Greenhouse Gas Observation & Climate-Smart Agriculture

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 730995

Training workshop with focus on preparing oceanographic data for sharing

SEACRIFOG Deliverable 5.3

July 2019

Ingunn Skjelvan [1], Abdirahman M. Omar[1], Elsheikh B. Ali[2], Kristin Jackson-Misje[3], Tor de Lange[3] Truls Johannessen[3], Knut Barthel[3]

[1] NORCE Norwegian Research Centre, Bjerknes Centre for Climate Research, Norway (NORCE)
[2] Institute of Marine Research, Red Sea University, Sudan (IMR-RSU)
[3] Geophysical Institute, University of Bergen,Bjerknes Centre for Climate Research, Norway (UoB)

NORCE

Universitas Bergensis

Bjerknes Centre for Climate Research

Project: 730995 - Supporting EU-African Cooperation on Research Infrastructures for Food Security and Greenhouse Gas Observations (SEACRIFOG)

Work package number: WP 5

Work package title: Interoperability of infrastructures, access and data sharing

Deliverable number: D 5.3

Deliverable title: Training workshop with focus on preparing oceanographic data for sharing

[Original title according to project proposal: 'Training workshops with focus on preparing data for sharing.']

Lead beneficiary: NORCE Norwegian Research Centre, Norway (NORCE)

Lead authors: Ingunn Skjelvan, insk@norceresearch.no
Abdirahman M. Omar, abom@norceresearch.no
Elsheikh B. Ali, sheikhbashirali@yahoo.com
Kristin Jackson-Misje, kristin.jackson@uib.no
Tor de Lange, tor.lange@uib.no
Truls Johannessen, truls.johannessen@uib.no
Knut Barthel, knut.barthel@uib.no

Submitted by: Veronika Jorch (Thünen Institute)

Table of Contents

Executive Summary

A workshop on analytical oceanography was held in Bergen, Norway in April 2019. The workshop focussed on educating students, technicians and researchers in performing oceanographic measurements including cruise preparation, data sampling, analyses and primary quality control. The aim of the workshop was to perform capacity building and to produce a dataset ready to be shared with a larger community. All the material (presentation, procedures, recipes, software, relevant links, and data sets) are available at the SEACRIFOG web page ensuring transparency.

The workshop aimed at using instruments and methods which, with limited resources, the participants can use in their home countries. Unfortunately, some of the participants were not able to make it to Bergen due to visa issues, and lessons learned might be to engage immigration authorities at an early stage and ensure that the participants start visa application immediately after the invitation is received. Except from this, the workshop on analytical oceanography was very successful, and we hope for future possibilities to arrange a similar workshop, preferable in an African country facing the sea.

1 Introduction

1.1 Background

NORCE and University of Bergen have a long-lasting cooperation with Institute for Marine Research, Red Sea University (IMR-RSU) in Port Sudan, where the focus has been biogeochemistry of the Red Sea, therein ocean physics, the general carbon cycle, deoxygenation and ocean acidification. As part of a project on capacity building, 13 Sudanese students in chemical and physical oceanography have graduated over the years, and approximately half of these have continued as PhD students.

SEACRIFOG opened a possibility to (i) extend the cooperation by including other African countries neighboring the Red Sea and the Gulf of Aden and (ii) facilitate a network of students, technicians and researchers involved in oceanographic activities in that region.

The proposed plan was to arrange workshops at IMR-RSU. Unfortunately, the plan had to be changed because IMR-RSU did not manage to become a partner of the SEACRIFOG project. Based on this, the decision was taken to move the workshop to Bergen. Due to high travel expenses, the workshop could only house maximum 8 participants in comparison to the planned 28 in Port Sudan.

During the period 1st to 10th of April 2019, two SEACRIFOG workshops took place in Bergen, Norway: one on analytical oceanography and another on data management. The workshops are tightly connected. Oceanographic data was the focus of both workshops, the participants were the same, and the introductory material presented during the first days laid the basis for both workshops. The workshop on data management is a deliverable for WP4 (D4.4) in the SEACRIFOG project and will be described in a separate report. The workshop on analytical oceanography will be described in the following subsections. Please note that some of the activities and material, e.g. the outreach activities and theory of physical and chemical oceanography are similar for the two workshops.

1.2 Document purpose

This document aims at describing all aspects of the workshop: the preparatory phase, the realization, the material developed, and lessons learned, with the aim to hold similar workshops in the future.

