

MERMEX

compiled by Cécile GUIEU

Notes:

Reporting Period is January 2012 – December 2012

Information will be used for: reporting, fundraising, networking, strategic development & outreach

1. Scientific highlights

Attenuation of UVR and PAR in relation with chromophoric dissolved organic matter in surface coastal waters of the Northwestern Mediterranean Sea

Radiometric and chromophoric dissolved organic matter (CDOM) measurements were performed monthly between November 2007 and December 2008 at a coastal station in the Northwestern Mediterranean Sea during MERMEX WP4 project. Surface irradiance ($E_s(\lambda)$) (Figure 1) strongly varied with season (particularly for UVR-B) and was from 0.14 to 4.6, 12 to 59 and 30 to 159 $\mu\text{W cm}^{-2}$ for UVR-B (305 nm), UVR-A (340 nm) and PAR (490 nm), respectively. Examination of the UVR-B/UVR-A, UVR-B/PAR and UVR-A/PAR surface irradiance ratios indicated that UVR-A and PAR were similar and evolved temporally. In contrast, the UVR-B increased 7 to 8 fold more than its UVR-A and PAR counterparts during the summer. The diffuse attenuation coefficients for downward irradiance [$K_d(\lambda)$] of UVR-B, UVR-A and PAR were from 0.21 to 0.48, 0.16 to 0.27 and from 0.04 to 0.09 m^{-1} , respectively. These values indicated that the waters were highly transparent throughout the year. These results suggest that during the summer, the higher relative abundance of UVR-B and the stratification of the water column promote photochemical reactions in the surface waters of the Bay of Marseilles. The relationships between CDOM absorption and $K_d(\lambda)$ in this oligotrophic system suggested that CDOM contributed to UVR attenuation in the UVA domain, but also played a significant role in PAR attenuation. [1]

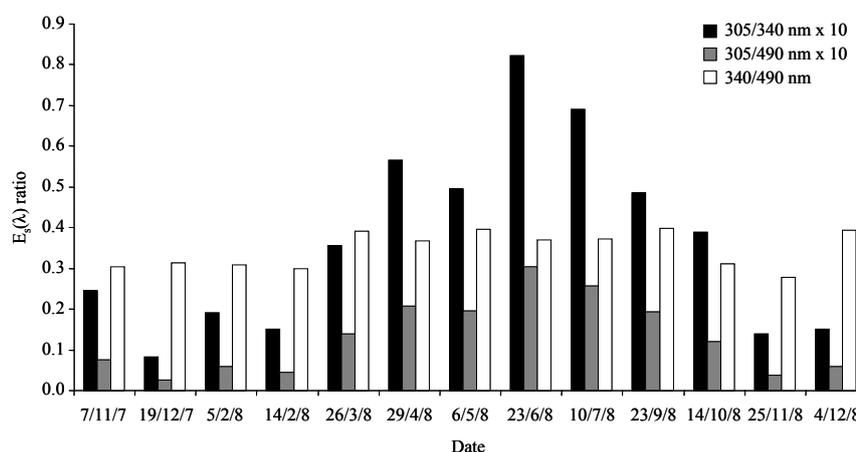


Figure 1. Temporal variability of surface irradiance [$E_s(\lambda)$] ratios measured at the SOFCOM station at solar noon, including UVR-B/UVR-A (305/340 nm), UVR-B/PAR (305/490 nm) and UVR-A/PAR (340/490 nm). The UVR-B ratios are multiplied by 10.

(contact : richard.sempere@univ-amu.fr)

[1] Para J., Tedetti M., Charrière B., Mallet M., Sempéré R., Attenuation of UVR and PAR in relation with chromophoric

dissolved organic matter in surface coastal waters of the Northwestern Mediterranean. Submitted.

