

BELGICA CRUISE 2010-23
REPORT
13th – 16th September 2010

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Program identification	:	2010-08 : AMORE (“ESA-ROUSSEAU”) 2010-23 : BELCOLOUR-2 (“BMM-RUDDICK”) 2010-11 : SHIPFLUX (UA-BENCS / UA-LB)

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1. GENERAL FORM BELGICA 2010

1.	Cruise N°	2010-23
2.	Date/Time ETD Zeebrugge ETA Zeebrugge	Monday 13/09 10:30 Thursday 16/09 14:00
3.	Chief scientist Participating institutions	Kevin Denis MUMM, ULg: BELCOLOUR-2 UMONS: AMORE UA-LB (UA-BENCS / UA-LB) ULB (DSTE): BELISSIMA
4.	Area of investigation DIPCLEAR necessary?	Belgian continental shelves. No
5.	Scientific Personnel	10
6.	Intervention? - Navy divers - Navy medical assistance - Pilots	None
7.	Infrastructure needed on the quay or onboard for the embarkation or disembarkation of equipment? Embarkation Zeebrugge Disembarkation Zeebrugge	Ship's crane 13/09 08:00-10:30 16/09 14:00-16:00
8.	Logistic assistance MUMM? SCTD, data acquisition (ODAS) or else?	ODAS, SCTD, OURS start-up.
9.	<u>Remarks</u>	
1st Responsible : Kevin Denis		

Standard remarks c/o MUMM - Measurement Service Oostende :

- i) All scientists involved in deck operations are to wear appropriate safety clothing such as safety shoes/boots, gloves etc.. Only safety helmets are available on board.
- ii) Please note that scientists are invited to bring their own GSM. The Belgica GSM shall be made available only in exceptional circumstances such as communications related to operational aspects of the ongoing cruise (e.g. calls to MUMM concerning ODAS) and in case of an emergency.
- lii) All participants are requested to settle their accounts aboard in Euro (small bills please). Checks are no longer accepted, and neither credit cards nor proton facilities are available.
- iv) Following governmental regulations, as from January 1st 2006 smoking inside the ship is entirely prohibited. Please refer to the information posted on the message board inside the ship for the dedicated smoking areas on the outer decks.

2. SCIENTIFIC PERSONNEL

Table 1: participants of Belgica cruise 2010/23

Name	Institution-Team	13-16/09
DENIS Kevin (*)	UMONS - EcoNum	X
NEUKERMANS Griet (*)	MUMM	X
VANHELLEMONT Q.	MUMM	X
VANTREPOTTE Vincent	ULCO (guest MUMM)	X
PARK YoungJe	CSIRO (guest MUMM)	X
BENCS Laszlo (*)	UA	X
HOREMANS Benjamin	UA	X
CHAMPENOIS Willy (*)	ULg/BELCOLOUR-2	X
DEPOORTER Mathieu (*)	ULB - DSTE	X
BOEREBOOM Thierry	ULB - DSTE	X
TOTAL		10

(*) team leader

3. SCIENTIFIC OBJECTIVES

Introduction

This cruise report is a summary of the scientific activities of participants to Belgica cruises 2010/23. More details on scientific results could be obtained by contacting directly scientific team leaders (as indicated in Table 1).

Global objectives

UMONS – EcoNum

The research project AMORE-3 seeks to contribute to the development of Sustainability Science for the management of coastal zones. In particular AMORE-3 address the dual control of changing human activity and climate on eutrophication processes in the Belgian coastal zone and the feedback effect of eutrophication on goods (newly-deployed offshore mussel farming) and services (atmospheric CO₂ absorption) provided by the Belgian coastal zone.

UMONS will test the FlowCAM, a real-time digital imaging flow cytometry in field conditions, and more particularly the possibility for continuous measurements and real-time analysis of natural phytoplankton communities present in spring in the Southern Bight of the North Sea. Tests will be performed by pumping seawater directly in the FlowCAM along transects realized between sampling stations.

