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Response of water temperature in the Black Sea to atmospheric forcing: the sensitivity study

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The Black Sea ecosystem experienced severe degradation during the 1970s and 1980s. There is growing understanding that physical processes such as vertical mixing and horizontal exchanges can play a role in the health of the biologically productive shelf areas. In order to quantify these processes numerical models should properly represent circulation patterns and the structure of water masses, in particular on the shelf. The accuracy of results produced by numerical models depend on many factors e.g. approximations in the governing equations, errors introduced by the numerical scheme, and uncertainties in input parameters such as atmospheric forcing. In this paper we analyse how sensitive the model output is to variations in the meteorological parameters used to force the model. We apply a 3D full physics model POLCOMS with 6 km horizontal resolution and a terrain following coordinates with 30 vertical s-layers. The model uses Arakawa B grid, spherical polar coordinate system, time splitting k-epsilon GOTM closure scheme and a Piecewise Parabolic Method (PPM) advection scheme for improved front conservation. The model code has been modified to better describe specific features of the Black Sea such as exchanges through the Turkish straits. Model domain was 41 to 46.7 °N; 28 to 42 °E The model was spun up using monthly climatic temperature and salinity distributions to achieve a quasi-geostrophic balance.

In order to assess the effect of variations in input data on model output, the model was run for the period 1 January-31 December 2006 with 2 sets of meteo data from alternative sources, whilst all other parameters and boundary conditions were kept identical. The meteo forcings (U and V -wind, air temperature at sea surface, relative humidity, cloudiness, precipitation) were taken from NCEP reanalysis-2 data set with horizontal resolution around 1.6 degree and JRA-25 reanalysis data set with a resolution 1.125 degrees, both with 6 hours intervals. The difference between 2D distributions of meteo parameters as well as the difference in model results forced by alternative meteo inputs was assessed by calculating the Willmott skill parameter which is often used to assess how well a model represents observations. The value of Skill=1 represent the ideal match, Skill=0 means no match. The main parameters we have analysed were Sea Surface Temperature, vorticity of the surface currents and temperature cross-sections on a transect off the city of Gelendgik in the NE part of the Black Sea. It was shown that the discrepancy between the model and observations and the two sets of model outputs are time dependent. Generally the difference due to alternative atmosperic inputs is of the same order of magnitude as difference between the model and observations. This work was partly supported by the following grants: EU FP6 SESAME, EU FP7 MyOcean, RFBR-00-05-00240.