

Report for the year 2017 and future activities

SOLAS 'Italy'

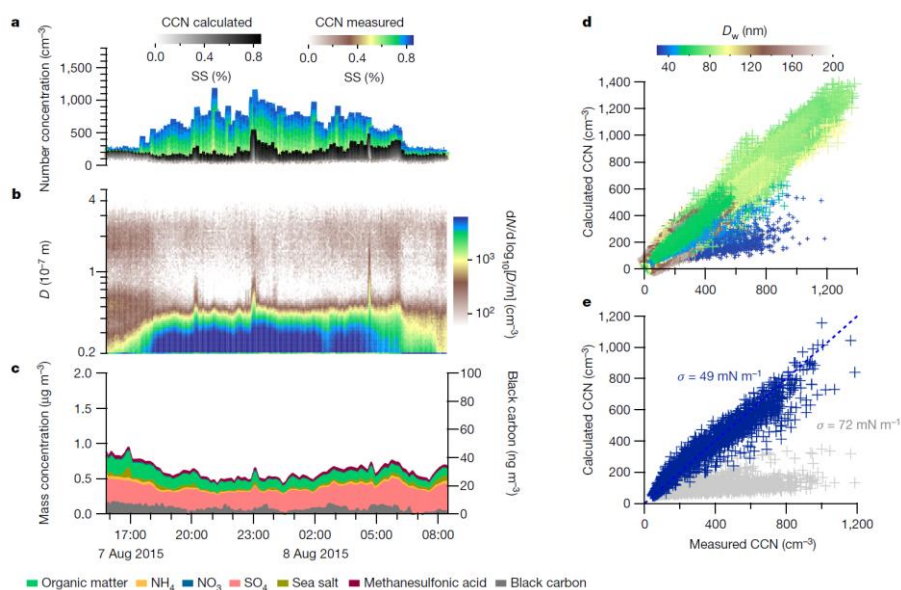
compiled by: 'Chiara Santinelli'

PART 1 - Activities from January 2017 to Jan/Feb 2018

1. Scientific highlight

Surface tension prevails over solute effect in organic-influenced cloud droplet activation

The spontaneous activation of cloud condensation nuclei (CCN) depends on the interplay between the Raoult effect, whereby activation potential increases with decreasing water activity or increasing solute concentration, and the Kelvin effect, whereby activation potential decreases with decreasing droplet size or increases with decreasing surface tension. Surface tension lowering caused by organic surfactants, which diminishes the Kelvin effect, is expected to be negated by a concomitant reduction in the Raoult effect, driven by the displacement of surfactant molecules from the droplet bulk to the droplet–vapour interface. Here we present observational and theoretical evidence illustrating that, in ambient air, surface tension lowering can prevail over the reduction in the Raoult effect, leading to substantial increases in cloud droplet concentrations. We suggest that consideration of liquid–liquid phase separation, leading to complete or partial engulfing of a hygroscopic particle core by a hydrophobic organic-rich phase, can explain the observations. An adequate representation of the CCN activation process is essential to the prediction of clouds in climate models, and given the effect of clouds on the Earth's energy balance, improved prediction of aerosol–cloud–climate interactions is likely to result in improved assessments of future climate change.



CCN, chemical composition and size distribution time series for the nascent ultrafine mode event and the CCN closure. **a**, Measured (colour traces) and calculated (grey traces) activated CCN number concentrations, assuming a surface tension of $\sigma = 72 \text{ mN m}^{-1}$. Both measured and calculated CCN span the whole supersaturation range of $SS = 0.2\text{--}0.82\%$; that is, the

