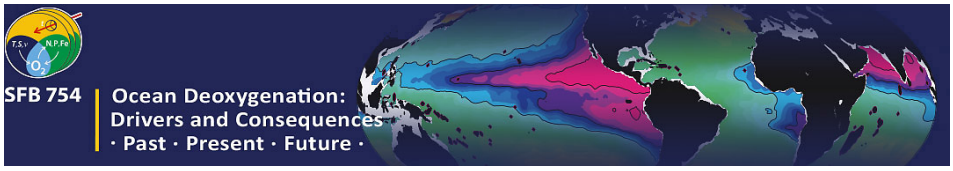

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Recent biogeochemical trends in the Peru upwelling system

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The Peruvian Upwelling System (PUS) is one of the most important coastal upwelling system in the world ocean because of its intense Oxygen Minimum Zone (OMZ) and high productivity supporting the largest anchovy fishery. Between the 1980s and 2000s, a sea surface cooling, a subsurface deoxygenation and nearshore surface chlorophyll increase were evidenced from satellite and in situ observations.
In the present work we investigate the physical and biogeochemical processes driving the biogeochemical trends from 1979 to 2008 using the physical-biogeochemical coupled ROMS-PISCES model. Numerical experiments were made to evaluate the respective impact of the remote (e.g. equatorial waves) and local forcings (e.g. upwelling favorable winds) on these trends. The model was able to reproduce the alongshore deoxygenation and productivity increase. Deoxygenation (-4 µmol.kg-1.dec-1) was mainly found between 20-100 m depth and a shoaling of the upper limit of the OMZ was also evidenced. The modelled increase of productivity (+0.4 mg Chl.m-3.dec-1) was significant in the Northern-Central part off Peru (6°S-10°S). The modelled phytoplankton growth limiting factors indicated that the productivity increase was due to a reduction of nutrient limitation caused by the nutricline shoaling, while no change in light limitation was observed. Sensitivity experiments demonstrated that the remote forcing drove the deoxygenation and productivity increase, due to the more frequent occurrence of central Pacific El Niño (El Niño Modoki) events in the recent period. Upwelling Kelvin waves are generated during the offset of these events, driving the shoaling of the nearshore thermocline, nutricline and oxycline.

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