ARTIFICIAL UPWELLING INTENSITY AND MODE HAVE A MAJOR IMPRINT IN DISSOLVED ORGANIC MATTER DYNAMICS

M. Gómez-Letona[1], M. Sebastián[2], I. Baños[1], A. González[1], N. Hernández-Hernández[1], M. F. Montero[1], M. Baumann[3], U. Riebesell[3], J. Arístegui[1]

[1] Instituto de Oceanografía y Cambio Global, Universidad de Las Palmas de Gran Canaria, Las Palmas, SPAIN.
markel.gomezletona@ulpgc.es, isabel.banos@ulpgc.es, acorayda.gonzalez@ulpgc.es, nauzet.hernandez@ulpgc.es, maria.montero@ulpgc.es, javier.aristegui@ulpgc.es
[2] Department of Marine Biology and Oceanography, Institut de Ciències del Mar, CSIC, Barcelona, SPAIN.
msebastian@icm.csic.es
[3] Marine Biogeochemistry, Biological Oceanography, GEOMAR Helmholtz Centre for Ocean Research Kiel, Kiel, GERMANY
mbaumann@geomar.de, uriebesell@geomar.de

Abstract: In the face of climate change there is a need to reduce atmospheric CO_2 concentrations. Artificial upwelling of nutrient-rich deep waters has been proposed as a method to enhance the biological carbon pump in oligotrophic oceanic regions in order to fuel carbon sequestration. However, the fate of the newly produced organic matter, and specifically of its resulting dissolved fraction, is not clearly understood. In the present work, nutrient-rich deep water was introduced to large scale (~44 m^3) mesocosms in the oligotrophic subtropical North Atlantic with the aim of studying how the intensity and mode of artificial upwelling (large single pulses vs recurring smaller pulses) affects the dissolved organic matter (DOM) pool. Artificial upwelling yielded marked increases in the concentration and shifts in the characteristics of DOM. The magnitude of the observed changes was mostly related to the upwelling intensity: more intense treatments led to higher accumulation of dissolved organic carbon (>70 μM of excess DOC over ambient waters for extreme treatments), as well as increases in the concentration and average molecular weight of chromophoric DOM (CDOM) and the intensification of humic-like fluorescent DOM, suggesting transformation of the DOM pool. The artificial upwelling mode also affected DOM, with singular treatments overall resulting in higher CDOM quantities and molecular weight than recurring treatments. Our results indicate that under artificial upwelling, large DOM pools may accumulate in the surface ocean without being remineralised in the short-term. This persistence could be associated with a combination of the molecular diversification of DOM due to microbial reworking, nutrient limitation and reduced metabolic capabilities of the prokaryotic communities inside the mesocosms. The present study highlights the importance of considering DOC when assessing the carbon sequestration potential of artificial upwelling.

Key words: dissolved organic matter, carbon sequestration, negative emission technologies, artificial upwelling, mesocosm