Australia's National Science Agency

International Nutrient Inter-Comparison Newsletter #9

Keep up to date on the facts, plans and people involved with the International Nutrient Inter-Comparison voyage (INIV) scheduled for June 2023

Image credit: Alicia Camac

INIV is finally back on the horizon with only twelve months to go! Planning and communication will now ramp up as we enter the formal voyage planning phase with the Marine National Facility.

As we return to some modicum of normality resembling pre-pandemic days, we look forward to harnessing everyone's enthusiasm as we roll out planning for the cruise.

Welcome

Welcome to the ninth INIV newsletter. In this newsletter we can finally confirm the dates of our voyage and announce some exciting news from the Southern Ocean Observing System (SOOS). Finally, we present the findings from Niskin sampling experiments conducted on a recent RV Investigator voyage at the location of the Southern Ocean Time Series (SOTS). Read on and get in touch with any thoughts from experimental results.

Voyage dates

The RV Investigator schedule has now been released. **INIV** will proceed as voyage *"IN2023_V04"* from the **5th to 18th of June 2023**. There will be a period of mobilisation prior to the voyage.

Over the next year, we will be in communication to coordinate planning and necessary logistics for the voyage. We will continue to communicate with participants and stakeholders as our timeline unfolds. Keep an eye out in your inbox for the next all participants virtual meeting for Aug/Sept.

SOOS endorsement

The Southern Ocean Observation System (SOOS) is officially endorsing our INIV research project. They have acknowledged that this voyage will *"fill critical gaps in our knowledge of nutrient measurement variability by engaging an international community effort to compare onboard measurement practices, while also collecting new data on a circumpolar scale"*. They also point out that *"INIV aligns well with multiple SOOS Science Themes, particularly those related to fundamental processes, primary productivity, the biological carbon pump, and nutrient cycling"*.

SOOS SOUTHERN OCEAN OBSERVING SYSTEM

SOOS have outlined their enthusiasm to support us. As we get closer to the voyage, and especially following the voyage, they will be communicating the outcomes through many of their mediums.

INIV experimental planning piggyback project

During a recent voyage on the RV Investigator, the CSIRO Hydrochemistry team collected water samples from the Southern Ocean to better understand and quantify natural variability in the Circumpolar Deep Water (CDW) (Experiment #1), as well as understand within Niskin bottle homogeneity (Experiment #2).

Want to know more about the CDW? Check out the Summer Student Project from Newsletter #8.

Experiment 1:
Nutrient variability in Circumpolar Deep Water

This experiment examines the natural variability of nutrients within the Upper (UCDW) and Lower (LCDW) Circumpolar Deep Water. The UCDW is characterised by an oxygen minimum and the LCDW by a salinity maximum. The oxygen minimum and the salinity maximum depth range was determined during the down cast to 4000 m. On the upcast, a Niskin bottle was fired every 50 m within the salinity maximum and oxygen minimum water mass, as well as within the 200 m below and above these ranges. Part A & B explain in detail.

Part A: Oxygen minimum (UCDW)

The oxygen minimum (UCDW) region is between 1700 m and 1900 m. The sensor data shows an average oxygen value of 173.53 ± 0.28 µmol/L within this depth range (Figure 1). The mean concentration of the 5 bottles sampled within the UCDW is 2.4 ± 0.02 µmol/L for Phosphate, 33.9 ± 0.37 µmol/L for Nitrate, and 78.5 ± 2.4 µmol/L for Silicate (Figure 1).

Part B: Salinity Maximum (LCDW)

The Salinity Maximum (LCDW) region was deemed between 2700 m and 3000 m. The sensor data shows an average salinity value of 34.743 ± 0.001 PSU within this depth range (Figure 2). The mean concentration of the 5 bottles sampled within the LCDW is 2.2 ± 0.01 µmol/L for Phosphate, 31.0 ± 0.06 µmol/L for Nitrate, and 96.2 ± 2.8 µmol/L for Silicate (Figure 2).

