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Let's Solve Water

Application Note
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Mission improved in-situ sensors

OceanSensor is a 3-year ERA-NET Cofund -MarTERA project (2018-2021) with 6 partners, and co-ordinated by GEOMAR, located in Germany. The main goal is to develop new chemical sensors, and improve and refine existing underwater sensor technology.

"Aanderaa contributes to in-situ calibration system and develops trace, ultrastable oxygen, gradient and turbulence measurements."

In-situ calibrations

A miniaturized in-situ calibration system for Trace-Oxygen (nanomolar resolution, Fig.[1]), pH, and pCO_2 optodes has been developed and successfully tested in the laboratory. Sensor drift is removed by automated one-point calibrations in the field during long, multi-year deployments. Mechanical reliability of the calibration system and long-term stability of the reference material are two challenges that are addressed as a prototype system is prepared for in-situ trials.

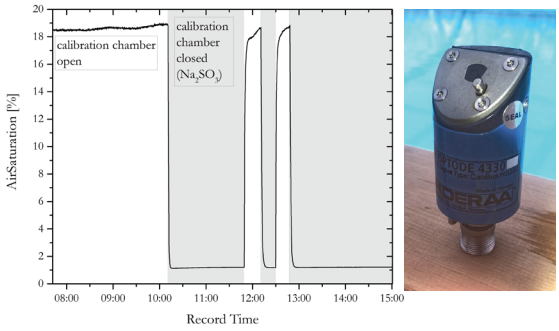

Figure [1]

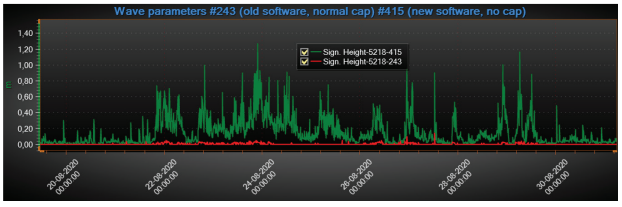

Figure [3] Significant wave height, Oeresund straight, 35 m depth with new (green) and old algorithms (red).

Gradients, turbulence with pressure, and better wave detection:

A **SeaGuardII instrument** (Fig. [2]) has been equipped with about 10 sensors to measure chemical/density/turbulence gradients close to the seafloor. The goal is to develop a simple method to assess sediment-water fluxes of variables reflecting biological, chemical, and geological activity. Resolution and cross-referencing of sensors at different depth levels is a challenge as is the measurements of transport coefficients and turbulence. We have used pressure-based wave and tide sensors that log at 4 Hz for this. Results from in-situ measurements and laboratory calibrations are promising. These sensors' wave detection algorithms are improved, so that small waves can be detected with the sensors positioned down to 40 meters depth. (Fig. [3]).

Figure [2]: SeaGuardII prepared for gradient measurements with 2*O_2, 2*pCO_2, 2*salinity/temp, 2*wave/tide and current.

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Accurate UV nitrate:

The ability to compensate for interferences of bromide and Coloured Dissolved Organic Matter (CDOM) in seawater on nitrate measurements using an TriOS UV nitrate sensor was improved in a controlled laboratory set-up. The sensors utilize a xenon flash lamp for the nitrate detection and include a reference diode to compensate for the signal dampening from turbidity. The nitrate sensors updated with the new compensation algorithms were taken to the field in two very different settings. One was to measure nitrate in the surface water during an expedition in the North Sea, in an area influenced by the nutrient-rich river the Elbe. The other was water column profiling down to 4000 m from a cabled CTD in the Tropical Atlantic. These trials gave data that were in excellent agreement with reference samples analyzed by conventional laboratory methods (Fig. [4], from Nehir et al. 2021, submitted).

