TWO DIMENSIONAL NUMERICAL SIMULATION OF TURBIDITY VARIATION IN IMHA RESERVOIR

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Imha multi-purpose Dam is located at 10 km from the city of Andong, Gyeong Sang Province, Korea, and 350 km upstream from the estuary of the Nakdong River. The 10-year averaged annual rainfall from 1995 to 2004 on the watershed of Imha reservoir is 1,085 mm. Seventy per cent of the annual rainfall occurs from June to September and turbidity currents flow into the reservoir in the same period.

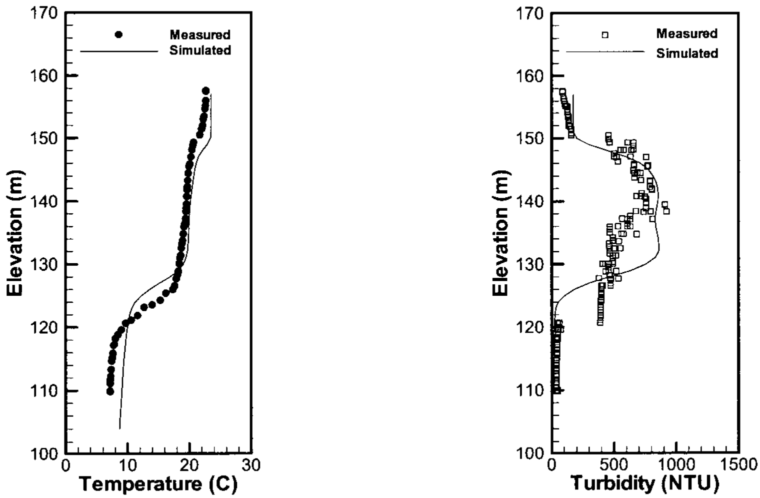
The watershed of Imha reservoir had huge amounts of rainfalls due to Typhoon Rusa in 2002 and Typhoon Maemi in 2003. Turbidities of the water in Imha reservoir were more than 800 NTU (Neuphelometry Turbidity Unit) right after the typhoons and they slowly decreased with time, but the turbidities remained above 100 NTU for more than five months. To cope with such high turbidities for a long time, it is necessary to figure the movement of turbid water, and temporal and spatial turbidity distributions.

The movement of turbid water in Imha Reservoir was analyzed using field measurements of water temperature turbidity before and after Typhoon 'Rusa' came on the watershed. Turbidity currents occurred due to the heavy rainfall and they moved into the middle layer because the density of them was heavier than that of the epilimnion and lighter than that of the hypolimnion. The turbid water remained in the middle layer until the turnover happened and they then advected and diffused over the whole reservoir.

The turbidity variation in Imha reservoir after Typhoon 'Rusa' was simulated using CE-QUAL-W2, a two dimensional hydrodynamic and water quality model. The vertical profiles of temperature and turbidity on Sep. 14, 2002 are shown in Fig. 1. The pattern of the simulated temperature profiles seems reasonable. The numerical results predict the elevations of the two thermoclines. The elevation of the first thermocline close to the water surface was well predicted but that of the second thermocline was predicted to be about 5 m higher. The simulated temperature profile is generally larger than the measurement over the whole depth. The estimated water temperature of the inflow might seem to be little higher.

The turbidity profile was obtained using the relationship between turbidity (NTU) and the concentration of suspended solids. The simulated turbidities agree well with the measurement from the surface to El. 138 m. They are larger from El. 138 m to El. 126 m and then decrease. The turbidity measurement shows that the turbidity near El. 120 m abruptly decreases but the simulated turbidity decreases near El. 132 m. Such difference might be resulted from the discrepancy in the water temperature predictions.

The results of numerical simulation of turbidity are qualitatively reasonable but there are some discrepancies from the turbidity measurements. The cause might be that the crude estimation of water temperature and the concentration of suspended solids for the simulation period because there is no measurement of water temperatures of inflow. To improve the accuracy of numerical modeling of turbidity currents, water temperature of inflows and concentration of suspended solids should be accurately estimated with more measurements of water temperature and also concentration of suspended solids in rainy days.



(a) Water temperature (b) Turbidity

Fig. 1 Temperature and turbidity profiles near Diversion Tunnel

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