Estimating the Water Quality of İzmir Bay by Using GCM

E. Saner, E. Sayın and O. Uslu

Institute of Marine Science and Technology, 35340 İnciraltı, İzmir
Tel +90-232-2785083 Fax +90-232-2785082
e-mails: saner@imst.deu.edu.tr / sayin@imst.deu.edu.tr / uslu@imst.deu.edu.tr

Abstract

Izmir Bay is one of the most polluted estuaries in the whole Mediterranean Sea. Especially the Inner Bay is heavily affected by domestic and industrial loads amounting to ca. 5 million population equivalents (PE). As a result of these loads, strong eutrophication occurs in the inner sections of the Bay, which is temporally anaerobic. The ecologically sensitive approach of the local authorities in the last decade gave rise to a wide variety of monitoring and research studies. The Institute of Marine Sciences and Technology - 0?mir (IMST) with its research vessel R/V K.Piri Reis has conducted very intensive monitoring since 1988 and especially during the years 1994, 1996-1998. The monitoring study covers the water column and bottom sediments encompassing a wide range of physical, chemical, biological and geological parameters. All collected data is used to calibrate and validate the models that will be described in this paper.

Calibration and validation of the physical component of the model has been completed in 1997. Bryan-Cox-Semtner free surface model (KILLWORTH Model) is used for this study. The importance of this version of model is the handling of surface elevation information explicitely. The surface elevation is a prognostic variable in the model. This gives a possibility to use satellite sea level measurements directly as a boundary condition. TOPEX/POSEIDON data is analysed for this purpose in order to obtain the barotropic part of the velocities. With the inclusion of in situ observations full, three dimensional estimates of the flow field and its properties were reproduced. The model experiments covered the summer and winter seasons. This study has proven that the hydrological part of the KILLWORTH model is a very powerful tool to give detailed information about İzmir Bay circulation patterns. From the analysis of currentmeter measurements and the model results, it can be concluded that the İzmir Bay currents are not only driven by wind, but also sea level variations in the Aegean Sea and the seasonal stratification in the Bay play a very important role to drive the currents.

As a biological waste water treatment plant with nitrification-denitrification and biological phosphorus removal is under construction, uncontrolled discharge of wastewaters into the Inner Bay will start to be stopped gradually in the near future. To investigate the possible different treatment and discharge alternatives, water quality model studies have been initiated by the Water and Sewerage Authority in İzmir (IZSU). The main goal of these studies was to produce the necessary details to support the decision mechanisms of IZSU. For this water quality study, again KILLWORTH Model has been used. The reason for this selection is the encouraging recent usage of this model in ecomodeling and the already proven power of the background hydrological component.

The developed quality model is used to estimate total nitrogen, phosphate, dissolved oxygen and BOD distributions in the Bay. It is calibrated and validated by using the large volume of collected data describing the present environmental state of the Bay. The validation phase showed that the model gives a very good estimate of the monitored quality parameters. Later, different scenarios for the discharge of the treated and untreated effluents into the Bay, in parallel with the construction and operation phases of the treatment plant are solved. The wastewater will be discharged into the Middle Bay from the sea surface after a mechanical treatment first and a secondary treatment later. So, the model experiments are conducted to assess the impacts that may probably arise after the implementation of possible engineering options for the ongoing project.

This modelling approach for the management of water quality in a bay, together with treatment and discharge alternatives is one of the first in Turkey. The quality and comprehensiveness of the results have also encouraged the local politicians and decision makers to develop an understanding and trust for the application of predictive models.