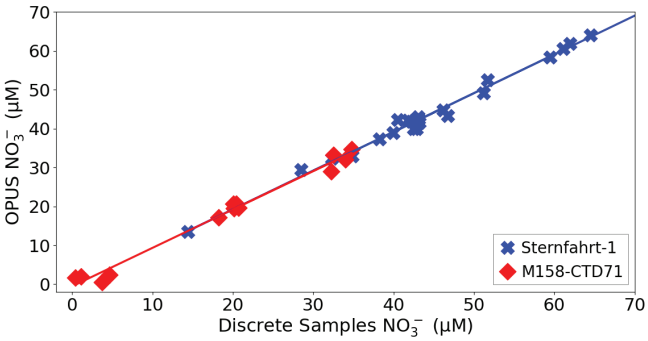

Figure [4] Blue crosses are data from the North Sea, red diamonds are from CTD profiling in the Tropical Atlantic.

Improved in-situ nutrient analyzer:

Accurate nutrient (nitrate, phosphate, ammonium, and silicate) measurements are required for water quality assessments and biogeochemical observations. In the OceanSensor projects, efforts are made to improve the existing commercially available system and further develop systems like Lab-on-Chip and electrochemical nutrient sensors for silicate and phosphate measurements by molybdenum (Mo) complexation. The later technology was successfully used in the field in a moored application and tested on profiling Bio-Argo floats. Several field campaigns have been organized in the project. The latest was in October 2020 at the Kristineberg Marine Research Station (Fig. [5])

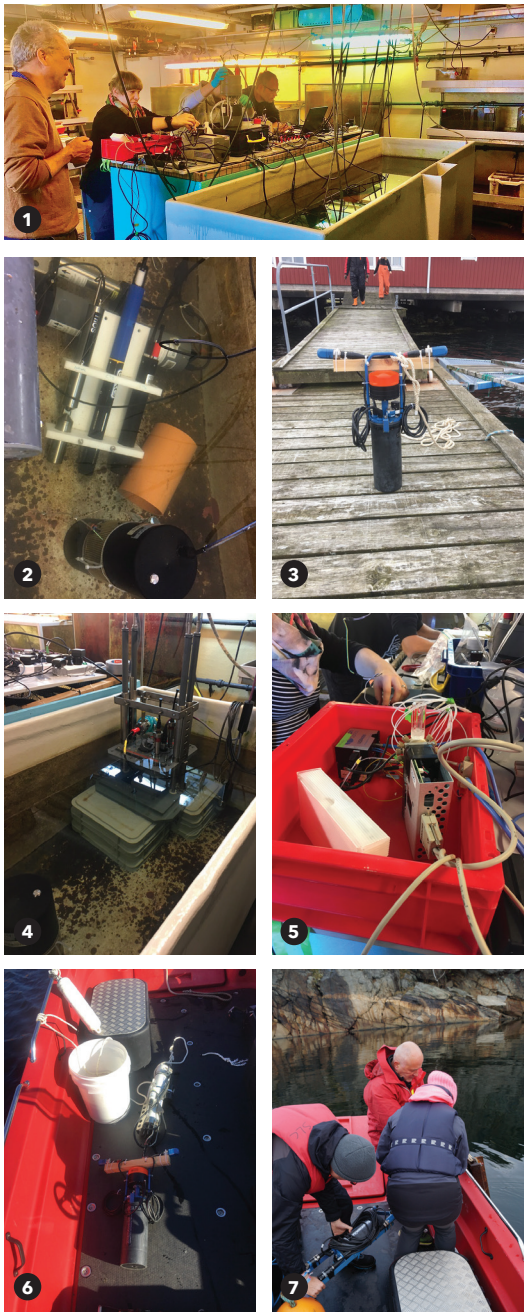

Figure [5]
(1) Flow through water tank packed with instruments & sensors.
(2) Instruments in tank for pH (4 types), Nitrate & Algae
(3) Dock trials with new Cond/Sal/Temp
(4) Bottom lander chamber for pressures vs turbulence trials
(5) Lab on chip for nutrients
(6) Water column profiling
(7) Deployment of mooring with Trace-Oxygen optodes

Partners OceanSensor:

MarTERA ERA-NET COFUND

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