

Autosub Long Range AUV Deployments Beneath the Ronne and Filchner Ice Shelves - The Engineering Challenges

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The Autosub Long Range (ALR) AUV is a 3.6 m long, 800 kg AUV with a depth rating of 6000 m. Known by some as “Boaty McBoatface”, it is capable of endurance of more than a month, and runs at speeds of 2.5 km hr^{-1} . It is designed to be a relatively low cost AUV; for example using a magnetic rather than gyro compass for heading estimation. In February 2018 it measured turbulence, CTD and currents during multi-day and dangerous explorations under the Ronne and Filchner Ice Shelves in the Weddell Sea, Antarctica.

There were many technical challenges to be overcome to successfully and safely execute these missions. The AUV Navigation must be accurate (figure 1), critically so where, because of ice cover, the AUV cannot simply surface at the end its mission (figure 2). Achieving this accuracy was encumbered by high currents in the operating area (figure 3), the scientific requirement to make measurements a long distance from the sea bed (out of Doppler sea bed lock) and the use of a low cost compass. Another challenge is to control the AUV depth trajectory, safely avoiding, in an unknown environment, the ice shelf overhead and the seabed below.

Finally recovery was made more complex by the sea ice and freezing temperatures (figure 4)

In my talk I will discuss how, from an engineering perspective, we have tackled these and other technical issues. I will also introduce the recently commissioned 1500 m rated ALR AUV, which trades depth rating for greater energy storage. With planned implementation of more sophisticated navigation and collision avoidance systems, we will be able to execute long distance polar ocean missions in complex environments. A very exciting prospect!

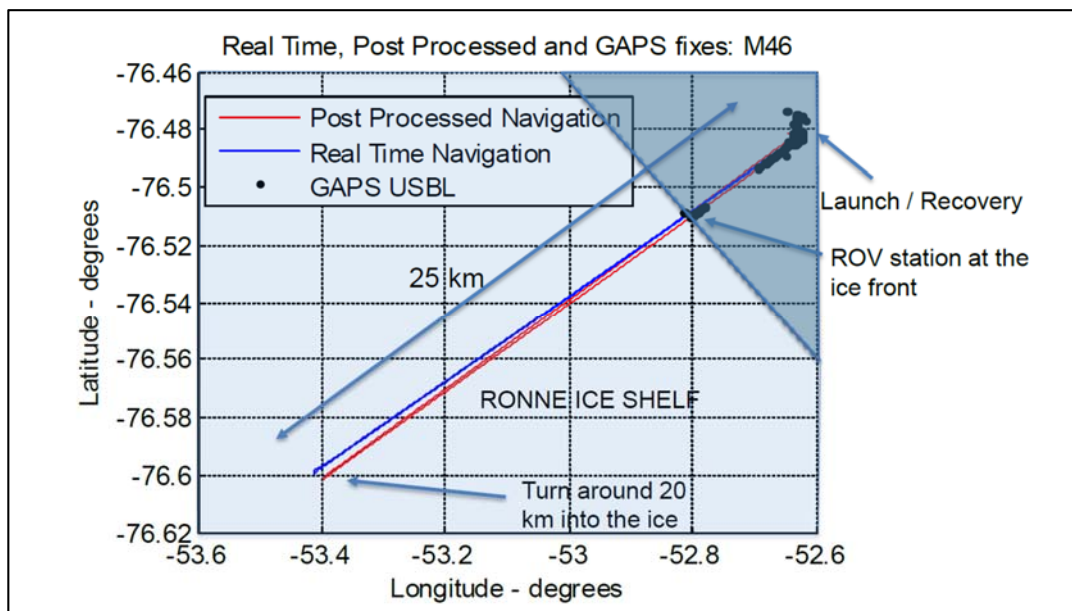


Figure 1 The real time, and post processed Navigation for ALR Mission, which went 25 km under the Ronne ice shelf, taking 24 hours. USBL positioning at the start of the dive facilitated reconstruction of the trajectory.

