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## Methane bubbles in Lake Kinneret: Quantification and temporal and spatial heterogeneity

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**ABSTRACT:** The amount of methane bubbles rising from the bottom of Lake Kinneret was quantified by using a dual-beam echo sounder. Both echo-counting (EC) and echo integration (EI) techniques were implemented. Bubbles can confound the identification of fish targets because their acoustic sizes strongly overlap. Analysis of vertical changes in densities in the anoxic hypolimnion (with no fish) indicated that multiple targets were most abundant near the bottom, which caused an essential bias of bubble density estimates by EC. EI was a reliable tool for assessment of bubble density near the bottom. In the upper part of the water column, both techniques provided similar estimates of density of targets (mainly bubbles) because they were measured between dense fish schools during the daytime. The mean acoustic size of rising bubbles decreased in the hypolimnion but increased in the epilimnion, suggesting change in the relative importance of factors controlling gas volume. In summer and fall 2001, the bubbles became predominant echo-reflecting objects in the epilimnion. Temporal and spatial changes in bubble densities were highly heterogeneous, suggesting strong variability in factors affecting the gas ebullition. This variability should be taken into consideration when attempting to quantify the methane ebullition and assessing fish abundance in aquatic systems.

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