June Newsletter

Achievements

New ICOS Ocean publications can be found at the bottom of this newsletter. Please send us more with a brief piece of text describing the main results - it's great to see ICOS Oceans data being published.

Congratulations to Agneta Frannson et al from the Norwegian Polar Institute who has published a paper in Frontiers of Marine Science entitled "Variability of Sea-Air Carbon Dioxide Flux in Autumn Across the Weddell Gyre and Offshore Dronning Maud Land in the Southern Ocean https://doi.org/10.3389/fmars.2020.614263

Events

The Intercomparison workshop will take place on 28th June - 11th July 2021. More details to follow

Forward looking:

The ICOS Science Conference 2022

13 -15th September 2022

Location: Utrecht, Netherlands

An announcement will be made in Autumn 2021.

Welcome to the quarterly newsletter from the ICOS Ocean Thematic Centre. Never has the importance of quantifying ocean C uptake been more important. Our mission is to support the 21+ ICOS ocean stations to deliver the data we need to better quantify the oceans' role in carbon cycling.

Here is an update on activities in the OTC. As a reminder we divide our activities into 5 work-streams: leadership and management, labelling, data, technology and training and station support.

Leadership

The OTC holds weekly meetings that discuss and review activities within the 5 work-streams. We have started inviting 2/3 ocean station PI's a month to attend. It is fantastic to hear directly from the PI's on their activities! It is also a great opportunity for us to lend further support and advice. If you are interested in joining us one week, please let us know.

You can find more information on the OTC website that can be found here and on Twitter @OTCCO2.

Our major focus this year has been on working with various funding agencies to build momentum for a stronger and more coordinated funding environment for ocean stations. These include JPI Oceans and the G7 Future of the Seas and Oceans Initiative.

There has been a lot of activity around the JPI Oceans. We wrote a scoping paper to the JPI Oceans board around the possibility of joining up activities to deliver more science and a more sustainable observing system delivering to policy. The board liked this and around half the JPI Oceans countries nominated experts to serve on the working group to scope out what a workshop this autumn might look like. Currently this group has the status of a JPI ocean 'Knowledge Hub' and it is intended that this should identify synergies, potential cost savings and key knowledge gaps that sit in the JPI Oceans area. One key outcome is hoped to be better levels of internal synergy within countries, so if you would like information on nominated experts or programme committee members in your country, please come back to us for more information

At an international level there is considerable momentum building around a need for a step change in the way ocean carbon observations are organized and funded. The recent G7 meeting in the UK included the following statement in their official outcomes 'As part of this work we will convene scientific and policy experts to discuss the carbon absorption function of the ocean, furthering targeted and effective ocean action'. In the run up to the COP this year the role of the oceans is being increasingly realized. The work that all of you do is crucial for informing this understanding, please do inform us if there are additional ways in which we can advocate for you at national and international levels.

Labelling

Currently, the ICOS ocean network consists of 23 stations, and of these, 8 are labelled. The latest one being BE-SOOP Simon Stevin, which was accepted as a Class 1 station at eh GA in May.

The Saildrone (ATL2MED) mission ended, as mentioned before, last July 2020 after 9 months of sailing. The Saildrone carbon data have been made available at the Carbon Portal and also submitted to SOCAT in January 2021. Further, the data have also been made available for the Winter 2020 effort, which aims to explore if and how the very dry 2018 affected the ocean. 7 fixed ocean stations were involved in the CO_2 part of the Saildrone mission, of these 5 ICOS stations (DE-FOS CVOO, IT-FOS W1M3A, IT-FOS E2M3A. IT-FOS Miramare, and IT-FOS Paloma). It has taken quite some time to post calibrate the fixed station sensors, and thus, we are heavily delayed regarding the final comparison between the FOSs and the Saildrone CO2 sensors.

Training and station support

Setting up the tank facility for the 1st ICOS pCO2 instrument inter-comparison.

