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Contribution of oxygen minimum zone waters to the coastal upwelling off Mauritania

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A special feature of today's marine oxygen fields is the presence of extended oxygen minimum zones in the tropical oceans. These areas can be of particular biogeochemical relevance whenever oxygen levels fall low enough to allow for anaerobic conversion of fixed nitrogen, a major nutrient essential for biological production, into gaseous N2 not accessible to most organisms. Thereby waters emerging from oxygen minimum zones may exhibit low NO3:PO4 ratios and high concentrations of N2O, which is a potent greenhouse gas. For an assessment of associated physical-biogeochemical feedbacks in the climate system, it is essential to understand where the oxygen minimum waters go to, what their residence times are, and how sensitive their pathways are to changing climatic conditions.

In a model trajectory study, simulated 'floats' are deployed in the oxygen minimum zone which is located in 200 to 300m depth off West Africa. They are advected using three-daily velocity fields from a 1/12 degree North Atlantic model. It is found that water from the oxygen minimum zone contributes to less than 5% of the upwelling off West Africa and that it's water is distributed mainly in a diffusive way rather than in distinguishable currents. In order to identify the source regions and supply routes to the upwelling off West Africa, floats are released in the upwelling region and then numerically integrated backwards in time. With this method, source regions of the upwelled water masses are investigated and found to be mainly the North Equatorial Undercurrent for water masses upwelled south of 22°N and the Azores Current for waters upwelled north of 22°N. In a dye tracer release experiment the results of the purely advective floats are compared with a passive dye tracer which is subject to both advection and diffusion.