CCN was calculated for exactly the same supersaturation as what was measured. The activated CCN concentration is calculated for the measured supersaturation by using κ -Köhler theory with an effective κ corresponding to the total AMS composition. **b**, Time series of aerosol number size distribution during the particle production event. **c**, Time series of specific aerosol chemical species mass concentrations—organics, ammonium, nitrate, sulphate, sea salt, methanesulfonic acid and black carbon. **d**, Scatter plot of calculated versus measured CCN using the same κ -Köhler settings as in a, but including the whole month of August 2015. The colour scale indicates a weighted SMPS size diameter (D_w) for every point: the smallest diameters (in dark blue) correspond to the particle production event and deviate from the 1:1 line. **e**, Scatter plot (subset of d) including only the particle production events. The grey points in e correspond to the dark blue points in d but using the nascent ultrafine mode chemical composition instead of bulk AMS composition; blue points correspond to the particle production event after the assumed surface tension for the CCN calculation with κ -Köhler theory was reduced to 49 mN m⁻¹.

Ovadnevaite J, Zuend A, Laaksonen A, Sanchez K J, Roberts G, Ceburnis D, Decesari S, Rinaldi M, Hodas N, Facchini M C, Seinfeld J H & O' Dowd C, 2017, Surface tension prevails over solute effect in organic-influenced cloud droplet activation, NATURE, 546, 637-641, doi:10.1038/nature22806.

2. Activities/main accomplishments in 2017 (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, social sciences, and media).

ACTIVITIES and EXPERIMENTS:

- 1. Study of total atmospheric deposition of dissolved organic matter (DOM) at the Lampedusa Island (Central Mediterranean Sea).** [Galletti Y., Pulido Villena E., Becagli S., Disarra A., Gonnelli M., Sferlazzo D., Vestri S., Santinelli C.] Atmospheric depositions were collected between March 19th 2015 and October 6th 2017 at the Station for Climate Observations "Roberto Sarao" ENEA (Lampedusa Island, Italy). DOC, DON and DOP fluxes were in the range 0.06-1.78 mmol C m⁻² day⁻¹, 0.015-0.25 mmol m⁻² day⁻¹, and 0-0.027 mmol m⁻² day⁻¹, respectively. The highest atmospheric DOC fluxes were found in correspondence with high values of both soluble metals and nutrients. C:N:P molar ratios in atmospheric DOM showed a marked variability, with average values of C:N:P of 1909:292:1. The Parallel Factorial Analysis (PARAFAC) applied to 91 excitation emission matrixes, validated a seven-component model. The excitation and emission spectra of these components were similar to those observed in the open waters of the Mediterranean Sea and in the oceans, in dust samples collected in alpine lakes as well as in aerosol particles collected in the polar region.
- 2. Estimating chlorophyll from continuous fluorescence measurements in North Adriatic (Emilia-Romagna coast) to validate satellite remotely-sensed observations.** [Ravaoli M., Riminucci F., Bohm E., Santoleri R.]. 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. INTERNOS)
- 3. Sea-spray measurements** from the CNR-ISMAR Acqua Alta platform in the Northern Adriatic Sea in collaboration with University of Toulon (France). Supported by **JERICO NEXT TNA project**. During the experimental campaign, aerosol data were acquired in the 0.1-45 μm size range using two, co-located classical scattering spectrometer probes (Particle Measuring Systems, Boulder, CO, USA), the CSASP-200 and the CSASP-100HV. For chemical characterization, aerosols were periodically sampled with a low pressure cascade impactor (Dekati). The main objectives of the experiment were: i) to characterize the complex mixing between sea spray aerosols locally generated at the sea surface by the wind-waves interaction processes and a continental component resulting from natural and/or anthropogenic sources; ii) to provide a data set useful to validate atmospheric

chemical transport models dealing with sea spray. The campaign will continue in 2018.

