# Belgica Cruise Report 2011/13

Geology: 02/05/2011 – 06/05/2011


**Contact details:**

**DCP-KD:** FOD Economie, KMO, Middenstand en Energie - Dienst Continentaal Plat, Koning Albert II-laan 16, 1000 Brussel (tel. 32(0)2 2778411, mob. 32(0)473 345331, e-mail: koen.degrendele@economie.fgov.be)

**BMM-KR:** Beheerseenheid Mathematisch Model van de Noordzee, Gulledelle 100, 1200 Brussel (tel. 32(0)2/7732131, e-mail: k.ruddick@mumm.ac.be)


## 1. Cruise Details

| | |
|---|---|
| Vessel: | RV A962 BELGICA |
| Cruise number: | 2011-13 |
| Date/Time: | Zeebrugge 02/05, 13h30 departure<br>Zeebrugge 06/05, 13h30 arrival |
| Area: | Belgian Continental Shelf |
| Chief Scientist: | Koen Degrendele |
| Participating institutes: | FPS Economy, DGMR (annulled) and MUMM |

## 2. Participants

| NAME | Institute | 02-06/05/2011 |
|---|---|---|
| Koen DEGRENDELE | FPS Economy | X |
| Marc ROCHE | FPS Economy | X |
| Geneviève LACROIX | MUMM | X |
| Dimitry VANDERZANDE | MUMM | X |
| Valérie Dulière | MUMM | X |
| Jérôme HARLAY | ULg | X |
| Total number of participants | | 6 |

## 3. Scientific Objectives

**DCP-KD**

Implementation of the continuous investigation laid down in section 3, §2, subsection 3, of the law of June 13th 1969, concerning the exploration and exploitation of non living resources on the Belgian Continental Shelf, and the concession decisions.

The follow up of the repercussions of the sand extraction on the stability of the sand banks en surrounding area in the exploitation zones, in order to formulate policies concerning the exploitation in the concession zones on a scientific base. The sediments of the Belgian continental shelf will be investigated in order to:

1. Establish the impact of sand extraction on the sand budget and seabed sediments.
2. Survey the sand winning sites to detect significant changes of the seabed sediments and the morphology of the seabed and sand banks in order to guarantee the availability of sand to extract in the future.

**BMM-KR**

**BELCOLOUR-2: MUMM+ 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 $CO_2$ and primary production) for key applications such as aquaculture and air-sea $CO_2$ 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 main objective of this campaign is making measurements of $pCO_2$ and relevant biogeochemical (SPM, Chl) variables in waters characterized by different/contrasted salinity and turbidity in order to develop algorithms to derive synoptic $pCO_2$ fields from remote sensed data. During the campaign in-situ measurements should be realized as much as possible simultaneous with satellite overpasses of MERIS (Medium Resolution Imaging Spectrometer) and MODIS (Moderate Resolution Imaging Spectrometer).

**MUMM - FerryBox**

With the installation of the so-called “FerryBox”, the Belgica becomes one of the leading platforms in the field of autonomous measurements at sea. The system will provide the continuous measurement of salinity, temperature, dissolved oxygen, pH, plantpigments, turbidity, nutrients (nitrate, nitrite, phosphate and silica), $pCO_2$ and radiation. The system is fully integrated in the existing platform and the data will be available for all scientific institutes. The expected output is a major contribution to marine research with, in particular, the study of eutrophication and it’s effects, the development and testing of models, the research of climate change and ocean acidification. It can also be seen as the next step in the continuous monitoring of the marine environment.

## 4. Operational Course

*Local time (UTC+2)*

### Monday 2nd May

08:00-10:00: Arrival of participants;
Embarkation of equipment;
Departure delayed due to problems with GPS;

13:30: Departure from Zeebrugge;
Transit to the S01;

15:35-15:43: Station S01: BELCOLOUR-2 (BMM-KR);
16:35-16:43: Station 150: BELCOLOUR-2 (BMM-KR);
17:10-17:18: Station CH10: BELCOLOUR-2 (BMM-KR);
17:52-18:03: Station 700: BELCOLOUR-2 (BMM-KR);
18:47-18:55: Station CH08: BELCOLOUR-2 (BMM-KR);
20:01-20:08: Station 230: BELCOLOUR-2 (BMM-KR);

21:30: Belgica anchored near coast, weather conditions to bad for multibeam;

### Tuesday 3rd May

07:03-07:11: Station CH01: BELCOLOUR-2 (BMM-KR);
07:58-08:10: Station CH02: BELCOLOUR-2 (BMM-KR);
08:57-09:07: Station CH03: BELCOLOUR-2 (BMM-KR);
10:01-10:06: Station CH04: BELCOLOUR-2 (BMM-KR);
10:28-10:37: Station 130: BELCOLOUR-2 (BMM-KR);
12:30-12:39: Station 330: BELCOLOUR-2 (BMM-KR);
13:43-13:54: Station 435: BELCOLOUR-2 – MODIS matchup (BMM-KR);
15:35-15:44: Station 800: BELCOLOUR-2 – MODIS matchup (BMM-KR);
16:50-16:58: Station 545: BELCOLOUR-2 (BMM-KR);
18:37-18:46: Station 350: BELCOLOUR-2 (BMM-KR);
19:21-19:29: Station 250: BELCOLOUR-2 (BMM-KR);
Transit to the Thorntonbank;

21:15-00:45: Calibration of multibeam near Thorntonbank (DCP-KD);
Transit to the Vlaamse Banken;

### Wednesday 4th May

02:30-05:50: Multibeam surveying on KBMA (DCP-KD);
06:10-08:30: Multibeam surveying on R2 (DCP-KD);
08:55-11:50: Multibeam surveying on KBMB (DCP-KD);

12:21-12:28: MERA: BELCOLOUR-2 – MERIS matchup (BMM-KR);

12:50-16:45: Multibeam surveying on BRMA (DCP-KD);
17:00-19:45: Multibeam surveying on BRMC (DCP-KD);
20:00-22:50: Multibeam surveying on BRMB (DCP-KD);
23:15-01:45: Multibeam surveying on ODMA (DCP-KD);
Transit to MH1;

