Instrumenting our oceans for better observation: a training course on a suite of biogeochemical sensors

June 10-June 19, 2019

Sven Lovén Center for Marine Sciences (Kristineberg, Sweden)

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Course Agenda

(version 7 June 2019)

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The course will consist of a mixture of lectures and hands-on demonstrations and practical exercises. Majority of sessions, including all lectures, will take place in the "Kristineberg Aula" which is the lecture hall located in "Huvudbyggnaden" (the Main Building with reception). Several other sessions will take place in Rooms 006, 009 and 020 (all downstairs from where the reception is), as well as in the Seminarierum and in the Kurslab (Room 206) - all located in the Main Building as well. A few evening sessions will take place in the Mässen building where the dining facilities are also located.

Please note that from June 9 to June 13 all lunches and dinners will be served in the Gullmarsstrand Hotel, 15 minutes walk from the Lovén Station. Please see the walking directions here.

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MONDAY, JUNE 10, 2019

07:30-08:30 *Breakfast (Mässen)*

09:00 **Welcome, introduction, housekeeping**
Course Organisers

09:20 **Course objectives, expected outcomes, logistics and format of the course**
Course Organisers

09:45 **Session 1: Scientific importance of instrumenting our oceans**
Lecture by Telszewski [60 min]

10:45 *Coffee break*

11:15 **Session 2: Coordinated global observing networks for marine biogeochemistry**
Lecture by Telszewski [60 min]

13:00 *Lunch (Gullmarsstrand Hotel, leaving from the Main building at 12.45 sharp)*

13:45 **Session 3: Sensors – inside out (Part 1)**

- *Lecture on oxygen sensors by Bittig [90 min]*
- *Coffee break [30 min]*
- *Lecture on bio-optical sensors by Briggs & Dall'Olmo [90 min]*

17.15 **Overview of the next day**

18:00 Dinner (Gullmarsstrand Hotel, leaving from the Main building at 17.45 sharp)

19:00 **Session 4: Introduction to sensor deployment**

Dall'Olmo, Briggs, Neill, Bittig

TUESDAY, JUNE 11, 2019

07:30-08:30 Breakfast (Mässen)

08:45 **Health and safety training by the Loven Station staff**

09:00 **Session 5: Sensor deployment**

Participants familiarize themselves with the sensors and deploy their sensors (oxygen and bio-optical) off the pier.

- *Oxygen sensors – Instructors: Bittig & Neill*
- *Bio-optical sensors – Instructors: Briggs & Dall'Olmo*

12:30 Lunch (Gullmarsstrand Hotel, leaving from the Main building at 12.15 sharp)

13:30 **Session 6: Sensors – inside out (part 2)**

- *Lecture on pH sensors by Atamanchuk & Bresnahan [90 min]*
- *Coffee break [30 min]*
- *Lecture on pCO_2 sensors by Skjelvan & Neill [90 min]*

17.00 **Overview of the next day**

18:00 Dinner (Gullmarsstrand Hotel, leaving from the Main building at 17.45 sharp)

19:00 **Evening session: Flash (2-min) presentations by participants and lecturers**

WEDNESDAY, JUNE 12, 2019

07:30-08:30 Breakfast (Mässen)

09:00 **Session 7: Sensor deployment**

Participants familiarize themselves and deploy their sensors off the pier.

- *pH sensors – Instructors: Atamanchuk & Bresnahan*
- *pCO_2 sensors – Instructors: Skjelvan and Neill*

12:45 *Lunch (Gullmarsstrand Hotel, leaving from the Main building at 12.30 sharp)*

13:30 **Session 8: Interfacing sensors**
- *Lecture by Neill [60 min]*

14:30 **Session 9: Calibration and validation: what are the needs? Part 1**
- *Lecture focused on general perspectives by Neill [45 min]*
- *Coffee break [30 min]*
- *Lecture focused on oxygen sensors by Neill [45 min]*
- *Lecture focused on bio-optical sensors by Briggs/Dall'Olmo [45 min]*

17.15 **Overview of the next day**

18:00 *Dinner (Gullmarsstrand Hotel, leaving from the Main building at 17.45 sharp)*

19:00 **Evening session: Optics and oxygen data projects (group work assignment)**

The participants will be split into eight groups working on four different datasets. We will provide two optics datasets (chlorophyll-a and backscatter) collected by autonomous platforms that will allow the participants to experience first hand the fun (and difficulties) of analysing real data. Two other assignments will be related to deriving biogeochemical quantities from oxygen data.

THURSDAY, JUNE 13, 2019

07:30-08:30 *Breakfast (Mässen)*

09:00 **Session 10: The Carbon system: assessing and controlling measurement uncertainty in estimating the seawater CO_2 system**
Lecture by Dickson [90 min]

10:30 *Coffee break*

11:00 **Session 11: Calibration and validation: what are the needs? Part 2**
- *Lecture focused on pH sensors by Bresnahan [45 min]*
- *Lecture focused on pCO_2 sensors by Skjelvan [45 min]*

12:45 *Lunch (Gullmarsstrand Hotel, leaving from the Main building at 12.30 sharp)*

13:30 **Session 12: Equilibrator-based surface measurements**
- *Lecture on xCO_2 and N_2O by Rehder [60 min]*
- *Practicals by Rehder & Neill [3 h]*
- *Coffee break [15 min] some time during the practicals*

17.40 **Overview of the next day**

18:00 *Dinner (Gullmarsstrand Hotel, leaving from the Main building at 17.45 sharp)*

19:00 **Evening session: Optics and oxygen data projects**

Complete analysis, summarise results within each group, compare results with other group working on the same dataset and prepare one presentation for all during Session 17.

