PREMILINARY CRUISE REPORT

PEACETIME cruise
R/V POURQUOI PAS ?

From La Seyne-sur-Mer, France, 10.05.2017
To La Seyne-sur-Mer, France, 11.06.2017

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1 – SCIENTIFIC CONTEXT

Understanding the exchange of energy, gases and particles at the ocean–atmosphere interface is critical for the development of robust predictions of future climate change and its consequence on marine ecosystems and the services they provide to society. Our understanding of such exchanges has advanced rapidly over the past decade but we remain unable to adequately parameterize fundamental controlling processes as identified in the new research strategies of the international Surface Ocean–Lower Atmosphere Study group (SOLAS; *Law et al., 2013*). A critical bottleneck is the parameterization and representation of the key processes brought into play by atmospheric deposition in Low Nutrient Low Chlorophyll (LNLC) regions such as the MS where the ecosystem functioning may be modulated by pulsed atmospheric inputs in particular deposition of Saharan dust (*Guieu et al., 2014a*). PEAcEtIME is instrumental in tackling such challenges on air-sea interaction in an area designed as a hot spot for biodiversity but also a hot spot for climate change and anthropogenic pressure. Indeed, the evolution of the climate conditions, clearly indicates a dryer and warmer climate in the MS (e.g. *Déqué, 2007*), a situation that could enhance dust emissions due to an increase in aridity (*Moulin and Chiapello, 2006*). Combined to modification of the rain regime, this will likely impact the occurrence and intensity of dust deposition events. Ongoing and future anthropogenic and global changes, both increasing atmospheric emissions (Nitrogen for ex., *Duce et al., 2008*) and *in situ* conditions (stratification, T, pH) may also induce changes in atmospheric deposition fluxes, turn over time in the surface mixed layer, and in stoichiometry of the 'new nutrients' coming from the atmosphere (*Leeuw et al., 2013*). Profound changes can be expected that will likely result in changes in both biodiversity and microorganism adaptive strategies for competing for nutrients (e.g. *Guieu et al., 2014b*). In this context, there is a strong need to improve understanding of the relevant processes at the scale of a small ocean like the MS in order to predict changes in ecosystems functioning, which obviously influence the cycles of major biogenic elements, biodiversity, productivity in the ocean, atmospheric CO_2 uptake, fisheries that ultimately have socio-economic impacts.

A key action of the PEACETIME 4-years project is an oceanographic campaign cruise in the Mediterranean Sea: the campaign took place 3 months ago 10 Mai-11 juin 2017.

At the national level, PEACETIME is mainly connected to the MISTRALS meta-program (both actions MERMEX and CHARMEX). PEACETIME is also of interest to the CNES TOSCA program since it will provide a data set of optical atmospheric and marine properties from the remote Mediterranean that are useful for the validation of spaceborne products. PEACETIME is also linked to the DIADEME project (PI: C. Ridame, Co-PI: K. Desboeufs), funded by LEFE/CYBER-CHAT for 2015 which the goal of this project is to determine trace metals (other than Fe) released by Saharan dust which control N2 fixing activity.

At the international level: One of the major lessons learned over the past decade of research is that the evolution of climate and global environmental quality over the next century is intimately linked to air-sea fluxes. Interdisciplinary approaches such as those proposed in PEACETIME is directly in the scope of the international programs: SOLAS (Surface Ocean Lower Atmosphere Study: http://solas-int.org/) or **GEOTRACES** http://www.geotraces.org/). More specifically, the sensitivity of marine biogeochemical cycles and ecosystems to external forcing such as atmospheric inputs, that will be studied in PEACETIME is relevant to the international project IMBER. PEACETIME has received support from SOLAS and IMBER and was also endorsed by GEOTRACES as a process-study. Both SOLAS and IMBER are now under the umbrella of Future Earth.

Other links to international community projects and observation concern near-real time products on aerosols (AERONET, MSG/SEVIRI, MODIS) based on the ICARE data center and facilities that were used during the PEACETIME campaing. PEACETIME contributes providing data to the Maritime Aerosol Network (MAN) of AERONET. PEACETIME did intensively use altimetry and ocean color satellite products (MODIS, AVISO) in order to i) guide the adaptive, Lagrangian sampling strategy for in situ process study and ii) to provide insights into the spatial and temporal variability of the physical and biogeochemical characteristics of the surrounding waters of the cruise. In return, the field campaign did provide to the satellite oceanography community new in situ data (relative dispersion based on drifter release, detailed thermohaline structure and fluorescence distribution in the surface layer) for satellite calibration/validation.

2 – OBJECTIVES

The objective of PEACETIME and associated strategies are to:

-1. Characterize and quantify impact of atmospheric deposition on marine nutrient budget, biogeochemical processes and fluxes in today and future climate conditions, radiative budget, and marine emissions.

-2. Track a real Saharan dust deposition to measure in situ before, during and after, the direct impacts on various compartments of the water column.

-3. To use the information obtained during the cruise to develop an improved description of these biogeochemical and physical processes in a biogeochemical model and to provide better estimations of atmospheric deposition impact on marine ecosystem and retroaction on climate by coupling regional atmospheric chemistry transport models to the improved dynamical-biogeochemical model NEMO-Med12/PISCES.

- 4. Conduct and important effort in outreach and communication.

3 – COLLECTED DATA

The multitude of results obtained through continuous monitoring of the atmosphere and ocean, process studies, flux measurements both underway and at stations (11 short stations, 2 long stations and 1 "Fast action" station) will allow us to better understand and quantify how atmospheric deposition impacts the functioning of the pelagic ecosystem of the Mediterranean today and in future climate conditions. These chemical, biological and physical properties of the atmosphere, the marine surface micro-layer and the deeper layers of the Mediterranean have thus been characterized in the large number of different bioregions traversed during the campaign.