### Thursday 5th May

07:03-07:11: Station MH1: BELCOLOUR-2 (BMM-KR);

08:07-08:14: Station MH2: BELCOLOUR-2 (BMM-KR);
09:13-09:18: Station MH3: BELCOLOUR-2 (BMM-KR);
10:26-10:34: Station MH4: BELCOLOUR-2 (BMM-KR);
11:38-11:46: Station MH5: BELCOLOUR-2 (BMM-KR);
12:44-12:52: Station MH6: BELCOLOUR-2 (BMM-KR);
13:42-13:49: Station TH4: BELCOLOUR-2 (BMM-KR);
15:21-15:29: Station TH2: BELCOLOUR-2 (BMM-KR);
16:31-16:38: Station TH3: BELCOLOUR-2 (BMM-KR);
18:12-18:18: Station TH5: BELCOLOUR-2 (BMM-KR);
19:44-19:52: Station TH1: BELCOLOUR-2 (BMM-KR);
Transit to the Hinderbanken;

**Friday 6th May**

00:30-03:00: Multibeam surveying on HBMA (DCP-KD);
03:10-05:45: Multibeam surveying on HBMA (DCP-KD);
Transit to CH06;

09:35-09:42: Station CH06: BELCOLOUR-2 (BMM-KR);
10:20-10:26: Station CH07: BELCOLOUR-2 (BMM-KR);
11:17-11:35: TVP: BELCOLOUR-2 – High resolution vertical profile TriOS-microFlu (BMM-KR);
12:42-12:50: MERB: BELCOLOUR-2 – MERIS matchup – High resolution vertical profile TriOS-microFlu (BMM-KR);

13:00: End of measurements;
Transit to Zeebrugge;

13:30: Arrival in Zeebrugge;
Disembarkation of equipment and participants;

**End of campaign**

## 5. Results

**DCP-KD**

### 1. Calibration 03/05/2011

Installation parameters:

| | roll | pitch | heading |
|---|---|---|---|
| **SH1** | **34.42** | **0.75** | **358.96** |
| **SH2** | **-34.15** | **0.45** | **2.66** |
| **Att2** | **0** | **0** | **0** |

**Time delay:**

Lines:
0000_20110503_191356_Belgica.all
0002_20110503_193138_Belgica.all
0003_20110503_195228_Belgica.all

Time delay = 0.25;

**Roll and Pitch:**

Lines:
0004_20110503_202502_Belgica.all
0005_20110503_203715_Belgica.all
0006_20110503_204706_Belgica.all
0007_20110503_205929_Belgica.all
0008_20110503_212543_Belgica.all

Roll head 1: -0.15
Roll head 2: -0.15
Pitch head 1: 0.5
Pitch head 2: 0.5

**Heading:**

Lines:
0010_20110503_220125_Belgica.all
0011_20110503_222160_Belgica.all
0012_20110503_223804_Belgica.all

Head 1: 0.25
Head 2: 0.25

New installation parameters:

| | roll | pitch | heading |
|---|---|---|---|
| **SH1** | **34.42** | **0.75** | **358.96** |
| **SH2** | **-34.15** | **0.45** | **2.66** |
| **Att2** | **-0.15** | **0.5** | **0.25** |

### 2. KBMA1113

ZDA values are unusable;

Active Pos. system used as source for clock;
Time delay checked with line 0 and line 1: no change;

3. **R2_1113**

ZDA values are unusable;
Active Pos. system used as source for clock;

4. **KBMB1113**

ZDA values are unusable;
Active Pos. system used as source for clock;
Time delay check with lines 7 and 9: small delay of 0.5s?

5. **BRMA1113**

ZDA values are good;
ZDA used as source for clock;
Time delay check with lines 0 and 2: time delay OK