- 4. The PAMELA Experiment** (Photosynthetic Actinic radiation Modulation Experiment at Lampedusa) was carried out in Lampedusa, at the Station for Climate Observations (<http://www.lampedusa.enea.it>), from May 15th to June 10th, 2017. *Participants: ENEA, CNR-IBF, CNR-ISAC, Universities of Florence (Chemistry and Biology Departments), Rome (Physics Dep.) and Valencia (Dep. of Earth Physics and Thermodynamics, Spain), and PMOD (Switzerland), MIO (Marseille, France), in collaboration with Area Marina Protetta delle Isole Pelagie (<http://www.ampisolepelagie.it>).*

The main goals of the experiment were:

- 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 impact of atmospheric deposition on DOM dynamics in the surface layer of the Med Sea
 - Investigate the biological lability of atmospheric DOM
- 5. Atmospheric deposition of airborne microbes into the Northern Red Sea and its effects on ambient microbial communities – a mesocosm approach.** *Participants: CNR-IBF, Italy, Israel Oceanographic and Limnological Research (IOLR), Institute of Marine Science, University of California, Santa Cruz, USA.* The experiment was carried out in Eilat (29°28'N, 34°55'E), located on the Gulf of Aqaba at the edge of a long narrow estuary separating the Arabian Peninsula and the Sinai desert. Aerosol samples were collected from the Northern Red Sea during dust storms in two different periods (February 28th and May 18th 2017), using pre-cleaned glass plates at the Interuniversity Institute (IUI) of Eilat.

The main goals of the experiment were:

- Study the biochemical and biological impacts of aerosols (2 types) on the autotrophic and heterotrophic surface microbial populations during summertime in the NRS.
- Estimate the ecological significance of airborne microbes in such deposition events to the NRS.
- Investigate the direct and indirect effects of dust deposition on DOM (DOC and CDOM) dynamics in the surface layer of the Med Sea

CRUISES

- 6. CELEBeR Project Cruise** (In the framework of XXXII PNRA Expedition) PNRA16_00207 - A3 -P.I. Paola Francesca Rivaro. (SOLAS Core Theme 5: Ocean biogeochemical control on atmospheric chemistry). R/V Italica, Ross Sea (Antarctica), 30th December 2016 - 20th February 2017.
- 7. INTERNOS CRUISE**, R/V Minerva I (CNR), March 6th to 21st 2017, (*Chief scientist: M. Bastianini-CNR-ISMAR*). 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
- 8. MARINE STRATEGY**, monitoring cruises, performed in July-August 2017 in the Tyrrhenian and Ionian Seas, onboard the R/V Minerva I (CNR). The WP1 activities (Phyto-zooplankton, chemical-physical characteristics of the water column and beached wastes,

with the Sub-program 1.3: Monitoring of the chemical-physical variables and nutrients in the offshore area and Sub-program 1.7: Qualitative and quantitative monitoring of plankton in offshore environments) involved several Institutes from CNR (CNR-ISAC, CNR-IAMC, CNR-ISMAR) and CONISMA. The aim of this research project is to assess environmental health status of the Mediterranean Sea, through the study of the processes that regulate marine environmental functioning. In fulfillment of the commitments assumed by Italy at the European level in the Marine Strategy Framework Directive (MSFD), the agreement signed between the Ministry for the Environment and the Protection of the Territory and the Sea (MATTM) and CNR, attributed to CNR the definition of the good environmental status (GES) of pelagic marine waters; such an assessment is further submitted to the MATTM and then to the European Commission. For this purpose, the study of microbial communities and of their role in biogeochemical processes allow us to get a complete picture of the health conditions of the Mediterranean basins in order to reach the final objective of the Marine Strategy project, i.e. to achieve Good Environmental Status (GES) by 2020.

9. SENTINEL3 CRUISE. R/V Minerva I (CNR), May 24th to June 12th. (P.I.: R. Santoleri- CNR-ISAC, Rome). Area: Ionian Sea, Sicily Channel. Ship borne measurements were 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: (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.

