Geophysical Research Abstracts
Vol. 14, EGU2012-9848, 2012
EGU General Assembly 2012

The future of coastal upwelling ecosystems: the impact of potential wind changes on ocean acidification and coastal hypoxia

Z. Lachkar and N. Gruber

Swiss Federal Institute of Technology ETH Zurich, Environmental Physics, Institute of Biogeochemistry and Pollutant Dynamics, Environmental Sciences, Zürich, Switzerland (zouhair.lachkar@env.ethz.ch)

The upwelling of deep, low pH, and low oxygen water to the surface makes eastern boundary upwelling systems (EBUS) naturally prone to global change induced perturbations such as ocean acidification and ocean deoxygentation related to decreased ocean ventilation. The severity of these chemical perturbations may further be exacerbated in EBUS by the potential increase in upwelling favorable winds induced by global warming. Here, we explore the impact of upwelling-favorable wind changes on modern and future ocean acidification and coastal hypoxia through a comparative study of the California Current System (California CS) and the Canary Current System (Canary CS). To this end, we undertook a series of idealized wind perturbation studies for present-day and year 2050 conditions with eddy-resolving setups of the Regional Oceanic Modeling System – ROMS– to which a nitrogen-based Nutrient-Phytoplankton-Detritus-Zooplankton (NPDZ) biogeochemical model was coupled. Our results show that the increase of upwelling favorable winds leads to a substantial shoaling of the hypoxic boundary in the California CS, while the same wind perturbation results in a reduction of the hypoxic water volume in the Canary CS. This is because coastal hypoxia is driven by local remineralization of organic matter on the shelf in the Canary CS, while it is essentially driven by large-scale advection of low oxygen water in the California CS. The intensification of upwelling tends to acerbate ocean acidification in the surface ocean, but mediates it below it, leading to complex change pattern reflecting the intricate interplay between biologically and physically -driven changes in calcium carbonate saturation state. Additionally, our results reveal differential biogeochemical responses to upwelling intensification in the water column and on the continental shelf with, therefore, contrasting implications for the benthic and the pelagic communities of these ecosystems.