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Modeling the seasonal and inter-annual variability of physical and ecosystem characteristics in the upper layer of the Central-Eastern North Atlantic

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A 3D eco-hydrodynamical model of high resolution ($0.25^\circ \times 0.25^\circ$, 27 σ-levels) is used to simulate the seasonal and inter-annual variability of ocean circulation and marine ecosystem in the Central-Eastern basin of the North Atlantic (CENA - The area limited from the south and the north to parallels 15 ° N and 28 ° N, coast in the east and a meridian 18 ° W in the west) in the period 1958-2006.

Simulated temperature and salinity fields both qualitatively and quantitatively agree well with satellite and expeditionary observations. Simulated surface phytoplankton distributions are in qualitative agreement with surface distributions of chlorophyll “a” derived from satellite data. According to model results and observations, in the winter period “spots” of maximal phytoplankton biomass are often located in upwelling zones in the open ocean on the periphery of cyclonic eddies rather than in the coastal upwelling zones. In the summer period, when phytoplankton biomass reaches maximal (in the annual cycle) values, maximums of phytoplankton are located in the coastal upwelling zones. There is no simple relationship between the nitrate distributions, on the one hand, and phytoplankton ones, on the other hand. However, the calculated values of chlorophyll concentration are, as a rule, considerably lower than the results of expeditionary and satellite measurements. The calculated amplitude of seasonal oscillations of the total primary production (averaged over the model area) is in good agreement with satellite estimates, whereas modeled mean annual values of primary production are overestimated in comparison with them. At the same time, between satellite and expeditionary data also there are appreciable divergences.

Inter-annual changes in mean annual temperatures averaged over CENA region for the period from 2000 to 2006 amounted to 0.9 ° C and 1.0 ° C for the model and satellite data, respectively. Similar changes in primary production for the period from 1998 to 2006 amounted to +60, -100 and 50 mgC m-2 day-1 (+6, - 13 and +12% of its mean annual values), respectively, according to the model results, satellite-derived estimate based on the Epply version of standard evaluation method and satellite-derived estimate based on carbon method. Despite the existing quantitative divergences between model results and satellite data, the spatial distributions during the various periods of an annual cycle were similar.

Reasons of the above discrepancies between the model and observations will become clear by a more thorough analysis of the results and study of the sensitivity of solution to poorly known parameters.