Mission Report for Second Field Trials Hosted by IDS in Ireland

16–21 October 2016

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Additional support input from some other IDS team members including John Riordan, Edin Omerdic (Dino), Joe Casey and Alan O Brien.

Introduction and objectives

IDS hosted the second set of BRAAVOO sensors trials. The testing took part in IDS premises in Tuamgraney and Kilrush marina from 16th-21st October 2016.

All three BRAAVOO sensors were tested and integrated to the BRAAVOO buoy:

Nano-immuno-sensors. This system uses label-free antibody-based immuno-sensing on innovative nano-optical platforms such as bimodal evanescent waveguides and asymmetric Mach-Zehnder interferometers.

BIOLUM instrument. This platform produced by UNIL consists of live bacterial "bioreporters," which produce bioluminescence in response to chemical exposure.

Algae photosystem sensor. This instrument contains encapsulated marine algae and measures changes in photosystem II fluorescence induced by exposure to toxic compounds.

The objectives of this mission were:

- To integrate all three BRAAVOO sensors on the IDS Braavoo Data Buoy. The level of integration required the extraction of the sea water samples and the instruments analyses. The IDS system allowed either remote access to the instrument or captures the data on the IDS server.
- To test the performance of the biosensors from UNIL, BIOSENS and ICN2/Lionix. These were tested initially with natural sea water at the test site but also with seawater that was spiked with target compounds at known concentrations.

The trials were carried out at two locations: (i) close to the IDS workshop/office premises, and (ii) the harbour in the town of Kilrush, Co Clare. The reason for selecting Kilrush was that it provided good shelter which was essential when planning an October deployment mission.

Mission Activities

Preparation

Preparation of the tests actively involved all partners in making the BRAAVOO sensors ready for the final testing, transport and deployment of the IDS BRAAVOO buoy to the Kilrush marina. In addition to the buoy deployment, the IDS team completed modifications and preliminary testing of the buoy panels making them ready for the integration with the sensors.

The photos below show the transport and deployment operations.

Photos. IDS Team loading the Braavoo buoy before transport to the Kilrush Test Site. Transport to Kilrush

The teams spent three days on the IDS premises and two days on the field in Kilrush.

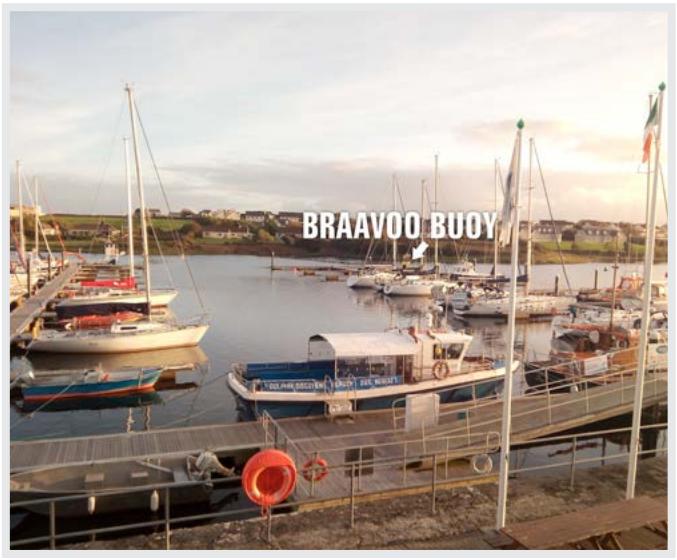
Working day 1 – Monday 17th

On the first day, the sensors were inspected after being shipped to IDS and integration with the IDS system. Any transit damage was fixed and the individual instruments were hooked up on the bench to the IDS system. In some cases the software needed to be slightly modified to allow the IDS system control the sample initialisation (this was a case with the Nano-immuno-sensors) and upload measured data to one of the IDS servers (for the BIOLUM instrument).

Both teams (Lionix and UNIL) also performed a number of bench-marking tests and prepared the solutions required for analyses and initial test samples.

Inspection and fixing of the damaged caused by transport

Hands on integration, teams working together



View from the lab/office to BRAAVOO data buoy

Pre testing Lab work at the IDS premises.

The ALGAE PHOTOSYSTEM SENSOR integration was simpler than for the other two sensor systems and primarily involved power control with RS232 communications. With a little effort, the system was integrated with the IDS control. However, sample injection could not yet be carried out remotely. The BIOSENS engineer tested the device in the lab with a very satisfactory outcome.