BELCOLOUR-2 : MUMM + CSIRO + ULCO + ULg

The general objective of the BELSPO-funded BELCOLOUR-2 project is to improve the quality of existing optical remote sensing products for marine, coastal and inland waters based on new scientific knowledge and to develop new products (including partial pressure of CO₂ and primary production) for key applications such as aquaculture and air-sea CO₂ flux quantification. In addition to algorithm work and image processing BELCOLOUR-2 participates in seaborne cruises for the purposes of calibration of algorithms and for validation of the end products. The primary objectives of this campaign are making in-situ measurements simultaneous with satellite overpasses of MERIS (Medium Resolution Imaging Spectrometer) and MODIS (Moderate Resolution Imaging Spectrometer), measurements of a very detailed set of apparent and inherent optical properties (optical closure, characterization of specific inherent optical properties for use in algorithm calibration/evaluation) and measurement of carbon-related parameters (partial pressure of CO₂, primary production).

The ULg team will participate in this cruise to analyze dissolved oxygen, pH and total alkalinity as well as continuous measurements of pCO₂ at each BELCOLOUR-2 station.

The *Université Littoral Côte d'Opal* (ULCO) will participate in this cruise through an *ad hoc* collaboration in optical property measurements and POC.

The CSIRO Land & Water Environmental Earth Observation Group (Australia) will participate in this cruise in the framework of the BELCOLOUR-2 project to make underwater light measurements.

SHIPFLUX (UA-LB)

The aim of the SHIPFLUX project is (1) to study the dry and wet deposition of ship-traffic pollutants (e.g. heavy metals and some gaseous/solid phase nutrients and persistent organic pollutants (POPs)) over the coastal waters of the Southern North Sea and at a coastal spot of the Belgian coast (De Haan), by means of atmospheric gaseous, aerosol, and precipitation samples, (2) to compare and understand temporal and seasonal differences in these atmospheric pollutant fluxes over North Sea waters. The methodology is based on combining atmospheric measurements and computer-based model calculations. Measurements of

relevant gaseous and particulate species will be carried out over sea during certain research cruises, aiming to collect a sufficient sample of observations for establishing a representative view on pollutant concentrations over the marine region under study. For the sampling of atmospheric gases, aerosols and precipitation, denuders (e.g. for HNO₂, HNO₃, NH₃), automatic air-quality monitors (e.g., for NO_x, SO₂, and O₃), and low (for metals) and high (for POPs) volume aerosol samplers, and rainwater samplers will be applied. For the analysis of various chemical species, X-ray spectrometric and chromatographic analytical methods will be applied. The acquired atmospheric data, including precise geo-location determined by a GPS and temporal information, will then be used to validate computer simulations performed by means of atmospheric models.

ULB (DSTE): BELISSIMA

The BELISSIMA (*Belgian Ice Sheet – Shelf Ice Measurements in Antarctica*) project aims at improving our understanding and prediction of the cryospheric contribution to future sea level rise. The objectives are twofold: i) to investigate the deglaciation history and stability of ice rises (points where the ice shelf gets buttressed), and (ii) to investigate the role of ice-ocean interactions in the stability of the ice sheet – ice shelf system. The project is within the framework of the newly established Princess Elisabeth Station (Antarctica) and the studied area is situated on the coastal stretch (Princess Ragnhild Coast, Dronning Maud Land), 180 km north from the research station, where a number of distinct ice rises have been identified. Field investigations are based on ground based ice-penetrating radar (Radio-echo sounding), differential GPS, ice core drilling and CTD logging. A multi-parametric analysis of the physical and chemical properties of the ice is carried out on the acquired samples. RES, D-GPS and CTD data are analysed using state-of-the-art techniques and modelling tools. This campaign on the Belgica aims at testing the newly acquired CTD system in order to have it under control for the coming 2010-11 Antarctic expedition.

4. AREA OF INVESTIGATION – SAMPLING STATIONS

All coordinates of sampling stations are provided in table 2 and figure 1.