2. Activities/main accomplishments (research projects, cruises, special events, workshops, remote sensing used, model and data intercomparisons etc)

Various activities of MERMEx program, via the WP4 are running in 2012 concerning:

1. The assessment of gas fluxes (CO₂) and acidification and the impacts on ecosystems and biogeochemical cycles, through different projects:

CALIBORON (CALibration of paleo-pH reconstruction technique based on **BORON** isotopes in calcareous species (corals and bivalves) from the Mediterranean Sea: quantification of surface water acidification due to industrial era; Eric.Douville@lsce.ipsl.fr). This project aims to develop and apply the paleo-pH technique based on boron isotopes for new specific calcifying species (bivalves and corals) for the reconstruction of recent past pH changes in the Mediterranean Sea. The first measurements of boron isotopes for Mediterranean shallow, deep-sea corals or red corals were conducted in 2012.

CARBORHONE (pCO₂ and DIC dynamics in the Rhone river estuary and the Gulf of Lions; Y. Bozec, bozec@sb-roscoff.fr). This project investigates the processes controlling the air-sea CO₂ fluxes from the inner Rhône estuary to the estuarine plume located in the surface waters of the Gulf of Lions. Two cruises have been carried out in 2012 covering the winter (February) and summer (July) periods, in complement of cruises of 2011 covering spring (April) and fall (early December) periods. This additional datasets allowed the determination of the physical, biological and chemical (mixing, NCP, thermodynamic) processes driving the air-sea CO₂ fluxes over an annual cycle. Collaborations with colleagues involved in the CASCADE and MERMEX-rivers (WP3) projects allowed further determination of the processes controlling the air-sea CO₂ dynamics, notably for the plume dispersal and processes occurring at the benthic interface. Moreover, our pCO₂ data has been made available for the SOCAT database (<http://www.socat.info/>) for a complete assessment of the role of estuarine plume on global estimates of air-sea CO₂ fluxes.

2. The study of aerosol fluxes at the interface air-sea which is coupled with the component ChArMEx of MISTRALS (Chemistry-Aerosol Mediterranean Experiment)

SAM (Quantification and determination of marine organic aerosol fluxes as a function of trophic conditions; B. D'Anna, barbara.danna@ircelyon.univ-lyon1.fr). A first lab experiment has been conducted in November 2012 for the measurements of primary marine particles (Number distribution of chemical, hygroscopic, volatile and CCN properties) and of trace gas fluxes (PTRMS). Fluxes of primary marine particles have been also measured during MedSea campaign in Corsica during this summer (dimensional spectra, CCN properties and chemical composition resolved in size).

3. The influence of solar radiations on biogeochemical cycles includes the potential effect of aerosol and tropospheric ozone attenuation on marine ecosystems.

PHOTOMED (Metabolic and structural changes of the bacterial community in response to the phototransformations of dissolved and particulate organic matter in Mediterranean Sea; joux@obs-banyuls.fr). Due to high solar radiation, Mediterranean Sea is the place of intense photochemical transformations of both DOM and POM. The consequences of these alterations on the metabolism and the diversity of the marine bacteria are explored in the PHOTOMED project. (1) Photodegradation of DOM from the Rhone River resulted in contrasting effects on both bacterial activity and diversity (DNA fingerprint)

depending of the dates: when a stimulation and a change in diversity were observed in March, no effects on both parameters were measured in June. Photodegradation of the phytoplanktonic DOM (*Chaetoceros* sp.) induced a decrease in the bacterial activity and a shift in the diversity. A detailed analysis of the diversity changes by pyrosequencing is in progress. (2) During irradiation of senescent cells of *Emiliania huxleyi* from non-axenic cultures experiments we measured the production of epoxyacids, attributed to the intervention of peroxygenases (enzymes allowing the bacteria to reduce the concentration of toxic hydroperoxides). These results confirm the role played by singlet oxygen in the transfer of photooxidation processes from phytodetritus to attached bacteria. It now remains to determine if this stress has a significant effect on the growth and diversity of attached bacteria.

SUNMEX (richard.sempere@univ-amu.fr). This project aims to determine the potential effect of aerosol and tropospheric ozone attenuation on marine ecosystems. In this purpose, simultaneous radiometric measurements of radiation in the atmosphere by sunphotometer (AERONET network) and in seawater by deploying of a mooring line (SUNMEX MIO buoy) allowing also the determination of biogeochemical parameters are carried out in the Bay of Marseilles. First results showed higher relative abundance of UVR-B among other radiations in the atmosphere in summer and allowed study of solar radiation attenuation by CDOM and Chlorophyll in the surface waters of coastal Med. Sea.



