MSM123 "BELS"

Halifax – St. John's

23 November – 27 December 2023

2nd Weekly Report (27.11. 2023 - 03.12.2023)

This week we were busy building up the underway systems on board, while traveling to the OSNAP West array. Underway measurements are continuously performed at approximately 5 m depth, essentially mapping the area of our cruise track. We observe sea surface temperature, salinity, total gas tension, dissolved oxygen, chlorophyll, and carbon dioxide (pCO_2) in the water. The Dal-SOOP underway system from Dalhousie University (https://www.dal.ca/diff/cerc/research/volunteer-observing-ships/VOS-system-design.html) is equipped with a membrane equilibrator connected to a CO_2-analyzer (Pro-Oceanus Systems Inc) and other biogeochemical sensors. The system delivers valuable high-resolution measurements critical for constraining the role of this data-poor region in the uptake of oxygen and carbon dioxide. It has been running well the whole week and the figure below illustrates the difference in CO_2 content between air (~420 ppm) and water (Figure 1). We have traveled through undersaturated sea surfaces to our current position, where the water and air are in equilibrium.

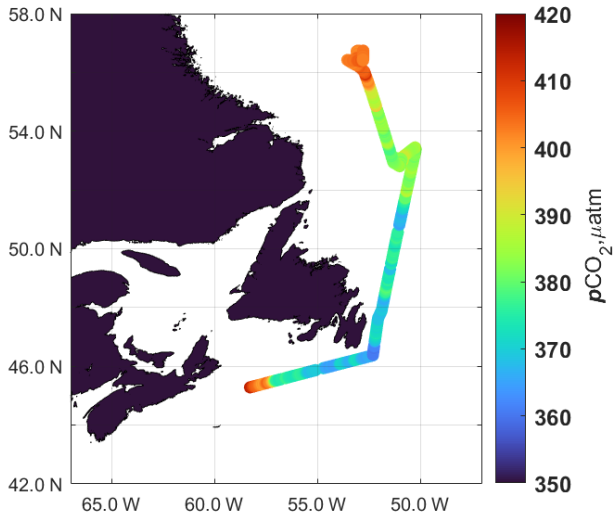

Figure 1. Underway pCO_2 measurements over the last week (from Dariia Atamanchuk).

The Overturning in the Subpolar North Atlantic Program (OSNAP) mooring arrays are designed to observe the fluxes of heat and mass in the subpolar North Atlantic Ocean. This region exerts important controls on North Atlantic, European, and global climate, but is sparsely measured. The area of the OSNAP West array is around 53°N in the Labrador Sea and the measurements there include dissolved oxygen. It is extremely useful to calibrate the mooring sensors with independent measurements, especially the deepest oxygen sensors. In order to assist in the calibration process, we traveled to the K8, K9, and K10 moorings to perform depth profiles measuring oxygen. The

sensors on board the Merian were calibrated with a chemical method called Winkler titration (performed by Meghan Molnar from the University of Victoria). This titration method was used additionally to intercompare the different water streams on board (Figure 2). Measurements are always taken in duplicate or triplicate and the samples are run within two days. It is evident from the on board intercomparison that the measurements are precise. Once the data from the depth profiles is polished using these titrations, it will be shared with the groups running the moorings to assess their simultaneous oxygen measurements.

