

TNA PROJECT REPORT

1. Project Information

Proposal reference number	JN_CALL_3_2
Project Acronym (ID)	INTERCARBO
Title of the project	Intercomparison of instruments for carbonate system measurements
Host Research Infrastructure	NIVA Research Station (NRS)
Starting date - End date	1.10.2018 – 31.1.2019
Name of Principal Investigator Home Laboratory Address E-mail address	Lauri Laakso Finnish Meteorological Institute Erik Palmenin aukio 1, FI-00560 Helsinki, Finland Lauri.laakso@fmi.fi
User group members	Lauri Laakso and Martti Honkanen, FMI, Finland Sami Kielosto, SYKE, Finland Martina Gehrung, HZG, Germany Jens Müller and Gregor Rehder, IOW, Germany Carolina Cantoni, CNR-ISMAR, Italy Christian Le Gall, Ifremer, France

2. Project objectives

The main objectives of the project were the following:

- 1) To compare the sensors provided by the user group against reference seawater carbonate system states, aiming to obtain information on their metrology performance (accuracy, precision, etc.).
- 2) To obtain information on functioning of the instruments in different salinities and temperatures.
- 3) To obtain information on time responses of the instruments in changing conditions.

3. Main achievements and difficulties encountered

The experiments took place at NIVA research station close to Oslo 21 – 28 November 2018. We had approximately 15 different marine carbonate system measurement instruments from participating institutes. After setting up the systems, we managed to complete 15 different experiments in different temperatures, salinities and pCO₂-concentrations. The observations went in general well. The main challenges came from the high alkalinity tap water used to produce low-salinity water (20 psu, 5 psu), which led to very long stabilization time (more than 12 hours) of the test tank water and increased the use of calibration gases by a factor of two. Fortunately, we found another source for low-alkalinity water, which reduced time required for the last experiments. From administrative perspective, there were some challenges related to the funding of the project as the experimental costs exceeded the planned and also due to delays in pre-payment.





4. Dissemination of the results

The participants will write a joint refereed paper on the results during the spring 2019 which is planned to be published in Ocean Sciences / Jerico-Next special issue. In addition, Lauri Laakso / FMI who initiated the experiment, will visit ICOS OTC meeting in 18-19 March 2019 in Southampton, UK and present the preliminary results to the ICOS-OTC community.

5. Technical and Scientific preliminary Outcomes

The INTERCARBO measurements were carried out in three 1 m³ tanks that were filled with seawater at salinity 5, 20, and 35 and carbon dioxide target values of approximately 200, 400, and 800 parts per million (ppm). The measurements were made on seawater temperatures of 10 °C and 20 °C.

The instruments used in the INTERCARBO experiment were:

pCO₂:

- 1 x Super-CO₂ (Sunburst Sensors LLC)
- 2 x Sami2 (Sunburst Sensors LLC)
-
- 3 x Contros HydroC FT (Kongsberg Maritime)
- 1 x Franatech pCO₂ (Franatech GMBH)
- 1 x silicon-tube based membrane system

pH:

- 1 x AFT-pH (Sunburst Sensors LLC)
- 1 x Ifremer pHT spectrophotometric reference
- 4 x Contros HydroFIA pH (Kongsberg Maritime)
- 1 x NIVA spectrophotometric pH sensor
- 1 SeaFET V2 pH sensor (Seabird)

Total alkalinity

- 1 x Contros HydroFIA TA (Kongsberg Maritime)
- 1 x Vindta (Marianda Ltd)

The preliminary results show that:

- 1) Despite the use of best practices for lab-based calibration and operation, there were clear differences between the instruments during the intercomparison under a more “real-life” measurement situation (e.g., calibration gas and CO₂CRMs as compared to measuring seawater from 1 m³ tanks).
- 2) There are specific aspects which make the installation of the carbonate system instruments on different platforms challenging, e.g. related to water inlet and outlet pressures;
- 3) Instrument intercomparison experiments for carbonate system sensors, as well as sensors for other EOVS, are mandatory for creating a harmonized and reliable coastal observing network.
- 4) Creating suitable experiments and setups for instrument comparison are challenging and require iterative process to be reliable.



Figures 1 and 2 show preliminary results from the experiments (for illustrative purposes only; data not fully corrected & some instruments not visualized). The data-analysis is partly on-going and should be completed during the spring and summer 2019.