2 Methodology and explanation of tasks done

2.1 Workshop description and content

The workshop on analytical oceanography took place in Bergen during the period 1st to 6th April 2019. The workshop was located partly at the Geophysical Institute, University of Bergen, and partly onboard a research vessel (R/V) heading for one of the fjords close to Bergen (Figure 1). The aim of the workshop was to educate students, technicians and researchers how to perform oceanographic measurements including preparation of cruises, data sampling, analyses and primary quality control. The objectives of the 2 cruise days aboard R/V Hans Brattstrøm was to acquire explanatory oceanographic dataset which could be shared with a larger community. All activities focused on selected Essential Ocean Variables (EOVs: https://www.climate.gov/maps-data/primer/ocean-oceanic-climate-variables).

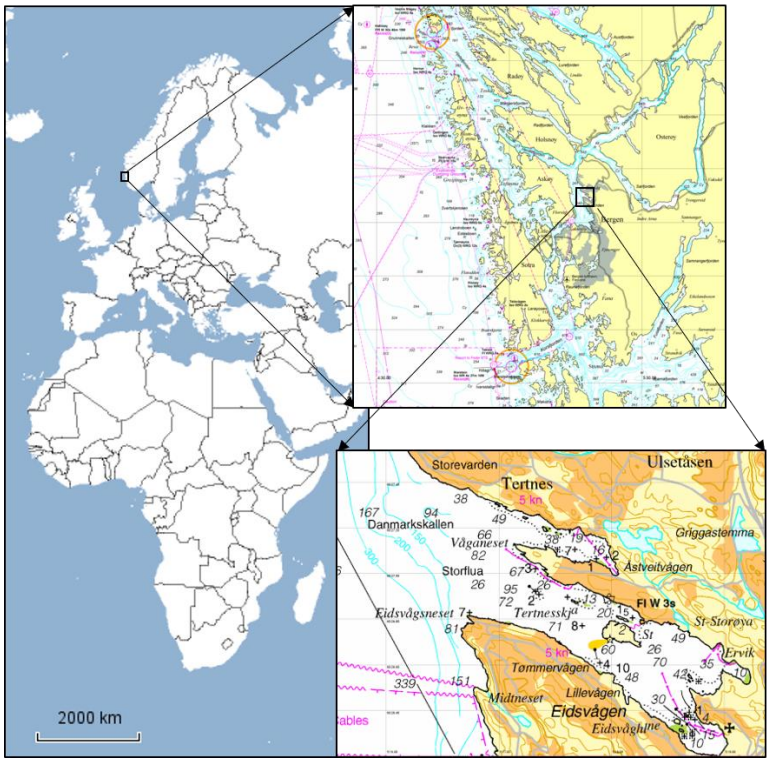

Figure 1. Location of the workshop on analytical oceanography. Upper picture: Geophysical Institute, University of Bergen; middle picture: the research vessel Hans Brattstrøm, which was used during the workshop; lower picture: a map of the western part of Norway, where the oceanographic sampling took place.

The workshop was split into two four parts, where the first laid the theoretical basis for physical and chemical oceanography, the second part concentrated on continuous measurements using a variety of oceanographic instrument, the third part focused on discrete seawater measurements, how to perform different types of analyses, and primary quality control of the results, and the fourth part where the participants should use the data in a cruise report. A schedule can be found in Table 1, and description in more detail below.

2.1.1 Continuous measurements and cruise preparation

After setting the stage of oceanography theory, the participants should learn how to use oceanographic instruments. The purpose of this part of the workshop was to give an overview of how to plan, design, deploy, and retrieve an oceanographic mooring. A mooring is a rope (Kevlar) with scientific instruments attached, and which is deployed in the water to continuously or semi-continuously collect data (Figure 2). The aim of this session was to make the participants familiar with this way of performing oceanographic measurements. The presentations were given in the instrumentation laboratory, and the participants got hands-on knowledge about the different instruments and equipment used for the mooring. The participants tested all the instruments before deployment. Regarding the mooring special

emphasis was put on flotation, Kevlar, anchor weight, scientific instruments, and acoustic release

Hands-on assignments were given, e.g. calculating buoyance of mooring elements, finding weight of instruments in air and seawater, initializing the instruments, and testing and retrieve data from instruments. In this way, the participants should be able to design their own mooring based on simple components and calculating vertical forces.

Links to software for more complex mooring calculation (including the horizontal forces from currents) were distributed.