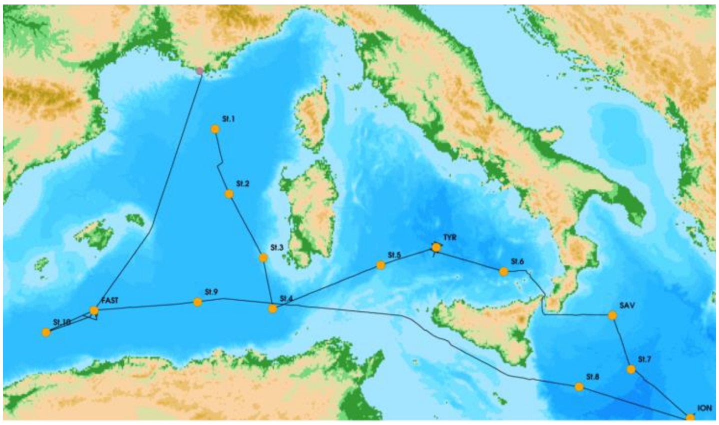

Figure 1. *Transect of the PEACETIME cruise: 30 days at sea to perform work at 11 short stations, 2 long stations and 1 station « Fast action »*

We were able to carry out 90 profiles with the conventional rosette-CTD loaded with optical instruments with sample collection for the measurement of stocks and biological and chemical fluxes (including Hyperbaric conditions) and Physical characterization of the water column; We carried out the collection of samples in 'ultra trace' condition (figure 2) thanks to the realization of 27 profiles with the "clean" rosette : measurements of metals could be made on board (Aluminum and dissolved iron) making it possible to indicate the regions impacted by atmospheric Saharan deposits of which these elements are the tracers (note that this work is done within the framework of the international program GEOTRACES).

Clean rosette used in PEACETIME (left) Deployment preparation (right) Subsampling from clean rosette bottles respecting trace metal clean techniques (bottle were removed from the rosette and subsampling in clean container).

The zooplankton biodiversity will be studied through 27 strikes along the transect. The micro-layer, which is the area of the interface between the atmosphere and the ocean, could be sampled 17 times from the ship's zodiac and will be characterized from a biological and chemical point of view. An innovative system of continuous "clean" pumping at 5 m under the boat thanks to a large peristaltic pump allowed the automatic, chemical, biological and physical analysis (with a focus on optical measurements) throughout the transect. The water thus conveyed in a dedicated laboratory has also been studied continuously with regard to its particle and gas emission properties in order to study the feedbacks from the ocean to the atmosphere. At the same time, atmospheric sampling was carried out throughout the transect using a dedicated container to monitor continuous air composition, parameters of atmospheric dynamics such as the boundary layer, and radiative parameters (incident radiation , Optical thickness, optical properties of the particles). In addition to these continuous sampling, 3 rains were collected and analyzed during the campaign, including the expected rainfall in FAST ACTION.

Several profiler floats were recovered / dropped during the journey: they will allow us to continue to study the system that we have characterized at a given moment. Three drifting moorings could be launched during the two long stations and the FAST station: exploitation of the results of this large-scale operation (line loaded with different types of sediment traps, measuring devices In situ respiration and physical instrumentation) will allow us to better understand the future of matter between the surface and the bottom, in particular the link between the deposits of Saharan dust and the export of carbon. SVP (Surface Velocity Program) drifters launched at the long duration stations provided information on the current at 15-m depth.

The ocean dynamics at fine scale was explored thanks to the deployments of the Moving Vessel Profiler in order to understand its possible impact on the biogeochemistry of the surface layer (0-300-m depth). Everyday, with the help of the onshore SPASSO team, satellite maps of altimetry-derived currents, sea surface temperature and chlorophylle was providing regional information around the cruise route and eventually guiding this latter.

Another specific feature of PEACETIME was to embark on "climatic reactors", installations that reproduce on a small scale the air-sea exchanges under present and future environmental conditions (acidification and increase of the temperature of the sea water). 5 days were successfully conducted in 3 distinct regions of in situ characteristics involving a large number of scientists on board.

Also in collaboration with IFREMER (project ABYSS), we deployed three times (2 long stations + Fast Action station) a multicore to collect sediments.
Finally, thanks to our FAST ACTION strategy, which was thought well upstream of the campaign, we were able to observe in situ the deposition of Saharan dust and monitor the effects in the ocean and the feedbacks to the atmosphere for 6 days. We are expecting particularly original results from this FAST ACTION.

Data Base.

All data acquired at sea or in land, are/will be found in several data base :

- LEFE-CYBER - LEFE CYBER Database: http://www.obs-vlfr.fr/proof/php/PEACETIME/peacetime.php
- SEDOO MISTRALS - MISTRALS database for PEACETIME: http://mistrals.sedoo.fr/PEACETIME
- BGC-Argo Floats - Biogeochemical-Argo Profiling Floats: http://biogeochemical-argo.org/float-map-interactive-map.php
- PEACETIME OPERATING CENTER - @SEDOO: http://poc.sedoo.fr/?current=20170316
- CORIOLIS

4 – PRINCIPAL RESULTS

1. *Air sampling*

Air sampling was carried out throughout the whole campaign using a dedicated container to monitor continuous air composition (gas and particles), parameters of atmospheric dynamics such as boundary layer, and radiative parameters (incident radiation fluxes, optical thickness, optical properties of the particles). The meteorolical conditions during the campaign enabled to sample air masses coming from various origins: European polluted, marine and southern African air masses (Figure 1). A large range of concentrations of gas and particles has been observed as well for typical atmospheric pollutant (NOx, O_3, Soots..) as for marine/natural species (biogenic VOC, marine aerosols,..).
In parallel, continuous sampling of surface seawater (5m) carried out thanks to an original pumping system deployed for the first time during the campaign (see further). This continuous pumping was also used to provide a “marine aerosol chamber”, i..e a chamber where the bubble bursting produced within foamy whitecaps is mimiced by bubbling, in order to quantify the seasalt aerosols fluxes.
This dataset enables to provide a good cartography of atmospheric and marine composition on the Western basin. In order to study the potential link between air and marine composition, a work of data analysis is going on to understand what are the parameters conditioning the variations of atmospheric concentrations, as atmospheric boundary layer, photochemistry, air masses origin, marine biological activities...
In complement of this work, the study on optical properties of aerosols and in particar their diming effect will be confront with the measurements of radiative budget in the surface seawater.
In addition to these continuous sampling, 3 rains were collected and analyzed during the campaign, including the expected rainfall during FAST ACTION. Two rains of these rains present a chemical signature of polluted rains and the FAST ACTION rain is marked by dust rain characteristics. The analysis of these rains will enable to have a best idea of chemical composition of wet deposition in remote marine area (in general wet depsoition is collected in the coastal environments). Following these rain events, a survey of water column was done by CTD.

