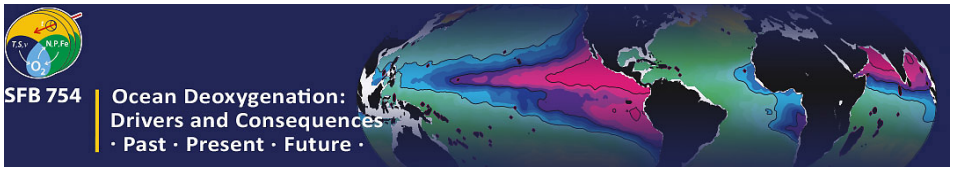

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Ventilation pathways for the North Pacific Oxygen Deficient Zone revealed by secondary oxygen maxima and Lagrangian particle tracking

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The oxygen deficient zones (ODZs) are confined to small volumes of the ocean but exert large influence on biogeochemical cycles, by altering the redox chemistry and microbial transformation of nutrients in these regions. The factors that regulate the size and sensitivity of ODZs to oceanic change are numerous, complex, and remain poorly understood. We synthesize recent autonomous and historical shipboard hydrographic observations with a high-resolution circulation model to show that the Northern Subsurface Countercurrent produces pronounced Secondary Oxygen Maxima (SOMs) in the Eastern Tropical North Pacific ODZ. We demonstrate that these SOMs are the result of an important eddy ventilation mechanism for the ODZ using a combination of Lagrangian particle tracking and an eddy-permitting numerical model simulation with an embedded ecosystem. The primary ventilation mechanisms for the North Pacific ODZ are the eddies produced by the Northern Subsurface Countercurrent, the water supplied by the North Equatorial Undercurrent Jets and seasonal detrainment of oxygen along the continent. These results suggest that predicting changes in the ODZ will require a better understanding of the narrow zonal jets that supply its oxygen.

Position

PhD Candidate

Affiliation

University of Washington

Email Address

Amargol@uw.edu

Are you a SFB 754 / Future Ocean member?

No

Primary author(s) : MARGOLSKEE, Andrew (University of Washingtron)

Co-author(s) : Dr FRENZEL, Hartmut (University of Washington); Prof. EMERSON, Steven (University of Washington); Prof. DEUTSCH, Curtis (University of Washington)

Presenter(s) : MARGOLSKEE, Andrew (University of Washingtron)

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