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A 1D-ecosystem model for pelagic waters in the southern Baltic Sea. Numerical simulations (future decades)

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This paper presents a one-dimensional Ecosystem Model. Mathematically, the pelagic variables in the model are described by a second-order partial differential equation of the diffusion type with biogeochemical sources and sinks. The temporal changes in the phytoplankton biomass are caused by primary production, respiration, mortality, grazing by zooplankton and sinking. The zooplankton biomass is affected by ingestion, excretion, respiration, fecal production, mortality, and carnivorous grazing. The changes in the pelagic detritus concentration are determined by input of: dead phytoplankton and zooplankton, natural mortality of predators, fecal pellets, and sinks: sedimentation, zooplankton grazing and decomposition. The nutrient concentration is caused by nutrient release, zooplankton excretion, predator excretion, detritus decomposition and benthic regeneration as sources and by nutrient uptake by phytoplankton as sinks. However, the benthic detritus is described by
phytoplankton sedimentation, detritus sedimentation and remineralisation. The particulate organic carbon concentration is determined as the sum of phytoplankton, zooplankton and dead organic matter (detritus) concentrations. The 1D ecosystem model was used to simulate the seasonal dynamics of pelagic variables (phytoplankton, zooplankton, pelagic detritus and POC) in the southern Baltic Sea (Gdańsk Deep, Bornholm Deep and Gotland Deep).

The calculations were made assuming:
1) increase in the water temperature in the upper layer - 0.008oC per year,
2) increase in the available light - 0.2% per year.
Based on this trend, daily, monthly and seasonal and annual variability of phytoplankton, zooplankton, pelagic detritus and particulate organic carbon in different areas of the southern Baltic Sea (Gdańsk Deep, Borrnholm Deep and Gotland Deep) in the euphotic layer was calculated for the years: 2000, 2010, 2020, 2030, 2040 and 2050.