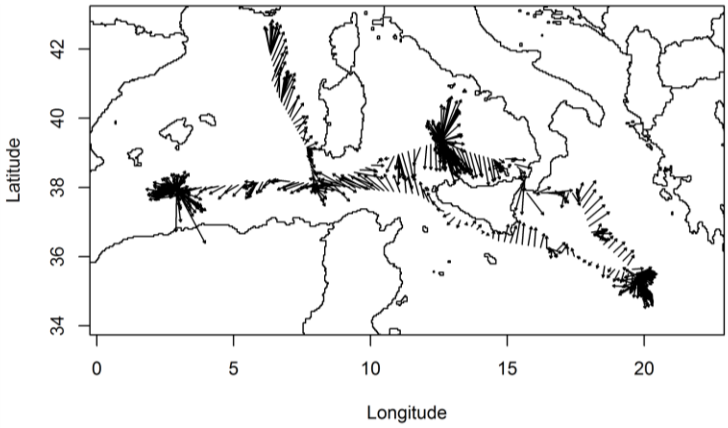

Figure 2. *Wind direction of sampled air during the peacetime cruise*

2. *Characterization of the seasurface microlayer*

Sampling on board and later analysis in the lab aim to study the chemical (trace metals, organic matter) and biological (pico and nano-plankton) composition of the SML in order to understand the role of this layer in the exchange of material and energy between the atmosphere and the sea. We carried out a total of 17 sampling in different sea and weather conditions. Dissolved (<0.22 µm) and total (unfiltered) samples were collected for trace metals analysis, as well a subsurface (0-1 m) dissolved sample. In addition, samples were collected for total combined carbohydrates, total hydrolysable amino acids, gel particles (TEP and CSP) as well as DNA filters from the surface microlayer and the subsurface at around 20 cm. Three incubation experiments were also carried out on board.

Figure 3. *Two 'clean' sampling devices were used when sampling from the ruber boat, to characterize the chemical (trace metals, organic matter) and biological (pico and nano-plankton)*

3. *Hydrology*

One of the specificities of the Mediterranean Sea belongs to the presence of various marine ecosystems over relatively small regions, that, reinforced by mesoscale eddy activity of the sea circulation, makes each station of the cruise plan singular. In order to characterize in real time such diverse marine environment, collections of CTD casts were collected at every stations and vertical profiles of core environmental parameters (pressure, temperature, salinity, dissolved oxygen, biooptical properties : fluorescence of chlorophyll-a, fluorescence of CDOM, particle transmission, light radiation) were acquired, processed and dissimineted on board and sent to Coriolis GDAC center.

To do so, two CTD-systems were operated; both are composed of SeaBird's SBE911 upmost accurate technology and a set of 24 sampling bottles fired at chosen pressure levels. The first system (so called "classical") used Niskin bottles; it was hanged on a metallic cable and deployed from the vessel's winch. The second system so called "trace-metal-clean" used Go-Flo bottles; it was hanged on a Kevlar cable and deployed from its own winch.

The initial sampling plan has been fully reached thanks to the reliability of the instruments, as well as the scientific quality of the measurements thanks to the stability of the sensors. It consisted on at least three casts at short stations: one shallow (0-500m) and one deep (0-bottom) with the classical system, one deep (0-bottom) with the trace-metal-clean system. At long stations, the CTD operations were intensified in order to characterize short term variations of the ecosystem (until the diurnal cycle) and eventually to adapt the vertical discrete sampling to surface processes. Overall 118 casts were collected, 91 with the classical system and 27 with the trace-metal-clean system.