Table 2: *Coordinates of stations for Belgica cruise 2010/23. (*) indicates stations not sampled because of bad weather conditions.*

Station	LAT (N) Deg Min	LON (E) Deg Min	State
W01	51° 22.50'	3° 11.25'	B
W02	51° 13.50'	2° 51.50'	B
W03	51° 10.10'	2° 42.83'	B
W04	51° 25.10'	3° 15.15'	B
W05	51° 25.00'	2° 48.50'	B
W06	51° 15.80'	2° 28.10'	B
W07	51° 35.00'	3° 00.50'	B
W08	51° 27.50'	2° 21.00'	B
W09 (*)	51° 45.00'	2° 42.00'	B
W10 (*)	51° 41.00'	2° 25.00'	B
130	51° 16.25'	2° 54.30'	B
150	51° 25.00'	3° 03.00'	B
230	51° 18.50'	2° 51.00'	B

MH1 (*)	51° 38.03'	2° 33.68'	B
B&W S1	51° 25.31'	3° 2.92'	B

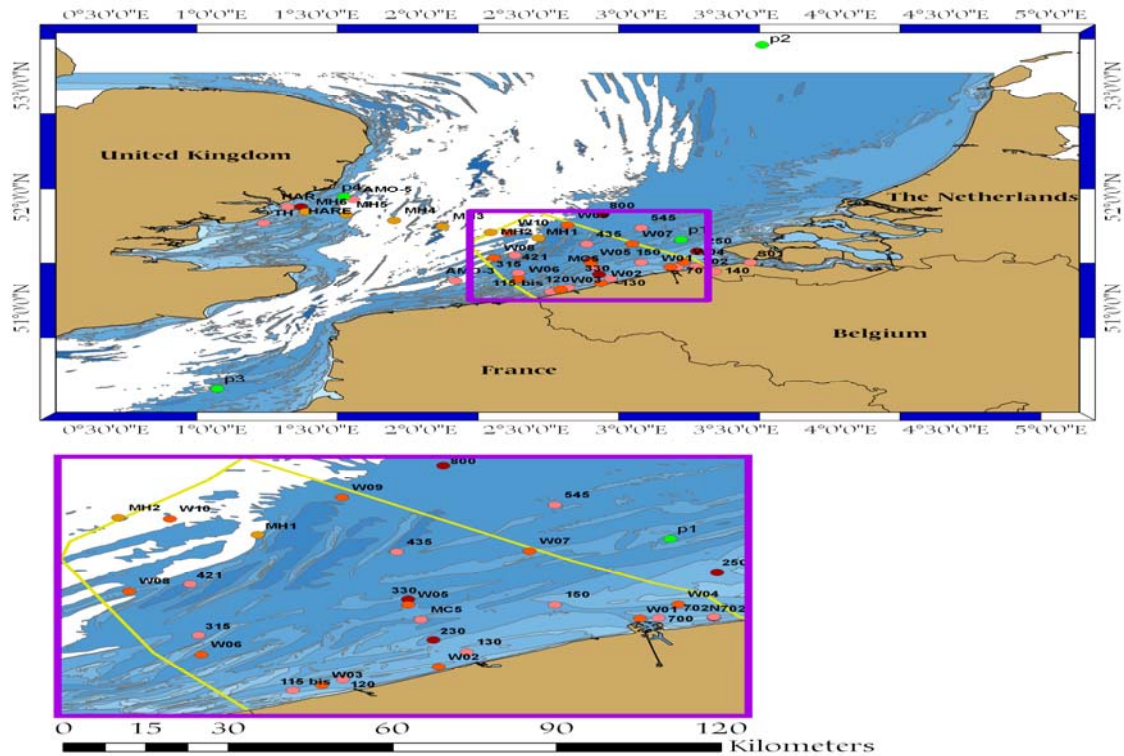


Figure 1: Location of initial stations for sampling during Belgica cruise 2010/23.

5. OPERATIONS

5.1. General conditions

The geographical coverage of the cruise was the Belgian Coastal Zone (BCZ).

Different material problems occurred during this cruise:

- the OURS system wasn't functional,
- the SeaCAT profiler didn't communicate with the computer room,
- there wasn't enough talkie-walkie on board
- the LISST of MUMM wasn't operational and was replaced by an other one.

In addition, it wasn't possible to get information from satellites because of clouds present at overpass time excepted at an additional station called station 1023.