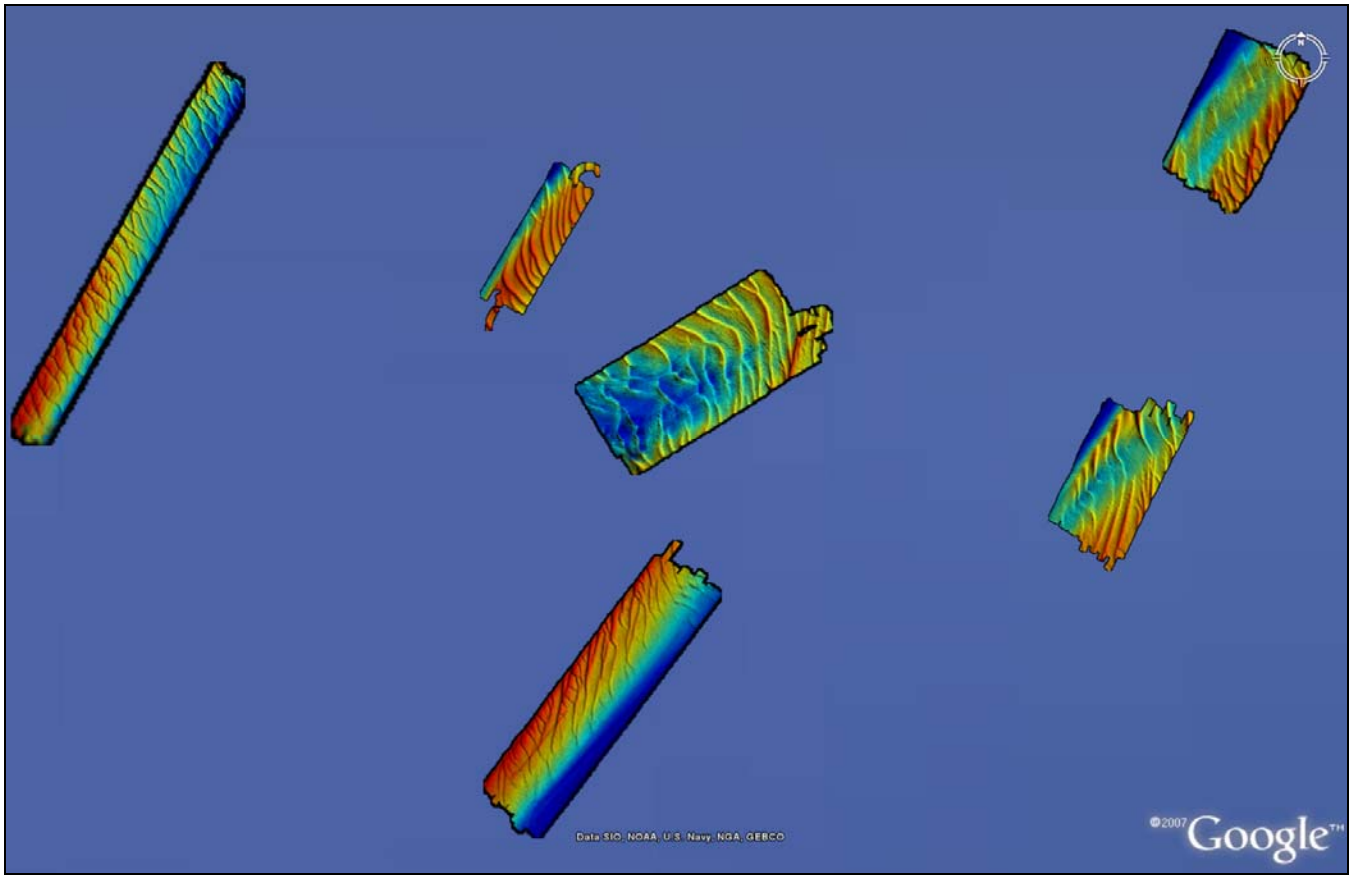
6. **BRMC1113**

ZDA values are good;
ZDA used as source for clock;

7. **BRMB1113**

8. **ODMA1113**

ZDA values are elevated;
ZDA used as source for clock;
Time delay check with lines 0 and 1: time delay +0.1s

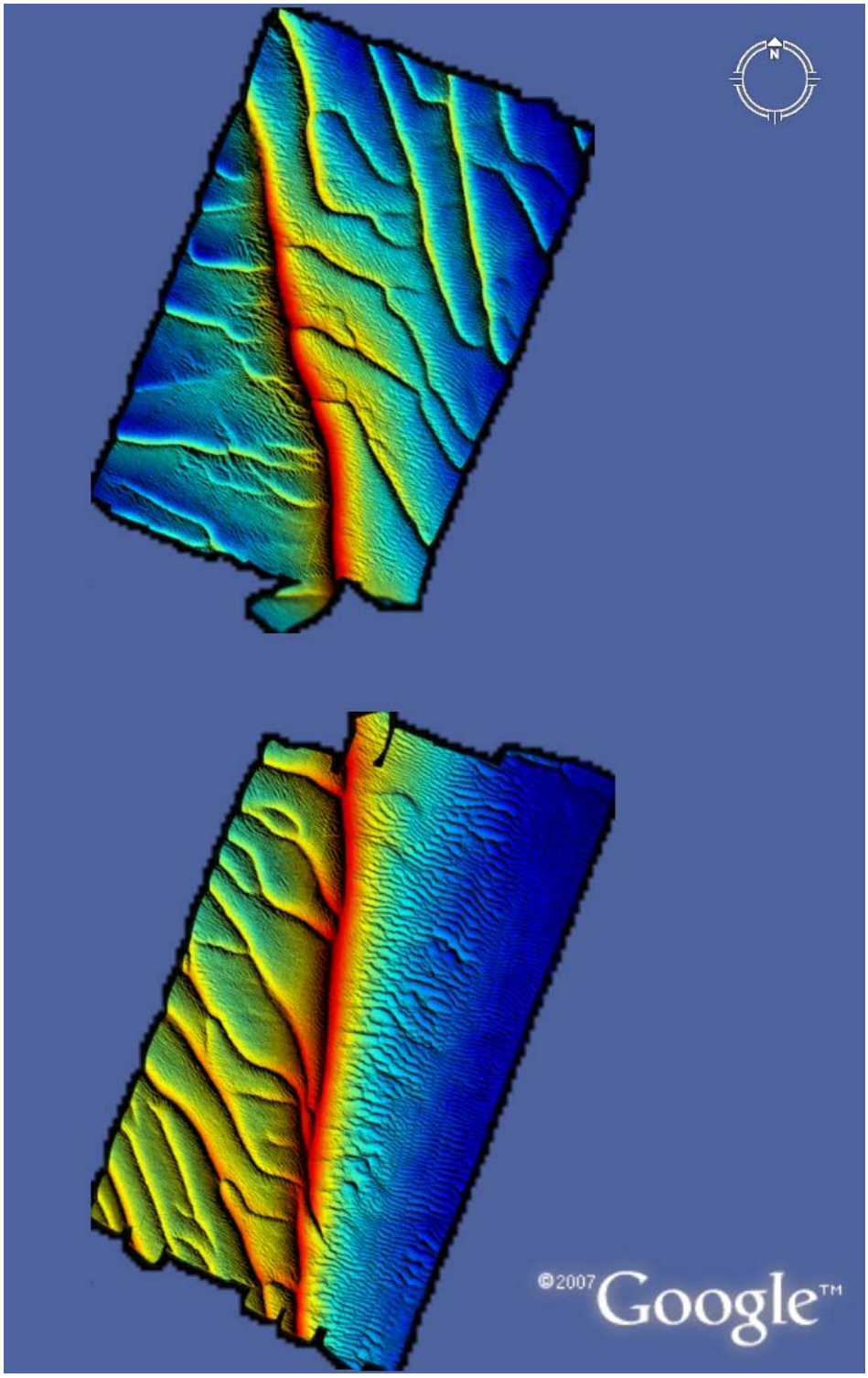


### 9. HBMA1113

ZDA values are good;
ZDA used as source for clock;
From line 12:
ZDA values are unusable;
Active Pos. system used as source for clock;
Time delay checked with lines 11, 12 and 13: no change;

### 10. HBMB1113

ZDA values are unusable;
Active Pos. system used as source for clock;



