Geophysical Research Abstracts
Vol. 20, EGU2018-12565, 2018
EGU General Assembly 2018

Physical and biogeochemical controls on dissolved oxygen in coastal upwelling systems

João Bettencourt (1), Vincent Rossi (2), Lionel Renault (1), Peter Haynes (3), Yves Morel (1), and Véronique Garçon (1)

(1) LEGOS, CNRS/CNES/UPS/IRD, Toulouse, France., (2) MIO, Marseille, France, (3) DAMTP, Cambridge University, Cambridge, UK

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-biogeochemical model of an idealized coastal upwelling system of the Iberian Peninsula to determine the controlling factors of dissolved oxygen variability. An Oxygen-Phytoplankton-Zooplankton model is implemented within the ROMS model and the system is forced by upwelling favourable wind stress. 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, although small-scale turbulence tends to homogenize this gradient by transporting offshore oxygen-rich submesoscale filaments. 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 the phytoplankton growth rate substantially reduce the rates of oxygen enrichment due to strong non-linear interactions between biological and physical factors. Future work will aim at disentangling those complex processes driving oxygen concentrations variability in a more permanent and less oxygenated upwelling system.