

## Report for the year 2018 and future activities

### SOLAS ITALY

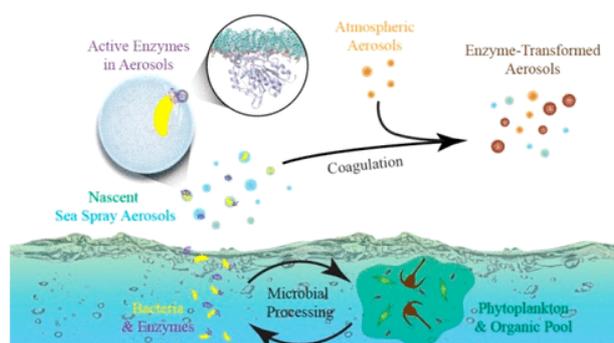
compiled by: *'Chiara Santinelli*

#### PART 1 - Activities from January 2018 to Jan/Feb 2019

##### 1. Scientific highlight

#### Detection of Active Microbial Enzymes in Nascent Sea Spray Aerosol: Implications for Atmospheric Chemistry and Climate

A diverse array of microbial enzymes (protease, lipases, and alkaline phosphatase) are transferred from the ocean into the atmosphere and often become even more active with measured activities in Sea Spray Aerosol (SSA) particles that are 1-2 orders of magnitude higher than those in bulk seawater. We hypothesize that these enzymatic reactions are enhanced in the interfacial environment of droplets and aerosols that can dynamically modify surface chemical species and properties. Simulations reveal that enzyme-containing SSA particles can rapidly coagulate with other preexisting aerosols, thus transferring the impact of enzyme reactions to a broad range of marine aerosols. These biotic reaction pathways are expected to profoundly change the composition of marine aerosols, particularly at the interface, and thus will impact cloud properties in marine environments. This study, carried out in the framework of the collaboration between OGS and the Center for Aerosol Impacts of Climate and Environment (UCSD, USA), deepens our understanding on the selective mechanisms that enrich certain bacterial species in SSA and open up novel research avenues on biotic transformation in SSA mediated by bacterial enzyme once ejected in the atmosphere.



*Malfatti F, Lee C, Tinta T, Pendergraft M A, Celussi M, Zhou Y, Sultana C M, Rotter A, Axson JL, Collins D B, Santander M V, Anides Morales A L, Aluwihare L I, Riemer N, Grassian V H, Azam F, Prather K A, 2019, Detection of Active Microbial Enzymes in Nascent Sea Spray Aerosol: Implications for Atmospheric Chemistry and Climate, Environmental Science & Technology Letters.*

**2. Activities/main accomplishments in 2018 (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. **ECCSEL - NatLab Italy, which is part of ECCSEL-ERIC (European Carbon Dioxide Capture and Storage Laboratory Infrastructure).** *De Vittor C. [OGS]*

The field activities conducted during the scientific diving summer school, hosted at the NatLab Italy of Panarea each year since 2016, supply a series of data on the physico-chemical (pH, Temperature, salinity, pCO<sub>2</sub>) dynamics of the shallow hydrothermal systems of Panarea and on the effects of the acidified conditions on the associated living communities.

2. **Estimating chlorophyll from continuous fluorescence measurements in North Adriatic (Emilia-Romagna coast) to validate satellite remotely-sensed observations.** *Ravaioli M. [CNR-ISMAR], Riminucci F. [CNR-ISMAR], Bohm E. [CNR-ISAC], Santoleri R. [CNR-ISAC]*

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.

3. **Estimating water organic contaminants, in particular PCB** (with Acquagaps passive samplers) from the CNR-ISMAR S1-GB platform in the Northern Adriatic Sea in collaboration with HCMR Hellenic Centre for Marine Research (Grece). Supported by **JERICO NEXT TNA project.** *Riminucci F. [CNR-ISMAR]*

4. **Study of carbonate system chemistry and CO<sub>2</sub> air-sea fluxes** in the Ross Sea (Antarctica). Analysis on the samples collected in the framework of the **CELEBeR Project**, in the shelf area of the Ross Sea (Antarctica) during austral summer 2016-17 and data processing are currently underway. *Rivaro P. [UniGe]*

5. **Study of total atmospheric deposition of dissolved organic matter (DOM) at the island of Lampedusa (Central Mediterranean Sea).** *Galletti Y., [CNR-IBF], Becagli S., [UniFi], di Sarra A. [ENEA], Gonnelli M. [CNR-IBF], Pulido-Villena E. [MIO], Sterlazzo D.M. [ENEA], Traversi R. [UniFi], Vestri S. [CNR-IBF], Santinelli C. [CNR-IBF].*