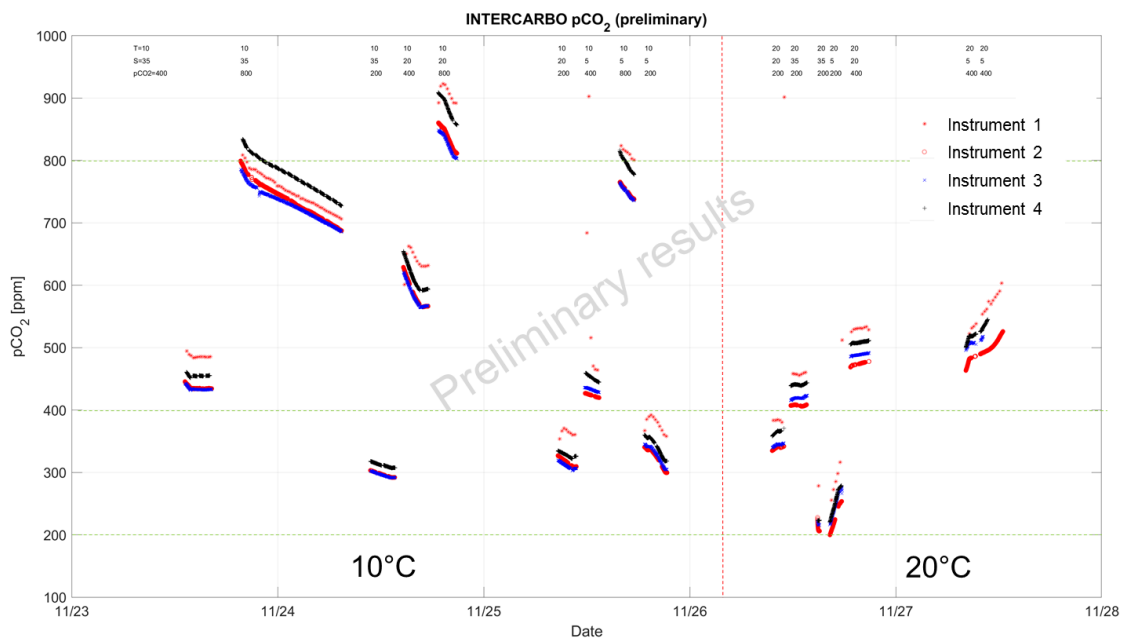


Figure 1: Comparison of four different pCO₂ instruments during the INTERCARBO experiments (preliminary result).

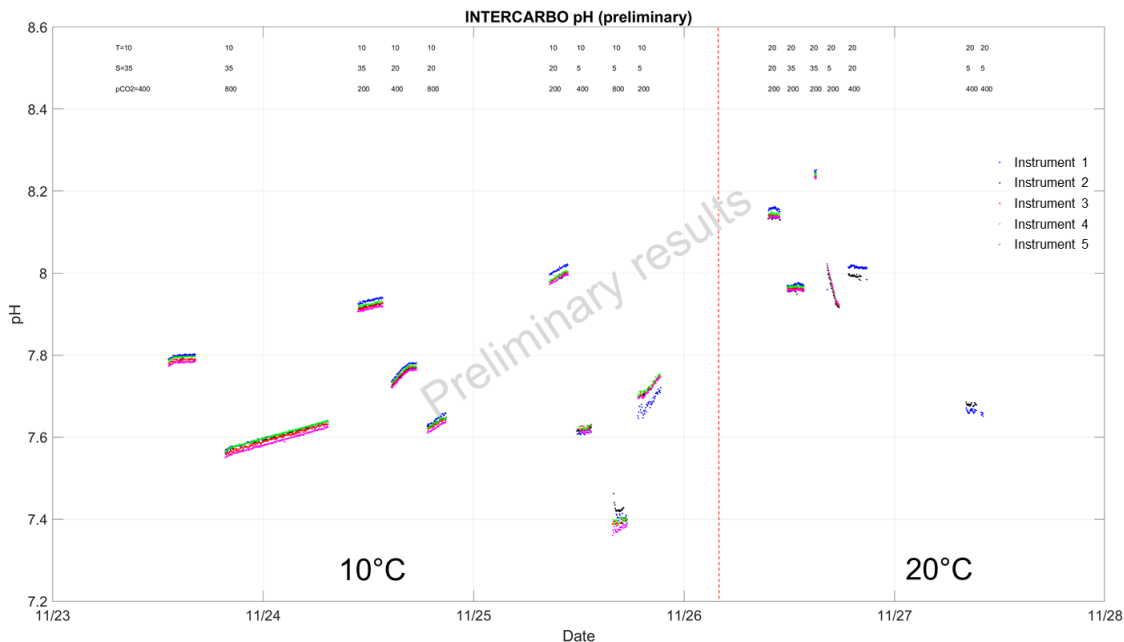


Figure 2: Comparison of five different pH instruments / observing methods during the INTERCARBO experiments (preliminary result).