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Nitrogen and phosphorus seasonal dynamics and annual budget in the Northwestern Mediterranean deep convection region inferred from a 3D physical/biogeochemical coupled model

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A multi-element biogeochemical model forced by a 1 km resolution hydrodynamical model was used to gain in understanding of the biogeochemical functioning of the North-Western Mediterranean (NW Med), the only region in the whole Mediterranean Sea with a marked and recurrent spring bloom behavior related to the winter dense water formation characterizing this area. After an assessment of the simulation using satellite derived chlorophyll and Dewex project in situ nutrients observations, the nitrogen and phosphorus seasonal cycles were analyzed using model outputs on the period 2012-2013. Injections of nutrients during the wind intensification period allow the triggering of the autumn bloom. Then, convection in winter upwells large amounts of nutrients in the euphotic layer. When the conditions for phytoplankton development are gathered (reduction of vertical mixing, low grazing pressure), a bloom is triggered with a massive consumption of nutrients during more than one month resulting at the end of April in a depletion of nutrients at the surface. Nutrients consumption continues to deplete nutrients at increasing depth, increasing the nutriclines and deep chlorophyll maximum depths. That finally leads to the summer oligotrophy of the water column. Then a quantification of nitrogen and phosphorus budgets of the open-sea convection area was performed on an annual basis. The deep convection area represents a sink of nitrate and phosphate, and a source of organic nitrogen and phosphorus for the peripheric regions. Regarding the biogeochemical nitrogen cycle, the deep-nitrate based new production is responsible for 19% of the total nitrogen uptake. This new production dominates during the winter deep convection and spring bloom periods. Finally, our results suggest that the NW Med open sea convection represents a major source of nutrients for the Mediterranean surface sea.