

A MOORED PROFILER FOR OCEANOGRAPHIC RESEARCH AND ENVIRONMENTAL MONITORING

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Abstract

This presentation concerns the research and development of the ocean moored profiler Aqualog. This technique allows a user to obtain regular time series of oceanographic data at fixed geographical location by using conventional oceanographic probes, which are transported by a special carrier that moves vertically between surface and bottom of the sea.

Keywords: Monitoring, Currents, Deep Waters

A moored profiler is a useful tool for multidisciplinary investigations such as water exchange and deep current structure. In the framework of conducting oceanographic research the profiler is a useful tool for field investigations of the variability of both biotic and abiotic parameters of the sea environment from a few hours to a few months. The estimation of the short-period variability and its impact on the generation of mixing is possible on the basis of regular probing during a sufficiently long time. To assess the dynamics of barotropic and baroclinic waves, eddies and wave-eddy structures and their role in the water transfer and exchange, it is necessary to observe the spatial peculiarities of hydrophysical parameters. This makes it necessary to conduct simultaneous probing by a set of profilers in a number of sea locations. Finally, a topical task is revealing climate signals in multi-year series of oceanographic data at fixed locations in sea basins. To achieve these objectives it is important to get regular and homogeneous ensembles of the observational data.

A new moored profiler named Aqualog was designed in P.P. Shirshov Institute of Oceanology in 2005-2009 (Fig. 1). It was tested at field trials in the Black Sea and the Caspian Sea. The profiler is built to carry a load of modern oceanographic instruments. It moves down and up along the mooring line as a sea 'lift' carrying various instruments including FSI Excell 2" Micro CTD probe, Nortek Aquadopp current meter, and AANDERAA Oxygen Optode 4330F. The payload of this sea elevator may also comprise other environmental probes e.g., fluorimeter and turbidimeter. The profiler mooring line is made of stainless steel wire that allows a user to extend the maintenance period of the mooring system up to several months. The programmable hardware of the profiler allows to set up an automatic operation algorithm (variable movement speed, time and period of the profiling, etc.).

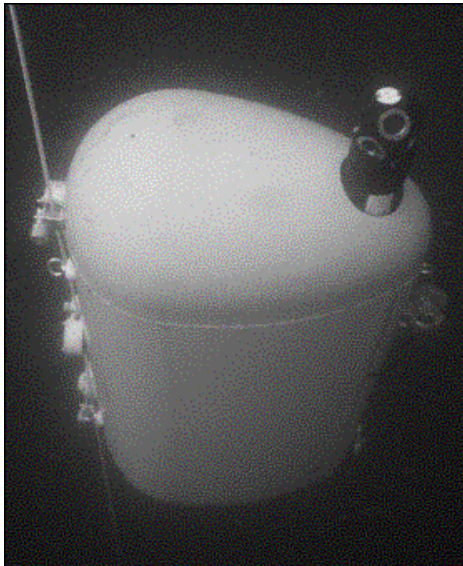


Fig. 1. The profiler in the Black Sea waters. The profiler is photographed from above under a movement limiter at a depth of approximately 7 m right before another downward/upward profiling cycle. The vertically stretched mooring line is passed through the drive-wheel on the profiler. In the upper right part of the profiler an acoustic Doppler current meter Nortek Aquadopp is shown.

So far the typical depth range of Aqualog's operation was 5–600 m. With a titanium instrument housing the maximum operation depth reaches out to 3000 m. Vertical speed can be set up within 0.05 and 0.3 m/s. The payload is up to 4 instruments; 1 slot is available for mounting an optional ocean probe. Weight in the air is 62 kg without the sensors or up to 75 kg with the sensors. Start and stop is by magnetic switch or as preprogrammed. There is a light indication of the system status. The total profiling distance is about 800 km in still waters for the profiler with lithium battery pack. The Aqualog has an energy resource sufficient for profiling the water column in the programming regime for up to several months.

The custom measurement instruments are high-precision, stable and fast-response. When the carrier is moving with the speed of 0.1 m/s the vertical profiles are measured with a vertical resolution of 0.05 m for pressure, conductivity and temperature (FSI Excell 2" Micro CTD), 0.6 m for the current speed (Nortek Aquadopp) and 0.8 m for the dissolved oxygen (AANDERAA Oxygen Optode 4330F).

The Aqualog was successfully tested during expeditions into the Black and Caspian Seas in 2005-2009. By using the Aqualog new data was obtained about inertial oscillations, mesoscale variability, and vertical exchange in the coastal waters. Over the north-eastern Black Sea shelf, the depth of the seasonal thermocline, the vertical gradient of density driven by temperature distribution and the current velocity gradient in the thermocline as well as the vertical exchange coefficient, all are substantially modulated by inertial oscillations and mesoscale vortices. Moored autonomous profiling stations located at a fixed geographical point represent the most preferable technical means for regional marine environmental monitoring. A moored profiler station inhibits a smaller risk of loss and facilitates technical services including power batteries and maintenance of the sensors.

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References

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