IV. CONCLUSIONS

This work describes a field test conducted to acoustically localize a benthic Rover deployed at 4000 m depth from an autonomous surface vehicle. For this purpose a new application using a Wave Glider as a single-beacon LBL has been developed. The work presented in this paper proves the good performance of this method.

ACKNOWLEDGMENT

This work was partially supported by the project NeXOS from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 614102. We also had financial support from Spanish Ministerio de Economia y Competitividad under contract CGL2013- 42557-R (Interoperabilidad e instrumentacion de plataformas autonomas marinas para la monitorizacion sismica, INTMARSIS). The main author of this work have a grant (FPI-UPC) from UPC for his PhD research. We gratefully acknowledge the support of MBARI and the David and Lucile Packard foundation.

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ID38- DATA COMPARISON BETWEEN THREE ACOUSTIC DOPPLER CURRENT PROFILERS DEPLOYED IN OBSEA PLATFORM IN NORTH-WESTERN MEDITERRANEAN

MATIAS CARANDELL WIDMER[223], MARC NOGUERAS CERVERA[222]

Abstract – Three different Acoustic Doppler Current Profilers (ADCP) have been deployed in OBSEA platform, a 20 meters depth underwater observatory cabled with a 4 km mixt cable to Vilanova i la Geltru's coast. Two months of continuous data have been collected in order to confirm their proper operation and long term North current characteristic from the area.

Keywords – ADCP, Doppler Effect, North current

I. INTRODUCTION TO THE DOPPLER EFFECT

The Doppler effect is the difference in frequency that can be appreciate in a wave when the observer is moving in different directions. In example, an observer walking into the waves will see more waves in a given interval than someone standing still, and this will see even more than an observer moving away [1].
ADCPs use the Doppler effect by transmitting sound at a fixed frequency and listening to echoes returning from scatterers in the water. These scatterers are everywhere in the ocean and they float in the water moving on average at the same horizontal velocity as the water. So ADCP receives sound echoed from the scatterers and Doppler-shifted to a different frequency proportional to their movement. The angular motion causes no Doppler shift, only the radial one.
ADCPs use multiple beams pointed in different directions in order to calculate different velocity components. With three beams, east, north and up velocity can be calculated and there's an extra one to estimate the validity of the sensor data.

II. OBSEA PLATFORM

OBSEA is an underwater observatory connected to the coast with a 4 km mixt cable that provides power and data. It is placed at a depth of 20 meters in a fishing protected area near the coast of Vilanova i la Geltrú. The main advantage of the cable observatory is the capacity to feed the station from the land up to 3.6 kW and the high bandwidth communication link of 1 Gbps. This gives the opportunity of observe in real-time multiple marine environment parameters.
The main objective of OBSEA is to have a test bed for the development of oceanographic instrumentation while providing real time data to the scientific community.
This platform counts on two subsea nodes in series and one Buoy connected to the first one. Further, there's a secondary buoy connected to the first recently

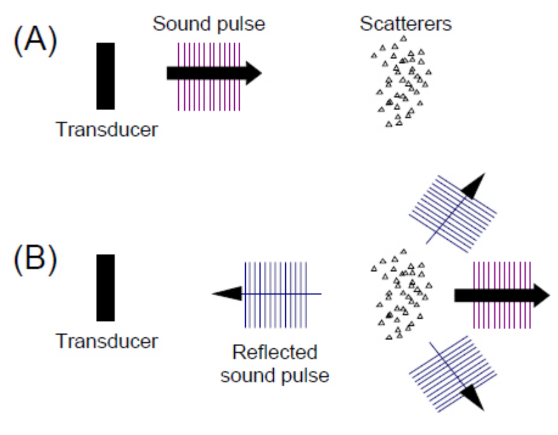

Fig 1. Backscattered sound. (A) Transmitted pulse; (B) A small amount of the sound energy is reflected back (and Doppler shifted), most of the energy goes forward.

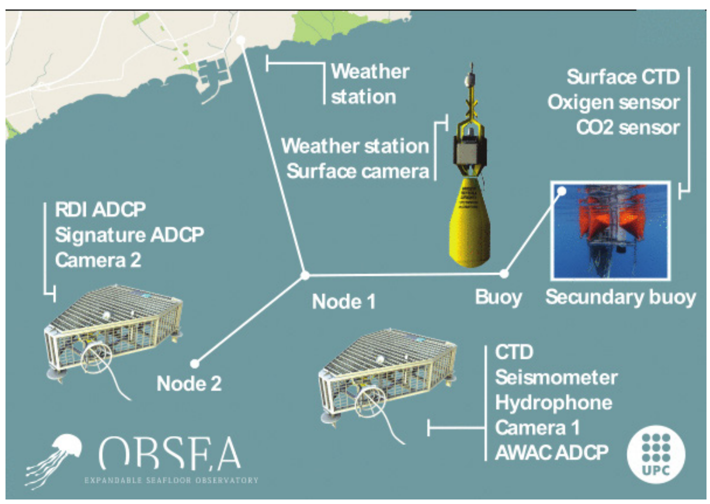

Fig 2. OBSEA platform distribution

installed. Each has its own instruments such as ADCPs, CTDs cameras or a seismometer. The actual distribution of OBSEAs platform can be seen in figure 2.

