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Nitrogen and Phosphorus Budgets in the Northwestern Mediterranean Deep Convection Region

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ABSTRACT

The aim of this study is to understand the biogeochemical cycles of the northwestern Mediterranean Sea (NW Med), where a recurrent spring bloom related to dense water formation occurs. We used a coupled physical-biogeochemical model at high resolution to simulate realistic 1-year period and analyze the nitrogen (N) and phosphorus (P) cycles. First, the model was evaluated using cruises carried out in winter, spring, and summer and a Bio-Argo float deployed in spring. Then, the annual cycle of meteorological and hydrodynamical forcing and nutrients stocks in the upper layer were analyzed. Third, the effect of biogeochemical and physical processes on N and P was quantified. Fourth, we quantified the effects of the physical and biological processes on the seasonal changes of the molar NO_3:PO^4 ratio, particularly high compared to the global ocean. The deep convection reduced the NO_3:PO_4 ratio of upper waters, but consumption by phytoplankton increased it. Finally, N and P budgets were estimated. At the annual scale, this area constituted a sink of inorganic and a source of organic N and P for the peripheral area. NO^3 and PO^4 were horizontally advected from the peripheral regions into the intermediate waters (130–800 m) of the deep convection area, while organic matter was exported throughout the whole water column toward the surrounding areas. The annual budget suggests that the NW Med deep convection constitutes a major source of nutrients for the photic zone of the Mediterranean Sea.

Full Text

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