Moreover, because of bad weather conditions, some modifications have been performed in the original program in order to sample as much stations as possible:

Monday 13 September

- The departure has been delayed for more than 2 hours in order to replace the LISST of MUMM by the LISST of VLIS/ILVO (Oostende).
- The tidal cycle begun at 15h and not at 12h00 as planned because of the delayed departure.
- The tidal cycle was stopped at 18h00 because of bad weather which compromised the sampling with niskin bottles and the “grappe optique”.

Tuesday 14 September

Because of bad weather conditions, it wasn't possible to navigate to W09 and MH1. After the station W07, the Belgica returned close to the coast to sample W02 and W03 stations.

Wednesday 15 September

Because of bad weather conditions, it wasn't possible to sample 3 stations: W09, W10 and MH1. After the station W08, W05 station were sampled and the Belgica returned close to the coast.

Thursday 16 September

Because W05 was sampled the day before, only stations 130 and 230 were sampled on Thursday.

5.2. Sampling description (list and sequence)

UMONS - EcoNum

- ODAS print: start sampling
- Sampling surface seawater with a bucket
- Sample fixation with lugol 1%
- Parallel analysis of surface seawater using the FlowCAM coupled with the continuous pumping system (real-time phytoplankton communities analysis).
- ODAS print: stop sampling
- ODAS print: start transect
- Analysis of seawater using the FlowCAM coupled with continuous pumping system during

the transect between stations at normal speed (variation of phytoplankton communities).
 - ODAS print: stop transect

BELCOLOUR - ULg

- Rotation of Belgica, so that relative azimuth between the sun and the ship's prow is 135°, to then start the above water marine reflectance measurements (during 10 minutes).
- Surface water deployment of ULCO optics profiling package, with the LISST from the small A-frame.
- CTD profile with the SeaCAT, followed by water sampling at the surface with a 10L Nisking for ULg and ULCO (DOC+CDOM) samplings.
- Second Niskin surface water sampling for MUMM filtrations for suspended matter, phytoplankton pigments and turbidity.
- Water column profile with the ULCO optics profiling package .
- End of above water marine reflectance measurement.
- Start of CSIRO under water marine reflectance measurement with the HyperPro.

SHIPFLUX – (UA)

Sampling continuously air within each transect and at berth. Accordingly, the filters and the denuder tubes are changed when changing the cruise tack/berth. The length of the sampling cycle is also be taken into account to provide pollutant content high enough for the chemical analysis to be performed at the university.

ULB - DSTE

The SV48M Memory Probe (CTD) is turned on during all profile made with the SeaCat, it allows a comparison between the two CTD systems. Moreover, seawater surface will be taken as an offshore station.

BELCOLOUR - Satellite overpass

If not at a station during satellite overpass times (see Table 3), the ship should be stopped to make an additional measurement at the time of the overpass (only if cloud free). At that time, the position of the ship is less important.

Table 3: MERIS and MODIS overpass times for Belgian waters in UTC.

	MERIS overpasses (viewing angle)	MODIS aqua overpasses (viewing angle°)
13.09.2010	10:50 (24°)	11:55 (54°)
14.09.2010	10:19 (17°)	12:38 (10°)
15.09.2010	XXXXXXXXXXXX	13:20 (46°)
16.09.2010	10:56 (30°)	12:25 (27°)

5.3. Measured parameters

All times are given in local time (=UTC + 2 hours)

Continuous measurements of the SHIPFLUX program were done during all the cruise from Monday to Thursday.

Monday 2010-09-13

08:30 - 10:30: Embarkation Zeebrugge

- 12:50: Departure Zeebrugge
- 13:20: Station W01 [N 51 22.3330, E 3 11.3743]
 Sampling: Marine reflectance, ULCO optics, LISST, MUMM filtration, ULg, ULCO filtration, bucket, FlowCAM.
 Transit to B&W S1.
- 14:50: Station B&W S1 on anchor [N 51 25.5260, E 3 2.7006]
 Sampling: ULCO optics, LISST, MUMM filtration, ULg, ULCO filtration, bucket, FlowCAM
- 15:00: Beginning of MUMM tidal cycle.
- 18:00: Stop tidal cycle because of bad weather conditions.

