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Observations of the influence of diurnal convection on upper ocean dissolved gas measurements

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ABSTRACT

An important example of the interaction between biological productivity and near-surface oceanography is the role of nocturnal convection and diurnal restratification in modifying the environment in which photosynthetic activity takes place. *In situ* time series measurements of dissolved oxygen reveal the effects of photosynthetic activity, respiration and redistribution by mixing. Moored thermistor time series and frequent CTD casts show that restratification during the day is confined to a warmer shallow surface layer where most of the biological production is expected to occur. The depth and rate of mixing is measured with neutrally buoyant floats which track the vertical excursions of convecting water parcels. Early in the evening, at the onset of night time convection, this warm oxygenated water is mixed down and diluted by deeper less oxygenated water. The interpretation of oxygen time series at specified depths (here 21 m and 30 m) requires knowledge of this mixing process. Use is made of *in situ* dissolved nitrogen time series to infer that gas transfer at the surface is of secondary importance in determining the diurnal dissolved oxygen budget. A qualitative coupled biological/oceanographic model of the data is presented and discussed. It is concluded that a serious overestimate of daily oxygen production can result from excluding diurnal convection from the interpretation of oxygen time series.

1. Introduction

Primary production in the ocean is forced at various time scales primarily by meteorological and oceanographic changes. Of particular interest is the coupling of these driving forces, and the subsequent feedback on primary productivity. It is commonly accepted that the depth of the mean seasonal thermocline increases during colder winter months and shallows during the warmer summer months allowing spring blooms of phytoplankton to occur. Perhaps not fully appreciated however, is the often significant diurnal variability that can exist in meteorological and oceanographic forcing of production. The mixing layer associated with nocturnal convection and daytime solar heating, particularly during winter months, can deepen from the near surface to the base of the seasonal thermocline in a matter of hours.

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