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Vertical Mixing Effects on Phytoplankton Dynamics and Organic Carbon Export in the Western Mediterranean Sea

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ABSTRACT

A 3-D high-resolution coupled hydrodynamic-biogeochemical model of the western Mediterranean was used to study phytoplankton dynamics and organic carbon export in three regions with contrasting vertical regimes, ranging from deep convection to a shallow mixed layer. One month after the initial increase in surface chlorophyll (caused by the erosion of the deep chlorophyll maximum), the autumnal bloom was triggered in all three regions by the upward flux of nutrients resulting from mixed layer deepening. In contrast, at the end of winter, the end of turbulent mixing favored the onset of the spring bloom in the deep convection region. Low grazing pressure allowed rapid phytoplankton growth during the bloom. Primary production in the shallow mixed layer region, the Algerian subbasin, was characterized by a long period (4 months) of sustained phytoplankton development, unlike the deep convection region where primary production was inhibited during 2 months in winter. Despite seasonal variations, annual primary production in all three regions is similar. In the deep convection region, total organic carbon export below the photic layer (150 m) and transfer to deep waters (800 m) was 5 and 8 times, respectively, higher than in the Algerian subbasin. Although some of the exported material will be injected back into the surface layer during the next convection event, lateral transport, and strong interannual variability of MLD in this region suggest that a significant amount of exported material is effectively sequestrated.

Full Text

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