Two different methods for deploying moorings were presented, and their pros and cons were discussed. Further, corrosion and biofouling on moorings and instruments were also discussed. The oceanographic mooring was designed as a sub-surface mooring, but with Kevlar and a surface float attached to the main buoyancy spheres. In this way the mooring could easily be retrieved from the fjord without using an acoustic releaser. This nicely demonstrates how to design a low-cost mooring infrastructure.

Deployment of the mooring and the attached instruments were done in a small fjord close to Bergen. The R/V Hans Brattstrøm was used to deploy and retrieve the mooring. Before the deployment there was a brief presentation of this ship including the important facilities that are needed in buoy operation; crane, winches, block, GPS, echo sounder and electronic map. Health, Safety, and Environmental (HSE) with focus on mooring operations onboard a ship was also a topic before deployment of the mooring. All participants used safety equipment during operations onboard.

The participants were involved in preparing instruments and equipment, deployment, retrieving the mooring, data read-out, and cleaning instruments after the field campaign. Emphasize was put on the importance of metadata, making notes during different phases and making a good report describing the deployment and retrieving of the mooring.

After deployment and prior to retrieving the mooring, discrete water samples were collected from the whole water column close to the mooring. At the same time, temperature, salinity, and depth were monitored by lowering a CTD (Conductivity, Temperature, Depth) instrument throughout the water column. This is part of ordinary quality control of data from moored instruments. The mooring was deployed for two days which resulted in a data series including diurnal effects.

Documentation describing all equipment and how to use them was provided to the participants and is also available at the SEACRIFOG web site (https://www.seacrifog.eu/news-events/news/training-workshop-on-analytical-oceanography-and-data-management-by-seacrifog/).

Figure 2. The group of participants working at the instrumentation laboratory (upper) and onboard the vessel/V Hans Brattstrøm (lower).

2.1.2 Discrete ocean measurements

The next part of the workshop was about discrete sampling of seawater. Prior to the cruise, the participants prepared chemical solutions in preparation for the Winkler titration for dissolved oxygen. Working in pairs, the participants prepared solutions that would be used during sampling: sodium hydroxide/sodium iodide and manganese chloride, as well as sulfuric acid, sodium thiosulfate, and a potassium hydroxide standard solution. This involved weighing out solids, dissolving them in distilled water, and use of volumetric flasks. This was a good introduction to chemical preparation, especially for those without experience.

Discrete water samples were taken at four stations on the cruise on Wednesday 3 April. Participants learned how to prepare bottles on a rosette, use the water sampler, and use a CTD instrument. They got experience sampling for 3 parameters: dissolved oxygen, pH, and salinity. This worked well with the number of participants as each had the opportunity to sample a whole station of each parameter, however, planning of at least one practice station would have been better to avoid running out of water.

Thursday 4 April was dedicated to analysis of the samples from the day before. First, participants were introduced to the Winkler titration for dissolve oxygen in sea water. This was done by the manual procedure, using a 25 ml hand-controlled burette. All worked separately to measure the standard, which was measured out with a Knudsen pipette. This took a long time as participants were not familiar with the use of the pipettes or the burette. Thus, it was decided that it would be better to work in pairs. They were shown the measurement of a blank, then worked in pairs to analyze at least three samples. For the three participants who had no experience with this titration, this was very beneficial. The one who had experience may also have been interested in using the automated titration system. The group of four participants appeared to be a good size for exchanging knowledge in the laboratory. For a larger group, more instructors would have been required.

The participants were then shown how to calibrate the Portasal salinometer with standard seawater and measure samples for salinity. Each participant was able to measure at least two samples on Thursday 4 April and two more on Saturday 6 April. Finally, participants learned about spectrophotometric pH measurement. The measurement of tris buffer and carbon reference material was demonstrated, and each participant was able to measure at least one sample. An automated system was used, but it may have been more interesting for the participants do it more manually and see the spectra as samples were measured.

On the cruise on Friday 5 April, the CTD was used again and salinity samples were taken just before the mooring was retrieved. CTD profiles were taken at the same stations as during the first cruise. Participants were able to measure at least one more salinity sample each the next day.

Documentation describing all analyses, how to prepare chemical solutions, and the instruments used was provided to the participants and is also available at the SEACRIFOG web site (https://www.seacrifog.eu/news-events/news/training-workshop-on-analytical-oceanography-and-data-management-by-seacrifog/).