FRIDAY, JUNE 14, 2019

07:30-08:30 *Breakfast (Mässen)*

09:00 **Session 13: Recovery of oxygen and bio-optical sensors (raw data)**
- *Oxygen – Instructors: Bittig & Neill*
- *Bio-optical – Instructors: Briggs & Dall'Olmo*

12:30 *Lunch (Mässen)*

13:30 **Session 14: Theory of data processing (oxygen and bio-optical)**
- *Lecture on oxygen data processing by Bittig [30 min]*
- *Lecture on bio-optical data processing by Briggs & Dall'Olmo [30 min]*

14:30 **Session 15: Practicals of data processing (oxygen and bio-optical)**
- *Oxygen - Instructors: Bittig & Neill [2 x 90 min]*
- *Bio-optical – Instructors: Briggs & Dall'Olmo [2 x 90 min]*
- *Coffee break [15 min] some time in between*

17.00 **Overview of the next day**

19:00 ***Kristineberg Station Summer Party (with dinner included)***

SATURDAY, JUNE 15, 2019

07:30-08:30 *Breakfast (Mässen)*

09:00 **Session 16: How to choose the right sensor depending on your circumstances?**
Lecture by Atamanchuk [90 min]

11:00 **Session 17: How to derive meaningful biogeochemical quantities from bio-optical and oxygen sensors?**
Joint presentation of data analysis results from groups working on the data projects, followed by a discussion.
Issues with biofouling in bio-optical measurements also covered in this session.

12.25 **Overview of the next day**

12:30 *Lunch (Mässen)*

13:30 **Field trip / social activities**

19:00 *BBQ Dinner*

SUNDAY, JUNE 16, 2019

07:30-08:30 Breakfast (Mässen)

09:00 **Session 18: Recovery of sensors 3 & 4 (raw data)**
- *pH sensors – Instructors: Atamanchuk & Bresnahan*
- *pCO_2 sensors – Instructors: Becker & Neill*

12:30 *Lunch (Mässen)*

13:30 **Session 19: Theory of data processing (pH and pCO_2)**
- Lecture on pH data processing by Atamanchuk/Bresnahan [30 min]
- Lecture on pCO_2 data processing by Becker [30 min]

15:00 *Coffee break*

15:30 **Session 20: Practicals of data processing (pH and pCO_2)**
- *pH - Instructors: Atamanchuk & Bresnahan [2 x 60 min]*
- *pCO_2 – Instructors: Becker and Neill [2 x 60 min]*

17.30 **Overview of the next day**

17:45 *Dinner (Mässen)*

MONDAY, JUNE 17, 2019

07:30-08:30 *Breakfast (Mässen)*

09:00 **Session 21: Modelling for best observation design**
- Lecture by Véronique Garçon [90 min]

10:30 *Coffee break*

11:00 **Session 22: How to take care of data?**
- Lecture by Meike Becker [90 min]

12:30 *Lunch (Mässen)*

13:30 **Session 23: Combining remote sensing and in situ biogeochemical observations**
- Lecture by Giorgio Dall'Olmo [90 min]

15:30 *Coffee break*

16:00 **Session 24: Smart data extrapolation**
- *Lecture by Peter Landschützer [90 min]*

17.30 **Overview of the next day**

17:45 *Dinner (Mässen)*

TUESDAY, JUNE 18, 2019

07:30-08:30 *Breakfast (Mässen)*

09:00 **Session 25: From surface measurements to fluxes (FluxEngine toolbox)¶**
- *Lecture (remotely) by Jamie Shutler [45 min]*
- *Coffee break [15 min]*
- *Practical by Tom Holding and Ian Ashton* [2.5 h]

12:30 *Lunch (Mässen)*

13:30 **Session 26: All I always wanted to know about sensors**
- *Hands-on Question & Answer session with experts and manufacturers. Multiple types of sensors presented and discussed for each parameter.*

17.30 **Overview of the next day**

17:45 *Dinner (Mässen)*

Evening **Session 27: Short presentations by sponsors and manufacturers**

WEDNESDAY, JUNE 19, 2019

07:30-08:30 *Breakfast (Mässen)*

09:00 **Session 28: Emerging technologies**
- *Lectures by Doug Connelly and Véronique Garçon [90-120 min]*
- *Coffee break [30 min]*

11:30 **Session 29: Brief overview of other relevant issues and solutions**
Lecture + open discussion [60-90 min]

12:30 *Lunch (Mässen)*

13:30 **Session 30: Ocean Best Practices (OBP) Initiative and Repository**
Presentation and demonstration by Telszewski and Palacz [45-60 min]

14:30 **Course evaluation**

15:30 **Feedback on the 2015 IOCCP users guide to selected autonomous biogeochemical sensors.**

19:00 *Course ends this evening with a dinner party*

THURSDAY, JUNE 20, 2019

07:30-08:30 *Breakfast (Mässen)*

By 10:00 Check-out from rooms

DEPARTURE