After more than two years of preparation the 1st ICOS OTC pCO2 instrumentation inter-comparison will start in a few weeks. From June 28 until July 11th, 2021, we will run 29 pCO2 instruments: buoy systems, submersible systems and equilibrator based underway systems in an indoor seawater tank. Some will be installed in pairs so that we will have 17 different instrument types.

The inter-comparison will take place in a tank facility at the Flanders Marine Institute's (VLIZ) Marine Station Oostende (MSO) Site. The exercise was initially planned to take place in 2020 with up to 40 interested scientists from all over the world on site.

Due to the Corona-virus pandemic we rescheduled it to summer 2021 and instead of having a larger group on site we will be there with a small core team of 5 persons setting up and running all instruments. Daily workshops with involved parties will be held to discuss the results and plan the next steps. The inter-comparison will start and end with open access, free to attend webinars. The first one will focus on the rational, scope and details of the activity, while the second one will focus on initial results and highlights from the 2 weeks. For updated information please visit the OTC web site at https://otc.icos-cp.eu/node/144 and follow us on twitter under #pco2compare.

New Technology

The CarCASS (Carbonate Chemistry Autonomous Sensor System) project

Focusing on the highest scientific priority for chemical measurement i.e., the effects of carbon dioxide (CO_2) in water, the CarCASS (Carbonate Chemistry Autonomous Sensor System) project is delivering the first integrated sensor for pH, Dissolved Inorganic Carbon (DIC) and Total Alkalinity (TA) that can operate from the surface to full ocean depth. The NOC CarCASS technology will be used to improve our understanding of the ocean's rapidly changing CO_2 reservoir, as well as monitor ocean acidification. Despite the effects of the global pandemic, CarCASS has achieved many of its key deliverables and the project team are currently preparing for trials and science demonstration activities in 2021.

Central to the CarCASS concept is that using multiple sensors together enables a complete characterization of the ocean carbonate system and using a mixture of fast and slower but more accurate sensors enables this to be done accurately and at high speed. Recent progress has seen demonstration of all three Lab-On-Chip (LOC) sensors (pH, TA, DIC) together and separately. Currently the individual LOC sensors have reached TRL 8 (pH), TRL 6/7 (TA) and TRL 6 (DIC). Deployments have included: trials of all CarCASS sensors onboard Autosub Long Range in Loch Ness; pH on a deep descending (~4800 m) sensor frame in the region of the Porcupine Abyssal Plain; and pH, TA and DIC multiple times in the North Sea as part of the STEMM-CCS project developing sensors for monitoring Offshore Carbon Capture and Storage. In March of this year, the sensors have been deployed in the Solent integrated on an autonomous surface vehicle (Liquid Robotics Wave Glider https://www.liquid-robotics.com/wave-glider/how-it-works/). Currently the team are implementing an algorithm and associated software and hardware to integrate the individual sensors into the combined CarCASS instrument whilst progressing the TRL of a combined TA/DIC sensor.

pH, DIC and TA LOC sensors developed through the CarCASS

A Liquid Robotics Wave Glider equipped with LOC pH, TA and DIC sensors in the Solent. Photo's courtesy of Socratis Loucaides

The CarCASS project is part of the OCEANIDS programme and can found here:
https://noc.ac.uk/projects/oceanids

Meet a station

HAUSGARTEN – the northernmost ICOS Fixed Ocean Station

Hausgarten - photo courtesy of Thomas Soltwedel, AWI

The Arctic environment is in rapid transition and is severely impacted by Climate Change, with air temperatures increasing twice as fast in the Arctic as in other regions of the planet. What happens in the Arctic has far-reaching implications around the world.

For this reason, continued intensive research in the Arctic is urgently need.