### Planned operations (Belcolour)

Due to some modifications regarding the initial plan cruise (cancellation of DGMR, additional stations requested by ULg, new instrumentation to test for MUMM), the design of the campaign has been adapted just before departure with all researchers.
Additional operations requested regarding the initial plan cruise:

- ULg requested 8 additional stations (denoted as CHXX) to cover the spatial gradients of transparent exopolymer particles concentration (TEP), total alkalinity (TA), dissolved oxygen ($O_2$), methane ($CH_4$) and nitrous oxyde ($N_2O$) along the Belgian coastal area.
- MUMM received two new TriOS-microFlu fluorometers just before the campaign. The standard microFlu-chl-Ti fluorometer is equipped with an ultra bright LED in pulsed mode with 460nm excitation and a sensor with 685nm detection, constructed for the detection of chlorophyll-a. The customized microFlu-chlX-Ti fluorometer is equipped with an ultra bright LED in pulsed mode with 430nm excitation and a sensor with 685nm detection, constructed for the detection of chlorophyll-c3. During this cruise the two fluorometers will be used to take the opportunity to test the functionality of the FerryBox by comparing the different chlorophyll-a measurements. Additionally the combination of the microFlu-chl-Ti and microFlu-chlX-Ti will be used to investigate the possibilities to distinguish between the presence of *Phaeocystis* and Diatoms.

The cruise plan was designed to allow:

- Daytime measurements for the BELCOLOUR-2 project at a range of stations in Belgian waters, along the “Harwich transect” in UK waters and near the Scheldt estuary mouth in Dutch waters as well as arbitrary places at the time of satellite overpasses. An estimated 23 stations were initially planned. Four possibilities of satellite overpasses had been identified.
- Simultaneous chemical measurements for the BELCOLOUR-2 project (ULg).
- TEP, TA, $CH_4$ and $N_2O$ measurements (ULg) at the 23 stations initially planned and 10 additional coastal stations including TriOS-microFlu and satellite overpasses (total 33 stations), $O_2$ determination at 29 stations (all stations except the last day for technical constraints, see below).
- High resolution vertical profile of TriOS-microFlu at station TVP to evaluate the degree of homogeneity of chlorophyll.
- Continuous measurements from FerryBox, ODAS and CUBE ($pCO_2$) during the whole campaign.

### Implementation of planned operations (Belcolour)

Weather conditions and efficient working allowed the operations to be implemented as planned for the BELCOLOUR-2. One station initially planned has been skipped (TH6) for a question of route efficiency and timing. 3 additional stations have been visited (2 for satellites match up (MERA, MERB) and 1 (TVP) for the TriOS-microFlu vertical profile) for BELCOLOUR-2. 8 additional stations have been visited for the TA, TEP and discrete dissolved gases determination (ULg). In total, 33 stations were sampled. The objectives of the campaign were totally fulfilled for BELCOLOUR-2 and additional measurements have been realized (details in respective team report).

## 1. Overview of measurement stations

The cruise log is given in Tables 3-7. An inventory of samples collected is given in Table 2. Figure 1 shows the stations sampled during the campaign. An overview of the metadata is given in table 8.

**Table 1. Samples taken on each station. Set of measurements: (a) CHL + TSM + Turbidity + Fluorescence in surface sampled water [MUMM], (b) TA + O2 + TEP + N2O + pCO2 + CH4 in surface sampled water [ULg], (c) TA + N2O + pCO2 + CH4 in bottom sampling water [ULg], (d) CTD + TriOS-microFlu (bottom, 3.5m, surface) [MUMM], (e) Secchi depth [MUMM], (f) General optical conditions [MUMM], (g) High resolution vertical profile of fluorescence with the TriOS-microFlu instrument [MUMM]. See below for a full description of measurements (a)-(g). Time & positions during surface sampling.**

| Date | Time (UTC) | Station | Lat (Deg, Min) | Lon (Deg, Min) | BELCOLOUR (MUMM/ULg) |
|---|---|---|---|---|---|
| 2 May 2011 | **13:43** | S01 | 51°25.0760 | 3°34.1639 | a, b, c, d, e |
| | **14:43** | 150 | 51°24.9440 | 3°23.9274 | a, b, c, d, e |
| | **15:18** | CH10 | 51°24.0020 | 3°20.1095 | b, c, d, e |
| | **16:03** | 700 | 51°22.5730 | 3°13.1579 | a, b, c, d, e |
| | **16:55** | CH08 | 51°21.9200 | 3°6.7759 | b, c, d, e |
| | **18:08** | 230 | 51°18.3410 | 2°51.0854 | a, b, c, d, e |
| 3 May 2011 | **05:11** | CH01 | 51°9.5960 | 2°35.1489 | b, c, d, e |
| | **06:10** | CH02 | 51°12.4660 | 2°40.1903 | b, c, d, e |
| | **07:07** | CH03 | 51°14.9160 | 2°46.3877 | b, c, d, e |
| | **08:06** | CH04 | 51°15.6840 | 2°51.0621 | b, c, d, e |
| | **08:37** | 130 | 51°16.2000 | 2°54.2708 | a, b, c, d, e |
| | **10:39** | 330 | 51°26.3230 | 2°48.3808 | a, b, c, d, e |
| | **11:54** | 435 | 51°34.8260 | 2°47.8200 | a, b, c, d, e, f |
| | **13:44** | 800 | 51°50.5530 | 2°52.6253 | a, b, c, d, e, f |
| | **14:58** | 545 | 51°43.5870 | 3°2.8586 | a, b, c, d, e |
| | **16:46** | 350 | 51°34.9940 | 3°15.3941 | a, b, c, d, e |
| | **17:29** | 250 | 51°31.2750 | 3°18.7807 | a, b, c, d, e |
| 4 May 2011 | **10:28** | MERA | 51°19.4920 | 2°39.2014 | a, b, c, d, e, f |
| 5 May 2011 | **05:11** | MH1 | 51°37.8100 | 2°33.2424 | a, b, c, d |
| | **06:14** | MH2 | 51°41.1970 | 2°19.8659 | a, b, d, e |
| | **07:18** | MH3 | 51°44.2820 | 2°6.2298 | a, b, d, e |
| | **08:34** | MH4 | 51°46.8630 | 1°52.0876 | a, b, d, e |
| | **09:46** | MH5 | 51°50.8330 | 1°38.4871 | a, b, c, d, e |
| | **10:52** | MH6 | 51°52.3830 | 1°27.0801 | a, b, c, d, e |
| | **11:49** | TH4 | 51°48.2520 | 1°18.0529 | a, b, c, d, e |
| | **13:29** | TH2 | 51°41.9220 | 1°27.6066 | a, b, c, d, e |
| | **14:38** | TH3 | 51°36.0400 | 1°18.3531 | a, b, c, d, e |
| | **16:18** | TH5 | 51°29.8770 | 1°0.1362 | a, b, c, d, e |
| | **17:52** | TH1 | 51°29.7600 | 1°26.3112 | a, b, c, d, e |
| 6 May 2011 | **07:42** | CH06 | 51°19.0780 | 2°56.8109 | b*, c, d, e |
| | **08:26** | CH07 | 51°20.5750 | 3°1.5816 | b*, c, d, e |
| | **09:35** | TVP | 51°26.9970 | 3°0.3324 | b*, c, d, e, g |
| | **10:50** | MERB | 51°23.1930 | 3°7.9565 | a, b*, c, d, e, f, g<br>* excl. $O_2$ |