Figure 3. The participants in action at the chemical laboratory (upper) and on the cruise (lower).

After the data were analysed, the participants learned how to perform primary quality control, and to do simple calculation of the marine carbonate system using the software package

CO2SYS (Pierrot et al., 2006). The participants were split into two groups and each of the groups mad a cruise report including instruments used and their settings, as well as the data acquired.

2.1.3 Lecturers contributing to the workshop

The workshop consisted of lectures, practical sessions with hands-on training, and discussions. The following lecturers contributed to the data management workshop:

- Elsheikh B. Ali - PhD and head of Institute of Marine Research, Red Sea University, Sudan
- Knut Barthel - associate professor, Geophysical Institute, University of Bergen, Norway
- Kristin Jackson-Misje – chief engineer, Geophysical Institute, University of Bergen, Norway
- Truls Johannessen - professor, Geophysical Institute, University of Bergen, Norway
- Tor de Lange – senior engineer, Geophysical Institute, University of Bergen, Norway
- Abdirahman M. Omar - senior researcher, NORCE Norwegian Research Centre, Norway
- Ingunn Skjelvan - senior researcher, NORCE Norwegian Research Centre, Norway

Regarding gender distribution, out of 7 lectures, 2 (12%) were female.

Table 1. Detailed schedule of the two SEACRIFOG Workshops on Analytical Oceanography and Data Management, which took place in Bergen, Norway from 1 to 10 April 2019. The introductory material during the first days were common for both workshops, while the remaining of the data workshop took place during 8 to 10 April.

DATE/TIME	***ACTIVITY***	***TEACHER***	***PLACE***
MONDAY 1 APRIL			
9:00-11:00	Welcome Course overview Presentation of participants and institutions - Institute of Marine Research, Red Sea University - Faculty of Marine Sciences and Fisheries, Red Sea University - East African University - Berbera Marine and Fisheries Academy - Benadir University	Truls Johannessen Ingunn Skjelvan All participants	Inger Brun
11:00-11:15	***Break***		
11.15-13:00	Physical oceanography theory	Knut Barthel	Inger Brun
13:00-14:00	***Lunch***		

14:00-16:00	Sampling strategies Cruise preparation - mooring	Ingunn Skjelvan Tor de Lange	Inger Brun / Alleg 55
16-16:15	***Break***		
16:15-18:00	Continuation moorings Cruise report	Tor de Lange Ingunn Skjelvan	
TUESDAY 2 APRIL			
9:00-11:00	Chemical oceanography theory	Elsheikh B. Ali	Inger Brun
11:00-11:15	***Break***		
11.15-13:00	Continuation moorings	Tor de Lange	Alleg 55
13:00-14:00	***Lunch***		
14:00-16:00	Continuation moorings	Tor de Lange	Alleg 55
16-16:15	***Break***		
16:15-18:00	Lab safety Cruise preparation – chemistry and discrete sampling	Kristin Jackson Kristin Jackson	Jahnebakken 3
WEDNESDAY 3 APRIL			
9:00-17:00	Cruise to Eidsvågen Prepare and deploy mooring Collect discrete samples	 Tor de Lange Kristin Jackson	Nykirkekaien, *R/V Bratt-strøm*
THURSDAY 4 APRIL			
9:00-11:00	Lab analyses	Kristin Jackson	Jahnebakken 3
11:00-11:15	**Break**		
11.15-12:10	Lab analyses	Kristin Jackson	Jahnebakken 3
13:00-14:00	***Lunch***		
14:00-16:00	Lab analyses	Kristin Jackson	Jahnebakken 3
16-16:15	***Break***		
16:15-18:00	Lab analyses Carbon calculation software (CO2SYS) Quality check of data Cruise report	Kristin Jackson Abdirahman M. Omar Abdirahman M. Omar Ingunn Skjelvan	Jahnebakken 3 Inger Brun
FRIDAY 5 APRIL			