Time-series studies of arctic marine ecosystems are rare. This is not surprising since polar regions are largely only accessible by means of expensive modern infrastructure and instrumentation. To detect and track the impact of large-scale environmental changes on the marine ecosystem in the transition zone between the northern North Atlantic and the central Arctic Ocean, the Alfred Wegener Institute, Helmholtz-Center for Polar and Marine Research (AWI) established the LTER (Long-Term Ecological Research) observatory HAUSGARTEN in the Fram Strait, the only deep-water connection between the Nordic Seas and the central Arctic Ocean. Since 1999, repeated sampling in the water column and at the seafloor during yearly expeditions in summer months was complemented by continuous year-round sampling and sensing using autonomous instruments on anchored devices.

Currently, the observatory constitutes a network of 21 permanent sampling sites, the majority of which are located along a bathymetric transect between ~250 m and ~5,500 m water depth at about 79°N from the Kongsfjorden (Svalbard) in the east, along the Vestnesa Ridge towards the Molloy Hole (i.e., the deepest known depression in the Arctic Ocean) and across the Greenland continental margin (stations in the western Fram Strait were newly established in 2014). Three sampling sites close to the ice-edge between 79°30'N and 80°00'N in the north-eastern Fram Strait and a supplementary site in a permanently ice-free area at 78°30'N in the eastern part of the strait complete the network.

Time-series studies at HAUSGARTEN provide insights into processes and dynamics within an arctic marine ecosystem and act as a baseline for further investigations of ongoing changes in the Fram Strait, including variations in gas exchange between the ocean and the atmosphere and shifts in the carbonate system of seawater that are expected to affect the composition of planktonic communities and thus the entire marine food web. Long-term observations at HAUSGARTEN will significantly contribute to the global community's efforts to understand variations in ecosystem structure and functioning on seasonal to decadal time-scales in an overall warming Arctic and will allow for improved future predictions under different climate scenarios.

Article by Agneta Fransson, PI for CO2-VOS RV Kronprins Haakon

Norwegian Polar Institute, Norway

Antarctica sea ice and KPH, photo courtesy of Robin Hjertenes (IMR)

Antarctic surface water as a large sink of atmospheric CO2 in autumn.

There are few observations of surface water pCO2 in the ice-covered part of the Southern Ocean, south of 66°S, and few observations in autumn.

There is still a question on whether the Antarctic waters are a net CO2 sink or a source.

In 2019, in February-April (austral autumn), the Norwegian research vessel Kronprins Haakon and ICOS-VOS station had the opportunity to investigate the coast and ice-covered ocean off the Dronning Maud Land (DML), Kong Håkon VII Hav and Weddell gyre, Antarctica, starting in Punta Arenas, Chile and ending in Cape Town, South Africa. Norwegian and South African researchers, PhD and post-doctoral students contributed to the interdisciplinary research onboard. Along the route, continuous surface water observations of fugacity of CO2 (fCO2), dissolved oxygen, chlorophyll, salinity and temperature were performed.

In addition, water samples for dissolved inorganic carbon (DIC), total alkalinity (AT) and pH were collected from the water intake, in order to compare the continuously measured CO2 with calculated CO2 (from DIC, AT, pH).

In January 2021, a new paper with the title “Variability of Sea-Air Carbon Dioxide Flux in Autumn Across the Weddell Gyre and Offshore Dronning Maud Land in the Southern Ocean” by Ogundare M., A. Fransson, M. Chierici, Warren R. Joubert and A. N. Roychoudhury was published in Frontiers of Marine Science, https://doi.org/10.3389/fmars.2020.614263, where data and new insights from the Weddell Gyre and DML Antarctic cruise were presented. The surface water fCO2 was below atmospheric fCO2 (about 405 µatm) in most areas, meaning that the ocean acted as a CO2 sink, where the lowest fCO2 was observed in the southern area at 66-68°S, near the Antarctic coast and coastal ridges (e.g., Astrid Ridge). The relatively low surface fCO2 coincided with high chlorophyll, which was mainly explained by an on-going or previous plankton bloom, consuming CO2, in combination with colder and fresher surface water. In the Weddell Sea, at the ridge extending from the Antarctic Peninsula, higher surface fCO2 than atmospheric levels were observed, indicating upwelling of CO2-rich sub-surface water, due to topographic features, resulting in ocean outgassing of CO2 (ocean CO2 source). Going northward, from the Antarctic coast, the cruise crossed several frontal regions and the Maud Rise, clearly visible in the changes in salinity, temperature and fCO2 observations.