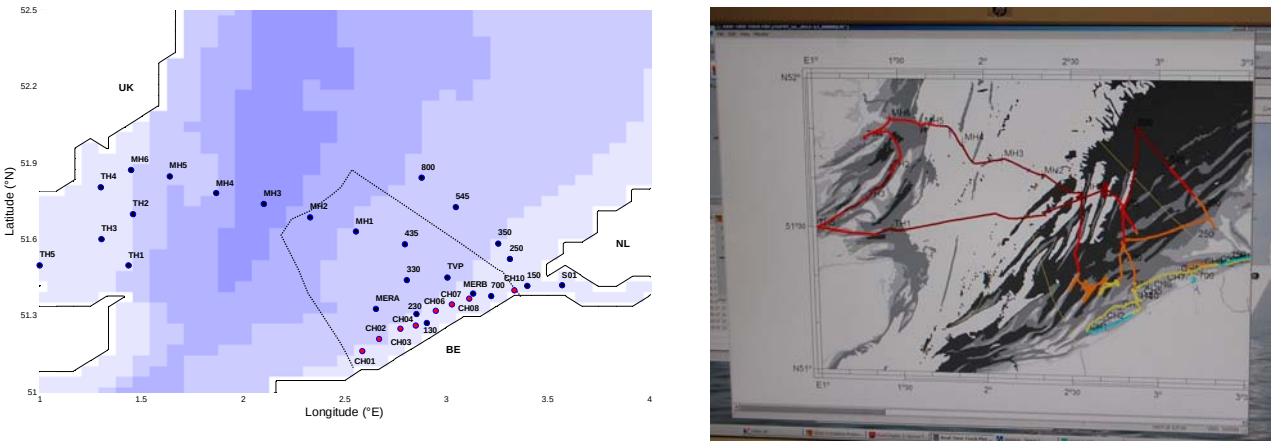



**Figure 1. Left: overview of the stations. Right: salinity track plot.**

- At 24 stations the following standard set of observations were made for the BELCOLOUR project:
  - One water sample (+/- 10l) was taken by Niskin at the surface and used to:
    **(a)** Filtration using GF/F filters (MERIS validation protocol) for analysis by MUMM of suspended particulate matter and HPLC pigments. Filters for HPLC analysis were stored onboard in liquid nitrogen. A subsample was used to measure turbidity (2100P ISO Turbidimeter and Aquafluor_A) and fluorescence (Aquafluor_B) at the beginning and end of filtrations.
    **(b)** Measurement by ULg of TEP, TA, $pCO_2$, $CH_4$, $N_2O$ and $O_2$.
  - **(c)** One water sample (+/- 10l) was taken by Niskin near the bottom for measurement by ULg of total alkalinity, Transparent Exopolymer particles (TEP), $pCO_2$, $CH_4$ and $N_20$, dissolved oxygen (excepted at stations MH1, MH2 and MH3 where depth was higher than the TriOS-microFlu cable length).
  - **(d)** In parallel to a CTD profile, measurements of fluorescence with the TriOS-microFlu have been realized close to the bottom, at 3.5m (depth of FerryBox uptake water) and at the surface.
  - **(e)** Secchi depth was measured (except at station MH1).
  - **(f)** General optical conditions (cloud cover and type, sun visibility, sea surface appearance) were noted for satellite matchups (435, 800, MERA & MERB).

- At 8 additional stations (CHxx), (b), (c), (d) and (e) measurements have been realized.

- At 1 additional station (TVP), (b), (c), (d) and (e) measurements have been realized and extra high resolution vertical profile of fluorescence was made with the TriOS-microFlu instrument **(g)**.

- Partial pressure of $CO_2$ ($pCO_2$) was recorded continuously during this cruise.

**Table 8 Metadata corresponding to locations of BELCOLOUR-2 stations. Time & positions during surface sampling. Flu-Chloro from FerryBox (avg during TriOS-microFlu measurements).**

