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A Coupled 1D-Ecosystem Model

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A coupled one-dimensional ecosystem model consists of three submodels: a meteorological submodel for the physics of the upper layer and a biological submodel, which also is driven by output from the physical model. The meteorological component calculates the forcing functions for the physical oceanographic and biological components. Wind stress, global radiation and the heat balance at the sea surface are determined from standard meteorological data and hydrographic climatological data. The system of equations of the biological submodel consists of five nonlinearly coupled partial differential equations of second order for phytoplankton, microzooplankton, mesozooplankton and two nutrients and one ordinary first order differential equation for benthic detritus pool. The biological upper layer submodel incorporates formulations of the primary production mechanism and of the remineralization mechanisms within the mixed layer, in the lower layers and at the bottom as well as of the daily migration of zooplankton mechanism. The model is based on total inorganic nitrogen and phosphate. The mesozooplankton (herbivorous copepods) has been introduced into the model having definite patterns of growth, reproduction, and mortality. The phytoplankton standing stock, micro- and mesozooplankton and nutrient in the water column serve as time- and depth- dependents pools. Detritus is a time-dependent pool at the bottom. All pools are prognostic state variables. Bacteria are not explicitly simulated as prognostic variables. Their activity only appears implicitly in the parametrizations of the remineralization terms. Benthic detritus accumulates by sinking out of the water column. It is regenerated diffuses upwards by turbulent diffusion. The numerical studies were made for station at Gdansk Gulf. The 1D-ecosystem model describes observed temporal patterns for characteristics investigated quite well.