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Aquatic Respiration Rate Measurements at Low Oxygen Concentrations

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Abstract:

Despite its huge ecological importance, microbial oxygen respiration in pelagic waters is little studied, primarily due to methodological difficulties. Respiration measurements are challenging because of the required high resolution of oxygen concentration measurements. Recent improvements in oxygen sensing techniques bear great potential to overcome these limitations. Here we compare 3 different methods to measure oxygen consumption rates at low oxygen concentrations, utilizing amperometric Clark type sensors (STOX), optical sensors (optodes), and mass spectrometry in combination with $^{18-18}O_2$ labeling. Oxygen concentrations and consumption rates agreed well between the different methods when applied in the same experimental setting. Oxygen consumption rates between 30 and 400 nmol L^{-1} h^{-1} were measured with high precision and relative standard errors of less than 3 %. Rate detection limits in the range of 1 nmol L^{-1} h^{-1} were suitable for rate determinations in open ocean water and were lowest at the lowest applied O_2 concentration.

Key-words: oxygen minimum zones (OMZs), respiration rates, amperometric Clark type sensor (STOX), optical oxygen sensor (optode), membrane inlet mass spectrometry (MIMS), trace oxygen