Tuesday 2010-09-14

- 09:00: Station W04 [N 51 25.4110, E 3 14.7936]
 Sampling: Marine reflectance, MUMM filtration, ULg, ULCO filtration, CSIRO system, bucket, FlowCAM
- 09:50: Start transect between W04 and 150
- 11:00: Station 150 [N 51 25.1969, E 3 3.3552]
 Sampling: Marine reflectance, MUMM filtration, ULg, ULCO filtration, bucket, FlowCAM.
- 11:25: Start transect between 150 and W07
- 13:10: Station W07 [N 51 35.1180, E 3 0.3782]
 Sampling: Marine reflectance, MUMM filtration, bucket, FlowCAM
- 14:00: Start transect between W07 and W02
- 17:35: Station W02 [N 51 13.5240, E 2 51.5843]
 Sampling: Marine reflectance, MUMM filtration, ULg, bucket, FlowCAM
- 17:50: Start transect between W02 and W03
- 18:45: Station W03 [N 51 10.5990, E 2 43.2048]
 Sampling: Marine reflectance, ULCO optics, LISST, MUMM filtration, ULg, ULCO filtration, bucket, FlowCAM
 Anchor near Nieuport for the night

Wednesday 2010-09-15

- 09:00: Start transect between Nieuport and W06
- 11:05: Station W06 [N 51 15.7640, E 2 28.0504]
 Sampling: Marine reflectance, ULCO optics, LISST, MUMM filtration, ULg, ULCO filtration, CSIRO system, bucket, FlowCAM
- 11:35: Start transect between W06 and W08
- 13:50: Station W08 [N 51 27.8220, E 2 21.4343]
 Sampling: Marine reflectance, MUMM filtration, ULg, ULCO filtration, CSIRO

system, bucket, FlowCAM
Sea water taken for the ULB team

- 14:05: Start transect between W08 and W05
- 15:15: Station 1023 (satellite overpass) [51.4783 °N, 2.6365 ° E]
Sampling: Marine reflectance, MUMM filtration, ULg
- 16:50: Station W05 [N 51 24.6870, E 2 48.7269]
Sampling: Marine reflectance, MUMM filtration, bucket, FlowCAM
Anchor near Oostende for the night

Thursday 2010-09-16

- 08:55: Station 130 [N 51 16.2900, E 2 54.4108]
Sampling: Marine reflectance, ULCO optics, LISST, MUMM filtration, ULg,
ULCO filtration, bucket, FlowCAM
- 09:10: Start transect between 130 and 230
- 09:40: Station 230 [N 51 18.5150, E 2 51.0146]
Sampling: MUMM filtration, ULg, ULCO filtration, CSIRO system, bucket,
FlowCAM
- 09:55: Start transect 230 – Zeebrugge
- 11:40: Arrival to Zeebrugge

6. LABORATORIES

Microbiology: FlowCAM (UMONS) and storage of material of UA and ULB
Biology: MUMM, ULCO
Chemistry: ULg
Wetlab: AC9, computers (MUMM, ULCO), pumps for the FlowCAM
Bridge: Computer for optics data acquisition (MUMM)
BC monitor for continuous monitoring of air (UA)

7. ACHIEVEMENTS OF OBJECTIVES AND PROBLEMS

The officers and crew of the RV Belgica are greatly acknowledged for their cooperation, their assistance during all the Belgica cruise 2010/23.

AMORE III - UMONS

In the frame of the AMORE III project, UMONS team develops a system to automatically recognize phytoplankton communities in real-time. This system is based on a digitization device (FlowCAM) and a software for the automatic identification of the images (Zoo/PhytoImage). One of the challenging goals is to analyze communities when the Belgica is in movement. For such application, UMONS has developed a system based on two peristaltic pumps and one tube in fibreglass used to inject surface seawater directly in the FlowCAM. This system should allow the scientists to analyze phytoplankton communities along transects in the North Sea.

