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Novel Optical Oxygen Sensor for Profiling Observation Platforms: Fast Response Time Enables Higher Spatial and Temporal Data Resolution

Ocean warming has a severe impact on oxygen distribution because it reduces oxygen solubility and increases stratification in the upper ocean. Models predict a decline of the global oxygen inventory of about 1-7% over the next century and data show a decrease of more than 2% since 1960 (Schmidtke et al., Nature, 2017). Quantifying global as well as regional changes of oxygen will improve the understanding of chemical, biological and physical processes, especially in Oxygen Minimum Zones (OMZ) where consistent trends of intensification and spatial expansion exist (e.g., Stramma et al., Science, 2008).

Although optical sensors, so-called optodes, are available to accurately measure changes in ocean oxygen levels, users still wish to obtain better spatial and temporal resolution on profiling observation platforms than can be currently achieved. Here we demonstrate the utility of a novel and fast, commercially-available optode for in-situ and autonomous oxygen measurements, potentially closing this gap. This novel oxygen optode shows a temperature-dependent response time ($t_{63\%}$) of about 4 seconds and is thereby at least 50% faster compared to other optical oxygen sensors.

We aim to fully characterize this optode with regard to accuracy, precision, pressure dependence, long-term stability and drift, response time as well as air-calibration compatibility. Results build on data from extensive laboratory experiments and field deployments in the Tropical North, South and Southern Atlantic (underway, mooring, float and CTD-cast applications). This promises high quality observations for detecting oxygen level changes on small and fast-changing scales in this ocean region.

This novel optode could be used on a wide range of autonomous observation platforms such as ships for Repeat Hydrography, time-series stations and wave gliders, yet is especially promising on floats, gliders and fast-moving ships. In a changing ocean those applications eventually will contribute valuable information to the global oxygen budget.

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