9:00-14:00	Cruise to Eidsvågen Retrieve mooring Collect discrete samples	Tor de Lange Kristin Jackson	Nykirkekaien, R*/V Bratt-strøm*
14:00-16:00	***Free time***		
16:00-18:00	Post cruise activities	Tor de Lange	
SATURDAY 6 APRIL			
9:00-11:00	Analyses of discrete samples Explore data Cruise report	Kristin Jackson Abdirahman M. Omar Ingunn Skjelvan Elsheikh B. Ali	Jahnebakken 3 Inger Brun
11:00-11:15	**Break**		
11:00-13:00	Continue cruise report	Abdirahman M. Omar Ingunn Skjelvan Elsheikh B. Ali	
13:00-14:00	***Lunch***		
MONDAY 8 APRIL			
9:00-11:00	Introduction data management	Benjamin Pfeil	Helland-Hansen
11:00-11:15	***Break***		
11.15-13:00	Ocean Data View (ODV) - introduction and hands on	Benjamin Pfeil	Helland-Hansen
13:00-14:00	***Lunch***		
14:00-16:00	ODV continuation	Benjamin Pfeil	Helland-Hansen
18:00	Deadline for cruise report	Ingunn Skjelvan	
TUESDAY 9 APRIL			
9:00-11:00	Open data	Rocio Castaño-Primo	Helland-Hansen
11:00-11:15	***Break***		
11.15-13:00	Access to data sources	Benjamin Pfeil	Helland-Hansen
13:00-14:00	***Lunch***		
14:00-15:00	How to make your own data available	Benjamin Pfeil	Helland-Hansen
15:00-16:00	Travel claims – forms to fill out	Ingunn Skjelvan	
18:00	Deliver final cruise report	Ingunn Skjelvan	

WEDNESDAY 10 APRIL			
9:00-11:00	Other tools for data handling: Jupyter notebook	Maren K. Karlsen	Helland-Hansen
11:00-11:15	*Break*		
11.15-13:00	Data management in action: RI ICOS	Benjamin Pfeil	Helland-Hansen
13:00-14:00	*Lunch*		
14:00-15:00	Wrap up	Ingunn Skjelvan Abdirahman M. Omar Elsheikh B. Ali	Helland-Hansen

2.2 Participants

The workshop was announced in February 2018 by e-mail to research communities in Sudan, Djibouti, and Somalia. By the deadline in April 2018, 21 applicants from Somalia and Sudan had announced their interest to NORCE by submitting their application including CV and recommendation letters from their home institutions. A panel consisting of lecturers from NORCE and IMR-RSU decided the final admission and the selection was performed based on the candidate's education, their current work, and an evaluation of how useful the workshop would be for their employer. 7 participants from 5 institutions in Somalia and Sudan were selected and in September 2018, all of them received invitation letters to prepare for visa applications.

Due to circumstances out of our control, 3 Somalian participants did not receive their visa in time, and thus the workshop took part with only 4 participants, all of them from Sudan (Figure 4). The participant list including their home institution and gender can be found in Annexe I, and in the table is included also the participants which did not get visa in time. The 3 Somalian have got access to all the course material via the SEACRIFOG project web site (https://www.seacrifog.eu/news-events/news/training-workshop-on-analytical-oceanography-and-data-management-by-seacrifog/).

Out of the accepted 7 participants, 3 were female (43%), and of the 4 actual participants, 3 were female (75%). 4 of the 7 accepted participants were technicians, 2 were marine science lecturers, while one of them was a PhD student.

Figure 4. Participants and some of the teachers at the analytical oceanography workshop.

2.3 Workshop materials

All the workshop materials are available via the SEACRIFOG webpage (https://www.seacrifog.eu/news-events/news/training-workshop-on-analytical-oceanography-and-data-management-by-seacrifog/). The site is password protected and the password will be provided by the project office. The materials consist of presentations from the lecturers as well as from the participants, manuals and instructions for the different instruments used, recipes of chemical solutions used for analyses and for calculation of buoyancy, and links to software for carbonate calculation. In the material are also photos from the cruises, laboratory work and presentations.

2.4 Outreach and communication activities

The workshops in Bergen were communicated primarily through the SEACRIFOG webpages and twitter accounts:

https://www.seacrifog.eu/news-events/news/training-workshop-on-analytical-oceanography-and-data-management-by-seacrifog/

https://twitter.com/SEACRIFOG

Further, an interview of the Norwegian SEACRIFOG PI from NORCE, Abdirahman M. Omar was performed by students from the SEACRIFOG partner TCD (Trinity College in Dublin, Ireland) as part of their science communication project, and this will be made available soon.

