Modeling Mediterranean pelagic phytoplankton

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Ecosystem models form a valuable tool for understanding marine ecosystem dynamics and addressing management questions that are related to dynamic feedbacks between physical and biotic processes. A generic biogeochemical model is presented here that is based on the European Seas Ecosystem Model (ERSEM), which is currently coupled with the Mediterranean basin scale hydrodynamic model of the operational "POSEIDON" forecasting system. The ERSEM model applies a 'functional' group approach where biotic groups are distinguished not by species but by their functional role (producers, consumers, and decomposers) in the ecosystem, using size as the primary characteristic. The ecological characteristics described are not site specific and respond to the varying physico-chemical environment from coastal and river influenced areas up to the open sea. The simulation results were validated against available remote sensing (ocean color) and in situ data. The model qualitatively reproduces the observed patterns of the Mediterranean Sea surface nutrients and chlorophyll concentration, and is consistent with estimates of primary and bacterial productivity. Despite some discrepancies between the model simulation and in situ measurements, the model successfully reproduces the pelagic plankton food web dynamics that captures the seasonal and spatial overarching trend among autotrophs and heterotrophs. The mean simulated Mediterranean phytoplankton biomass is characterized by the dominance of picoplankton and nanoplankton in oligotrophic areas, followed by diatoms and dinoflagellates that coexist alongside them in more productive areas. Heterotrophic nanoflagellates, which follow a similar pattern to picoplankton and heterotrophic bacteria, show a higher relative abundance in oligotrophic areas, whereas microzooplankton present an opposite distribution and are more abundant in more productive areas, due to the greater variety of their diet (nanoplankton, microphytoplankton, and heterotrophic nanoflagellates). Mesozooplankton present a slightly greater increasing gradient toward the productive areas, as they feed mainly on diatoms and dinoflagellates, along with microzooplankton. As a next step, the assimilation of remote sensing (ocean color) data could provide an operational forecast for ecosystem dynamics.