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## Dissolved oxygen dynamics in coastal upwelling systems: insights from idealized submesoscale physical-biogeochemical modelling

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Coastal and shelf regions are particularly vulnerable to deoxygenation due to the highly productive upper ocean ecosystem and to physical transport bringing low oxygen levels from subsurface open ocean waters. Here we use a coupled physical (ROMS-CROCO)-biogeochemical (Oxygen-Phytoplankton-Zooplankton) model of an idealized coastal upwelling system of the Iberian Peninsula forced by upwelling favourable wind stress to determine the controlling factors of dissolved oxygen variability. It causes the surfacing of cold, nutrient-rich waters promoting phytoplankton growth and oxygen production by photosynthesis. An unstable front generates a field of mesoscale and submesoscale turbulence that controls the stirring of the oxygen field and redistributes dissolved oxygen across the shelf. A bi-modal pattern emerges with oxygenated waters inshore and depleted waters offshore. Oxygen enrichment of the surface coastal upwelling is highly sensitive to wind regime and phytoplankton growth rate. Our model results suggest that sustained upwelling lowers the enrichment rate due to continuous low oxygen injection from below; conversely, a wind relaxation period following intense upwelling increases the enrichment rate due to the cessation of low oxygen input, allowing photosynthesis to replenish the oxygen levels. Changes in phytoplankton conditions substantially reduce the rates of oxygen enrichment due to strong non-linear interactions between biological and physical factors. Future work will investigate the importance of current-wind interaction for the dissolved oxygen dynamics and will aim at disentangling those complex processes driving oxygen concentrations variability in a more permanent and less oxygenated upwelling system.

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