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Fingerprint of the atmospheric deposition on the biogeochemical functioning in the Mediterranean Sea - Evolution since the preindustrial era and projections

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The atmospheric deposition of trace elements in the marine environment plays a major role in low-nutrient low-chlorophyll (LNLC) regions, such as the Mediterranean Sea. Particularly the deposition of nitrogen (mainly nitrate and ammonium) and phosphorous (phosphate) represents an important source of essential nutrients for the growth of phytoplankton and bacteria, enhancing the marine productivity in these oligotrophic areas.
In this study we investigate how the increase in atmospheric deposition of N over the past 1.5 century, together with a smaller increase in atmospheric P deposition onto the surface seawater, affected the nutrient stoichiometry and the marine ecosystem in the Eastern Mediterranean Sea and how this impact will change in the near future. To this end, and in order to understand the atmospheric and marine processes that regulate the effects of atmospheric deposition in the marine ecosystem and the N/P ratio as well as its temporal evolution in the Eastern Mediterranean, a 1-D coupled physical- biogeochemical model is used. The model is forced by observations of atmospheric deposition fluxes at Crete, while for the hindcast (1860) and forecast (2030) simulations, the changes in atmospheric deposition calculated by global chemistry- transport models are applied to the present-day observed fluxes. Then, a coupled 3-D hydrodynamic/biogeochemical model that is currently operational within the POSEIDON forecast system, forced by the TM4-ECPL global atmospheric chemistry transport model, is implemented at Mediterranean basin scale.
Both the 1D and the 3D models show that the atmospheric deposition of N and P is capable of explaining the observed west-to-east gradient of N/P ratio in the sea. Impacts of atmospheric deposition of N and P on the marine carbon and nutrients cycles are investigated and discussed.
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