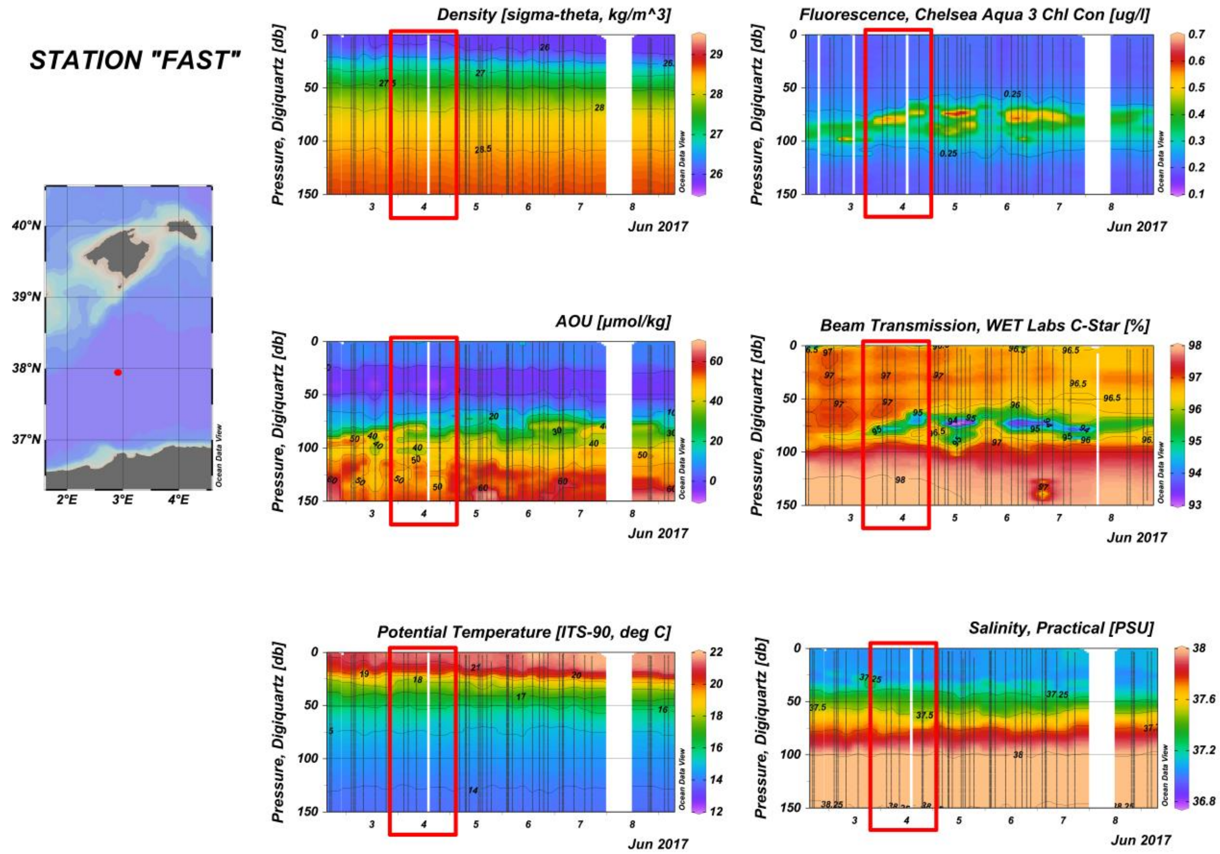

Figure 4. *Collection of CTD-casts collected at the FAST station, before, during (red frame), and after the dust event. Time series of six environmental paramters on the first 150m of the water column.*

4. *Water sampling and processes studies in the water column*

Saharan dust deposition can enhance the export of particulate organic carbon (POC) to the deep ocean by fertilizing and acting as ballast and facilitating aggregation processes. In the framework of the PEACETIME cruise, this last hypothesis has been investigated through several approaches detailed below: oxygen consumption rates (using several tools RESPIRE, IODA and HPB-O2 measurements), prokaryotic activities (heterotrophic production, dark CO2 fixation and ectoenzymatic activities), structure and diversity of microorganisms, remineralization rate of suspended matter estimated using particulate biogenic barium (barite) concentrations, and sinking particles experiments.

- Fate of organic matter. Prokaryotic heterotrophic production and ectoenzymatic activities. Fate of organic matter was flowwed by simulteneously determining hydrolysis of macromolecules and heterotrophic bacterial production. Their controlling factors by N, P and labile C sources were determined by enrichment experiments processed at sites TYR, ION and FAST.
- Structure and diversity of microorganisms. MiSeq sequencing will be done to determine the structure and the diversity of microorganisms.
- Remineralization rate of suspended matter estimated using particulate biogenic barium (barite) concentrations
- Sinking particles experiments.
- Export and processes from drifting moorings. Moorings were successfully deployed at the three long stations, ST_TYRR, ST_ION, ST_FAST. The morring was designed and carried out by the team of the DT INSU in Brest in close connection with the team on board to ensure its implementation during the mission (no DT people embarking). SVP drifters were also deployed at the long duration stations, providing information on the current at 15-m depth. The originality of this mooring lies in its modular design allowing it to be adapted to the needs of the campaign. Realization of the anchor lines of the 0-250m part with halyards of different elementary lengths (1m-5m-10m-20m-50m), which can be easily interchanged to adjust the immersion of the various instruments depending on the hydrological conditions (in particular the depth of the mixing layer) found at the different stations. The instruments attached to the mooring were:

• 3 Technicap particle traps type PPS5 equipped with StarOddi inclinometer (Tilt, P and T).
• 3 IODA (In situ Oxygen dynamics Auto-analyzer).
• 2 Clean Sediment Trap RESPIRE – (UTAS, Hobart)
• 2 Sediment Trap RESPIRE Titanium (UTAS, Hobart)
• 1 Sediment Trap PVC tube type KC 28
• 4 SeaBird Microcat SBE37 type CTD / O2.
• 4 Aquadopp Nortek Doppler current transmitter.
• 5 RBR Autonomous Temperature and Pressure Sensors.

• 5 RBR stand alone temperature sensors.
Fluxes (and composition of the collected particles are currently being analyzed by Cellule Piege INSU. We'll only give an example of the in situ results acquired during the deployment with the IODA intruments measuring continuously the **Oxygen consumption rates.** Several tools have been used during the PEACETIME cruise: the RESPIRE and the IODA have been deployed on the mooring line during both 'Long Stations' while measurements of oxygen both under in situ pressure conditions (HPB-O2) and at atmospheric pressure conditions have been performed on discrete samples.

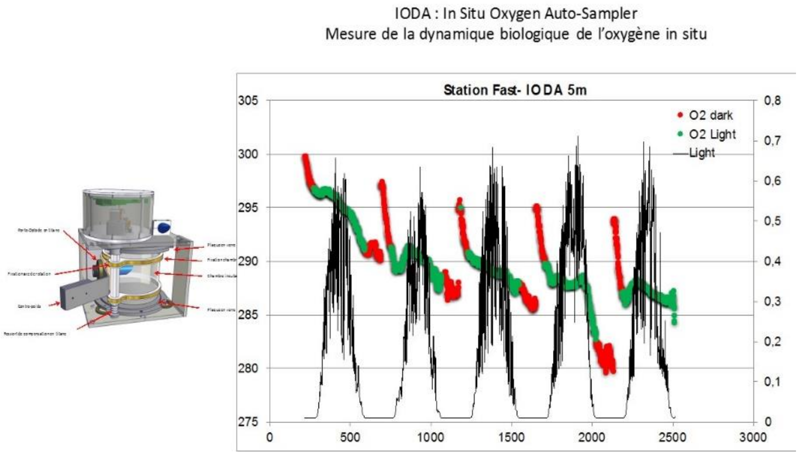

Figure 5. *Preliminary results from IODA deployment on the Fast station , 5 m., X axis is time in 180 seconds, Y axis units are O2 in µmol dm-3 (uncalibrated) and PAR on a.u. Red are O2 during the night and green during the day light.*

5. *Ocean Dynamics at (Sub)Mesoscale using the MVP*

The MVP (Moving Vessel Profiler) was used to perform high frequency 0-300m profiles of CTD (and fluorescence and LOPC-Laser Optical Particle Counter, when the "big fish" was towed instead of the "small fish") between the short stations and in the long station areas as frequent as possible. A total of more than 1000 profiles have been obtained enabling to identify nice structures such as submesoscale processes in action (Figure 7, left) or strong changes in salinity probably associated with rain (Figure 7, right).

