

## **Surface water CO<sub>2</sub> measurements in the North Atlantic Ocean: optimize methodologies and analytical procedures.**

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High quality in situ observations of surface CO<sub>2</sub> concentrations are essential in order to increase the robustness of CO<sub>2</sub> flux estimates and the statistical analyses that underpin them. Various efforts - ranging from centralized EU Research Infrastructures (e.g. ICOS, EMSO, EuroARGO) to scientific community driven ones such as the Surface Ocean Carbon Atlas (SOCAT) - are attempting to fill in spatial and temporal data gaps with high quality observations of all necessary variables (fCO<sub>2</sub>, Sea Surface Temperature, Salinity, Nutrients, etc.). Development of new technologies and optimization of methodologies is also critical to further improve data quality and reduce the uncertainties of derived products (i.e. fluxes).

Within this spirit and endorsed by ICOS, the UK's National Oceanography Centre (NOC) and the Flanders Marine Institute (VLIZ), both members of ICOS, have collaborated on two open ocean cruises in the North Atlantic in order to perform continuous surface seawater CO<sub>2</sub> and total alkalinity (TA) observations. DY103 on RRS Discovery at the PAP-SO time series site (ICOS and EMSO station, <https://projects.noc.ac.uk/pap/>) in June – July 2019, and JC191 on RRS James Cook, a GO-SHIP hydrographic cruise along 24.5°N from January until March 2020.

The DY103 cruise was setup as an inter-comparison exercise for equipment, methodologies and best practices of measuring and analyzing carbon parameters. During the cruise, different systems for surface water CO<sub>2</sub> and TA were installed on the underway water supply of the RSS Discovery. These systems ranged from custom made surface water CO<sub>2</sub> system (VLIZ equilibrator with Picarro G2201-i system), commercial sensors (Contros HydroC-CO<sub>2</sub> FT, Pro-Oceanus CO<sub>2</sub>PRP) and also novel microfluidic systems by NOCs OTE group. Discrete samples were collected from the underway water supply and the CTD rosette Niskin bottles for dissolved inorganic carbon, TA, pH and nutrients. The discrete samples were analyzed in different laboratories both at sea and on land. There are differences between results from the various sensors/ equipment, as well as the discrete samples. During the second cruise (GO-Ship, JC191) systems were installed on the RSS James Cook to measure pCO<sub>2</sub> (VLIZ equilibrator with Picarro G2201-i system and HydroC-CO<sub>2</sub> FT) and TA (Contros HydroFIA-TA) continuously. Additional carbon parameters were analyzed in discrete samples from 145 stations as well as from the underway water supply. Sea surface pCO<sub>2</sub> concentrations varied between 345 and 400 μatm, and showed differences between the western and eastern part of the transect.

This work will focus on the setups, equipment and methodologies that were used and identify the points that will allow further optimization of the sampling, analytical and methodological procedures in order to reduce the data uncertainties and consequently the products.

## **Poster presentations in session 9**

### **Quantifying methane emissions from coal mining ventilation shafts using a small Unmanned Aerial Vehicle (UAV)- based system**

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