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A simple method of hydrophone calibration at very low frequencies

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The MERMAID (Mobile Earthquake Recorder in Marine Areas by Independent Divers) is equipped with a hydrophone which, when deployed in oceans, allows us to record telesismic P waves. The Rafos II hydrophone used on the MERMAID float has a flat frequency response from 5 Hz to 10 kHz but the hydrophone behaviour below 5 Hz is not documented by the manufacturer (Benthos) while the frequency band of telesismic waves is below 2 Hz. We study the behaviour of the Rafos II hydrophone and associated electronics by developing a simple and low-cost calibration method at low frequencies applicable to any type of hydrophone. In this methodology we generate a brief pressure variation of around 1000 Pa by immersing the hydrophone at a constant depth and by moving it down vertically by 10 cm in less than 1 second. We then study the output signal of the system including the filtering and digitizing steps.
A Matlab subroutine allows us to characterize the recorded signals by optimization with four parameters: *A*, α, τ and g, which control the shape and the spatial position of the signals, and thereby define the instrumental response. *A* and α define the shape: *A* represents the maximum voltage recorded by the hydrophone at the end of the descent into water, at $t = \tau$ second and α the signal relaxation. τ and g respectively characterized the time of the hydrophone descent and the signal offset.
Using a set of 50 experiments to characterize the Rafos II instrumental response in association with electronics we obtain a good repetitiveness of signals with a mean spread of 2.21%. The method developed here offers a good and simple way to estimate the response at low frequencies which is defined by $A = 1.09 \pm 0.06$ V/1000 Pa and α = 1.02 ± 0.10 sec^{-1}.