- 4. SENTINEL3 CRUISE.** R/V Minerva (CNR), May 24<sup>th</sup> to June 12<sup>th</sup>. (P.I.: R. Santoleri- CNR-ISAC, Rome). Area: Ionian Sea, Sicily Channel. Ship borne measurements will be carried out in the same period as PAMELA experiment from the Italian CNR Minerva R/V, with the aim of characterizing ocean color and providing additional measurement for ground truth validation of satellite observations. Main goals of the cruise are: (1) Characterization of bio-optical properties of Central Med Sea waters; (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.
  - 5. Oceanic observatory of the station for climate observations at Lampedusa.** Planned activities include the activation of measurements of air-sea interaction at the Oceanic Observatory of the Station for Climate Observations at Lampedusa, in the central Mediterranean. The Oceanic Observatory (OO) (35.49°N, 12.47°E) is an instrumented buoy dedicated to the air-sea interactions which complements the Atmospheric Observatory (<http://www.lampedusa.enea.it>; 35.52°N, 12.63°E). Measured parameters at the OO include components of the surface heat budget (radiation components, sensible heat), meteorology, broadband and spectral surface albedo, as well as radiation components in the water column, water temperature at different depths, and oceanographic parameters (Temperature, Salinity). The buoy has been developed by ENEA and measurements are conducted in collaboration with the CNR. Measurements at the AO include radiation,

aerosol properties, deposition, meteorology, atmospheric composition, greenhouse gases, etc.

6. **Sea-spray measurements** from the CNR-ISMAR Acqua Alta platform in the Northern Adriatic Sea in collaboration with University of Toulon (France), period March-June 2017. Supported by **JERICO NEXT TNA project**.

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

IAPSO IAMAS IAGA 2017 joint assembly, Cape Town (South Africa) 27-31 August 2017

<http://www.iapso-iamas-iaga2017.com/index.php>

## 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 and Organisation (downloadable from the SOLAS website) the activity topics relate – including the core themes and the cross cutting ones)

- **AIR-SEALAB (2015-2017)**. Aerosol-cloud interaction in marine areas. CNR funded Bilateral Project.
- **BACCHUS (2013-2017)**. Impact of Biogenic versus Anthropogenic emissions on Clouds and Climate: towards a Holistic UnderStanding. Funded by EU FP7. [www.bacchus-env.eu/](http://www.bacchus-env.eu/)
- **ADORE (2016-2017)**. 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.
- **CELEBeR Project (2016-2017)** (CDW Effects on glaciaL mElting and on Bulk of Fe in the Western Ross sea) -PNRA16\_00207 - A3 -P.I. Paola Francesca Rivaro funded by Italian Ministry of Research MIUR. (SOLAS Core Theme 5: Ocean biogeochemical control on atmospheric chemistry)
- **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/](http://www.fixo3.eu/wp2/)
- **ECCSEL (European Carbon Dioxide Capture and Storage Laboratory Infrastructure), H2020 INFRADEV-3 Project (2016-2017)**. Coordinator: NTNU Norway, Italian partners: OGS Italy, SOTACARBO Italy. The mission of ECCSEL has been of opening access for researchers to a European research infrastructure devoted to **Carbon Capture and Storage (CCS)** technologies in order to combat global climate change. ECCSEL will enable researchers from Europe (and third countries) to access facilities to conduct advanced technological research relevant to CCS. ECCSEL, also finances Transnational Access to the ECCSEL Research Infrastructures, allowing research groups to access free of charge the available ECCSEL facilities as the ECCSEL NatLab-Italy laboratory in Panarea, funded by the Italian Ministry of University and Research and opened on June 2015.. In particular, the transnational access to Panarea NatLab is available for 1 project for a maximum of 5 days during each call (<http://www.eccsel.org/Sections.aspx?section=554>).
- **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/>
- **RITMARE (2012-2017)**. Italian Flagship Project, supported by the Italian Ministry of Research and University. [www.ritmare.it](http://www.ritmare.it).
- **PRokaryotes Interactions with Antarctic phytodetritus: a Micro- to macroscale voyage from the surface to the deep Ocean (PRIAMO-PNRA Project) (2016-2019)** Coordinator: OGS, Partner: Padova University. The PRIAMO project aims at providing novel information on the metabolism of Ross Sea prokaryotes when supplied with phytodetritus. This area is one of the most productive (CO<sub>2</sub> sink) in the Southern Ocean and is characterized by a pronounced export of particulate organic carbon (POC) to the deep layers of the water column (up to 50% of surface primary production). During the 2016-2017

Italian Expedition in Antarctica in situ samplings and onboard experiments have been performed in order to establish the effect of microalgal-derived POC on prokaryotic growth rates, inorganic and organic carbon uptake, organic matter degradation spectra and velocity. Metagenomic analyses and dedicated experiments aimed to assess microbial interactions with living Antarctic algae on a microscale perspective will be performed in 2017 and following years.

- **Professionalità “Ivano Becchi” Project (2017).** Project supported by Banca del Monte di Lombardia Foundation. PI: Yuri Galletti (PhD. Student at University of Trieste and CNR-IBF), the main goals of this project are: to study the atmospheric input of DOM to the Med sea, and to gain some information about the biological lability of atmospheric DOM.

#### **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 CO<sub>2</sub> exchanges, with particular regards to (i) the atmospheric CO<sub>2</sub> 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 CO<sub>2</sub> 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 CO<sub>2</sub> fluxes to the atmosphere.

##### **Future Activities:**

- An integrated air-sea observatory has been developed 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(CO<sub>2</sub>), 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). LTER sites are key nodes of the E-infrastructure for Biodiversity and Ecosystem Research ERIC - LifeWatch. The S1 system, now configured as an elastic beacon, will be implemented during 2017 with a 'yo-yo' device.
- Carbonate system measurements will be integrated at E2M3A site, South Adriatic Sea
- An integrated air-sea observatory is already working in the North Adriatic Sea (PALOMA station: 35.5°N, 13.6°E) since 7 years. Existing observations (atm pCO<sub>2</sub>, dissolved pCO<sub>2</sub> and oxygen) are dedicated to air-sea gas exchanges (CO<sub>2</sub> and O<sub>2</sub>), 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.
- pCO<sub>2</sub> and carbonate system measurements will continue at Miramare (Mambo buoy) in the northern Adriatic Sea and at E2M3A site in the southern Adriatic Sea

## **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 and marine coastal aerosols with anthropogenic influence

### **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
- Sea-spray measurements from the CNR-ISMAR Acqua Alta platform in the Northern Adriatic Sea in collaboration with University of Toulon (France)

## **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.**

- **Paola Rivaro** and **Leonardo Langone** are Project Partners of the project "Processes Influencing Carbon Cycling: Observations of the Lower limb of the Antarctic Overturning" (PICCOLO) submitted to the U.K. NERC RoSES call.
- The ICOS (Integrated Carbon Observing System) Joint Research Unit which has been constituted in Italy at the end of 2016, includes the research institutes of CNR and OGS in charge of the marine sites sites: Paloma (ISMAR-CNR) and Miramare in North Adriatic Sea (OGS), E2M3A in South Adriatic Sea (OGS) and W1M3A (ISSIA-CNR)in the Tyrrhenian Sea. The objective is to provide the long-term oceanic observations required to understand the present state and predict future behaviour of the global carbon cycle and climate-relevant gas emissions.

**Comments**