Figure 2: SUNMEX MIO buoy deployed in the bay of Marseille

- **New projects that started in 2012:**

CHIPIE: Comportement des éléments d'intérêt biogéochimiques et du carbone Particulaire aux Interfaces atmosphère-océan et continent-océan dans un contexte d'évolution des conditions Environnementales (guieu@obs-vlfr.fr). The objective of this project is to study the impact of climate and environment change (temperature, acidification) on the behavior of biogeochemical elements and particulate carbon at the atmosphere-ocean interface. The experimental approach ('clean minicosm in abiotic conditions') initiated at the end of the DUNE project (see Bressac, 2012) will be completed by temperature and turbulence controls and an integrated sampling system will be developed. Such developments are currently done in order to perform three experiments in 2013. A PhD started in fall 2012 (J. Louis, LOV) and 3 experiments are scheduled in 2013. (funding University Paris VI).

A working group started concerning the setting up of a proposal for a field cruise entitled **PEAcEtIME** "ProcEss studies at the Air-sEa Interface: a Mediterranean Experiment" (joint experiment between MERMEX and ChArMEx planned in 2015). This project was presented at the 2012 OSC to call for international collaboration on that "SOLAS cruise" in the Mediterranean, it will be submitted for funding at the autumn 2013.

. Human dimensions (outreach, capacity building, public engagement etc)

Several PhD are conducted under the actions presented above (1 CARBORHONE, 1 CALIBORON, 2 PHOTOMED, 1 CHIPIE, 4 MEDSEA mesocosms,

4. Top 10 publications in 2012 (Reports, ACCEPTED articles, models, datasets, products, website etc)

SOLAS NEWS issue 14, summer 2012:

- SOLAS ENDORSED PROJECT: MERMeX, p 53
- Bressac M., Dust deposition: the fate of atmospheric new nutrients, interactions with organic matter and the impact on carbon export. P6-7
- MedSea project: p 53-54

Website: <http://mERMEX.pytheas.univ-amu.fr>

5. International interactions and collaborations (including contributions to international assessments such as the IPCC, links with observation communities etc)

MedSea (EU FP7, started in February 2011, Mediterranean Sea Acidification in a changing climate. A first joint experiment using large pelagic mesocosms took place in Corsica (summer 2012) to assess the effects of ocean acidification on planktonic communities in oligotrophic areas (see article in this issue). Another experiment will take place in the Bay of Villefranche in Feb- March 2013. (see report in SOLAS NEWS issue 14, summer 2012).

eFOCE (BNP-Paribas, started in 2011, European Free-Ocean Carbon dioxide Enrichment experiments: development of benthic experimental systems to study the effects of ocean acidification of benthic communities in the field (Bay of Villefranche, Mediterranean Sea); started in 2011; J.-P. Gattuso, gattuso@obs-vlfr.fr.)

6. Goals, priorities and plans for future activities/events

In 2013, all the described actions will be continued. Several experiments are scheduled (CHIPIE, MedSea etc.). An important focus will be the drafting of a proposal for the PEACETIME cruise project; several group meetings are scheduled to prepare this proposal.

7. Other comments

The activities of MERMEX deal in part with natural and anthropogenic air-sea interactions (those activities being the WP4 coordinated by Frédéric Gazeau (gazeau@obs-vlfr.fr), LOV/OSU Villefranche/Mer, Karine Desboeufs (Karine.Desboeufs@lisa.univ-paris12.fr), LISA/IPSL Paris and Marc Mallet (Marc.Mallet@aero.obs-mip.fr), LA/OMP Toulouse. Those projects are strongly connected to IGBP-SOLAS programs and operationally connected to CharMex (The Chemistry-Aerosol Mediterranean Experiment; <http://charmex.lsce.ipsl.fr>) and MOOSE (Mediterranean ocean observing system on environment. <http://www.insu.cnrs.fr/co/expeditions-et-campagnes/moose-mediterranean-ocean-observing-system-on-environment>)