Total atmospheric depositions (dry and wet) were collected at the Station for Climate Observations (35.52°N, 12.63°E), maintained by ENEA (the Italian National Agency for New Technologies, Energy and Sustainable Economic Development), on the island of Lampedusa, Italy. The samples were collected between March 19<sup>th</sup> 2015 and April 1<sup>st</sup> 2017, bimonthly or immediately after strong rain or dust storm events. Dissolved Organic Carbon (DOC) fluxes ranged between 0.06 and 1.78 mmol C m<sup>-2</sup> day<sup>-1</sup>, Dissolved Organic Nitrogen (DON) ranged between 1.5·10<sup>-3</sup> and 0.25 mmol m<sup>-2</sup> d<sup>-1</sup> and Dissolved Organic Phosphorous (DOP) fluxes ranged between 0 and 2.7·10<sup>-3</sup> mmol m<sup>-2</sup> d<sup>-1</sup>. C:N:P molar ratios in atmospheric DOM showed a marked variability, with average values of C:N:P of 1909:292:1. These data indicate that atmosphere is an important source of DOM to the Med Sea with DOC fluxes up to 6 times larger than river input. The PM<sub>10</sub>, sea salt aerosol, dust and non-sea-salt calcium mean values were calculated and the Fe/Al ratio was determined in order to gain information on the main sources of atmospheric DOM. Our results suggest the contribution of different sources, both natural and anthropogenic, to the organic matter load in the aerosol, highlighting a remarkable contribution of Saharan dust events to DOM deposition over the Mediterranean Sea.

6. **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.** *Canepa E. [CNR-ISMAR]*

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 started in 2017.

## WORKSHOPS

1. Organization of two consecutive **workshops on SOLAS Themes 4 and 5** at the CNR headquarters in Rome (Italy), from 27 to 29 November 2018 [*ISAC Bologna*]:
  - WS 1. Influence of coastal pollution on marine atmospheric chemistry: effects on climate and human health
  - WS 2. Interactions between aerosols, clouds and marine ecosystems in contrasting environments
2. Organization of the first **National Workshop on C cycle** titled: "Terra, Vita e Clima. Il ciclo del Carbonio". Area della Ricerca del CNR di Pisa, November 22<sup>nd</sup>-23<sup>rd</sup> 2018.

## CRUISES

1. **ADRI18 cruises:** CNR-ISMAR participated in 2 cruises (May and October 2018) in the Southern Adriatic Sea with the aim to service instruments and sensors on long-term moorings.
2. **FIXO3-08** Multidisciplinary Approach to Research in Permanent Oceanographic Sites. This cruise was carried out in the South Adriatic Sea with the R/V Explora by OGS from 4<sup>th</sup> to 11<sup>th</sup> October 2018. Mooring and instrument maintenance was carried out at the E2M3A observatory and at CNR-ISMAR BB and FF moorings. CTD cast and water sampling for the CO<sub>2</sub> system and nutrients were performed along a transect from the Italian coast toward the centre of the south Adriatic pit.
3. **HighNorth-18:** The cruise was carried out in July 2018 in the Fram Strait (Svalbard) up to the latitude of 81°50'N. The cruise was led by the Italian Navy Hydrographic Institute (INHI), in synergy with the NATO Navy Research and Experimentation Center of La Spezia (NATO STO-CMRE) and the collaboration with major national research institutions (CNR, ENEA, OGS, INGV, ERI). During HighNorth-18 cruise, one oceanographic mooring was serviced and a new one was deployed on the Storfjorden continental slope (SW Svalbard) in a joint effort between CNR, OGS and INHI.
4. **INTERNOS 2019**, R/V Dallaporta (CNR), February 20<sup>th</sup> to 28<sup>st</sup> 2019, (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, SiO<sub>2</sub>), and phytoplankton in a shelf region, (2) maintenance of instruments and sensors on buoys.
5. **MSM72**, CNR-IBF participated in the transmed cruise MSM72 on the MARIA S.MERIAN (Institut für Meereskunde der Universität Hamburg), March 2<sup>nd</sup> to April 3<sup>rd</sup> 2018. The main goal of the cruise was to contribute to the understanding of long-term changes and trends in physical and biogeochemical parameters, such as the anthropogenic carbon uptake and to evaluate the hydrographical situation after the major climatological shifts in the eastern and western part of the basin. During the cruise, multidisciplinary measurements were conducted on a mainly zonal section along the whole Mediterranean Sea, contributing to the global repeat hydrography program GO-SHIP.
6. **NyA18 cruise:** CNR-ISMAR participated in a cruise (July 2018) in the Kongsfjorden (Svalbard) with the aim to servicing instruments and sensors on the long-term mooring MDI.