10. UVASS (Unmanned Vehicles for Autonomous Sensing and Sampling) CRUISE (Svalbard, June 2017). *Participants:* Azzaro M., Zappalà G., La Ferla R., Miserocchi S., Tesi T., Maimone G., Caruso G., Ferretti R., Odetti A., Azzaro F., Madonia A., Bonamano S., Piermattei V., Marcelli M., Piazzolla D., Cosenza A., Rappazzo A.C., Furnari M., Bruzzone G. [CNR-IAMC; CNR-ISSIA; CNR-ISMAR; University of Tuscia, DEB]. To understand how the climate change affects the microbial community in the Arctic Sea and the ongoing heating results in cascading effects on the globally delicate climatic equilibrium is an important challenge of recent research performed in vulnerable ecosystems such as the Svalbard Islands. Within the UVASS (Unmanned Vehicles for Autonomous Sensing and Sampling) project, an unmanned marine vehicle (PROTEUS, Portable RObotic TEchnology for Unmanned Surveys), equipped with an automatic water multisampler, designed and built by CNR-ISSIA and CNR-IAMC respectively, were applied to study the response of planktonic communities, particularly prokaryotes, in the extreme environment of Kongsfjorden. During June 2017, seawater samples collected by those automatic systems along three transects located from glaciers to the open sea were analyzed for nutrients, organic matter and its utilization by microbial activity, using Biolog-Ecoplates and extracellular enzymatic activity rates (leucine aminopeptidase, beta-glucosidase and phosphatase activities). Variations in organic matter distribution and in the functional diversity of microbial assemblages were observed.

3. Top 5 publications in 2017 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.

1. Braga F, Zaggia L, Bellafiore D, Bresciani M, Giardino C, Lorenzetti G, Maicu F, Manzo C, Riminucci F, Ravaioli M, Brando V E, 2017, Mapping turbidity patterns in the Po river prodelta using multi-temporal Landsat 8 imagery, *Estuarine, Coastal and Shelf Science*, 198, 555-567, DOI: 10.1016/j.ecss.2016.11.003
2. Canepa E, Builtjes P J H, 2017, Thoughts on Earth System Modelling: from global to regional scale, *Earth-Science Reviews*, 171, 456–462, <http://dx.doi.org/10.1016/j.earscirev.2017.06.017>
3. Celussi M, Malfatti F, Franzo A, Gazeau F, Giannakourou A, Pitta P, Tsiola A, Del Negro P, 2017, Ocean acidification effect on prokaryotic metabolism tested in two diverse trophic regimes in the Mediterranean Sea, *Estuarine, Coastal and Shelf Science*, 186, 125-138.
4. Gazeau F, Sallon A, Pitta P, Tsiola A, Maugendre L, Giani M, Celussi M, Pedrotti M L, Marro S,

Guieu C, 2017, Limited impact of ocean acidification on phytoplankton community structure and carbon export in an oligotrophic environment: results from two short-term mesocosm studies in the Mediterranean Sea, *Estuarine Coastal and Shelf Science*, 186, 72-88, DOI: dx.doi.org/10.1016/j.ecss.2016.11.016

5. Inghrosso G, Bensi M, Cardin V, Giani M, 2017, Anthropogenic CO₂ in the middle and southern Adriatic Sea, *Deep-Sea Research Part I*, 123, 118-128, DOI: 10.1016/j.dsr.2017.04.004
6. McCluskey C S, Hill T C J, Malfatti F, Sultana C M, Lee C, Santander M V, Beall C M, Moore K A, Cornwell G C, Collins D B, Prather K A, Jayarathne T, Stone E A, Azam F, Kreidenweiss S M, DeMott P J, 2017, A dynamic link between ice nucleating particles released in nascent sea spray aerosol and oceanic biological activity during two mesocosm experiments, *Journal of American Meteorological Society*, <https://doi.org/10.1175/JAS-D-16-0087.1>.
7. Ovadnevaite J, Zuend A, Laaksonen A, Sanchez K J, Roberts G, Ceburnis D, Decesari S, Rinaldi M, Hodas N, Facchini M C, Seinfeld J H & O' Dowd C, 2017, Surface tension prevails over solute effect in organic-influenced cloud droplet activation, *Nature*, 546, 637-641, doi:10.1038/nature22806.
8. Weinbauer M G, Guinot B, Migon C, Malfatti F, Mari X, 2017, Skyfall - Neglected roles of volcano ash and black carbon rich aerosols for microbial plankton in the ocean, *Journal of Plankton Research*, 39 (2), 187-198.

