



## February Newsletter

### Science Highlights

Congratulations to Meike Becker (et al.) for new publications in 2021.

Becker et al: The northern European shelf as an increasing net sink for CO<sub>2</sub>, *Biogeosciences*, 2021, <https://bg.copernicus.org/articles/18/1127/2021/>

Macovei, V. A., Voynova, Y. G., Becker, M., Triest, J. and Petersen, W. (2020). Long-term intercomparison of two pCO<sub>2</sub> instruments based on ship-of-opportunity measurements in a dynamic shelf sea environment. *Limnology and Oceanography: Methods*. doi:10.1002/lom3.10403.

### News

There has been many joint doctoral training occurring in ITM Marie Curie calls.

ICOS seeks EU funding for developing gas observations in cities. Known as PAUL (Pilot Application in Urban Landscapes towards Integrated city observatories for greenhouse gases). The deadline for submissions was 12th Feb 2021. The OTC have submitted their proposal. This proposal includes 3 pilot cities, Munich, Zurich and Paris.

Our plans for this year are obviously quite fluid, given the COVID situation but we see major actions around IOCOS linked to the UN Decade and the COP, we hope to work with new stations on labelling and data uploads and to seek funding for the membrane sensor calibration systems. The inter-calibration is looking like a fixed date, even if we have to run it in a COVID secure manner and we are excited to see the gas bottle standards rolling out across the network.

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 20+ ICOS ocean stations to deliver the data we need to better quantify the oceans role in carbon cycling.

### Updates to the work programme

The year 2020 has turned out very differently from the way we planned it, and many activities have been postponed/cancelled/modified in response!

Here is a quick 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:** Our major effort last year was on developing the IOCOS concept. Other important activities have included working on a Marie Curie ITN application, writing letters of support, responding to consultations and preparing for the ICOS evaluation. We also coordinate the station ringarounds which we conduct quarterly to hear about your problems, get feedback on our performance and tailor our activities. The data we get from these is proving invaluable in helping to make the IOCOS case for a different funding model.

We are also undertaking a small piece of work within a CCVS proposal to link stations through to satellite calibration actions, please contact us if you need more details.

**ICOS OTC Communications:** We communication with the network via a 3 monthly newsletter which is widely read. We shall be converting over to using MailChimp, allowing us to communicate the newsletter directly into email, rather than you having to open a separate attachment.

The OTC hold weekly meetings that discuss and review activities within the 5 work-streams. We would like to invite 2-3 stations a month to attend. It would be fantastic to hear directly from the PI's on their activities!

You can find more information on the OTC website that can be

## Other news

The ICOS RI are preparing a new "education" webpage, combining all the educational opportunities and materials offered by the wider ICOS network. The draft page can be found [here](#). Currently, the page includes the education tool "Jupyter", ICOS summer school information and a list of GHG courses offered by ICOS stations. Please let us know if you are aware of any other educational opportunities or materials, or of any GHG courses offered by ICOS partner institutes that the ICOS communication team can include on the website.

The ICOS NextCloud now hosts the ICOS Community Calendar. This is very helpful in avoiding any conflicts of future dates/events. If you have any events you would like added to the calendar then do please get in touch with us. To view the ICOS Community Calendar you can find it [here](#).

The ICOS Evaluation Report by the external committee is now complete. The assessment will be published after the next General Assembly meeting in April 2021.

## Upcoming Events

ICOS Virtual EGU2021

19th - 30th April 2021

Due to the ongoing risks associated with the coronavirus pandemic, this event will be held entirely online.

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

5th ICOS Summer School.

9th - 17th December 2021

POSTPONED

Forward looking:

The ICOS Science Conference 2022

13 -15th January 2022

Location: Utrecht, Netherlands

found [here](#) and on Twitter [@OTCCO2](#)

**Labelling:** Labelling: The OTC would like to welcome ES-SOOP CanOA to the network.

Presently the ICOS Marine Station network includes 23 stations, of which 7 have gone all the way through the labelling process. We are available to help you with all stages of the labelling process, from an initial enquiry to preparing the final reports.

The OTC would like to say congratulations to the Stations and the Saildrone group on a successful 9 month Saildrone (ATL2MED) mission. The ICOS element was designed to determine how long term deployments of mobile platforms traversing the open ocean can help in validating the fixed ocean stations so many thanks to the 7 FOS involved. The data correction is ongoing, but you can find the uncertainty analysis and variables on the OTC website.

**Data:** The Quince software package continues to receive updates to its interface, data flow and website. Currently we are working on Saildrone data which can be pulled in from the sources with the aim to ease automation of this.

We held a data reduction workshop in 2020 covering calculation best practices. We got good community feedback and have as a result revised how we use standards to calibrate data.

