Underway ADCP Systems on Research Vessels, USVs, and Gliders: A Key Resource for the Belgian Oceanographic Community

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Acoustic Doppler Current Profilers (ADCPs) are sensors designed to measure velocity profiles within specific ranges of the water column. Traditionally, ADCPs are mounted on Research Vessels (RVs) to study ocean currents over a defined area. While this approach offers benefits, it also has limitations. However, technological advancements have enabled ADCPs to be mounted on other mobile platforms, such as Unmanned Surface Vehicles (USVs) and Gliders, providing greater flexibility for research. This work highlights three applications of ADCPs on different moving platforms, showcasing the advantages of each system.

In the first case, two vessel-mounted ADCPs (Teledyne WorkHorse 600 kHz and Ocean Surveyor 75 kHz) were used to study velocity gradients and exchanges along a cross-shore transect between the Tunulliarfik fjord, in Southern Greenland, and the adjacent continental shelf and slope, within the domain of the Western Greenland Current (WGC). These measurements were conducted as part of the GreenFeedBack project during a summer 2023 cruise aboard RV Belgica, aimed at studying greenhouse gas (GHG) gradients between coastal and offshore regions. The two ADCP systems enabled high-resolution vertical profiling (0.5 m vertical) of both the fjord waters and the WGC, particularly in the upper 100 meters where the WGC's shear is most pronounced, while still allowing sampling in deeper regions of the fjord and the WGC using the Ocean Surveyor 75 kHz system. Results indicated that the combined use of both systems provided a high-resolution definition of the WGC, with good cross-validation against satellite altimeter-based geostrophic velocity at surface levels. Given the long distances, vertical range, and the need for collocated sampling with other oceanographic and GHG parameters, the vessel-mounted ADCP approach proved to be suitable for this context.

In the following case, vertical profiling with near-bottom measurements was required to study sedimentary processes in the Porcupine Basin, Ireland. To achieve this, a Glider-mounted ADCP (Nortek AD2CP-Glider) was used in conjunction with vessel-mounted ADCP data (also RV Belgica). As anticipated, the vessel-mounted ADCP faced limitations due to the side lobe effect, which, depending on local depth and the ADCP beam angle, restricted measurements to approximately 90% of the local depth. These limitations were mitigated by the Glider-mounted ADCP, which has a smaller beam angle and, most importantly, the ability to approach the seafloor closely. Whenever possible, collocated measurements from both the vessel-mounted and Glider-mounted ADCPs were used to cross-validate the results.

Finally, a third case employed ADCP measurements to study currents inside, at the entrance, and just offshore of the Port of Ostend. For the inner port area, a USV-mounted ADCP (USV Gobelijn) was used due to the vehicle's maneuverability and low draught, which enabled it to safely navigate the confined waters where a larger research vessel could not operate effectively. The USV's ability to perform multiple transects allowed for the identification of interesting eddy-like features. In the entrance and offshore areas of the port, measurements from both USV- and vessel-mounted ADCPs (RV Simon Stevin) showed good agreement. However, the USV-mounted ADCP provided higher spatial resolution due to its ability to operate at slower speeds near the port's breakwaters, where velocities peak and might pose issues for large vessels, yielding more detailed measurements.

In conclusion, the integration of ADCP systems on Research Vessels, USVs, and Gliders has proven to be a valuable resource for the Belgian oceanographic community. By overcoming the limitations of traditional vessel-mounted ADCPs, other mobile platforms such as USVs and Gliders offer enhanced flexibility, higher spatial resolution, and the ability to access challenging areas. The examples highlighted in this work demonstrate how these technologies can complement each other, providing a more comprehensive understanding of ocean currents and sedimentary processes. As technological advancements continue, the combined use of these systems will undoubtedly play an essential role in advancing oceanographic research in Belgium and beyond.

Keywords
ADCP; Glider; USV; Vessel; Greenfeedback; Porcupine; Greenland; Ireland; Ostend