4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2017? If yes, who? How did you engage?

PART 2 - Planned activities for 2018/2019 and 2020

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

1. Sea-spray measurements from the CNR-ISMAR Acqua Alta platform in the Northern Adriatic Sea in collaboration with University of Toulon (France). Supported by JERICO NEXT TNA project.
2. Cooperation among CNR-ISMAR, CNR-ISAC, UNIVPM and University of Toulon (France) for: a) to develop the sea spray local scale model MACMod; b) to study the influence of wave state and sea spray on roughness length using the WRF-Chem model.
3. The continuous collection of total depositions at the Lampedusa Island will continue in 2018. Chemical analysis (DOC, CDOM, Metals, nutrients) will be carried in collaboration among CNR-IBF, ENEA, University of Florence and MIO (Marseille, France).
4. Samples for CDOM optical properties and DOC, collected by CNR-IBF during the PAMELA experiment (May 15th to June 10th, 2017), will be analyzed and the dynamics of DOM studied in collaboration with ENEA, University of Florence and MIO (Marseille, France) and Israel Oceanographic and Limnological Research (IOLR)
5. Data on CDOM optical properties and DOC, collected by CNR-IBF during the mesocosm experiments carried out in July 2017 in Eilat (Gulf of Aqaba), will be analyzed in collaboration with Israel Oceanographic and Limnological Research (IOLR) and *Institute of Marine Science, University of California, Santa Cruz, USA*.
6. Samples analysis and data processing are currently underway in order to study carbonate system chemistry and CO₂ air-sea fluxes in the Ross Sea (Antarctica) shelf area during austral summer 2016-17.

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

1. Integrated Carbon Observing System Ocean Thematic Center, Annual meeting, Trieste. Local organizers : OGS & ISMAR CNR. 14-15 May 2018.
2. XVII Convegno Nazionale della Divisione di Chimica dell'ambiente e dei Beni Culturali dal titolo "La tutela dell'Ambiente e dei Beni Culturali in un Mondo che cambia" Genova, 24-27 Giugno 2018.

3. Funded national and international projects / activities underway.

- **ABBACO** - Restauro Ambientale e Balneabilità del SIN Bagnoli-Coroglio – Italian National Project
- **EMODnet European Marine Observation and Data network (2017-2020)**. 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.
- **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/>
- **Marine Strategy (MSFD) (2015-2018)**
- Progetto INFOR-MARE (2017-2019): Sistema INFORMATivo integrato per il litoRale Emiliano-romagnolo (PG/2015/731524)
- Readiness of ICOS for Necessities of integrated Global Observations (RINGO), Coordination and support action, supported in the framework of INFRADEV-03-2016-2017. Participants OGS, ISMAR-CNR, ENEA, Università della Tuscia.
- SeadataCLOUD (2016-2020): Pan-European infrastructure for ocean & marine data management

4. Plans / ideas for future projects, programmes, proposals national or international etc. (please indicate the funding agencies and potential submission dates).

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 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(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). 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 2018 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) since 7 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 (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.
- pCO₂ and carbonate system measurements will continue at the Miramare observatory (Mambo buoy and C1 LTER) in the northern Adriatic Sea and at E2M3A site in the southern Adriatic Sea in the framework of ICOS JRU Italy and ICOS ERIC activities. The observatories are also part of Global Ocean Acidification-Observing Network.

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.

Comments

Next year the activities carried out from the Italian community will be strongly reduced due to the unavailability of the Italian ship from the CNR and the continuous reduction of funds for research.