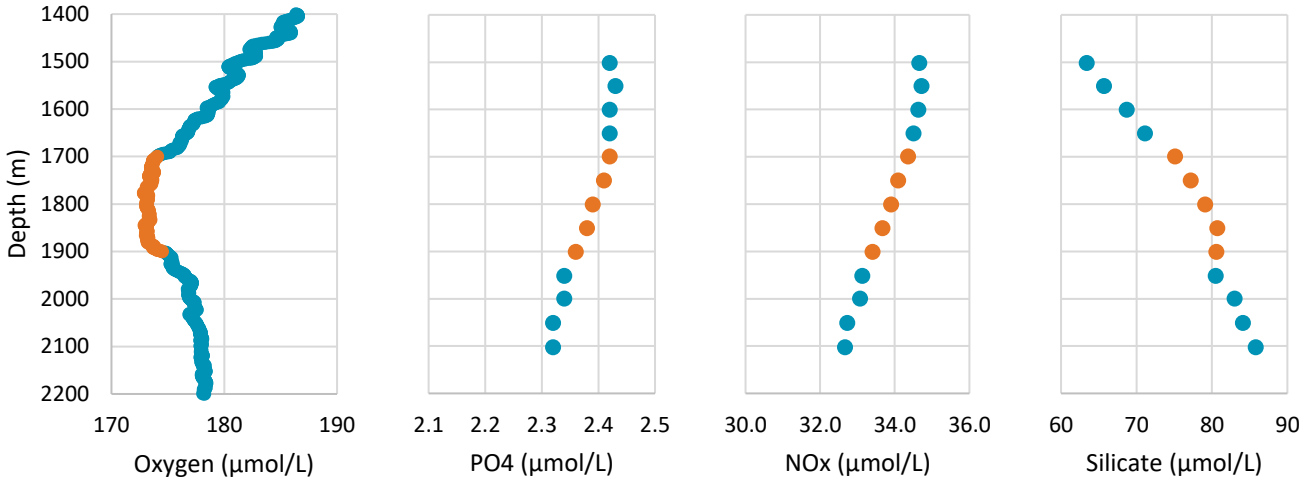

Figure 1: Exp. 1A – Corresponding oxygen (sensor) and nutrient (Niskin sample) concentrations within the UCDW (● orange) and samples taken 200 m below and above that water masses (● blue). Niskin bottle samples were collected every 50 m; oxygen sensor data is reported every 1 m.

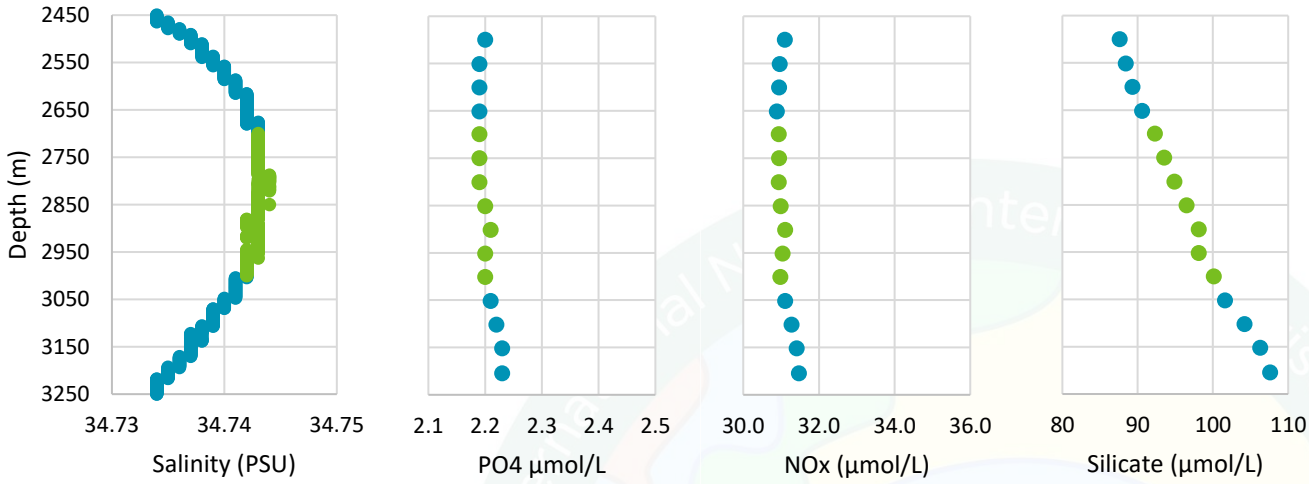

Figure 2: Exp. 1B – Corresponding oxygen (sensor) and nutrient (Niskin sample) concentrations within the LCDW (● green) and samples taken 200 m below and above that water masses (● blue). Niskin bottle samples were collected every 50 m; oxygen sensor data is reported every 1 m.