Since the last Belgica cruise in July 2010, UMONS team is able to digitize phytoplankton communities at normal speed of the boat using this pumping system (7- 11 knots). In July, the weather conditions were very good and no problems occurred with the system. The system

had thus to be tested in difficult conditions. The conditions of the Belgica cruise of September 2010 were thus perfect to test the full system of automatic recognition.

The pumping system works perfectly in bad weather conditions. This is an unexpected result which means that the system of automatic recognition can be used until 9 beaufort of wind and tides from 3 to 4 meters. In these conditions, it was not always possible and sometimes dangerous to sample with a niskin bottle or a bucket. The FlowCAM coupled with Zoo/PhytoImage offers thus a good alternative to traditional sampling procedures.

In addition, different transects have been realized during this cruise in order to analyze changes in communities between contrasted stations. First results already indicates changes in water columns.

Lastly, new acquired images will be used to increase the ability of the system to automatically recognize the different species digitized with the FlowCAM.

It is thus possible to analyze phytoplankton in real-time and when the Belgica navigates in the North even if weather conditions are difficult.

BELCOLOUR-2

MUMM – ULCO

During this campaign, BELCOLOUR sampled at 16 stations. An overview of sampling activities is given in Table 4. No CTD casts were done due to communication problems between the CTD and the Seasave software in the computer room. The 13h tidal cycle sampling at station BWS1 was aborted after 4 hours, due to worsening of the weather, to the point where the ULCO optics package could not be deployed safely anymore. Because of bad weather conditions, the ULCO optics package could not be deployed at 8 stations. One match-up candidate with the MODIS Aqua satellite was sampled on September 19th, where the cloud cover had decreased to 3/8. Due to almost continuous overcast skies no other match-ups were sampled. Due to almost continuous bad weather (high waves, strong currents), the full BELCOLOUR sampling scheme could only be carried out at one station (W06).

Table 4: Overview of BELCOLOUR sampling activities at 16 stations during Belgica cruise 10/23. Stations in bold is a potential match-up with MODIS Aqua. Time provided in UTC.

Station ID	Date	Time (UTC)	Lat (°N)	Lon (°E)	marine refl	ULCO optics	LISST	MUMM filtr	Ulg	ULCO filtr	CSIRO
W01	13-09-10	11:30	51.3793	3.1908	x	x	x	x	x	x	
BWS1-A	13-09-10	13:00	51.4249	3.0444		x	x	x	x	x	
BWS1-B	13-09-10	14:00	51.4261	3.0468		x	x	x		x	
BWS1-C	13-09-10	15:00	51.4262	3.0467		x	x	x		x	
BWS1-D	13-09-10	16:00	51.4264	3.0466		x	x	x		x	
W04	14-09-10	7:10	51.4285	3.2466	x			x	x	x	x
150	14-09-10	9:05	51.4240	3.0495	x			x		x	
W07	14-09-10	10:58	51.5837	3.0067	x			x			
W02	14-09-10	15:34	51.2281	2.8628	x			x	x		
W03	14-09-10	16:44	51.1764	2.7195	x	x	x	x	x	x	
W06	15-09-10	9:05	51.2635	2.4642	x	x	x	x	x	x	x
W08	15-09-10	11:40	51.4594	2.3518	x			x	x	x	x
1023	15-09-10	13:15	51.4783	2.6365	x			x			
W05	15-09-10	14:46	51.4116	2.8102	x			x			
130	16-09-10	6:50	51.2719	2.9045	x	x	x	x	x	x	
230	16-09-10	7:45	51.3086	2.8497				x	x	x	

Ulg

All objectives of the BELCOLOUR 2010/23 campaign were reached. Underway pCO₂ measurements were carried out from 13/09/2010 12:30 to 16/09/2010 9:50 using the CUBE device (permanent installation on the *RV Belgica*).

At each BELCOLOUR-2 station, samples were collected for the determination of

- Total Alkalinity (TA)
- dissolved oxygen (DO)
- Transparent Exopolymer Particle (TEP)
- pCO₂

- CH₄
- N₂O

Comments:

The gases (CH₄, N₂O) weren't sampled at the points W05, and 1023 because the bad weather didn't allow us to use the Niskin bottle (Tab. 5).