III. ADCPS CHARACTERISTICS AND SET UP

Three ADCPs have been deployed, two of them are Nortek technology and the third is from RD Instruments. The ones build by Nortek are able to measure current profile and waves height and direction while the RDI ADCP only provides the current profile. In this paper only the current profile date would be considered.
The three ADCPs include the follow sensors: tilt, pressure and temperature. All can be powered by batteries but are cabled to OBSEA nodes to provide real time data. This communication is through RS232 or RS422 in all cases. Each one has its personal software for communication.

The first that had been installed was the AWAC ADCP from Nortek (figure 3). It was first deployed in March of 2013 and it works at 1 kHz. It is connected at OB-

Fig 3. AWAC [Nortek] ADCP

SEA node 1, supported with a tripod at 10 meters and powered at 12 V. As it can be seen in figure number 3, it has 4 beams, 1 vertical and 3 at 25º. It was bought by CSIC (Consejo Superior de Investigaciones Científicas) for OBSEAs usage.
In April 2016 it was deployed the Sentinel ADCP in OBSEAs node 2. It is fixed to the cage of node 2 with brackets. In this case, it is powered at 48 V and works at

Fig 4. Sentinel [RD Instruments] ADCP

600 Hz. It can be appreciated from figure 4 that it has 4 beams symmetrically distributed in angle. It is property from SmartBay and deployed under the funding of SMARTSEA project of FixO3. The objective of this project is to test SmartBay equipment in a real scenario (OBSEA) before the deployment in Galway. Further, to train SmartBay personnel on operational procedures and, finally, to compare data and exchange know-how.
The last ADCP deployed has been the Signature from Nortek (figure 5). It works at 1 kHz and it's powered at 12 V. As the AWAC, it is supported with a tripod at 10 meters from node 2. This ADCP belongs to Nortek and it's in OBSEA under CISWE project funding from FixO3. The aim of CISWE is to execute a comparison of data between two Nortek currentmeters during a long period of time in order to perform the following: evaluation of the current speed estimations, evaluation of the current direction estimations and, evaluation of the power consumption.

Fig 5. Signature [Nortek] ADCP

Differences between both instruments.
It is important to avoid interferences between instruments. For this reason, no ADCP has been deployed nearby with the same frequency. AWAC (1 kHz) is at node 1 and Sentinel (600 Hz) and Signature (1 kHz) had been deployed at node 2. Additionally, magnetic interferences should be avoided to prevent errors in the compass side. It has been considered not to deploy instruments with magnetic materials in their supports. Both node cages are built with Stainless Steel.
All ADCPs have been set up with the same configuration so data comparison could be done. Taking care OBSEA is 20 meters depth, 20 beams have ben stablished, each one 1-meter height. In Sentinel ADCP only 19 cells were configured. ADCP measures the velocity at different distances from the transducer by measuring the Doppler shift of the returning signal at different times. No measurements are made immediately in front of the transducer in what is referred to as the blanking region. This allows time for the transducers and electronics to recover from the transmit pulse. The blanking region had been used to place the beginning of the first cell in each ADCP at the same position. Considering that the height of tripods and node cages are different, different blanking height were set up in order to align cells between ADCPs.
Finally, the sampling interval should be determined. It is not mandatory but setting the same in all ADCP is recommended.

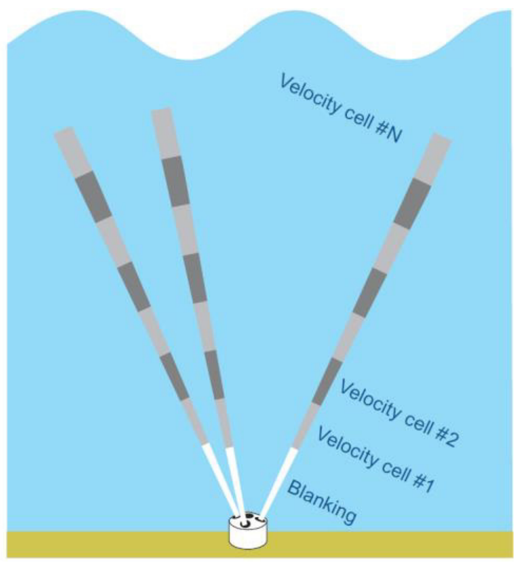

Fig 6. ADCP set up, Cells and Blanking

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Finally, the sampling interval should be determined. It is not mandatory but setting the same in all ADCP is recommended.

