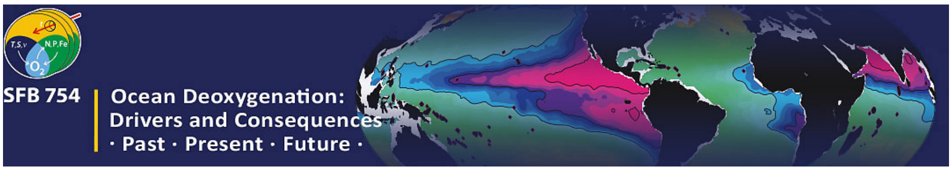

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Oxygenation and deoxygenation of Atlantic and Pacific Ocean Oxygen Minimum Zones by the wind interacting with mesoscale eddies

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Recent modelling studies revealed the importance of mesoscale eddies for a lateral transport of water mass anomalies from the eastern boundary upwelling systems into oxygen minimum zones (OMZ). Observational studies on individual eddies show that mesoscale dynamic change the biogeochemical eddy characteristics "en-route". Vertical nutrient flux into the euphotic layer controls local productivity and e.g. particle sinking and respiration/remineralization. In anoxic extreme environments (Pacific OMZ) short term, episodic flux of oxygen can have long lasting effect on sustaining aerobic communities and thus microbial diversity.

Different concepts of vertical fluxes in eddies have been discussed. "Eddy/wind interaction" based on the concept of a momentum flux difference across an eddy and applying an Ekman balance upwelling (anticyclonic eddies) or downwelling (cyclonic eddies) over the eddy is proposed. However, continues changes in wind stress direction occur over eddies and hence a time derivative on the wind stress/flow must be considered in the balance and hence Ekman is not applicable.

Time varying flow, wind stress and Coriolis force is solved in the framework of inertial currents/waves (NIWs). For the eddies wind stress variability can be created by the eddy rotation and mesoscale wind fluctuations are not always required. Near inertial internal wave (NIIW) energy propagation is modified by the vorticity structure of eddies: anticyclones are "superinertial" and NIIW energy propagates downward, cyclones are "subinertial" and energy is trapped and may dissipate at shallow depth. At the transition zone from the eddy core to the surrounding water a relative vorticity anomaly of reversed sign is created - hence all eddies are associated with both, superinerial and subinertial regions and a dynamical boundary between the two regions is the maximum swirl velocity of the eddy.

Using opportunistic high-resolution eddy surveys in the Atlantic and Pacific OMZ regions we estimate NIIW shear induced vertical flux through eddies. We observe that NIIW induced shear supports layering of properties in superinertial regions and reaching several hundreds of meters depth. The combination of lateral intrusion and vertical shear can drive deep-reaching vertical property exchange. Analysing the areal extend of all eddy core and eddy transition regions in Atlantic and Pacific OMZs we assess the subinertial and superinterial areas and estimate the associated vertical flux of properties. We use a new eddy tracking data set (Laxenaire et al.) based on absolute dynamic topography and which include the signature of "standing" eddies not detectable in sea-level anomaly based algorithms.

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