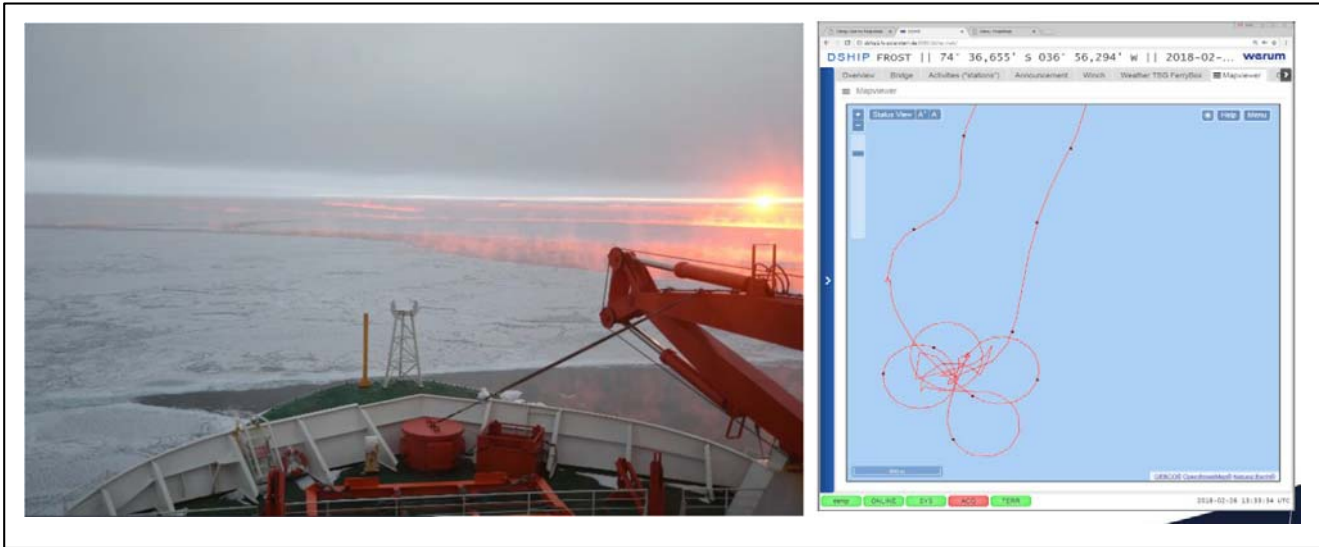


Figure 2 Conditions at the end of Mission 47, a 2 day dive under the Filchner Ice shelf. It was necessary for the ship to execute 'figures of 8' to break up the ice while the AUV circled 800 m under the ship.

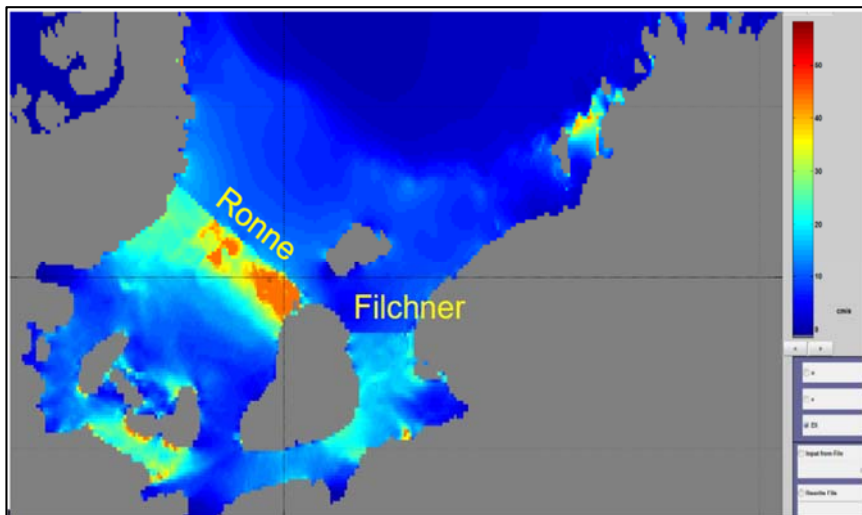


Figure 3 Output of the tidal model display (Laurie Padman), displaying the magnitude of tidal ellipses. Tidal flow conditions were difficult at exactly the positions we wanted to operate in (particularly at the Ronne Ice shelf).



Figure 4 Recovery onto the RV Polarstern was somewhat hampered by the Sea-ice