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INSTRUMENTS AND METHODS

In-situ measurement of dissolved nitrogen and oxygen in the ocean

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Abstract—Motivated by the need to separate changes in dissolved gas concentrations due to air–sea fluxes from biological production, a novel method of inferring dissolved nitrogen in the ocean is described. The method requires a local measurement of gas tension, dissolved oxygen, water temperature and salinity. Such instrumentation has been developed and tested at sea. Preliminary open ocean data are presented. The measurements during periods of low wind speed show a clear diurnal dissolved oxygen signal, incorporating biological photosynthetic response, solar heating and nocturnal convective mixing. The diurnal variability of the inferred nitrogen signal is approximately 10% that of the measured oxygen diurnal variability. The nitrogen diurnal variability is attributed to a 10 m separation between the primary measurements of gas tension and dissolved oxygen rather than any intrinsic change in dissolved nitrogen. These results are, however, consistent with the relative insensitivity of dissolved gaseous nitrogen to biological activity compared to that of dissolved oxygen. The open ocean results give good evidence for the integrity of the measurement scheme and indicate the potential for simultaneous measurement of dissolved nitrogen and oxygen in the study of biological cycling as well as gas transfer in the upper ocean.

1. INTRODUCTION

Air–sea gas transfer and biogeochemical cycling of dissolved gases in the upper ocean have local and global significance, yet these processes are poorly understood. This is particularly true of air–sea gas transfer during storms, where bubble mediated gas transfer can greatly enhance transfer coefficients (Farmer *et al.*, 1993). The severe conditions encountered, however, often prohibit taking water samples for dissolved gas analysis, particularly at depth as noted by Watson *et al.* (1991) during their shallow North Sea experiment. Water sampling under similar, or more severe, conditions in the open ocean would be virtually impossible. This has motivated the development of robust, dissolved gas measuring systems that can be freely deployed or moored in an autonomous state and recovered during fair-weather.

While techniques for measurement of dissolved oxygen are well established, a practical difficulty in the interpretation of short term variability is that oxygen fluctuations can arise

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