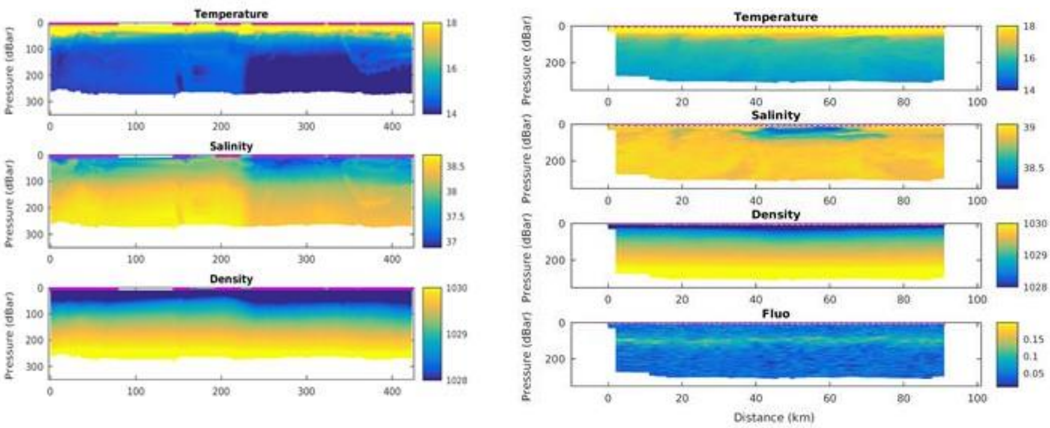

Figure 6. *(left) MVP Transect PL11 across the Sardinia Channel toward ST9. A rapid change in water masses is observed when entering in the Algerian basin and again approching the ST9, where a complex vertical structure in T and S is present. (right) MVP Transect PL08, the small cross in the ST_ION area. A surface low-salinity anomaly is observed in the Southern part of the transect.*

6. *Underway*

The underway objectives were to provide multiparametric information on the response of the oceanic mixed layer to atmospheric forcing such as dust input. Chemical properties (carbonate chemistry, O2), microbial assemblages, hydrological properties, optical properties related to community and particle composition and aerosol production (chemical composition, particles spectrum). A large peristaltic pump was installed to distribute the surface water from the TRAVOCEAN hole to the different instruments.

Figure 7. *Underway lab on board RV Pourquoi Pas?: the large peristaltic pump (left), the different water arrivals to distribute surface water to all the 9 instruments installed in the lab (right).*

Twenty one parameters (stocks and flux –chemical, biological and optics) were measured either continuously or from discrete sampling. The underway has been working continuously except when the Climate Reactors were filled (3 hours max at long stations).

Figure 8. *Map of particulate backscattering at 700 nm along the cruise track at ~5 m. The gap at the end of the cruise correspond to data not processed yet.(data N. Haëntjens)*

7. *Process studies in Climate Reactors*

The impacts of Saharan dust deposition on the composition and functioning of Mediterranean surface communities were investigated during the Peacetime cruise. Three experiments in 300 L experimental tanks have been conducted during the Peacetime cruise (Station TYR, ION and FAST). Experiments (involving people from 11 labs on board!) have lasted 72h for TYR and ION and 96h for FAST. The experimental tanks were filled with seawater from the continuous surface upon arrival at the stations TYR (17/05) and ION (25/05) and one day after arrival at station FAST (02/06). Tanks C1 and C2 were unmodified “control” tanks, D1 and D2 were enriched with dust, and G1 and G2 were warmed (+3°C) and acidified (-0.3 pH unit) tanks enriched with dust. Tanks C1, C2, D1 and D2 were flushed with ambient air and tanks G1 and G2 were flushed with air enriched with CO2 (at 1000 ppm) in order to prevent CO2 degassing from the acidified tanks). The tank’s closed atmospheric headspace were continuously monitored for their gas-phase composition, related to seawater emissions, and for the formation of new atmospheric particles. When filling the tanks, seawater was sampled for the measurements of selected parameters (sampling time = T-1). After filling the tanks, seawater was slowly warmed in the G1 and G2 tanks overnight. 13C-bicarbonate was added to all tanks at 4 am (local time) and G1 and G2 tanks were acidified by addition of CO2 saturated seawater at 4:30am. Sampling for many parameters took place (see list below) prior to dust seeding (sampling time = T0). Dust seeding was performed between 7am and 9am in tanks D1? D2, G1 and G2. Thereafter, seawater sampling was conducted 1h (T1), 6h (T2), 12h (T3), 24h (T4), 48h (T5) and 72h (T6) (+ 96 h = T7 for station FAST) after dust enrichment.

Samples to analyse more than 40 parameters (stocks and fluxes) were collected during those experiments.

Figure 9. *Six Climate Reactors were installed inside the container kindly provided by our colleagues from M I O. Two other serving as incubators with the same temperature conditions as the one used for the experiments were installed inside the thermostated laboratory.*

