Abstract

The assessment of human impact on complex estuarine systems is a multidisciplinary task that is highly demanding in terms of measurements and fieldwork. Nowadays the use of inexpensive and reliably modeling tools can substantially reduce the amount of measurements needed to characterize a system. These tools are also a convenient way to forecast the future evolution of the system and to study the impact of different scenarios of human influence.

In this communication a modeling system composed by hydrodynamic, transport and ecological models is used to assess the current trophic state of Sado Estuary (Portugal) and to predict the future trends of the system based on different scenarios of human intervention. Special care is taken to the impact of changing riverine nutrient loads. Sado estuary is a large European estuary that has been considered until now in good trophic conditions with eutrophication appearing only in some isolated spots. Nevertheless in recent years some studies point out that the situation is changing. Sado estuary is a system with strong environmental opposing interests. It hosts a major industrial and urban center around the city of Setúbal and the upper reaches are used to intensive cultures such as rice. On the other hand the estuary possess an important ecological value since it is used by several important species of fish as a spawning and nursery area and it's wetlands are used by many species of birds as winter shelters. Due to it's importance the majority of Sado Estuary is considered as Natural Reserve.

In this communication the model details as well as the application are explored. The modeling system includes a number of modules to simulate hydrodynamic; sediment transport; water quality and ecological behavior integrated using an object-oriented methodology. The hydrodynamic model solves the three-dimensional incompressible primitive equations and is coupled to both an eulerian and a lagrangian transport models. These transport models are used to run the sediment transport and the ecological models. The ecological model simulates the nitrogen cycle, the dissolved oxygen concentration, the BOD, the zooplankton and the phytoplankton population dynamics.

The modeling system is first used with a high-resolution mesh to characterize the dynamics of the region. After that a coarser mesh is used to perform inter-annual simulations. The hydrodynamic model is calibrated and validated. Nutrient and primary production field data are also used to ascertain the ecological model results.

The current state of the estuary is assessed and future trends are predicted for various scenarios. In this predictions the nutrient loads from the river are varied and the consequences to the state of the estuary are analyzed. This is an important issue for this region since a large water dam is being built in a neighboring river and large quantities of irrigation water will be used in Sado's catchment basin.

The results confirm the sensibility of the system to the increase in river load and can be used to identify the maximum amounts of irrigation water admissible maintaining sustainable conditions. The results also show the importance and potential of these modeling tools for the management of sensible estuarine areas.