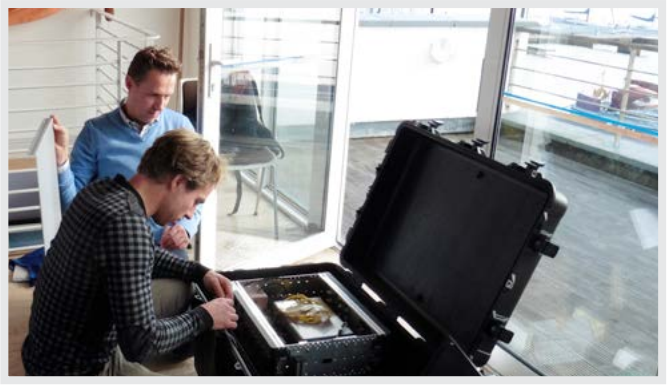
By the end of working day 1 all participants declared readiness to continue the trials in Kilrush .

Working Day 2 – Tuesday 18th

Before starting with trails the IDS data Acquisition system on the buoy was reinstalled and some final preparations in our improvised office/lab were done.

The first system to be installed on the buoy was the Nano-immuno-sensor. After some initial issues with the fluidic chip interface, the samples were successfully injected and an analysis was achieved by the sensor. While the buoy and the sample extraction tubing were deployed, it was decided that for testing purposes of the sensors it would be better to provide a single, stable sample for all the analyses. This was considered prudent as the ambient water around the buoy was changing and it would be difficult to determine if variation in readings were due to changes in the water or drift in the sensor. Consequently, approximately 40 litres of sea water were sampled and placed in the buoy as the main sample source. This also allowed to prepare spiked samples knowing that the background composition of the sample had not changed.

In spite of some initial and minor problems with power the UNIL team also successful installed their BIOLUM system on the buoy. The plan with the BIOLUM instrument was to leave it on automated analysis during the night (3-4 h for a single complete analysis). The system was observed for the first hour and all seemed to work correctly, but for some reason the sample analysis stopped after 20 minutes. The instrument performed a total of ten consecutive light readings successfully. Some issues with the programming script and also power supply were detected.



The LioniX team testing their system by connecting remotely to the buoy.

Work on the buoy with the Nano-Immuno-sensor

The UNIL team getting ready for the BIOLUM testing

BIOSENS engineer running remote tests from the Kilrush marina premises.

The ALGAE PHOTOSYSTEM SENSOR system ran a number of samples on shore and then the instrument was installed on the buoy. In this version of the prototype it was necessary to fill the sample wells manually, but the instrument was controlled remotely through the IDS system and data were successfully acquired and downloaded. This worked well and satisfied our requirement from an integration point of view.

Day 3 – Kilrush

An additional power source was added to the Buoy as we intended to operate all systems simultaneously to overcome any issue that might have arisen due to power in initial testing.

The UNIL team investigated the problem with the system stopping during the night. Some software issues were discovered, which were solved remotely by the UNIL engineer.

Integration of the LioniX system on the buoy and taking of the measurements.

During the third day, further samples were analyzed on the Nano-immuno-sensor system. This time, however, the fiber optic connector slightly detached, which caused more noisy signals from the installed chip than on the day before.

In the meantime, BIOSENS continued to charge manually the ALGAE PHOTOSYSTEM SENSOR instrument with samples and achieved several analyses.

A decision was made to bring 40l of sea water

back to base with all the equipment as we would be able to continue the trial at the IDS premises.

Day 4 – Back at IDS.

The BIOLUM instrument was successfully deployed to run four non-contaminated and spiked seawater samples during the next two days. The system performed well for the remainder of the week.

At the end of the day 4, the Nano-immuno-sensor and ALGAE PHOTOSYSTEM SENSOR instruments were packed and shipped backed to the partners (BIOSENS and Lionix). The IDS team returned to Kilrush and recovered the data buoy from the marina.

Day 5 – The final day

On day 5 the BIOLUM instrument continued to run two further samples.

Final comment

While there were some challenges as often happens when field trailing prototypes, we consider that the trials went very well. The integration of all three systems was successfully achieved. While BIOSENS had to charge the sampling wells of the ALGAE PHOTOSYSTEM SENSOR manually this is not a major issue and we understand that there was overall satisfaction with achieved results. Similarly, while the BIOLUM instrument had a few issues, there were resolved and it collected some good data. The problem with the Nano-immuno-sensor system was more bad luck (detached optical fiber) than anything else and resulted from a change in the make of epoxy that encapsulated the fiber connector. The system was successfully integrated and some results were achieved.

In conclusion, testing was overall successfully in proving that the BRAAVOO system could work as an integrated stand-alone automated device.