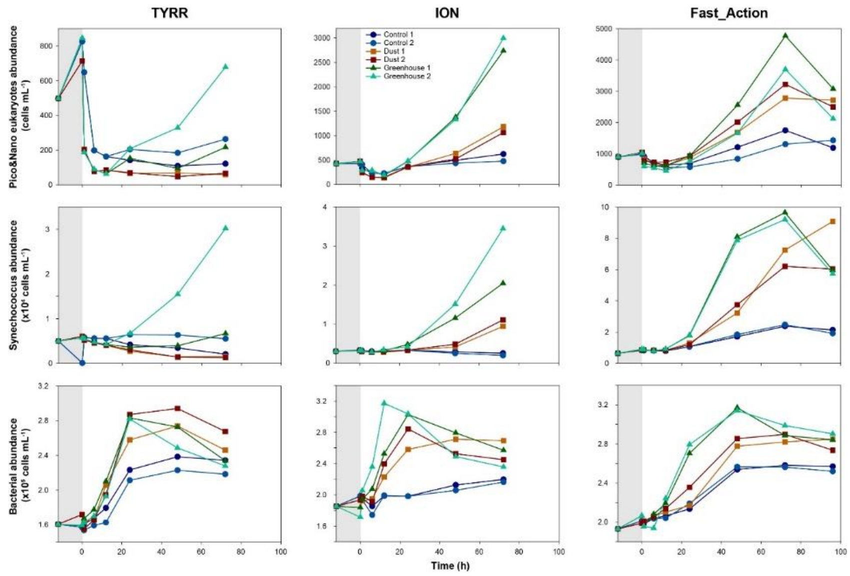

Figure 1. *Abundance of bacteria, synechocococcus and Pico-&Nano eukaryotes (flow cytometry) during the 3 minicosms experiments conducted at the TYRR, ION and Fast Action stations. Blue: no perturbation, orange/red: dust addition, green: dust addition in seawater +3°/-0.3 pH unit (data J. Dinasquet/P Catala).*

8. *Fast Action*

Fast Action team was devoted to identify an eventual dust deposition event in the Mediterranean area during the PEACETIME cruise. Based on models forecast and on available observations, two teams (on board and on land) have a daily meeting to discuss possible modification of cruise plan to sample a dust deposition event.

A FAST ACTION was finally launched in the Algerian sector from 2th to 7th of June. Rain was sampled during the 4th to 5th of June night.

Observations and models outputs from several sources were pooled together and analyzed in real time on land and transmitted on board. A daily meeting was organized on board to communicate with the on-land team (through telephone satellite com). The on-land team commented the available previsions and observations, whereas the on-board team informed on the cruise advancement and on the data collected. Generally, all the data were pooled together in a single file, produced daily and available on the ship network and on the web site of the Peacetime Operational Center (http://poc.sedoo.fr, managed by SEDOO). The whole data set used by the Fast Action team is available permanently on the POC for the following analysis. Important dust wet deposition was forecasted for the 28th of May over the Alboran Sea sector, initially only by some models (i.e. Skiron). The 29th of May, a first modification of the initial plan was decided (i.e. skipping Station 9 and moving eastward Station 8) as the event on Alboran was confirmed by others models. At the end of station 8 (i.e. 30th of May), the Fast Action Team decided to move westward, along the southern Sicilian coast (instead of through Messina Channel as planned), in order to reach a “Decision Point”, located in the Sicilian Channel. The “Decision Point” was positioned to allow a rapid movement toward the Alboran Sea (if fast Action declared) or to come back to initial plan (i.e. Thyrrennian Sea). The “Decision Point” was reached the 31st of May, and during a dramatic and full of consequence meeting, the Fast Action Team decided to declare the FAST ACTION operation in the Algerian Sector. A “new” station (i.e. station 9) was also decided in an intermediate point between Sardinia, Baleares and Algerian coastlines. The area interested by the dust load was confirmed by satellite observations, although for rain areas (required to have sufficient deposition at sea to be detectable at water), prediction models were not unanimous. The discussion with the Captain (as no authorizations were demanded for this area) conducted to fix the FAST Station southward of the Majorca Island, in the only very narrow corridor still considered as “International”. The PP? reached the FAST station the 2nd of June in the afternoon, and an intensive sampling was suddenly initiated. During the night between the 4th and the 5th of June, intense rain was detected by meteorological radar on the Iberian and Algerian sectors, moving toward the Balearic Sector (i.e. FAST station). Intense rain occurred at early morning of the 5th of June on the PP? location. The FAST ACTION was considered terminated the 7th of June.

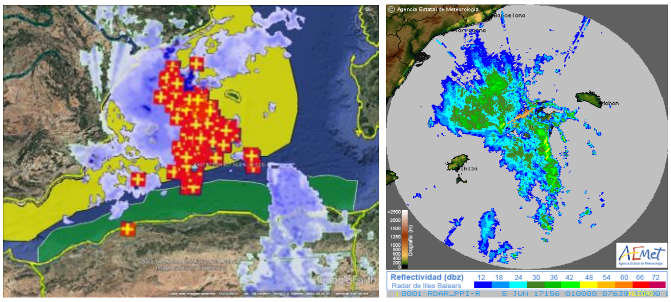

Figure 2. *Fast Action: Rain Radar observations for the 5th of June at 2h30 in the Western Mediterranean Sea.*

Interesting observations have been made during this Fast action, and this is one example showing the feedback of the deposition to the atmosphere. The continuous sampling during the FAST ACTION enabled to emphasize, the day after the rain, an increase in concentrations of several sulfur-containing gases and particles, as SO_2, MSA, Sulphate… which correspond to the products of reaction of atmospheric oxidation of DMS. This increase of concentrations was also associated to an event of formation of new particles (Figure 12). These preliminary results are maybe the first observations of a nucleation event linked to the production of DMS caused by the growth of phytoplankton after a rain dust event.

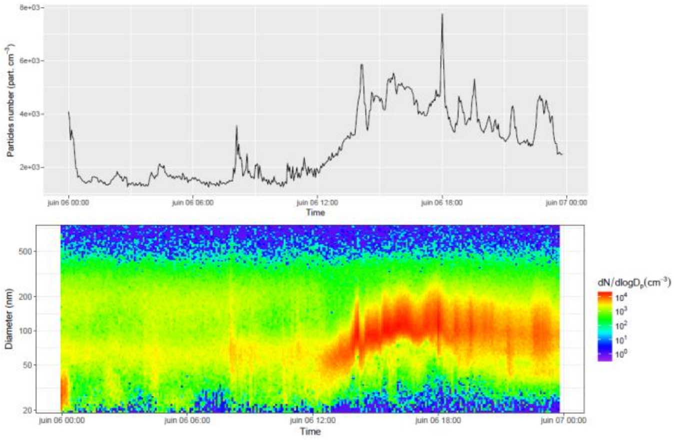

Figure 3. *Particle concentration during the day after the dust wet deposition event. The increase of concentration observed after 12:00 is associated with an increase of particle size, characterizing a nucleation event, i.e. the formation of new particles.*

