

Development and Testing of In Situ N₂, O₂ and Gas Tension Sensors for Oceanographic Studies

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Abstract

In this paper we present new measurements obtained in Lake Biwa, Japan, of dissolved nitrogen gas. The dissolved nitrogen concentration is calculated from simultaneous measurements of dissolved oxygen and gas tension. The data set show the robustness of the instrumentation and technique and indicate the potential of such measurements for use in bio-physical gas exchange studies.

1 Introduction

The air-sea interface and the upper ocean mixed layer have globally significant roles in the redistribution and recycling of dissolved atmospheric gases and their organic and inorganic derivatives. However, the detailed mechanisms by which the redistribution and recycling processes occur and the magnitude of the resultant fluxes are poorly known. This motivated a study to measure simultaneously dissolved nitrogen and oxygen concentrations under a wide range of oceanographic and meteorological conditions. The chief advantages of studying oxygen and nitrogen simultaneously are twofold. First, because dissolved nitrogen, unlike dissolved oxygen, has a low biological activity [e.g., Mague *et al.*, 1974], simultaneous measurements of these two gases provide a differential indicator of the magnitude of biological versus non-biological processes affecting these gases [e.g., Emerson *et al.*, 1991]. Second, the dissolved concentrations of these two primary atmospheric gases will directly influence bubble dissolution rates and hence bubble mediated air-sea gas exchange rates. Bubble dissolution is an important contribution to gas exchange at higher wind speed [Thorpe, 1984; Woolf, 1993; Woolf and Thorpe, 1991; Keeling, 1993; Farmer *et al.*, 1993]. To this end, novel dissolved gas sensors are being developed. Operating in situ, these devices can be moored or placed on freely drifting arrays to obtain extended time series measurements of dissolved oxygen, nitrogen and gas tension.