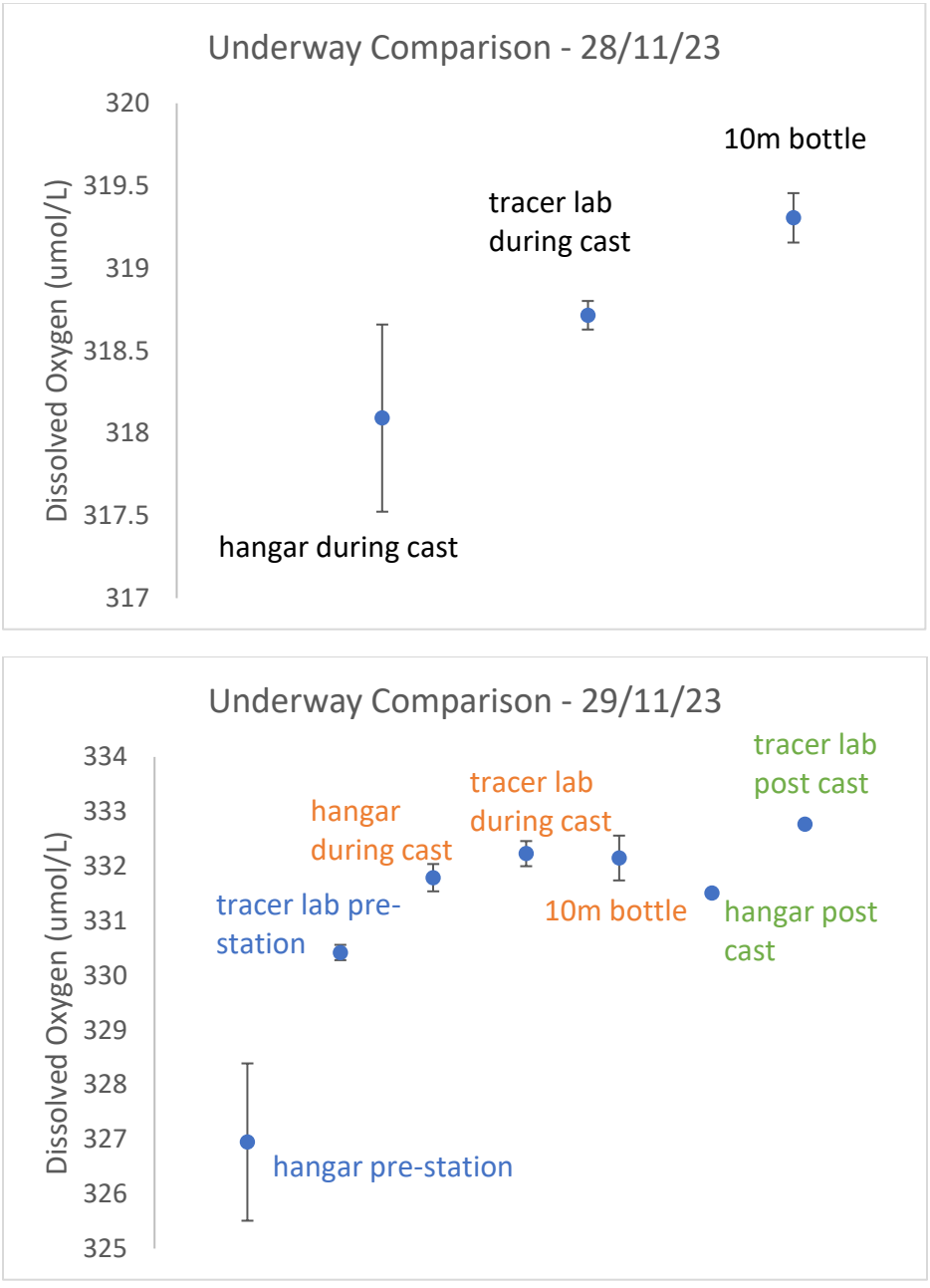

Figure 2. Intercomparison of dissolved oxygen values from two underway systems and the 10 m Niskin bottle (top performed 28 Nov, bottom performed 29 Nov).

This calibration effort was complicated by our first storm encounter, which made it difficult to conduct profiles. The ship weathered the storm easily, but I can't say the same for all of its inhabitants – luckily, we have had some days of recovery since. In those days, we began finding our Christmas spirit, leading up to the first day of Advent (Figure 3). The crew and scientists have begun decorating and the Lebkuchen is flowing. Let the holidays begin!

Figure 3. Holiday spirit in the lab (gas chromatography-mass spectrometry, Winkler titrations, and water filtrations are performed here).

Greetings from an energetic Labrador Sea,

Christa Marandino

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