ABSTRACT

Water regulation by reservoirs is needed in our country and it implies some environmental impacts. Many of them are related to a degradation of water quality which negatively affects both the environment and water uses. The European Framework Directive in the Field of Water Policy tackles those problems and demands that the Member States achieve some minimum quality levels in 2015. Efficient decisions in order to minimize those impacts can only be taken by studying the physical, chemical and biological processes involved. Chemical and biological processes are partly influenced by physical ones so the characterization of the reservoir hydrodynamics should be the first step in any investigation about reservoir water quality.

Numerical models in reservoir hydrodynamics are useful tools for management decision - making. They intend to simulate the hydrodynamics of a particular reservoir and predict its future behavior after some actions done. DYRESM 3.1, a one-dimensional (depth as dimension) hydrodynamics model is used in this study to predict temperature profiles in the reservoir by using meteorological data and discharges and temperatures of the inflows. A case study based on Riba-roja reservoir, which is located in the Ebro River lower course in Catalonia (North-East Spain), is developed and the results are analyzed.

Several meteorological, hydrological and thermal data gathering and processing have been developed to perform the case study. All the data series were converted to daily scale. Some needed data series as long-wave radiation or some inflow temperatures were not available. Stochastic models based on regressions between some of the available variables have been used to estimate them. The intersection of the availability periods of all the variables determined the simulation period, which finally was taken from May to December 2004.

A calibration has been proposed to adapt the DYRESM model parameters to the Riba-roja reservoir case study. The sensitivity analysis revealed that light extinction coefficient (LEC) is the most sensitive parameter. An average value of 0.9 m^{-1} has been estimated for the LEC at Riba-roja by some previous studies and this value has been shown to be the one that provides better results. Even so, LEC actually is a very variable parameter and DYRESM only admitted a constant average value, which is an important limitation of the model. Default values of the other parameters were adopted in the case study.

The DYRESM results have shown that the model is able to predict more or less accurately the evolution of the thermal profiles along the year. The stratification period and mixing processes have been correctly identified. Furthermore, outflow temperatures have been predicted with high accuracy, showing a root-mean-square error of 0.5 ºC.

The profiles of temperatures were better simulated in deeper layers. Errors ranged between $\pm 2^{o}C$ in layers deeper than 2 meters while the maximum error in surface layers could not be reduced under $+4^{o}C$. The problem lies in the difficulty of simulating Riba-roja special stratification, which is caused by the differences between its inflows temperatures rather than a differential heating of the water body. Results are thought to be very sensitive to inflow or long wave radiation data quality. Those data series just weren't available and they were estimated, so the inherent error possibly influenced negatively the simulation of the surface water temperatures.

Finally, one of these stochastic models based on variable relations was tested and analyzed against experimental measurements. This model was specifically developed to predict water temperatures from Segre River in Seròs during 2005 using air to water relations measured in 1999. Good predictions were obtained with a root-mean-square error of approximately 1.08 ºC.