APPLICATION OF THREE DIMENSIONAL AQUATIC ECOLOGICAL MODEL TO LAKE BIWA

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1. INTRODUCTION

Lake Biwa, located in Shiga prefecture, Japan, is essential for Osaka metropolitan district, providing water to no less than 14 million people in this region. Lake nutrients were increased in the 1970s, and several countermeasures against the lake eutrophication had improved water quality to a certain level. However, water quality of Lake Biwa has not improved especially since the 1990s in spite of reductions in pollution load via rivers[1]. Thus, the mechanism of the formation of water quality is not simple. The application of a numerical aquatic model to investigate the mechanism of the formation of water quality and/or to estimate future condition of the lake water after a certain environmental variation such as urbanization, could be an effective tool that would avert various kinds of critical influences.

2. OBJECTIVES AND METHODS

The aim of this study is to discuss the possible of application of a numerical model to Lake Biwa by the application of a three-dimensional, coupled hydrodynamic–ecological model, ELCOM-CAEDYM, to Lake Biwa. ELCOM-CAEDYM[2] is the coupling model of CAEDYM (aquatic ecological model) with ELCOM (three-dimensional hydrodynamic model). Boundary conditions are; bathymetry data, meteorological data, and inflow/outflow data. Inflow data of each river were estimated from total pollution load data [3] and patterns of land use in each watershed. The period of simulation is approximately one year: 353 days, from 7 Jan. to 25 Dec. in 2002.

3. RESULTS AND DISCUSSION

Figure 1 shows the results of vertical profiles of measured (asterisk) and simulated values (solid line) on the 176th day (1 Jul. 2002) at the point off Imazu; Items are water temperature, DO, T-N, T-P, and TOC. Although the actual trends of water temperature and DO were simulated properly, some of simulated values were inconsistent with measured values. In particular, the seasonal trends of T-N and T-P values were not described throughout the simulation period. If this model is completely accurate, there are three causes of differences between measured and simulated values; (1) inflow data differ from actual pollution load; (2) simulation time step and/or period are too long to maintain high reliableness; (3) calibration was not sufficient.

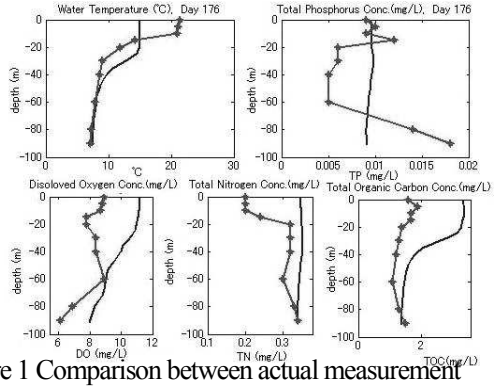

Figure 1 Comparison between actual measurement values and simulated values

4. CONCLUTIONS

In order to make more effective and efficient forecast by the application of a numerical model to a closed water area as Lake Biwa, three problems follow; (1) acquisition of sufficient speculated and measured data in quality and quantity, (2) choice of the proper model in consideration of cost and effect, (3) understanding of the reliable and applicable limits of a model. Efficiency and rationalization over related oganizations for shared purpose, along with solution to such problems, would allow tool of numerical model to be a more powerful tool for us.

REFERENCES: 1) Lake Biwa Comprehensive Preservation and Improvement Project; 2) J.R Romero, et al.(2004) One- and three-dimensional biogeochemical simulations of two differing reservoirs; 3) Shiga Prefecture(2002) White Paper on Environment