

## Report for the year 2016 and future activities

### **SOLAS 'Belgium'** **compiled by: 'Nathalie Gypens'**

*This report has two parts:*

- **Part 1:** reporting of activities in the period of January 2016 – Jan-Feb 2017
- **Part 2:** reporting on planned activities for 2017/2018 and 2019.

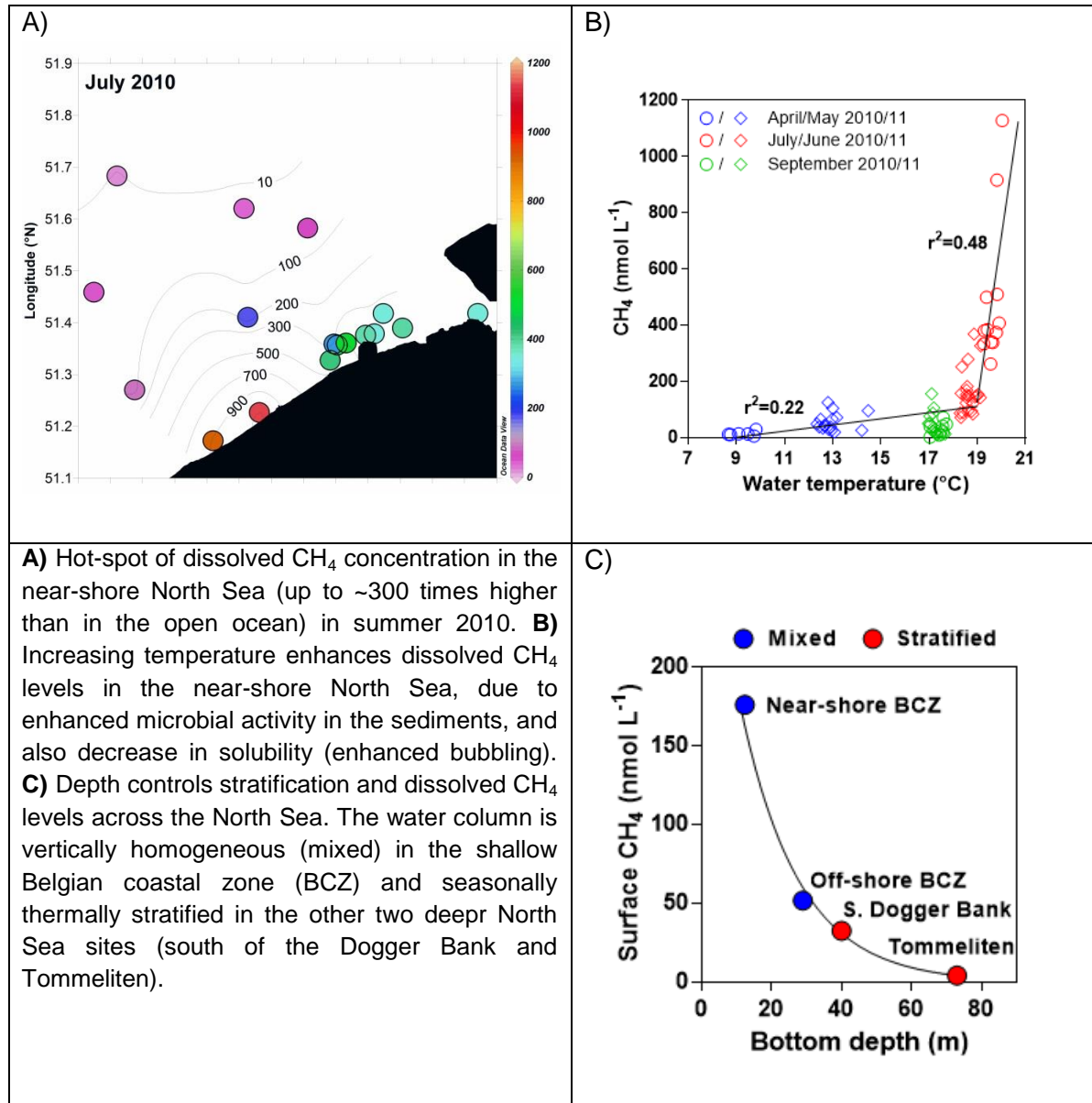
*The information provided will be used for reporting, fundraising, networking, strategic development and updating of the live web-based implementation plan.*

**IMPORTANT:** May we remind you that this report should reflect the efforts of the SOLAS community in the **entire country** you are representing (all universities, institutes, lab, units, groups, cities)!

