A summer full of biogeochemical observations

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At the Scottish Association of Marine Science (SAMS) on the west coast of Scotland, preparations for a summer full of biogeochemical ocean observations are in full swing. Not only are we organising an international workshop about biogeochemical ocean observations in June, but also packing up for our research cruise in the subpolar North Atlantic in July to recover moored oxygen sensors deployed by iAtlantic.

Biogeochemical measurements in ocean observing systems allow for assessment and sustainable management of oceanic ecosystems, yet they are underrepresented and underutilised. Myself and colleagues – an international team of 13 researchers and experts from seven different countries – are convening an observational training event to increase utilisation of biogeochemical datasets. The resulting workshop "*Best practices for biogeochemical ocean observation: instrumentation, operation, quality control*" takew place at SAMS on 15-17 June 2022, funded by the Partnership for Observation of the Global Ocean (POGO). Participants will learn how to calibrate and quality control data from biogeochemical sensors obrtained by Argo floats, moored, shipboard or glider observations. The training also features a mini conference where participants can present their own research, with the challenge to do so in just five minutes.

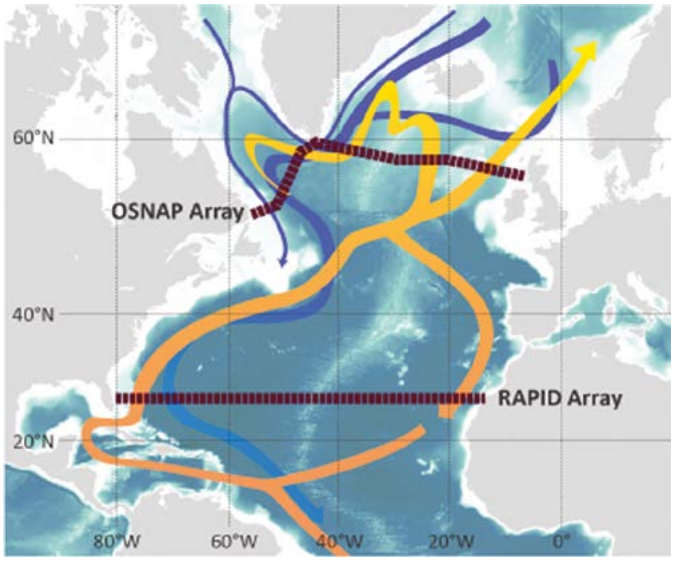
Preparations are in full swing. The training is offered as a hybrid event – trainers and participants will attend both virtually and in person. This new mode of event organisation is challenging but enables an amazing amount of flexibility. We have participants from 21 countries from Europe, America, Africa and Asia. Our collaboration with two other independent POGO observational training initiatives allows

Figure 1: Deployment of a mooring from RRS Discovery at the OSNAP array in the North Atlantic during expedition DY120, October 2020 (image courtesy Sam Jones, SAMS).

us to reach even a broader audience through the sharing of training resources. We are looking forward to the training in June and can't wait to meet the participants in Oban and online.

Skills learned at the workshop can be put into action just one month later, during the research cruise on RSS *James Cook* in the North Atlantic. The cruise forms part of the UK Overturning in the Subpolar North Atlantic Programme (UK-OSNAP) and Ellett Array projects, and aims to better understand ocean circulation and fluxes through continuous observations of the North Atlantic Subpolar Gyre (see Fig. 2). The OSNAP array was installed in 2014 to monitor the Atlantic Meridional Overturning Circulation (AMOC), a large system of ocean currents that spans the entire Atlantic. Its upper part transports warm water towards the north, whilst its lower part, deep below the ocean surface, transports cold water southwards. The AMOC plays an important role in mixing the world's ocean and distributing heat across the planet, thus influencing the climate. iAtlantic is contributing oxygen sensors to the OSNAP mooring array which were installed in 2020 from RSS *Discovery* (Fig. 1). Together with pH measurements (from the ATLAS project), this will give new insights to AMOC impacts on carbon fluxes.

