NUMERICAL EXPERIMENTS OF VERTICAL MIXING IN ESTUARINE SYSTEM

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A laterally averaged two-dimensional model of hydrodynamic and salt water intrusion mode has been developed and applied to the Danshuei River estuarine system to study the changes in current and salinity distribution when the parameters of vertical mixing are varied systematically. The numerical experiments were conducted with real geometry of the Danshuei River system (Fig. 1). The boundary conditions include a simple harmonic tidal oscillation and salinity forced at the Danshuei River mouth and a uniform river discharge applied at the upriver of three tributaries. Two parameters, the coefficients of vertical turbulent viscosity and diffusivity, A_z and K_z, respectively, have been taken (a) as time variation and (b) as a constant. The mixing processes are modeled with turbulent diffusion terms. The mixing length concept is used to calculate A_z and K_z. The following formulations similar to those proposed by Pritchard (1960) are used:

$$A_z = \alpha Z^2 (1 - \frac{Z}{h})^2 \left|\frac{\partial u}{\partial z}\right| (1 + \beta R_i)^{-1/2} \quad (1)$$

$$K_z = \alpha Z^2 (1 - \frac{Z}{h})^2 \left|\frac{\partial u}{\partial z}\right| (1 + \beta R_i)^{-3/2} \quad (2)$$

where Z=depth below water surface, h=total depth ($=H+\eta$); R_i=local Richardson number; the constants α and β need to be determined through the calibration process.

The constants A_z and K_z are also adopted for another numerical tests to compare with the calculation results of estuarine circulation and mixing when turbulent closure model is taken as time variation (Eqs. (1) and (2)) in the Danshuei River estuarine system. As the results of taking the average of time-series A_z and K_z using Eqs. (1) and (2), the constant A_z and K_z are employed as 24 cm^2/s and 20 cm^2/s, respectively, that is the equation of $K_z = \frac{5}{6} A_z$

It was found that the use of variable coefficients, A_z and K_z, instead of constant values, has reasonable results on the vertical profiles of current and salinity distributions during a tidal period. More understanding and better mathematical representation of the turbulent mixing processes are essential to improve the model capability.

Keywords: Vertical twodimensional model; Numerical experiments; Mixing; Vertical turbulent viscosity and diffusivity

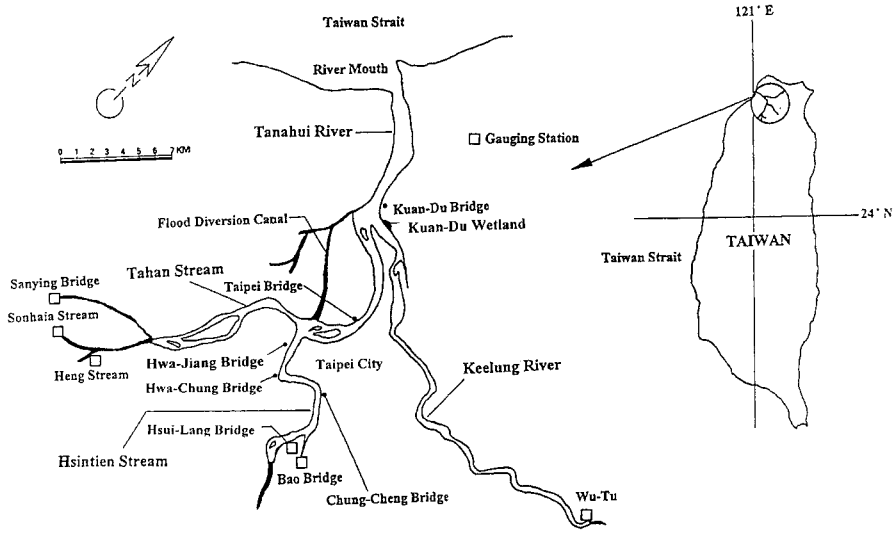

Fig. 1 Map of the Danshuei River estuarine system