**3. Top 5 publications in 2018 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.**

1. Arapov J, Skejic S, Kovačević V, Buzancic M, Bensi M, Giani M, Bakrač A, Mihanović H, Nincevic Gladan Z, Urbini L, Grbec B, 2018, Coccolithophore diversity in open waters of the middle Adriatic Sea in pre- and post-winter periods. *Marine Micropaleontology*, 143: 30-45.
2. D'Angelo A, Giglio F, Miserocchi S, Sanchez-Vidal A, Aliani S, Tesi T, Viola A, Mazzola M, Langone L, 2018, Multi-year particle fluxes in Kongsfjorden, Svalbard, *Biogeosciences*, 15, 5343-5363, <https://doi.org/10.5194/bg-15-5343-2018>.
3. Giani M, Miquel J C, De Lazzari A, Boldrin A 2018. Fluxes of particulate matter, carbonates, organic carbon and nitrogen in the northern Adriatic continental shelf: a synthesis overview, *Advances in Oceanography and Limnology*, 9(2): 45-58.
4. Laussac S, Piazzola J, Tedeschi G, Yohia C, Canepa E, Rizza U, Van Eijk A M J, 2018, Development of a fetch dependent sea-spray source function using aerosol concentration measurements in the North-Western Mediterranean, *Atmospheric Environment*, 193, 177–189, <https://doi.org/10.1016/j.atmosenv.2018.09.009>.
5. Malfatti F, Lee C, Tinta T, Pendergraft M A, Celussi M, Zhou Y, Sultana C M, Rotter A, Axson JL, Collins D B, Santander M V, Anides Morales A L, Aluwihare L I, Riemer N, Grassian V H, Azam F, Prather K A, 2019, Detection of Active Microbial Enzymes in Nascent Sea Spray Aerosol: Implications for Atmospheric Chemistry and Climate, *Environmental Science & Technology Letters*, <https://doi.org/10.1021/acs.estlett.8b00699>.
6. McCluskey C S, Ovadnevaite J, Rinaldi M, Atkinson J, Belosi F, Ceburnis D, Hill T C J, Lohmann U, Kanji Z, Facchini M C, O'Dowd C, Kreidenweis S M, DeMott P J, 2018, Marine and Terrestrial Organic Ice Nucleating Particles at the Mace Head Research Station, *Journal of Geophysical Research: Atmospheres*, 123, 6196–6212, 2017, <https://doi.org/10.1029/2017JD028033>.
7. Michaud J M, Thompson L R, Kaul D, Espinoza J L, Richter R A, Xu Z Z, Lee C, Pham K M, Beall C M, Malfatti F, Azam F, Knight R, Burkart M D, Dupont C L, and Prather, K A, 2018, Taxon-Specific Aerosolization of Bacteria and Viruses in an Experimental Ocean-Atmosphere Mesocosm, *Nature Communications*, 9(1): p. 2017, <https://doi.org/10.1038/s41467-018-04409-z>.
8. Molari M, Guilini K, Lott C, Weber M, de Beer D, Meyer S, Ramette A, Wegener G, Wezhöfer F, Martin D, Cibic T, De Vittor C, Vanreusel A, Boetius A, 2018, CO<sub>2</sub> leakage alters biogeochemical and ecological functions of submarine sands. *Science advances*, 4(2), eaao2040, <https://doi.org/10.1126/sciadv.aao2040>.
9. Rinaldi M, Nicosia A, Santachiara G, Piazza M, Paglione M, Gilardoni M, Sandrini S, Cristofanelli P, Marinoni M, Bonasoni P, Facchini M C, Belosi F, 2018, Ground level Ice Nuclei Particle measurements at Capo Granitola, a Mediterranean coastal site, *Atmospheric Research*, 219, 57–64.
10. Rivaro P, Ianni C, Raimondi L, Manno C, Sandrini S, Castagno P, Cotroneo Y, Falco P 2019, Analysis of Physical and Biogeochemical Control Mechanisms on Summertime Surface Carbonate System Variability in the Western Ross Sea (Antarctica) Using In Situ and Satellite Data Remote Sensing 11(3), 238, <https://doi.org/10.3390/rs11030238>.
11. Rizza U, Canepa E, Ricchi A, Bonaldo D, Carniel S, Morichetti M, Passerini G, Santiloni L, Puhales F S, Miglietta M M, 2018, Influence of wave state and sea spray on the roughness length: feedbacks on Medicanes, *Atmosphere*, 9, 301, <https://doi.org/10.3390/atmos9080301>.
12. Rahav E., Paytan A., Mescioglu E., Galletti Y., Rosenfeld S., Raveh O., Santinelli C., Yuan Ho T., Herut B. (2018). Airborne Microbes Contribute to N<sub>2</sub> Fixation in Surface Water of the Northern Red Sea. *Geophysical Research Letters*. 45. <https://doi.org/10.1029/2018GL077132>