| | | | | | | | | | | | | If possible matchup | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station | Date | Time (UTC) | Latitude | Longitude | Depth (m) | Wind (m/s) | Wind dir. | Sea T (°C) | Salinity (PSU) | Flu-Chloro (µg/l) | sol-rad (W/m²) | Waves (m) | Clouds (/8) | Sun state | secchi depth (m) |
| S01 | 02/05/2011 | **13:43** | 51°25.0760 | 3°34.1639 | 23.77 | 10.1 | 53.3 | 13.158 | 30.2701 | 10.41 | 839 | | | | 1 |
| 150 | 02/05/2011 | **14:43** | 51°24.9440 | 3°23.9274 | 15.04 | 10.5 | 42.9 | 12.9082 | 31.8718 | 21.41 | 673 | | | | 1.5 |
| CH10 | 02/05/2011 | **15:18** | 51°24.0020 | 3°20.1095 | 14.31 | 9.2 | 45.9 | 13.0188 | 31.1581 | 15.51 | 594 | | | | 1 |
| 700 | 02/05/2011 | **16:03** | 51°22.5730 | 3°13.1579 | 11.46 | 10.6 | 37.7 | 12.9858 | 31.3455 | 15.61 | 447 | | | | 1 |
| CH08 | 02/05/2011 | **16:55** | 51°21.9200 | 3°6.7759 | 10.21 | 13.5 | 39.2 | 12.8389 | 31.4682 | 13.15 | 289 | | | | 0.5 |
| 230 | 02/05/2011 | **18:08** | 51°18.3410 | 2°51.0854 | 11.23 | 18.7 | 36.6 | 13.0742 | 31.4184 | 15.17 | 102 | | | | 0.5 |
| CH01 | 03/05/2011 | **05:11** | 51°9.5960 | 2°35.1489 | 17.36 | 11.1 | 61.1 | 12.9543 | 31.018 | 16.05 | 80 | | | | 0.5 |
| CH02 | 03/05/2011 | **06:10** | 51°12.4660 | 2°40.1903 | 9.61 | 10.4 | 82.3 | 12.8372 | 31.1876 | 15.39 | 173 | | | | 0.5 |
| CH03 | 03/05/2011 | **07:07** | 51°14.9160 | 2°46.3877 | 7.39 | 11.2 | 69.4 | 12.659 | 31.3576 | 11.13 | 370 | | | | 0.5 |
| CH04 | 03/05/2011 | **08:06** | 51°15.6840 | 2°51.0621 | 11.24 | 11 | 58.9 | 12.4371 | 31.6553 | 10.91 | 560 | | | | 0.25 |
| 130 | 03/05/2011 | **08:37** | 51°16.2000 | 2°54.2708 | 9.63 | 10.4 | 61.5 | 12.3479 | 31.532 | 11.09 | 676 | | | | 0.25 |
| 330 | 03/05/2011 | **10:39** | 51°26.3230 | 2°48.3808 | 21.31 | 8.6 | 50.9 | 11.3798 | 32.6269 | 38.85 | 882 | | | | 2.5 |
| 435 | 03/05/2011 | **11:54** | 51°34.8260 | 2°47.8200 | 33.17 | 8.8 | 55.3 | 10.7969 | 33.8093 | 20.56 | 926 | 2 | | Clear | 2.5 |
| 800 | 03/05/2011 | **13:44** | 51°50.5530 | 2°52.6253 | 37.58 | 11.2 | 45.9 | 10.3849 | 34.574 | 24.47 | 801 | 2.5 | | Clear | 2.5 |
| 545 | 03/05/2011 | **14:58** | 51°43.5870 | 3°2.8586 | 39.17 | 11 | 24.9 | 10.6281 | 34.1051 | 28.89 | 617 | | | | 4 |
| 350 | 03/05/2011 | **16:46** | 51°34.9940 | 3°15.3941 | 32.43 | 7.5 | 21.2 | 11.2951 | 32.7261 | 35.59 | 327 | | | | 2.5 |
| 250 | 03/05/2011 | **17:29** | 51°31.2750 | 3°18.7807 | 7.12 | 11.5 | 25.1 | 11.9726 | 32.4006 | 19.62 | 200 | | | | 1 |
| MERA | 04/05/2011 | **10:28** | 51°19.4920 | 2°39.2014 | 29.86 | 4.9 | 60.8 | 11.9766 | 32.2512 | 17.56 | 869 | 0.5 | 0 | Clear | 4.5 |
| MH1 | 05/05/2011 | **05:11** | 51°37.8100 | 2°33.2424 | 38.6 | 7.4 | 132.6 | 10.8801 | 34.4034 | 31.60 | 82 | | | | 0 |
| MH2 | 05/05/2011 | **06:14** | 51°41.1970 | 2°19.8659 | 39.9 | 3.7 | 136.9 | 10.2122 | 34.8044 | 27.21 | 280 | | | | 4 |
| MH3 | 05/05/2011 | **07:18** | 51°44.2820 | 2°6.2298 | 51.81 | 5.9 | 136.7 | 10.3223 | 34.6649 | 35.07 | 288 | | | | 3.5 |
| MH4 | 05/05/2011 | **08:34** | 51°46.8630 | 1°52.0876 | 30.2 | 6 | 134.1 | 10.2964 | 34.5634 | 24.07 | 470 | | | | 3 |
| MH5 | 05/05/2011 | **09:46** | 51°50.8330 | 1°38.4871 | 22.5 | 7 | 159.1 | 9.7818 | 33.9211 | 5.50 | 676 | | | | 1 |
| MH6 | 05/05/2011 | **10:52** | 51°52.3830 | 1°27.0801 | 15.2 | 5.9 | 122.5 | 11.1344 | 33.5355 | 9.33 | 817 | | | | 0.5 |
| TH4 | 05/05/2011 | **11:49** | 51°48.2520 | 1°18.0529 | 14.1 | 6.8 | 126.4 | 11.7099 | 33.5576 | 6.17 | 670 | | | | 0.5 |
| TH2 | 05/05/2011 | **13:29** | 51°41.9220 | 1°27.6066 | 25.1 | 6.1 | 108 | 11.2422 | 33.9374 | 6.94 | 394 | | | | 1 |
| TH3 | 05/05/2011 | **14:38** | 51°36.0400 | 1°18.3531 | 22.2 | 7.8 | 125.4 | 11.2059 | 34.0557 | 7.69 | 377 | | | | 2 |
| TH5 | 05/05/2011 | **16:18** | 51°29.8770 | 1°0.1362 | 21.4 | 5.9 | 118 | 12.5762 | 33.7159 | 5.20 | 260 | | | | 1.25 |
| TH1 | 05/05/2011 | **17:52** | 51°29.7600 | 1°26.3112 | 18.4 | 6.8 | 111.7 | 10.4999 | 34.1329 | 8.60 | 110 | | | | 1.5 |
| CH06 | 06/05/2011 | **07:42** | 51°19.0780 | 2°56.8109 | 8.1 | 4.1 | 148 | 12.588 | 31.5811 | 9.03 | 310 | | | | 1 |
| CH07 | 06/05/2011 | **08:26** | 51°20.5750 | 3°1.5816 | 7.8 | 3.8 | 161.5 | 12.6597 | 31.321 | 9.47 | 498 | | | | 0.75 |
| TVP | 06/05/2011 | **09:35** | 51°26.9970 | 3°0.3324 | 23.4 | 2.6 | 134.9 | 11.9479 | 32.4662 | 7.81 | 756 | | | | 3.25 |
| MERB | 06/05/2011 | **10:50** | 51°23.1930 | 3°7.9565 | 11.1 | 3.8 | 31 | 12.5169 | 31.7979 | 9.72 | 757 | 0.1 | 1 | Hazy | 2 |