Table 5: Stations sampled by ULg team

Station	date	time	Lon (°E)	Lat (°N)
W01	13/09/2010	11:29	3.114102	51.358250
B&W S1	13/09/2010	13:07	3.266700	51.254900
W04	14/09/2010	07:13	3.147970	51.256540
150	14/09/2010	09:03	3.33561	51.251560
W02	14/09/2010	15:35	2.516569	51.135970
W03	14/09/2010	16:47	2.433059	51.106550
W06	15/09/2010	09:10	2.279748	51.157850
W08	15/09/2010	11:54	2.214796	51.277860
W05	15/09/2010	14:50	2.488421	51.246780
1023	15/09/2010	13:29	2.385506	51.286420
130	16/09/2010	06:51	2.544261	51.162910
230	16/09/2010	07:42	2.509839	51.185180

CSIRO

CSIRO joined this Belgica 2010-23 cruise as part of activities for Belcolour-2 project. The water reflectance measured by CSIRO's Hyperpro II system is to be compared to the above-water measurements by MUMM team. The measurements of underwater light profiles will also derive vertical light attenuation coefficients, which is one of key parameters in ecosystem models.

Despite strong wind and current and rough condition, it was possible to collect data from four stations. Three of four measurements were made under overcast sky at stations W04, BW&S1 and 130 while the other data were collected under partially cloudy sky at station W06. All these are suspected to be affected bubbles generated by broken waves and strong wind. At first glance, the data at station W06 is reasonable and further analyzed and compared to the above water reflectance next week.

Good weather conditions and sunlight illumination are required for measurement using a free-falling radiometer like Satlantic HyperPro II. Operators need to prepare for strong current, which seems normal in Belgian coastal waters. The hyperPro II system needs two persons to operate – one for data acquisition in PC and the other for deploying the instrument. An efficient communication between the two is required. Ship orientation along up-current direction was good so that the deployment was made on the stern.

In this cruise I wasn't possible to collect many data due to harsh weather conditions. The acquired data will be processed and compared to above water reflectance measurements. Since light availability is one of key factors determining the phytoplankton growth, the underwater light profile measurement could be desirable wherever possible.

SHIPFLUX

During the cruise, atmospheric gaseous pollutants (HNO₂, HNO₃ and NH₃), size-segregated aerosols (PM₁, PM_{2.5}, and PM₁₀ fractions) and organic pollutants have been sampled, for 20- to 24-hour-long intervals. These sampling cycles were proven to be sufficiently long enough to ensure appropriate concentrations of pollutants (e.g., elemental fraction of aerosols to be

analyzed by energy dispersive XRF) on the samplers for chemical analysis. Moreover, the atmospheric concentration of elemental carbon (soot) was monitored in each 2 min with the application of an aethalometer. The air samples were taken at different intersects of the Belgian Coastal Zone, according to the modified schedule of the campaign indicated as above (point 5.1). This modification of the schedule was necessary due to the rather bad weather conditions prevailing during the cruise with 7-9 B° winds and high sea. Therefore, the atmospheric air samples were taken from marine areas mostly off the shipping lanes, or near coastal sites, which will also be useful as background data on atmospheric pollution. These aerosol-samples will be processed and analyzed for water-soluble ionic compounds, for total elemental content and for some important organic pollutants (e.g., polycyclic aromatic hydrocarbons) at the analytical chemical laboratory of the University of Antwerp. Unfortunately, one of the sampling instruments (annular denuder) had been broken (flaw: electric shortcircuit) on the second day of the cruise, possible due to the large amount of seaspray fallen over the railing of the bridge and flown inside the instrument.

BELISSIMA - ULB

Tests of the newly acquired CTD probe (SV48M Memory Probe) have been conducted successfully. The team took advantage of the recovering of water by Niskin bottles to cast their probe and log 10 to 20 meters of the water column each time.

Everything was working as it should : sensors, connecting wire and software.

In addition, 320 litres of water were pumped at station W08 through the internal seawater circuit. The water (34,79 PSU and 17,24°C) has been collected in touries of 50 and 30 liters.

8. CONTACT DETAILS

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