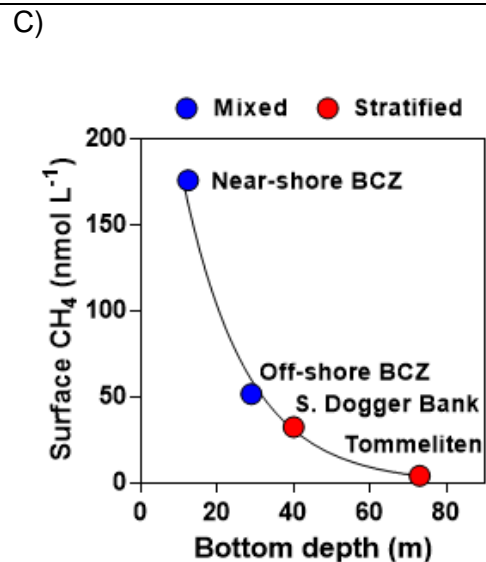
## PART 1 - Activities from January 2016 to Jan/Feb 2017

### 1. Scientific highlight

#### Massive marine methane emissions from near-shore shallow coastal areas



**A)** Hot-spot of dissolved CH<sub>4</sub> concentration in the near-shore North Sea (up to ~300 times higher than in the open ocean) in summer 2010. **B)** Increasing temperature enhances dissolved CH<sub>4</sub> levels in the near-shore North Sea, due to enhanced microbial activity in the sediments, and also decrease in solubility (enhanced bubbling). **C)** Depth controls stratification and dissolved CH<sub>4</sub> levels across the North Sea. The water column is vertically homogeneous (mixed) in the shallow Belgian coastal zone (BCZ) and seasonally thermally stratified in the other two deep North Sea sites (south of the Dogger Bank and Tommeliten).



Citation: Borges AV, W Champenois, N Gypens, B Delille, J Harlay (2016) Massive marine methane emissions from near-shore shallow coastal areas, *Scientific Reports*, 6:27908, doi:10.1038/srep27908

### 2. Activities/main accomplishments in 2016 (projects, field campaigns, events, model and data intercomparisons, capacity building, international collaborations, contributions to int. assessments such as IPCC, interactions with policy makers or socio-economics circles, etc.)

#### Field campaigns:

- Experiment at the Roland von Glasow air-sea-ice chamber of the University of East Anglia in Norwich. Collaboration with James France and Max Thomas (CO<sub>2</sub>, N<sub>2</sub>O dynamics) and E. Damm (Alfred Wegner Institute). Belgian Partners: Bruno Delille (Université de Liège) and Jean-Louis Tison (Université Libre de Bruxelles)
- Optimist 2016 sea ice survey in Storefjord in April 2017. This survey was carried out in the frame of the project OPTIMIST-bio (Observing Processes impacting The sea Ice Mass balance from In Situ Measurements: from physics to its impacts on biology) funded by the

CNRS (France) and led by F. Viviers. We will measure greenhouse gases (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O) concentration and air-ice fluxes. We will also collect sea ice for measurement of related physical and biogeochemical parameters. Belgian Partner Bruno Delille (Université de Liège)

- Storfjorden Polynya Multidisciplinary Study (STeP) in the Storfjorden in July 2016 onboard the RV Atalante. STeP is a project organized in the frame of the French Arctic Initiative and led by Elisabeth Michel. The aim of the project was to increase the current knowledge on the formation of brine-enriched shelf water (BSW) and its impact on ocean circulation and greenhouse gas (GHG) cycles through the solubility and biological ocean pumps. To this end, the project investigates processes governing the inter-annual variability of the physical and chemical properties of the newly formed BSW within a polynya, through a multidisciplinary approach, combining 2 years of observations and high-resolution regional modeling. Belgian Partners Bruno Delille (Université de Liège) and Jean-Louis Tison (Université Libre de Bruxelles)
- A biogeochemical cruise was conducted in May 2016 on board the RV Mare Nigrum in the Black Sea on the Ukrainian shelf. The campaign was performed in the framework of the BENTHOX project funded by the Fund for Scientific Research - FNRS (Belgium) and in collaboration with the EMBLAS-II project funded by UNDP and EU. The objective is to obtain a better understanding of the impact of benthic hypoxia on the diagenetic pathways. Microprofiling of geochemical gradients of dissolved O<sub>2</sub>, pH, H<sub>2</sub>S and N<sub>2</sub>O were taken on board the ship. Porewaters were extracted on board the ship using Rhizon technique under N<sub>2</sub> atmosphere for laboratory dissolved nutrients and major ions. Although the bottom waters were not hypoxic, the sediments have an oxygen layer only in the upper 2 cm.