## 2. Auxiliary hydro-meteo parameters

The ODAS auxiliary hydro-meteo data are available online at
http://www.mumm.ac.be/Common/Belgica/Campaigns/Odas/od2011_13.dat

## 3. FerryBox parameters

The parameters measured by the FerryBox during the campaign have been downloaded by the Belcolour-2 team onboard.

**BELCOLOUR-2 – MUMM**

Clear sky conditions during most of the time enabled measurements during satellite overpasses (stations 435 & 800 during MODIS 3/5 overpass, additional MERA & MERB respectively during MERIS 4/6 & 6/6). The data collected during this cruise met the cruise objectives of BELCOLOUR-2 stated in section 2 and even more.

Filtrations of surface sampling have been carried out at all the Belcolour stations (excepted TH6 skipped for a question of route efficiency and timing) plus 2 additional matchup stations (MERA & MERB). The samples have been prepared for a further analysis in laboratory. For 5 stations at the beginning of the cruise, confusion between the 3 replicates of TSM samples is possible (due to weakness in coatching and difficulties to check everything during busy days with fast succession of stations at the beginning).

Turbidity (2100P ISO Turbidimeter and Aquafluor_SensorA) and fluorescence (Aquafluor_SensorB) measurements were carried out successfully at all stations (33). The simultaneity of those measurements with the FerryBox enables cross-comparisons. The Fig. 2 shows for instance, a comparison between FerryBox Turb_2000 sensor and 2100P ISO Turbidimeter (for stations were Turb_2000 worked well – no alarm signal).

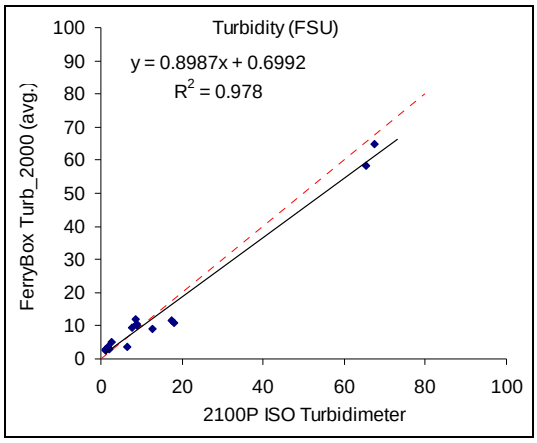



**Fig 2: Direct comparison between the turbidity measured with the 2100P ISO Turbidimeter (surface sample) and the FerryBox sensor Turb_2000 (3.5m depth water).**

The two TriOS-microFlu sensors were mounted in a special frame onto the SeaCat allowing the monitoring of chlorophyll a at different depths (Fig. 3.). This set-up was used to investigate the vertical distribution of phytoplankton (e.g. *Phaeocystis*) at the different stations.

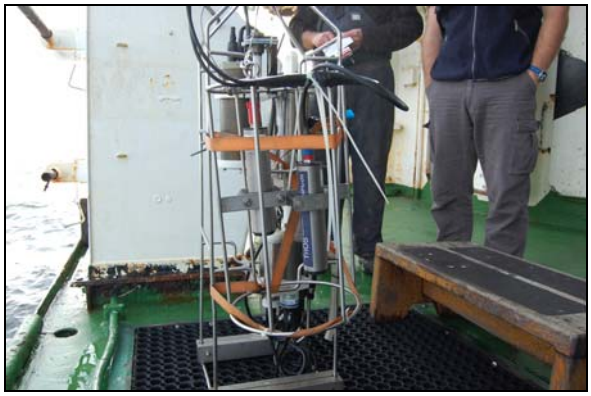


**Fig 3. The TriOS-microFlu sensors were mounted in a special frame onto the SeaCat**

For each station the chlorophyll was measured near the bottom, at a depth of 3.5m and at the surface. This set-up provided information on possible stratification of the water column. Figure 4 shows the

chlorophyll-a values for station 435 and 130 at these predefined depths. A clear difference can be observed between the coastal station where the water column is well mixed and the off-shore station showing a clear stratification.

