A CLIMATOLOGICAL SIMULATION FOR THE MIDDLE ADRIATIC COASTAL AREA

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Abstract

Numerical model is designed and used to reproduce seasonal cycle of thermohaline and dynamical properties of the middle Adriatic coastal area. Results of a three-year long experiment with perpetual atmospheric and riverine forcing reveal strong seasonal signal, which agrees with temperature and salinity data originating from the permanent oceanographic stations along Split-Gargano transect and with some early current measurements.

Keywords: numerical model, seasonal cycle, Adriatic Sea

Introduction

High-resolution oceanographic model, called ASHELF-2, was developed for the middle Adriatic coastal area and was used to simulate its climatological characteristics. Successful simulation of the climatological variability of the thermohaline and dynamical properties is needed as a starting point for the reliable oceanographic short-term forecast of the studied area.

The ASHELF-2 model is nested into the whole-Adriatic model (AREG) (1) and is run with the perpetual atmospheric and riverine forcing. Numerical model results are compared with climatological temperature and salinity data obtained at permanent oceanographic stations and with some early current measurements in the area (2).

Model setup

The oceanographic model used is modification of the Princeton Ocean Model (POM) (3). The ASHELF-2 model uses the grid of constant horizontal resolution of 1 km, which covers the studied area with 189x106 points. Along the vertical, 16 sigma levels were defined with finer distribution near the surface and bottom.

The oceanographic model was forced with monthly varying fields of surface momentum, heat and water fluxes and monthly discharges from four rivers: Jadro, Zrnovnica, Cetina and Neretva. Surface heat fluxes diagnosed by AREG were linearly interpolated onto the ASHELF-2 grid and corrected during 'perpetual year' simulation to produce seasonal climatology using ATOS data set (1). Surface water fluxes, computed from evaporative heat flux, precipitation data and monthly runoff from four rivers discharging into the ASHELF-2 domain, were also corrected during simulation to produce seasonal climatology and to avoid the excessive freshening of the basin that could result from the use of the climatological forcing.

At both open boundaries of the ASHELF-2 model a simple one-way nesting technique was applied. Nesting procedure is designed to satisfy the volume conservation constraint, which can be violated due to interpolation of the data from the coarse resolution model onto the open boundaries of the fine resolution model (1).

Results and discussion

Three-year long numerical simulation under climatological surface forcing has been carried out.

The general flow in the ASHELF-2 domain is directed northwestward with prominent wakes occurring behind Dalmatian islands during the greater part of the year (Fig. 1). Current reversal obtained between islands Hvar and Vis in August agrees with previous current measurements, which indicate strong seasonal signal in the surface current field with oppositely directed alongshore flow in the winter and summer seasons (2).

The importance of the properly imposed open boundary conditions can be seen by comparing current fields modelled for January with and without nesting procedure. In the numerical experiment without nesting, surface current field shows numerous cyclonic and anticyclonic gyres. In the similar numerical experiment with nesting most of the gyres disappear and the flow is dominantly of the northwest direction.

Modelled temperature annual cycle at the points that correspond to the coastal and open sea stations shows good agreement with observations, although modelled annual amplitude is lower than the one obtained from the data. Surface salinity measured at two coastal stations shows lower values and higher annual amplitudes than those obtained in numerical simulations. Discrepancy between modelled and measured surface salinity in the coastal area can be partly ascribed to the climatological salinity field used in correcting procedures, in which coastal areas are not well resolved. Better

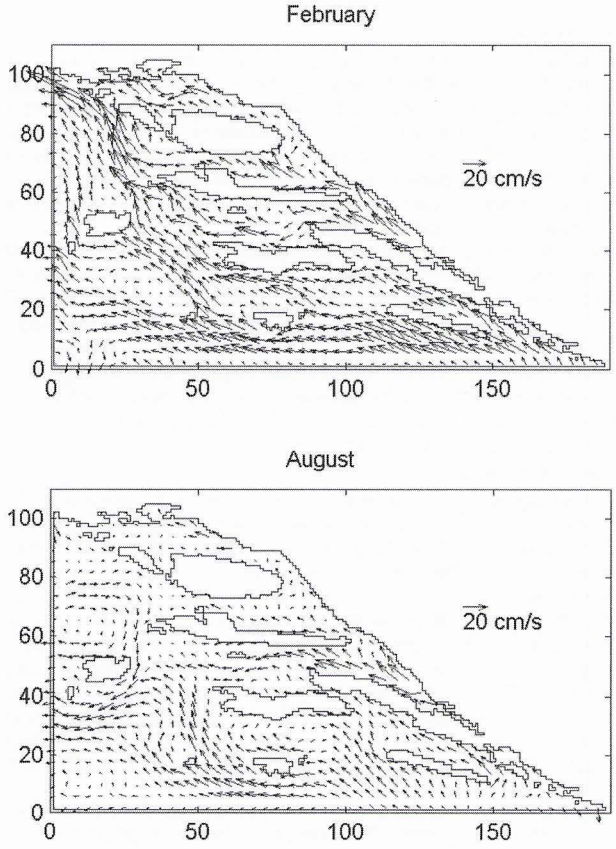

Fig. 1. Surface currents in the ASHELF-2 domain in February and August.

agreement between measured and modelled time series is obtained for the open sea stations although lower annual amplitude is again obtained by the model.

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