### Laboratory Experiments

Laboratory incubation experiments using *Trichodesmium* were conducted in 2016 to study the influence of pCO<sub>2</sub> and temperature on the biological nitrogen fixation of this filamentous cyanobacterium. Phosphate and dust addition bioassays in nitrate depleted media were carried out to investigate the effect of this nutrient and dissolved Fe on N<sub>2</sub> fixation. Special attention was given to studying the effects of mineral dust deposition which is believed to promote N<sub>2</sub> fixation through increasing availability of both Fe and P.

### Networking

Bruno Delille (Université de Liège), François Fripiat (Vrije Universiteit Brussel) and Jean-Louis Tison (Université Libre de Bruxelles) have been strongly involved in

- the renewal of the BEPSII (Biogeochemical Exchange processes at the Sea ice Interfaces) joint SOLAS-CLIC working group
- the new EC Vice (Essential Climate Variable for sea ice) SCOR working group

### Ongoing Projects:

- ISOTopic Investigation of Greenhouse Gases in Polar regions: An Ocean Ice-Atmosphere Continuum (ISOGGAP) funded by the FRS-FNRS (2016-2019, 432 kEur). This project covers the theme 8 "High Sensitivity Systems- HS2" but will focus on arctic systems. ISOGGAP will address: 1) Gas exchange monitoring and process studies; 2) Regional dynamics of stressors and their effect in sea ice systems; 3) Improvement of the representation of biogeochemistry in regional models of sea ice 4) Identification of the elements of HS<sup>2</sup> that are key parameters to global change and incorporate them into Earth System Models. Partners: Jean-Louis Tison (Université Libre de Bruxelles) Bruno Delille (Université de Liège)
- OCeANIC (nitrous Oxide and nitrogen Cycling in ANtartic sea Ice Covered zone, BL/12/C63, 2016-2019, 250 kEur) funded by the Belgian Science Policy. Partners: Bruno Delille (Université de Liège), Frank Dehairs (Vrije Universiteit Brussel), Jean-Louis Tison (Université Libre de Bruxelles)

- Iodide and halocarbons Dynamics in sea ice (IODInE, CDR J.0262.17, 2017-2018, 41 kEur) Research Project funded by the F.R.S.-FNRS, partners: Bruno Delille (Université de Liège)

### Conferences

Li X., D. Fonseca-Batista, J. Brouwers, N. Roevros, F. Dehairs and L. Chou (2016) The marine diatom and diazotroph under future climate: Role of Iron. EGU General Assembly 2016, 17-22 April 2016, Vienna, Austria. Poster presentation.

### 3. Top 5 publications in 2016 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.

Borges AV, W Champenois, N Gypens, B Delille, J Harlay (2016) Massive marine methane emissions from near-shore shallow coastal areas, *Scientific Reports*, 6:27908, doi:10.1038/srep27908

Carnat G., Brabant F., Dumont I., Vancoppenolle M., Ackley S.F., Fritsen C., Delille B., Tison J.-L., 2016. Influence of short-term synoptic events and snow depth on DMS, DMSP, and DMSO dynamics in Antarctic spring sea ice, *Elementa*, 4:000135, doi: 10.12952/journal.elementa.000135

Kotovitch M., Moreau S., Zhou J., Vancoppenolle M., Dieckmann G.S., Evers K.-U., Van der Linden F., Thomas D.N., Tison J.-L., Delille B., 2016. Air-ice carbon pathways inferred from a sea ice tank experiment, *Elementa: Science of the Anthropocene*, 4:000112, doi:10.12952/journal.elementa.000112

Tseng H-C, C-T A Chen, AV Borges, C-M Lai, TA DelValls & T-Y Chen (2016) Distributions and Sea-to-air Fluxes of Nitrous Oxide in the South China Sea and the West Philippines Sea, *Deep-Sea Research I*, 115, 131-144

Zhou, J., M. Kotovitch, H. Kaartokallio, S. Moreau, J. Tison, G. Kattner, G. Dieckmann, D.N. Thomas, B. Delille, 2016. The impact of dissolved organic carbon and bacterial respiration on pCO<sub>2</sub> in experimental sea ice, *Progress in Oceanography*, 141, 156-167, doi:10.1016/j.pocean.2015.12.005