3 Discussion

One important criterion for the workshop was that the methods, analyses and instruments presented during the days in Bergen should be relevant for the participants. This meant that the methods should not be too complicated, and it should be possible to get hold of equipment and ingredients also in the participants home countries, even with limited funding. This was fulfilled to a large extent. The mooring was deployed in such a way that no costs were needed for acoustic release, the temperature sensors (RBR solo 3T) are simple and relatively cheap, as well as possible to purchase from all countries, since they are produced in Canada. It is important to consider where the different instruments are produced, since some countries might have legal obstruction regarding to whom they can sell instruments.

The Winkler method for analyses of dissolved oxygen is relatively easy to set up and run. This is not the case for the pH analyses, which were run using an automated system. It is probably better as well as more interesting for the participants to perform the pH measurements manually, i.e. manual titration and visualize the spectrum. But the pH measurements did still give an overview of the method.

The visa issue is not easy to solve as it might be perceived as relatively unpredictable, however, suggestions for future situations are (i) to send a copy of the invitation letter to the Norwegian embassy, (ii) to inform the Norwegian Directorate of Immigration (UDI) early in the planning phase, (iii) to more closely follow up the participants. On the other hand, this kind of workshop would have been even better to hold within the environment of the users, which was the original plan. This will at least solve the visa issues entering Norway.

In conclusion, we see the workshop on analytical oceanography as successful, and we are hoping for future possibilities to arrange similar workshops in Africa.

Literature

Carter, B.R., J.A. Radich, H.L. Doyle, A.G. Dickson, An automated system for spectrophotometric seawater pH measurements. Limnol. Oceanogr.: Methods 11, 16-27, 2013.

Kawano, T. Method for Salinity (Conductivity Ratio) Measurement. In The GO-SHIP Repeat Hydrography Manual: A Collection of Expert Reports and Guidelines. Hood, E.M., C.L. Sabine, and B.M. Sloyan, eds. IOCCP Report Number 14, ICPO Publication Series Number 134 (http://www.go-ship.org/HydroMan.html), 2010.

Pierrot, D., E. Lewis & D.W.R. Wallace. MS Excel Program Developed for CO2 System Calculations. ORNL/CDIAC-105a. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tennessee. doi: 10.3334/CDIAC/otg.CO2SYS_XLS_CDIAC105a, 2006.

Strickland, J.D.H., and T.R. Parson. Determination of dissolved oxygen. in A Practical Handbook of Seawater Analysis. Fisheries Research Board of Canada,Bulletin, 167, 71–75, 1968.

Winkler, L.W. Die Bestimmung des in Wasser gelösten Sauerstoffen. Berichte der Deutschen Chemischen Gesellschaft, 21: 2843–2855, 1888.

Annex I – Participants

	Name	Gender	Institute
1	Bashir Haidar Ali Fadlalla	M	Institute of Marine Research, Red Sea University, Sudan
2	Magda Mustafa Mahmoud Ismail	F	Faulty of Marine Sciences and Fishery, Red Sea University, Sudan
3	Ekhlas Mohamed Omer Mohamed	F	Faulty of Marine Sciences and Fishery, Red Sea University, Sudan
4	Abeer Eissa Elamin Khiry	F	Faulty of Marine Sciences and Fishery, Red Sea University, Sudan
5	Liban Abdisalam Mohamed	M	East African University, Bosaso, Puntland, Somalia
6	Shafi I Hussein Muse	M	Berbera Maritime and Fisheries Academy, Berbera, Somaliland
7	Abdulrahman Mohamud Dirie	M	Faculty of Geosciences and Environment, Benadir University, Mogadishu, Somalia

Participant number 1 to 4 took physically part of in the workshop, while participant 5-7 received the workshop material afterwards.

Annex II – Information about instruments and methods

Instruments for continuous measurements	Variable	Producer
RBR solo3 T	temperature	https://rbr-global.com/products/compact-loggers/rbrsolo-t
SAIV CTD	temperature, conductivity, pressure, dissolved oxygen	http://saiv.no/ctdstd-model-sd208.html
SBE MicroCat	temperature, conductivity, pressure, velocity	https://www.seabird.com/moored/sbe-37-si-and-sip-microcat/family?productCategoryId=54627473785
AADI SeaGuard RCM	temperature, conductivity, pressure, dissolved oxygen, wave, tide, turbidity	https://www.aanderaa.com/productsdetail.php?SeaGuard-Platform-25

Instruments for discrete measurements	Variable	Method
Winkler titration	dissolved oxygen	Winkler, 1888; Strickland and Parson, 1968
Portasal	salinity	Kawano, 2010
Spectrophotometer	pH	Carter et al., 2013