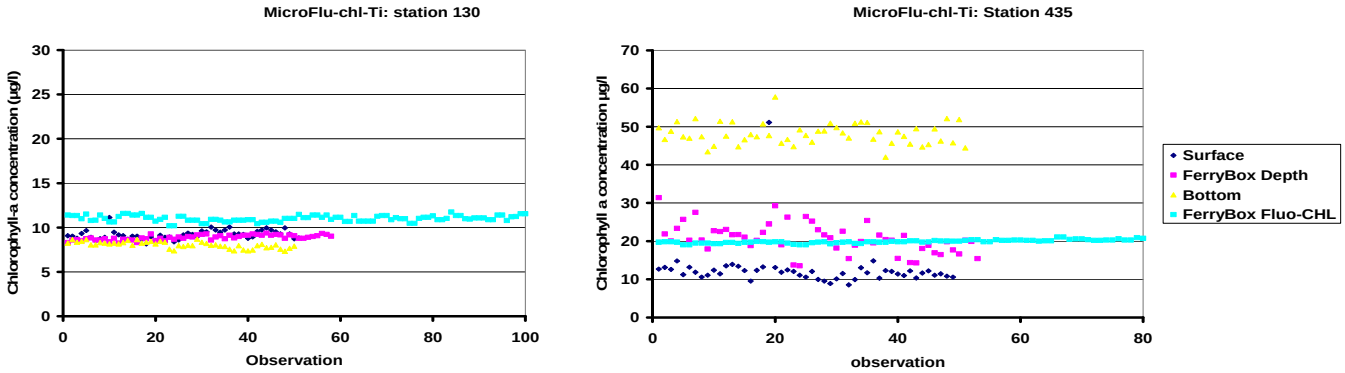



**Fig 4: Presentation of the chlorophyll-a concentrations observed with the TriOS-microFlu-chl-Ti fluorometer mounted on the SeaCat and the FerryBox. Observations were performed at three depths being surface, Ferrybox depth of 3.5m and bottom. On the left side the graph shows the well-mixed coastal waters at station 130 in terms of phytoplankton. On the right side a significant stratification can be observed. In both cases the FerryBox based chlorophyll-a observations closely match the TriOS-microFlu based chlorophyll-a concentrations.**

By adding a sampling depth of 3.5m a direct comparison between the chlorophyll-a measurement derived from the TriOS-microFlu sensor and the FerryBox was possible as the inflow of water for the FerryBox occurs at that depth. Fig. 5 presents the direct comparison between the two sensors showing a close correlation from which we can assume that the FerryBox is providing trustworthy chlorophyll-a estimates. With the availability of chlorophyll-a and turbidity measurements obtained using filtration methods and other devices (i.e…2100P ISO Turbidimeter and Aquafluor) will allow a more in-depth comparison in a later stage of the data processing.

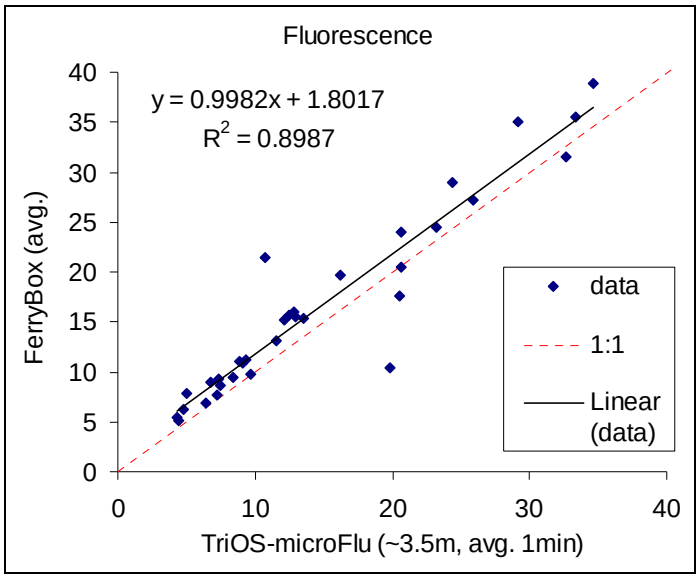



**Fig 5: Direct comparison between the chlorophyll-a measurement derived from the TriOS-microFlu sensor and the FerryBox for the 33 stations visited during the cruise.**

A high resolution profile of fluorescence has been realized at station TVP with TriOS-microFlu. This profile is shown in Fig. 6. The profile shows the possible presence of two layers in the water column which show clear differences in terms of chlorophyll-a concentrations. Further analysis of the data will be needed to study the effect of this phenomenon on the estimation of chlorophyll-a concentrations based on MERIS/MODIS satellite imagery.

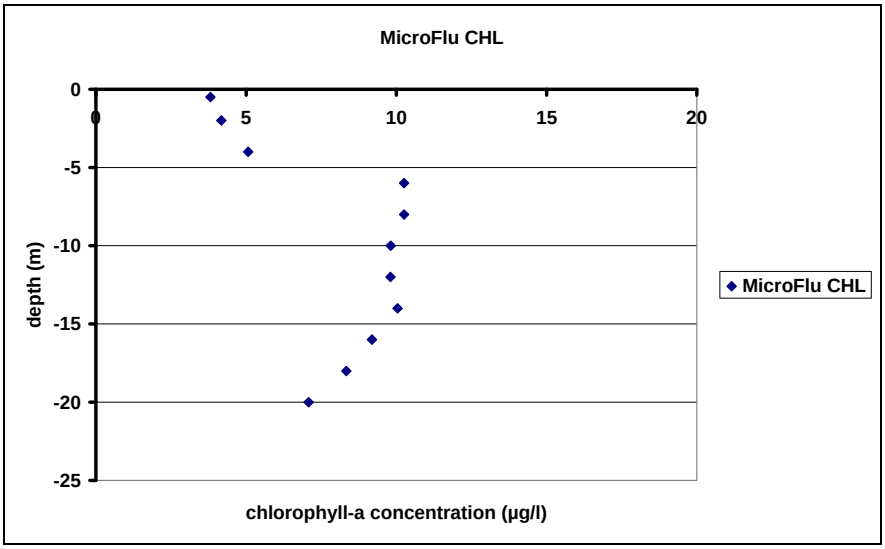



**Fig 6: Vertical chlorophyll-a concentrations obtained using the TriOS-microFlu-chl-Ti fluorometer at station TVP.**

All instruments functioned well throughout the cruise with the exception of the customized microFlu-chlX-Ti fluorometer.

### BELCOLOUR - ULg

$pCO_2$, $O_2$, total alkalinity measurements were carried out successfully at all the Belcolour stations in view of developping/validating RS algorithms to derive $pCO_2$ from Chlorophyll-a and salinity. Additional stations (CH* in table 2) were also carried out with success to sample for TEP, $CH_4$ and $N_2O$, in view of describing the spatial gradients of these quantities.
The limitation of our sampling of $O_2$ on the last day is due to the short delay at the end of the campaign, not sufficient enough to carry out the necessary chemical titrations for this quantity.

## 6. Remarks

The crew of the Belgica is acknowledged for its valuable and greatly appreciated cooperation.

### DCP-KD

70% of the program was finished with success. Some time was lost due to bad weather conditions and GPS problems. The insufficient quality of the replacement GPS induced time delay errors that have a negative influence on the quality of the resulting models.