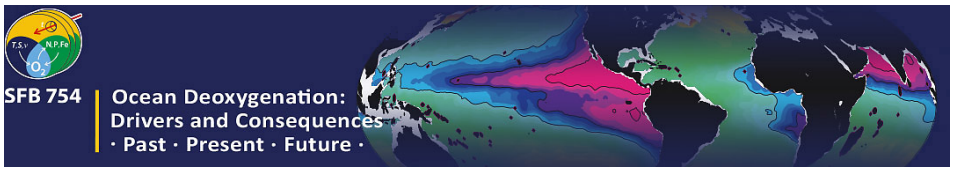


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# The role of filaments for ventilating the oxygen minimum zone off Peru

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Filaments and the associated submesoscale frontal processes are known to play a crucial role for the offshore and downward transport of biogeochemical tracers in Eastern Boundary Upwelling Regions (EBUS). These fluxes modulate subsurface oxygen concentrations directly but also indirectly through changes in biological production and subsequent remineralisation of organic matter. So far most studies are either based on observations or model simulations but seldom are both approaches combined to assess the importance of filaments for the biogeochemical cycling in upwelling systems.

Here we combine targeted interdisciplinary shipboard observations of a cold filament in the Peruvian upwelling region with submesoscale-permitting coupled physical (ROMS) and biogeochemical (PISCES) model simulations to (i) evaluate the model simulations in detail, (ii) investigate the pathways and timescales of biogeochemical modification of the newly upwelled water and (iii) quantify the net effect of filaments on biogeochemical tracer distributions in the oxygen minimum zone off Peru.

Enhanced nitrate concentrations of and offshore velocities of up to 0.5 m/s within the observed filament suggest an offshore transport of nutrients. Despite low chlorophyll α concentrations in the core of the filament, depth integrated primary production is 40% higher than at the upwelling front and 25% higher than offshore. The model simulation exhibits filaments that are similar in horizontal and vertical scale and structure compared to the observed filament. Nitrate concentrations and primary production within filaments are comparable to observations, suggesting these processes are well represented in the model. Our simulations further suggest that the net effect of submesoscale frontal processes is to increase subduction and offshore export of nitrate which leads to reduced primary production. An increase in oxygen that resembles the pattern of the decrease in nitrate suggests a ventilation of the shallow oxygen minimum zone off Peru by horizontal and vertical eddy-fluxes.

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