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A simple calibration procedure to improve oxygen optode data quality developed and tested within the EU FP7 project HYPOX

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The presence of higher aquatic life and the occurrence of particular biogeochemical processes strongly depends on ambient dissolved oxygen levels with specific thresholds spanning from normoxia to trace levels. As oxygen availability in both coastal and open ocean environments is expected to decrease dramatically in response to eutrophication and global warming, oxygen concentrations need to be monitored as accurately as possible. Within the EU FP7 Project HYPOX (www.hypox.net), strategies for oxygen monitoring are developed and tested in a variety of aquatic ecosystems. In order to improve observation quality a simple optode calibration strategy was developed and tested. Main requirement was to minimize the need for sophisticated instrumentation as well as for wet chemical analyses of oxygen levels. Sequentially, up to eight oxygen concentrations ranging from approx. 10 to 400 micromol / kg were established in a closed calibration vessel by mixing of nitrogen- and oxygen- saturated water. In a final experimental run sodium dithionite was added to reduce the oxygen concentration to zero. At each concentration level, temperature was slowly increased from 2 and 35 degrees Celsius. This simple approach resulted in many different conditions of temperature and oxygen partial pressures, which were then used as reference data for calibrating the sensors by a higher order two-dimensional polynomial fit as well as by a temperature corrected Stern Volmer equation. Analyses of data obtained in different calibration runs showed substantial improvements in optode performance especially with respect to temperature compensation as compared to factory calibrations based on batch characterizations of the sensing foil. Accuracies obtained by the suggested calibration approach were far better than specifications of the manufacturer. A comparison of successive calibration runs performed in the closed calibration vessel as well as in an open calibration facility indicated that optode characteristics slightly changed within a time period of a few months. It is hence advisable to perform calibration not too far ahead of the deployment irrespective of the negligible drift reported for these sensors while being submerged and operating.