### 4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2016? If yes, who? How did you engage?

## PART 2 - Planned activities from 2017/2018 and 2019

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

#### Field campaign and projects

- Jean-Louis Tison (Université Libre de Bruxelles) and Bruno Delille (Université de Liège) are involved in the project Polynyas, Ice production and seasonal evolution in the Ross Sea (PIPERS) funded by the NSF and led by S. Ackley. The principle objective of PIPERS is to quantify the full 3-D Suite of Atmosphere-Ocean-Ice (AOI) interactions within the Ross sea polynya. This includes transfer of heat, momentum, and CO<sub>2</sub> together with sea ice formation rate. This project has a strong multiple platforms approach (including AUV, UAV, buoys, mooring and cruise on the NB Palmer. 6 Belgian researchers (B. Delille, J.-L. Tison, F. Van der Linden, G. Carnat, C. Sapart, J. De Jong) will take part of the NB Palmer where will deal with sea ice biogeochemistry. This cruise is schedule in April-June 2017

- Bruno Delille (Université de Liège), Frank Dehairs (Vrije Universiteit Brussel), Jean-Louis Tison (Université Libre de Bruxelles) are also involved in survey of N<sub>2</sub>O and nitrogen cycling in the Pridz Bay in Collaboration with the Third Institute of Oceanography of People's Republic of China
- A second cruise in the framework of the BENTHOX project, in collaboration with the EMBLAS-II project, is planned in August 2017 also on board the RV Mare Nigrum on the Ukrainian shelf to study the benthic hypoxia. Microprofiling of geochemical gradients of dissolved gases (O<sub>2</sub>, H<sub>2</sub>S, N<sub>2</sub>O) in the sediments will be taken on board the ship. Porewaters will be in addition extracted on board the ship using Rhizon technique under N<sub>2</sub> atmosphere for laboratory dissolved nutrients and major ions.

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

### **Conferences:**

Gypens N, A. V Borges, Ghyoot C (2017). How phosphorus limitation can control climatic gas sources and sinks. EGU General Assembly.

Plant A., N. Roevros, A. Capet, M. Grégoire, N. Fagel and L. Chou (2017) Benthic hypoxia and early diagenesis in the Black Sea shelf sediments. EGU General Assembly.

Plant A., N. Roevros, O. Roman Romin, A. Capet, M. Grégoire, N. Fagel and L. Chou (2017) Hypoxia evolution on the Ukrainian shelf of the Black Sea. Goldschmidt conference.

Li X., D. Fonseca-Batista, F. Dehairs and L. Chou (2017) Environment and nutrient control of nitrogen fixation. Goldschmidt conference.

## **3. Funded national and international projects / activities underway (if possible please list in order of importance and indicate to which part(s) of the SOLAS 2015-2025 Science Plan and Organisation (downloadable from the SOLAS website) the activity topics relate – including the core themes and the cross cutting ones)**

### **Ongoing Projects:**

- ISOTopic Investigation of Greenhouse GAses in Polar regions: An Ocean Ice-Atmosphere Continuum (ISOGGAP) funded by the FRS-FNRS (2016-2019, 432 kEur). This project covers the theme 8 "High Sensitivity Systems- HS<sup>2</sup>" but will focus on arctic systems. ISOGGAP will address: 1) Gas exchange monitoring and process studies; 2) Regional dynamics of stressors and their effect in sea ice systems; 3) Improvement of the representation of biogeochemistry in regional models of sea ice 4) Identification of the elements of HS<sup>2</sup> that are key parameters to global change and incorporate them into Earth System Models. Partners: Jean-Louis Tison (Université Libre de Bruxelles) Bruno Delille (Université de Liège) relates to core theme 1
- OCeANIC (nitrous Oxide and nitrogen Cycling in ANtarctic sea Ice Covered zone, BL/12/C63, 2016-2019, 250 kEur) funded by the Belgian Science Policy. Partners: Bruno Delille (Université de Liège), Frank Dehairs (Vrije Universiteit Brussel), Jean-Louis Tison (Université Libre de Bruxelles) relates to core theme 1
- Iodide and halocarbons Dynamics in sea IcE (IODInE, CDR J.0262.17, 2017-2018, 41 kEur) Research Project funded by the F.R.S.-FNRS, partners: Bruno Delille (Université de Liège) relates to core theme 5

## **4. Plans / ideas for future projects, programmes, proposals national or international etc. (please precise to which funding agencies and a timing for submission is any)**

**5. Engagements with other international projects, organisations, programmes etc.**

**Comments**