Experiment 2:
Homogeneity of Niskin bottle sampling

The water budget for INIV will require a larger volume of water sampling per Niskin bottle than a typical voyage, therefore it is essential that the homogeneity within a Niskin bottle is accurately characterised. For this experiment, nutrients concentrations from previous casts in the same region were plotted to find the nutrient cline depth (representative of the steepest nutrient change) at 150 m. Three Niskin bottles were fired at 150 m to test the homogeneity from *within* (bottom to top) the Niskin bottle as well as *between* Niskin bottles. The sampling regime was to collect a nutrient sample then discard 1L of seawater from the Niskin bottle. This was repeated for a total of 10 nutrient samples from each Niskin bottle. Results for within and between Niskin bottle repeatability are summarised in Table 1 and Figure 3 (NOx only). Results were not reported for Ammonia or Nitrite due to the low concentration at 150 m.

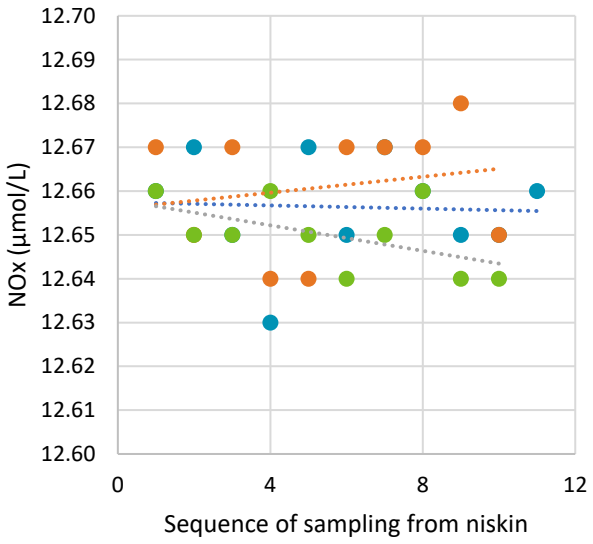

Figure 3: NOx concentration (µmol/L) in Niskin bottle rosette position 26 (● blue), 27 (● orange), and 28 (● green) fired at 150 m in the Southern Ocean.

Table 1: Mean and standard deviation results characterising (A) homogeneity within (n=10), (B) and between Niskin bottles (n=30) for nitrate, phosphate, and silicate at 150 m in the Southern Ocean. Bottles were fired consecutively indicated by Rosette position (RP).

A)	Homogeneity within Niskin (µmol/L)		
Nutrient	Niskin RP26	Niskin RP27	Niskin RP28
Nitrate	12.66 ± .01	12.66 ± .01	12.65 ± .01
Phosphate	0.95 ± 0.0	0.95 ± 0.0	0.95 ± 0.0
Silicate	3.05 ± .05	3.04 ± .05	3.04 ± .05

B)	Homogeneity between Niskins (µmol/L)		
Nutrient	Mean	Min Value	Max Value
Nitrate	12.66 ± .01	12.63	12.68
Phosphate	0.95 ± 0.0	0.94	0.95
Silicate	3.04 ± .05	3.0	3.1

What did these experiments show and what questions do they raise?

We invite you to comment on the nutrient data presented here. Have you ever performed similar experiments? Do you see a trend in the data? Why is the silicate variation in the UCDW and LCDW so much larger than nitrate and phosphate? And more.

We look forward to hearing from you. Our hope is that we can use the feedback gathered as a discussion in the next newsletter. Please send feedback to Cassie – cassie.schwanger@csiro.au.

Participant Bios

Merinda McMahon

Role: Hydrochemist

Organisation: CSIRO

Days at sea: 185 over 8 voyages

Favourite voyage:

My favourite voyage so far has been in2021_v01, it was my first Antarctic voyage, so lots of firsts. We saw lots of cool icebergs, a few Auroras, lots of interesting wildlife and snowflakes (my first-time seeing snow)! The science was exciting and there was a good community feel onboard.

On the other end of the spectrum, I also really enjoyed in2019_v06 where we sailed north of Darwin looking at the merging Indonesian Throughflow water into the Indian Ocean. We got to see flying fish, enjoy the tropics, see great sunsets and the ocean was so calm you could see your reflection on the water!

What interests you most about INIV?

Like most have already said, what I'm looking forward most about INIV is meeting and working with the nutrient community. There aren't many labs in Australia that do similar work to us so it will be really useful to work with and learn from the international community throughout this project.

Susan Becker

Role: Lab Manager, Oceanographic Data Facility

Organisation: Scripps Institution of Oceanography

Days at sea: 2,342 (> six years of life at sea!)

Favourite voyage:

Each trip has its high points and challenges. I do not think I can pick a favorite. I have been fortunate enough to sail in the Arctic, Antarctic, and numerous places in between. I work with a wide variety of scientists including: physical, chemical, and biological oceanographers. The variety in both the location and focus of the science and scientists my lab supports is what I have enjoyed the most over the course of my career.