Work has commenced on a spike detection algorithm. ICOS data flowing into SOCAT has not yet become fully automated but they are working on it.

ICOS is involved in EnvriFAIR (eg: standard vocabulary and tracking input values in fCO<sub>2</sub> calculations). They are also working on data interpolation and offsets with the aim to increase automation of data QC (e.g. gas standard offsets). For 2022 more work will be done on FOS support and on data reduction specifically. Please volunteer your experience on specific sensors – so we can build what you require to process the data.

**Training and station support:** Station visits are planned when travel restrictions are lifted. Please contact any in OTC with issues and Tobias Steinhoff specifically with any ideas for future training.

The data reduction workshop on the 2nd - 4th Nov 2020 was successful and we are happy to add more workbooks to supplement Quince.

The sensor training workshops will probably be postponed to 2022, due to COVID-19 restrictions.

The SOLAS summer school may happen in the fall and the ICOS summer school will most likely occur in Dec 2021.

Reference gases are available to all stations (4 have taken this up

so far). The OTC have 60 bottles and you can choose 150-800 ppm (others are available but may take longer). Please see the training and support pages of the OTC website to order gases. The OTC are also purchasing gas regulators for each SOOP.

In a parallel activity we are beginning to produce 'Dickson' style DIC and TA standards which many of you said you are keen to have. They are free to ICOS and will cost 10-15E outside of ICOS. You will then get an initial value of DIC and TA concentrations which will be validated later at Dickson lab, USA.

As mentioned elsewhere we see a major activity over the coming years being supporting stations who use membrane sensors. In the short term we are paying for 1 sensor calibration a year for each station to allow you to take advantage of bulk reductions. We have a number of ideas regarding how to support these stations in their calibration needs and plan to include these in future grant proposals – do contact us if you want to be involved.

### **New Technology:** Novel sensors and FOS support:

The development of novel sensor technology for pH, TA, DIC and pCO<sub>2</sub> is progressing at NOC and University of Exeter with field trials planned in March 2021 in Southampton. The new microfluidic spectrophotometric pH sensor is now commercially available and can be purchased by ClearWater Sensors ([www.clearwatersensors.com](http://www.clearwatersensors.com)). Engineering solutions providing measurement performance validation to membrane CO<sub>2</sub> sensors on FOS have been presented to the MSA. These solutions include sea-going mobile calibration units for testing sensor performance before and after deployment and autonomous samplers for validation sample collection during long deployments. Funding streams are currently sought for the development and testing of these technologies.

## **Meet a station**

### **DE-SOOP-Atlantic Sail**

#### **Augmenting SOOP-based CO<sub>2</sub> system observations with autonomous alkalinity measurements**

By Arne Körtzinger, Katharina Seelmann and Tobias Steinhoff  
GEOMAR Helmholtz Centre for Ocean Research

Modern ocean observation needs to be performed in a coordinated way following a 'system of systems' approach. Making such a combined system both fit for purpose and value for money, requires multiple purposes be addressed and synergy potential be leveraged wherever possible. The global 'Ship-of-Opportunity' Network as partly operated in ICOS is the backbone of the surface ocean CO<sub>2</sub> network and the basis for the SOCAT data product, and as such a prime requisite for the creation of the annual global carbon budget. One way of increasing its value, and thereby enhancing the chances of its long-term support, is to increase the suite of autonomously measured CO<sub>2</sub> system variables.

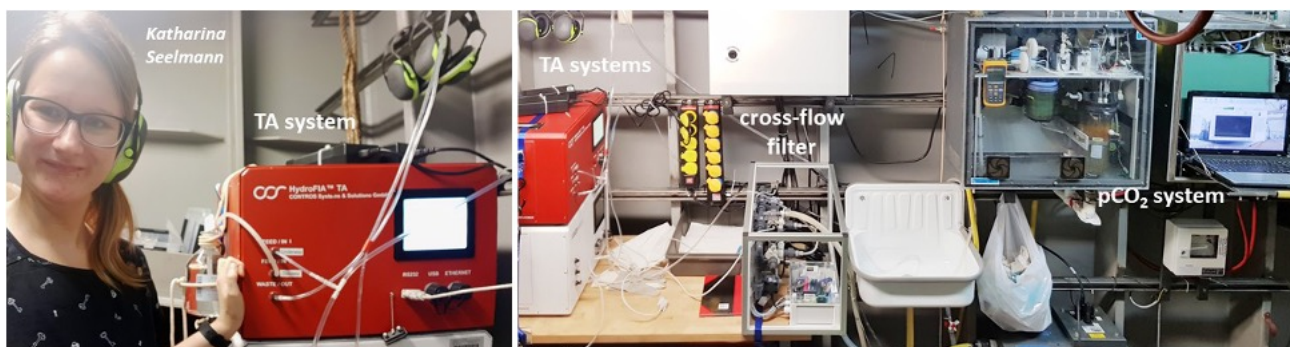
Based on methodological improvements in the area of high-precision flow-through spectrophotometric pH measurements (Aßmann et al. 2011), an autonomous flow-through analyser for total alkalinity (HydroFIA TA) was developed by CONTROS, a company based in Kiel/Germany. For a detailed characterisation and assessment of its quality, we took this instrument through intensive laboratory and field tests (Seelmann et al. 2019). The results clearly show that the instrument is capable of meeting the high accuracy requirements for 'climate-quality' TA measurements ( $\pm 2 \mu\text{mol/kg}$ ) as typically achieved by classical titration-based lab methods. While the long-term deployment of the system on ships revealed a slight but tolerable loss in accuracy, the observed small but non-negligible long-term drift called for further investigation.

