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# Modelling of the Long-Term Evolution of the Black Sea Ecosystem

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The Black Sea ecosystem manifested significant changes during the last few decades. Healthy ecosystem state was observed in early 70-ies. Then it was altered drastically by eutrophication, overfishing and large growth of opportunistic species in 80-ies. Three-dimensional Black Sea ecosystem model coupled with the basin dynamics is developed in the framework of the FP6 "Sesame" project and improved within the MyOcean project. The model of the Black Sea ecosystem consists of physical and biogeochemical parts. The physical part is the model of the Black Sea circulation based on (Princeton Ocean Model), driven by ERA40 atmosphere forcing. It has 26 sigma levels compressed towards the surface. The biogeochemical model is an extension of the one-dimensional models given by Oguz et al. (1999, 2000,2001). It has one-way off-line coupling with circulation model through current velocity, temperature, salinity and turbulent diffusivity. The biogeochemical model extends to 200m depth with 26 z-levels, compressed to the sea surface. It includes 15 state variables. Phytoplankton is represented by two groups, typifying diatoms and flagellates. Zooplankton is also separated into two groups: microzooplankton and mesozooplankton. The carnivorous group covers the jelly-fish Aurelia aurita and the ctenophore Mnemiopsis leidyi. The model food web structure identifies omnivorous dinoflagellate Noctiluca scintillans as an additional independent group. It is a consumer feeding of phytoplankton, bacteria, and microzooplankton, as well as particulated organic matter, and is consumed by mesozooplankton. The trophic structure includes also nonphotosynthetic free living bacteriaplankton, detritus and dissolved organic nitrogen. Nitrogen is considered as the only limiting nutrients for phytoplankton growth. Additional components of the biogeochemical model are dissolved oxygen and hydrogen sulfide. The model is applied to reproduce major stages of the marine biology evolution during the last 40 years. Simulations show reasonable description of major stages of the ecosystem evolution including healthy 70-ies, eutrophication and opportunistic species growth in 80-ies and slow recovering in 90-ies.
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