Seeing polar bears, walrus, penguins, seals, flying fish, whales etc. never gets old for me.

What interests you most about INIV?

I am an analytical chemist by training and at heart. The focus of my interests and career has been to obtain the best possible nutrient data. I am interested in the nutrient inter-comparison cruise to help develop and refine the analytical procedures and methods for the analysis of nutrients in seawater.

Voyage Website

We have a website! Check it out for additional information about our voyage including voyage location, planning, getting involved, FAQ and more: https://wp.csiro.au/iniv

Contact Us

Please feel free to reach out to the CSIRO Hydrochemistry team at any time during the planning process: iniv2022@csiro.au

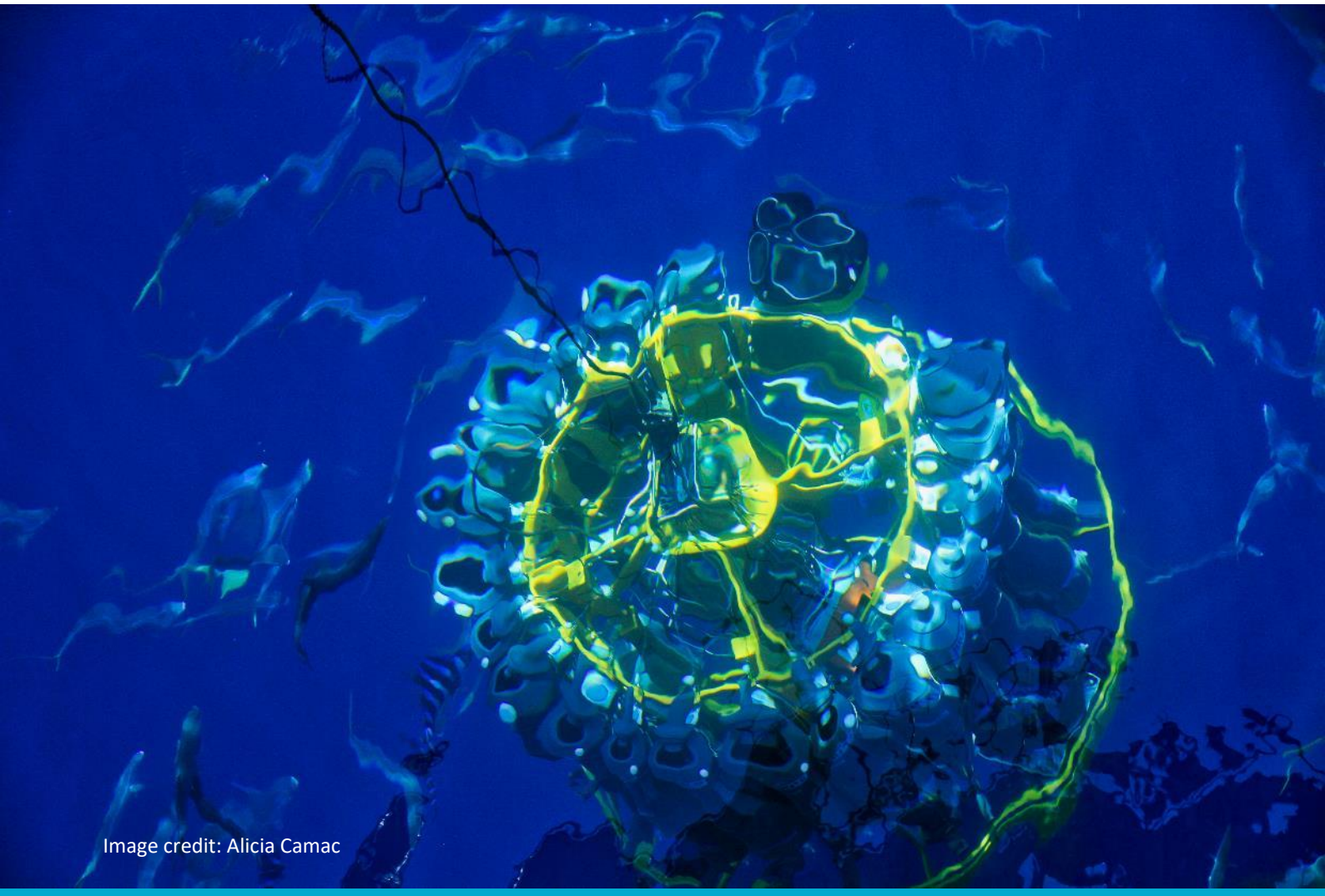

Image credit: Alicia Camac

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For further information

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