In a first step, we studied the quality of the pH indicator dye (bromocresol green) employed in the spectrophotometric TA method (Seelmann et al. 2020a). Earlier results with the pH indicator meta-

cresol purple had shown the biasing effect of varying levels of impurities in products from different vendors. After development of a high-performance liquid chromatography (HPLC) purification method, we purified BCG from four different vendors, which revealed both different qualities and quantities of impurities. Thorough tests with the purified BCG showed a clear influence of the impurities on the drift characteristics of the TA analyser both in terms of magnitude and shape of the drift. While drift magnitude generally scaled with the amount of impurities, the drift changed from linear to non-linear shape above a certain threshold in impurity concentration. Unfortunately, even the most pure BCG still showed a small linear drift, which is explained by slow accumulation of coloured deposits in the optical path of the flow-through system.

In the final step, we installed the HydroFIA TA system on our SOOP line across the subpolar North Atlantic (DE-SOOP-Atlantic Sail) and operated it in both attended and unattended mode (Seilmann et al. 2020b). We tried to address all recommendations that emerged from our earlier studies in the installation and measurement protocols. For provision of a particle-free continuous flow of seawater to the optical TA system, the use of a cross-flow filter system proved vital for long-term stability. The provision of an adequate volume of certified reference material (CRM from Andrew Dickson's lab at the Scripps Institution of Oceanography in La Jolla/CA, USA) for autonomous operation over several months, however, turned out to be more challenging. We had to test a large suite of deflatable, gas-tight bags to find a material that allowed reasonably unbiased CRM storage.

The encouraging outcome of this study is that unattended parallel pCO<sub>2</sub> and TA measurements from SOOP are possible now at high quality. We are therefore advocating to augment SOOP-based CO<sub>2</sub> system observations with autonomous alkalinity measurements wherever possible. This would provide drastically enhanced insight into the drivers of observed pCO<sub>2</sub> variability and trends and allow for improved parameterisations of surface ocean alkalinity all of which would make the SOOP network more connective to other observatories and hence more useful and important.

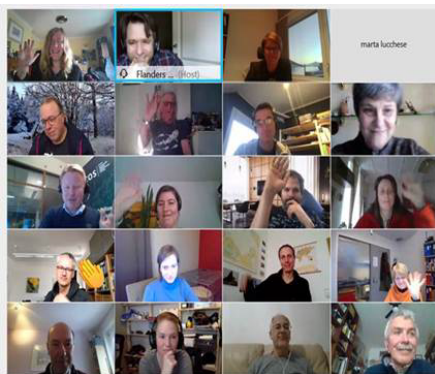


## References

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## News from the ICOS Ocean MSA meeting



On 16th of February the ICOS Ocean MSA had a virtual meeting. It was very encouraging to see the commitment of the stations and very promising to see how this community develops. The meeting covered a variety of points, but focus was on the support that the stations can already receive, the ways to optimize it but also how to implement new ideas and support tools. A number of working groups will start putting these together aiming to enhance the operational capacity and performance of the stations. The virtual meeting was productive and engaging, yet we hope that the next MSA meeting will be a face to face event. The Ocean MSA would like to thank OTC and HO for their support and commitment.

## 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.

## Recently funded projects:

Instrument development: A recent 9M€ EU H2020 funded, <https://cordis.europa.eu/project/id/101000825>

Objective: NAUTILUS will fill in existing marine observation and modelling gaps through the development of a new generation of cost-effective sensors and samplers for physical (salinity, temperature), chemical (inorganic carbon, nutrients, oxygen), and biological (phytoplankton, zooplankton, marine mammals) essential ocean variables.

The next issue of the newsletter will be published in May 2021. Things we plan to cover include a report from the ICOS evaluation and our initial thoughts on how to evolve the OTC services in response to it.

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?

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