The DML cruise was organized by the Norwegian Polar Institute and the CO2 study was part of the bilateral collaboration between Norway and South Africa within the SANOCEAN project SOPHY-CO2, “Southern Ocean phytoplankton community characteristics, primary production, CO2 flux and the effects of climate change”, funded by the Research Councils of Norway and South Africa. The study is also a contribution to ICOS, COMFORT and SOCAT.

Upcoming Science Calls

The EU is planning a large number of infrastructure calls over 2021/22. We see these as being a great opportunity to take the network to the next level. Full details aren't out yet but we've been looking at draft calls. As part of the ICOS network you are fully entitled to bid into these and we are keen to help you make the most of them. We have lists of tasks we want to get funded to help you but we are always happy to consider other actions. If you want help with accessing these funds then do drop us a line and we will see if we can help. There are calls on digital twins, data management, network development and technology and parallel science calls.

We are currently beginning to pull together some thoughts around one of these: HORIZON-INFRA-2022-TECH-01-01 R&D for the next generation of scientific instrumentation tools and methods This will bring together 3 ERICs, with a deadline in March 2022. We will work closely with industry, reducing environmental impacts and showing clear benefits to society. Ideas include intercalibrations, non-CO2 greenhouse gases, and standards.

Latest news from the PAP-SO Cruise

The DY130 cruise to the Northeast Atlantic Ocean was a continuation of a long-term time-series of observations at the Porcupine Abyssal Plain Sustained Observatory (PAP-SO). On DY130 Sue, Anita and Hashan were 'Team CO_2' measuring carbon dioxide (CO_2) and other gases in the surface ocean around the PAP-SO site.

The PAP-SO site has one of the longest biogeochemical time series records in Europe, e.g., year-round surface CO_2 measurements started 18 years ago. The main motivation is to detect changes in greenhouse gases and ocean acidification. To this end we measure parameters of the carbonate system (I) continuously but also (ii) from discrete samples.

On DY130, two membrane-based systems (ProOceanus CV and SubCtech Ocean Pack) were connected to the underway non-toxic seawater supply for continuous pCO_2 measurements in surface seawater (Figure 1).

The Met Office surface buoy deployed at the PAP-SO site is another system used for continuous measurements of pCO_2 in surface seawater and the atmosphere using ProOceanus sensors. To calibrate the sensors on the buoy and the underway systems, discrete samples for analysis of dissolved inorganic carbon (DIC) and total alkalinity (TA) are sampled routinely from the underway system and the CTD.

The site is a key component of two ocean networks that are interested in our me series measurements: ICOS (Integrated Carbon Observation System https://www.icos-ri.eu/) and EMSO (European Multidisciplinary Seafloor and water column Observatory http://emso.eu/).

The work is supported by CLASS (Climate Linked Atlantic Sector Science https://projects.noc.ac.uk/class-project/) and iFADO (Framework for the Atlantic Deep Ocean https://www.ifado.eu/).

Latest publications, 2021

"Variability of Sea-Air Carbon Dioxide Flux in Autumn Across the Weddell Gyre and Offshore Dronning Maud Land in the Southern Ocean" by Ogundare M., A. Fransson, M. Chierici, Warren R. Joubert and A. N. Roychoudhury was published in Frontiers of Marine Science, https://doi.org/10.3389/fmars.2020.614263

The next issue of the newsletter will be published in September 2021.

We are looking for articles from the community. Have you been on a cruise, published a paper, hosted a station exchange or started a new programme that you could tell us about? Or would you like to write a profile of your station?

If you would like to join us in one of our weekly Ocean Thematic Centre update meetings, do please let us know, you are more than welcome.

Please send text and images directly to Jess Thorn or Richard Sanders.