During the cruise we will deploy six BGC-Argo floats, turn around six moorings along the Ellet line and OSNAP array in the Rockall Trough and the Iceland Basin, and install a new drift-free bottom pressure recorder in the Rockall Trough. The bottom pressure recorder will stay in the water for 10 years and its data will be harvested remotely via an acoustic modem without the need to recover the instrument. This is unprecedented for AMOC observations. A similar sensor will be deployed by German colleagues at the western border of the Atlantic basin. The new bottom pressure recorders have the potential to monitor long-term changes in the AMOC with minimal observational effort. Because the sensors are drift free, the smallest changes like a continuous trend will be identifiable. This was not possible before because previous bottom pressure recorders were dominated by a strong sensor drift which only allowed us to study changes on timescales shorter than the deployment period. This opens a whole new world of sustained basin-wide ocean transport observations.



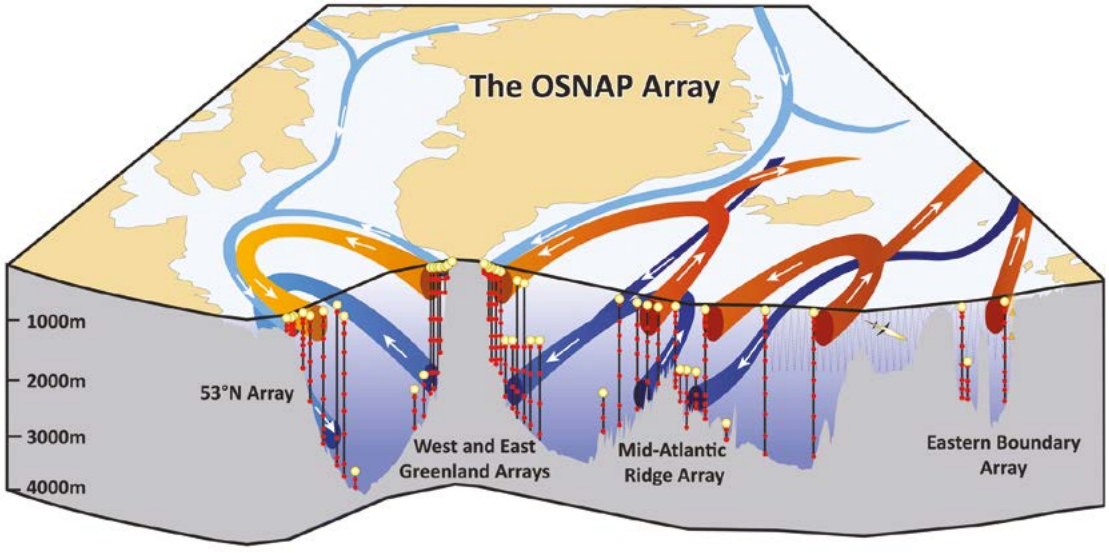


Figure 2: A schematic of the OSNAP mooring array (below), the location of which is also shown on the map (left). Warm currents in the upper one kilometer which flow north from the Gulf Stream and North Atlantic Current are shown in red and orange. The warm water cools as it flows round the subpolar gyre and in the Nordic and Labrador Seas east and west of Greenland. The cold waters in blue return southward at depths of one to four kilometers. This is the overturning circulation. To continuously monitor the strength and structure of all these currents, an array of moorings is continuously deployed between Newfoundland and West Greenland and East Greenland and Scotland. A mooring is a wire (black vertical lines) from the seabed to just below the surface and is held taught and vertical by syntactic foam and glass buoyancy (yellow dots). Instruments such as current meters, and temperature and salinity sensors are fixed to the wires (red dots). Every two years, over a period of three summer months, all the moorings are recovered during research expeditions. The data from the instruments can be downloaded for analysis New moorings and instruments are deployed for another two years. In the Eastern Boundary Array autonomous gliders (yellow vehicle with black wings), patrol regions where it is difficult to install moorings safely (mainly due to fishing). Gliders have an endurance of six to eight months, and are deployed and piloted by the Scottish Association for Marine Science.