**4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2018? If yes, who? How did you engage?**

## PART 2 - Planned activities for 2019/2020 and 2021

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

1. CO<sub>2</sub> 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.
2. CNR-ISMAR will be committed in 4 cruises with the aim to service the long-term oceanographic moorings of the Southern Adriatic, Kongsfjorden and Storfjorden slope (Svalbard). In particular, in the framework of a new collaboration with Agneta Fransson (Norwegian Polar Institute), it is planned to add a CO<sub>2</sub> sensor on the mooring MDI in the Kongsfjorden (Svalbard).
3. Researchers of the University of Southampton accessed to the NatLab Italy infrastructure in May 2018 in order to calibrate new equipment and facilitate the generation of new methods for determining gas flux, using acoustic and optic techniques, which will be applicable to both natural vent systems, and also in detecting leakages associated with Carbon Capture and Storage.
4. Cooperation among CNR-IBF, ENEA, University of Florence, MIO (Marseille, France) will continue in order to collect total atmospheric depositions at the Lampedusa Island and to carry out chemical analysis on atmospheric samples (DOC, CDOM, FDOM, Metals, nutrients).
5. DOC leaching experiments with different kind of dusts will be carried at the CNR-IBF, in collaboration with Israel Oceanographic and Limnological Research (IOLR), Institute of Marine Science and University of California, USA.
6. CNR-IBF and SZN will participate in the PERLE "Pelagic Ecosystem Response to dense water formation in the Levant Experiment" cruise carried out onboard the French R/V POURQUOI PAS.

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

1. 27<sup>th</sup> IUGG General Assembly, Montreal, Quebec, Canada, 8-18.07.2019 IUGG2019Montreal@jpd.com.
2. 3<sup>rd</sup> Workshop of RINGO WP 1.4 Developing ICOS RI readiness to provide information on ecosystem – river – stream – estuary – ocean carbon transport and GHG fluxes project will be held in Hyytiälä Finland from on 5.11 - 8.11.2019.
3. Integrated Carbon Observing System Ocean Thematic Center- The annual Member Assembly Meeting will be held in Southampton on 18.03.2019.

### 3. Funded national and international projects / activities underway.

1. **ECCSEL - NatLab Italy, which is part of ECCSEL-ERIC (European Carbon Dioxide Capture and Storage Laboratory Infrastructure)**, has been financed by the Italian Ministry of University and Research (MIUR) to create stable infrastructures accessible to the national and international scientific community, for studies on the effects of climate changes, on ocean acidification and on CCS (CO<sub>2</sub> capture and storage), in peculiar areas such as the volcanic system of Panarea. This site is considered as an incredible natural laboratory that allows a long-term monitoring of the dynamics associated to change in greenhouse gas fluxes (GHGs – Theme 1 SOLAS) and their impacts at the ecosystem level and to calibrate new instrumentations.
2. **ECOSS ECOlogical observing System in the Adria5c Sea**: integrating oceanographic observing systems and Natura 2000 sites. Interreg Italy-Croatia (2019-2021).
3. **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](http://www.emodnet-chemistry.eu).
4. **IPANEMA project**, submitted under the 2018 PON RI call, launched by MIUR, if approved,

will consistently implement the Panarea NatLab, part of ECCSEL ERIC, and will attract a large number of national and international researchers to perform their studies on CCS and acidification.

5. **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/>.
6. Progetto **INFOR-MARE** (2017-2019): Sistema INFORMATivo integrato per il litorale Emiliano-romagnolo (PG/2015/731524).
7. **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.
8. **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 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 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.
- 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.
- 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 (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 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 the collection of total atmospheric deposition of organic matter, macro and micro nutrient at Lampedusa (35.5°N, 12.6°E). (<http://www.lampedusa.enea.it>) in order to acquire information with a high temporal resolution.
- Mineralization experiments to investigate the impact of atmospheric deposition on surface DOM cycle.
- Leaching experiments in order to investigate the release of organic matter by dust.
- To use lagrangian oceanography and applications of lagrangian techniques to biological oceanography and marine ecology.
- To start a new series of collection of atmospheric deposition at the island of Gorgona (Ligurian Sea).

## **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.
- To investigate the sea-surface microlayer and its microbial community.
- 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).
- 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).

## **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.**

The ECCSELERATE project, to be submitted under the 2019 H2020 INFRADEV-3 call, will be linked to ECCSEL ERIC and thus to all the OGS facilities, dedicated to CCS and acidification studies.

ECCSEL ERIC will be linked to EMSO ERIC by an MoU, thus reinforcing the research collaboration already ongoing.

#### **Comments**

In the last year, the activities carried out from the Italian community were strongly reduced due to the unavailability of the Italian ship from the CNR and the continuous reduction of funds for research. The situation is not different in 2019.