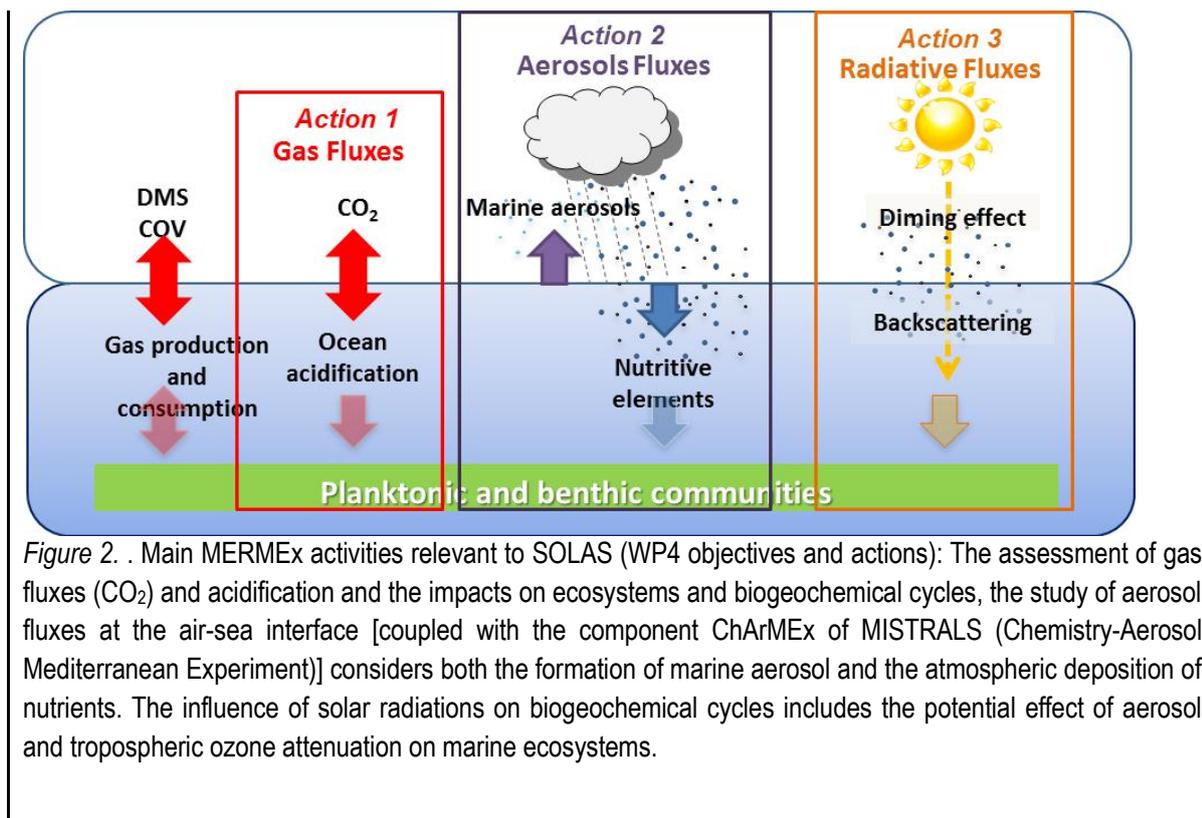


Figure 2. . Main MERMEEx activities relevant to SOLAS (WP4 objectives and actions): The assessment of gas fluxes (CO₂) and acidification and the impacts on ecosystems and biogeochemical cycles, the study of aerosol fluxes at the air-sea interface [coupled with the component ChArMEx of MISTRALS (Chemistry-Aerosol Mediterranean Experiment)] considers both the formation of marine aerosol and the atmospheric deposition of nutrients. The influence of solar radiations on biogeochemical cycles includes the potential effect of aerosol and tropospheric ozone attenuation on marine ecosystems.