IV. DATA TREATMENT

To validate the correct functionality of all ADCP two months of data have been collected. In each sampling moment, data of velocity in east, north and up components are collected for each cell in all current meters.

Getting data in a sample rate of 10 seconds, an hour average has been calculated for each velocity component (east, north, up). Multiplying this data per time we obtain the accumulated displacement of current for each cell and ADCP for an interval of time.

This can be plotted as it's done in figure number 7 and 8 where displacement of water can be appreciated for an interval of time.

V. CONCLUSIONS

Figures 7 shows the displacement of water between 18-04 and 09-05 in 2016 in AWAC. As it can be seen water has moved about 30 km south and 120 km west (depending on the cell position). Although there are some days of turbulent movement, generally it has a south-west

direction, parallel to the coast and following the North Current direction that describes the zone of north-western Mediterranean.

Figures 8 shows the displacement of water between 18-04 and 09-05 in 2016 in RDIs ADCP. The plot shows that water displacement components were 45 km south and 120 km west. In this plot can be seen, again, the characteristic North current because it has generally a south-west component, parallel to the coast.

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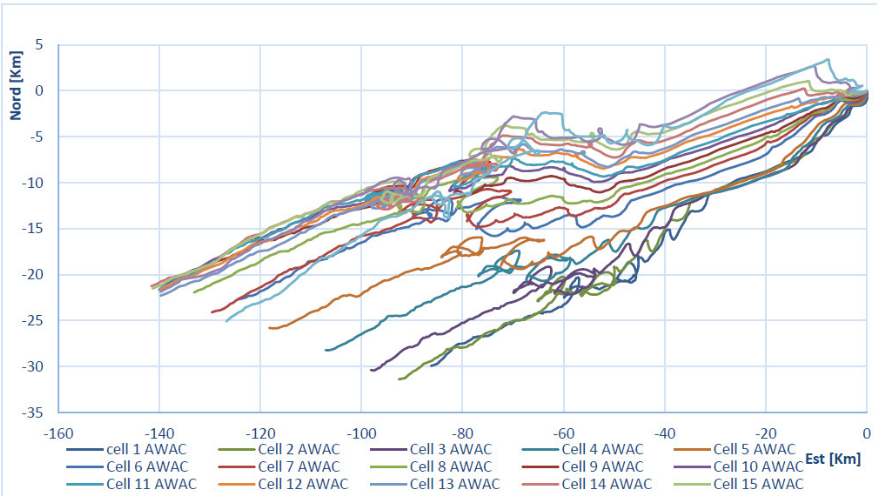

Fig 7. AWAC horizontal displacement of water

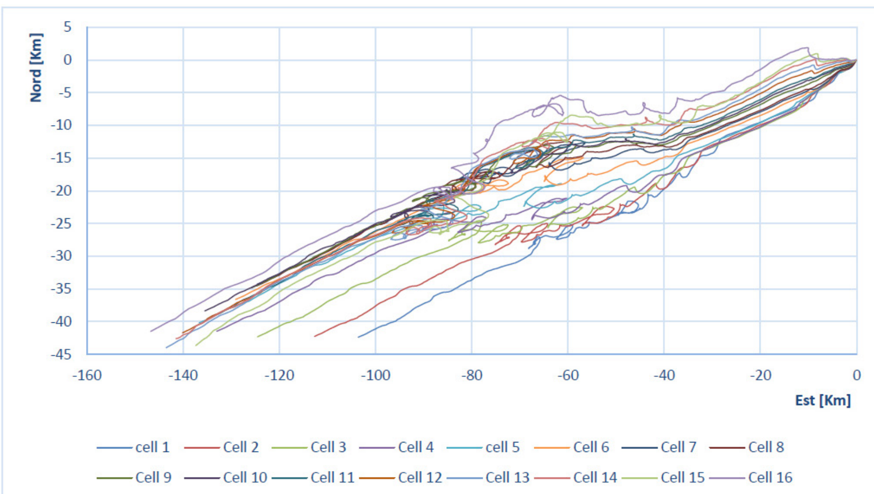

Fig 8. RDI horizontal displacement of water