Next step of the work is to finish analyse samples collected and interprete the numerous data acquired during the cruise both in situ (air and seawater) and from the Climate Reactors experiments. A goal of this was to improve the current biogeochemical modelling of the Mediterranean ecosystem. Unfortunately, this task was not funded (proposal PARIMED21 submitted to BNP-Paribas foundation, project preselected but not funded then). The modelling task will be done without fundings with the collaboration of colleagues from the LSCE (Samuel Albani, post doc Marie Curie with Yves Balkanski) and LOCEAN (Olivier Aumont. The first step of this work will be to work on the parameterization obtained from the Climate Reactors experiments conducted during the PEACETIME cruise in order to improve their representation in current PISCES biogeochemical modelling of the Mediterranean Sea.

9. *Outreach and Communication.*

Making science accessible to the general public, the young ones in particular, is a major goal of PEACETIME. We have develop several strategies to communicate to scientist and general public all along the project, and not only during the cruise.

First, building upon the outreach project and web platform "mon océan & moi" (monoceanetmoi.com), we are bringing to schoolchildren the PEACETIME science. We propose to develop science based-content focused on biogeochemical impacts of desert dust with dedicated resources. In addition, thanks to the numerous media types video, photo and audio acquired during the PEACETIME cruise, a video about the oceanographic observing tools is under preparation and will be part of the "mon ocean & moi" ressources. Within the "mon océan & moi" project, the initiative "adopt a float" is also used to invites schoolchildren to adopt the autonomous profiling floats deployed during the PEACETIME cruise, follow their journeys, interpret their measurements and share experiences with scientists and other students.

Secondly, Thomas Jessin (LOV) have developed a dedicated website for the project with a strong focuss on the oceanographic campaign http://peacetime-project.org/. Before the campaign a twitter account was launched in order to inform daily about the activities on board: 114 tweets were posted during the cruise and we were followed by at least 130 subscribers but much more if we consider that twitter is open to anybody without an account. A book of a selection of the tweets posted during PEACETIME is currently under preparation and anyone interested will be able to order a copy.

PEACETIME EVENTS LOG

STATION	TYPE	CAST	YEAR	MONTH	DAY	HOUR	MIN	LAT Degree	LAT MIN	LON Degree	LON MIN
ST01	CTD	1	2017	5	12	4	32	41	53.51	6	20.00
ST01	CTD	2	2017	5	12	5	38	41	53.51	6	20.00
ST01	CTD	3	2017	5	12	6	43	41	53.51	6	20.00
ST01	TMC	1	2017	5	12	10	26	41	53.51	6	20.00
ST01	CTD	4	2017	5	12	15	3	41	53.51	6	20.01
ST01	CTD	5	2017	5	12	15	27	41	53.51	6	20.00
ST01	CTD	6	2017	5	12	16	21	41	53.51	6	20.00
ST02	CTD	7	2017	5	13	4	36	40	30.37	6	43.79
ST02	TMC	2	2017	5	13	5	40	40	30.37	6	43.79
ST02	CTD	8	2017	5	13	8	57	40	30.37	6	43.79
ST03	CTD	9	2017	5	14	4	13	39	8.00	7	41.01
ST03	TMC	3	2017	5	14	5	27	39	8.00	7	41.01
ST03	CTD	10	2017	5	14	8	9	39	8.00	7	41.01
ST03	TMC	4	2017	5	14	10	5	39	8.00	7	41.01
ST04	CTD	11	2017	5	15	3	50	37	58.97	7	58.65
ST04	TMC	5	2017	5	15	5	9	37	58.99	7	58.61
ST04	CTD	12	2017	5	15	7	56	37	58.99	7	58.61
ST05	TMC	6	2017	5	16	2	4	38	57.19	11	1.40
ST05	CTD	13	2017	5	16	3	50	38	57.19	11	1.40
ST05	CTD	14	2017	5	16	5	55	38	57.19	11	1.40
TYR	CTD	15	2017	5	17	2	58	39	20.38	12	35.55
TYR	TMC	7	2017	5	17	4	9	39	20.40	12	35.57
TYR	TMC	8	2017	5	17	7	36	39	20.42	12	35.66
TYR	CTD	16	2017	5	17	9	54	39	20.44	12	35.72
TYR	CTD	17	2017	5	17	18	59	39	20.39	12	35.57
TYR	CTD	18	2017	5	18	2	57	39	20.39	12	35.57
TYR	CTD	19	2017	5	18	4	45	39	20.39	12	35.57
TYR	CTD	20	2017	5	18	8	56	39	20.39	12	35.57
TYR	CTD	21	2017	5	18	18	57	39	20.40	12	35.55
TYR	CTD	22	2017	5	19	2	53	39	20.38	12	35.56
TYR	TMC	9	2017	5	19	3	53	39	20.38	12	35.56
TYR	CTD	23	2017	5	19	4	40	39	20.38	12	35.56
TYR	CTD	24	2017	5	19	19	1	39	20.38	12	35.57
TYR	CTD	25	2017	5	20	2	45	39	20.37	12	35.57
TYR	CTD	26	2017	5	20	4	24	39	20.37	12	35.57
TYR	CTD	27	2017	5	20	8	15	39	20.37	12	35.58
TYR	CTD	28	2017	5	20	18	55	39	20.37	12	35.58
ST06	CTD	29	2017	5	22	2	56	38	48.46	14	29.97
ST06	TMC	10	2017	5	22	3	48	38	48.46	14	29.98
ST06	CTD	30	2017	5	22	5	57	38	48.46	14	29.98
SAV	CTD	31	2017	5	23	9	47	37	50.42	17	36.05
ST07	TMC	11	2017	5	23	19	11	36	39.49	18	9.29

