Vertical transport of biogenic CO2, O2 and ΔO2/Ar in eddies and at fronts is revealed by submersible mass spectrometer

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Abstract

Eddy dynamics are recognized as important sources of vertical mixing and transport throughout much of the ocean, including in subtropical gyres. Here, we use high-resolution biogeochemical profiles from a vertically towed submersible wet-inlet mass spectrometer (SWIMS) to estimate how eddies alter the surface ocean distribution of [CO_2], [O_2], and the DO_2/Ar ratio; the last as a tracer of Net Community Productivity. The eddy surveys found net heterotrophy in late winter (ΔO2/Ar = -11.7%) and in mid-summer (ΔO2/Ar = -8%), although photosynthesis below the mixed-layer in the subsurface chlorophyll maximum is responsible for significant autotrophy in summer. All three cyclonic eddies (CEs) we surveyed brought up cold water that resulted in more heterotrophic anomalies - higher in CO_2, lower O_2, lower DO_2/Ar than the transect average. By comparison, the three anticyclonic eddies (ACEs) showed positive temperature anomalies and greater autotrophy than the transect averages. We used a two-dimensional quasi-geostrophic form of the omega equation to determine ageostrophic vertical velocities up to +/- 4 meters per day. Strong vertical velocities were coincident with perturbations in CO_2, O2, and CDOM fluorescence, yielding large biogeochemical fluxes at eddy edges and along the North Wall of the Gulf Stream. These studies show how fast-response in-situ mass spectrometry can reveal eddy processes that impact export production in the surface ocean.

Biography - Brice Loose

Brice Loose is Associate Professor at URI Graduate School of Oceanography studying marine biogeochemical and freshwater cycles in the polar oceans.

Keywords

Mesoscale ocean processes, Submersible mass spectrometer, Sargasso Sea