ST07	CTD	32	2017	5	23	21	49	36	39.49	18	9.29
ST07	CTD	33	2017	5	24	2	58	36	36.21	18	9.95
ION	CTD	34	2017	5	24	15	5	35	29.38	19	46.51
ION	CTD	35	2017	5	25	2	20	35	29.35	19	46.57
ION	CTD	36	2017	5	25	2	34	35	29.35	19	46.57
ION	TMC	12	2017	5	25	3	28	35	29.35	19	46.57
ION	CTD	37	2017	5	25	5	37	35	29.35	19	46.57
ION	CTD	38	2017	5	25	10	19	35	29.35	19	46.57
ION	TMC	13	2017	5	25	13	43	35	29.35	19	46.57
ION	CTD	39	2017	5	25	18	55	35	29.35	19	46.59
ION	CTD	40	2017	5	26	2	25	35	29.35	19	46.59
ION	CTD	41	2017	5	26	3	53	35	29.29	19	46.79
ION	CTD	42	2017	5	26	12	29	35	29.35	19	46.59
ION	CTD	43	2017	5	26	18	59	35	29.35	19	46.58
ION	CTD	44	2017	5	27	2	26	35	29.35	19	46.59
ION	CTD	45	2017	5	27	3	52	35	29.35	19	46.59
ION	TMC	14	2017	5	27	6	24	35	29.35	19	46.59
ION	CTD	46	2017	5	27	8	19	35	29.35	19	46.59
ION	CTD	47	2017	5	27	18	44	35	29.35	19	46.59
ION	CTD	48	2017	5	28	2	21	35	29.35	19	46.59
ION	CTD	49	2017	5	28	3	45	35	29.35	19	46.59
ION	CTD	50	2017	5	28	12	3	35	29.35	19	46.59
ION	CTD	51	2017	5	28	18	32	35	29.35	19	46.58
ION	TMC	15	2017	5	29	7	19	35	21.64	20	0.53
ST08	CTD	52	2017	5	30	1	54	36	12.62	16	37.86
ST08	TMC	16	2017	5	30	2	48	36	12.62	16	37.86
ST08	CTD	53	2017	5	30	4	47	36	12.62	16	37.86
ST09	CTD	54	2017	6	1	17	17	38	8.08	5	50.45
ST09	TMC	17	2017	6	1	19	15	38	8.08	5	50.45
ST09	CTD	55	2017	6	2	2	2	38	8.08	5	50.44
FAST	CTD	56	2017	6	2	16	37	37	56.76	2	54.12
FAST	TMC	18	2017	6	2	17	16	37	56.76	2	54.12
FAST	CTD	57	2017	6	3	2	32	37	56.82	2	54.92
FAST	TMC	19	2017	6	3	3	33	37	56.82	2	54.92
FAST	CTD	58	2017	6	3	4	19	37	56.82	2	54.92
FAST	CTD	59	2017	6	3	8	1	37	56.82	2	54.92
FAST	TMC	20	2017	6	3	13	30	37	56.82	2	54.92
FAST	CTD	60	2017	6	3	18	30	37	56.82	2	54.91
FAST	CTD	61	2017	6	4	2	40	37	56.83	2	54.92
FAST	CTD	62	2017	6	4	4	42	37	56.83	2	54.92
FAST	CTD	63	2017	6	4	8	30	37	56.83	2	54.91
FAST	TMC	21	2017	6	4	18	57	37	56.82	2	54.92
FAST	CTD	64	2017	6	4	19	27	37	56.81	2	54.92
FAST	CTD	65	2017	6	5	2	44	37	56.81	2	54.98
FAST	CTD	66	2017	6	5	4	20	37	56.81	2	54.99

FAST	TMC	22	2017	6	5	6	54	37	56.81	2	54.99
FAST	CTD	67	2017	6	5	7	24	37	56.82	2	54.99
FAST	CTD	68	2017	6	5	8	51	37	56.79	2	55.01
FAST	CTD	69	2017	6	5	12	59	37	56.79	2	55.01
FAST	TMC	23	2017	6	5	13	50	37	56.79	2	55.01
FAST	CTD	70	2017	6	5	14	50	37	56.79	2	55.01
FAST	CTD	71	2017	6	5	16	53	37	56.79	2	55.01
FAST	CTD	72	2017	6	5	18	53	37	56.79	2	55.01
FAST	CTD	73	2017	6	6	2	2	37	56.80	2	55.01
FAST	TMC	24	2017	6	6	2	23	37	56.80	2	55.01
FAST	CTD	74	2017	6	6	2	51	37	56.79	2	55.01
FAST	CTD	75	2017	6	6	4	37	37	56.79	2	55.01
FAST	CTD	76	2017	6	6	9	25	37	56.80	2	55.01
FAST	CTD	77	2017	6	6	13	56	37	56.80	2	55.01
FAST	CTD	78	2017	6	6	17	2	37	56.80	2	55.00
FAST	CTD	79	2017	6	6	19	3	37	56.80	2	55.00
FAST	CTD	80	2017	6	6	21	2	37	56.80	2	55.00
FAST	CTD	81	2017	6	7	2	17	37	56.79	2	55.00
FAST	TMC	25	2017	6	7	3	38	37	56.79	2	55.00
FAST	CTD	82	2017	6	7	4	9	37	56.79	2	55.00
FAST	CTD	83	2017	6	7	8	58	37	56.80	2	55.00
FAST	CTD	84	2017	6	7	14	0	37	56.80	2	55.00
FAST	CTD	85	2017	6	7	17	13	37	56.80	2	55.00
ST10	CTD	86	2017	6	8	3	14	37	27.29	1	34.01
ST10	TMC	26	2017	6	8	4	55	37	27.42	1	34.02
ST10	CTD	87	2017	6	8	5	47	37	27.54	1	34.02
FAST	CTD	88	2017	6	8	19	18	37	56.81	2	54.96
FAST	TMC	27	2017	6	8	20	9	37	56.81	2	54.96
FAST	CTD	89	2017	6	8	20	39	37	56.81	2	54.96
FAST	CTD	90	2017	6	9	2	40	37	56.81	2	54.94
FAST	CTD	91	2017	6	9	4	33	37	56.81	2	54.94