Geophysical Research Abstracts, Vol. 9, 02749, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-02749

A 2D vertical two-phase flow model for sediment laden flows

J. Chauchat (1), S. Guillou (2) and K. D. Nguyen (1)

(1) Lab. M2C UMR CNRS 6143, (2) LUSAC EA-2607 (chauchat@meca.unicaen.fr)

In the field of sediment transport modelling the passive scalar hypothesis is usually assumed. As a consequence, the horizontal velocity of sediments is equal the fluid's one and the sediment vertical velocity differ from the fluid one by a settling velocity accounting for the difference of density between the sediment and the surrounding fluid. The concentration profile is usually computed with an advection-diffusion equation where the dispersion of sediment due the fluid turbulent motion is modelled by an empirical relation between the fluid eddy viscosity and the sediment diffusivity. Recently, experimental datas have proven that there is a measurable velocity lag between the fluid and the sediment and that this difference persits well away from the bed.

The two-phase flow modelling permit a more accurate description of the physical processes and especially give a theoretical explanation for the velocity lag of sediment and the increase of the diffusive flux with the size of sediment particles. The present two-phase flow model is based on averaged balance equations for each phase, fluid and sediment. The local instantaneous equations are averaged by an ensemble average operator and a weighting procedure is applied to the variables. We have introduce a modify $k-\varepsilon$ model for the fluid phase and a first order model, the so-called $k_s - k_{fs}$ model for the solid phase turbulence. It consist of a set of two transport equations, one for the turbulent kinetic energy k_s and one for the fluid-particle covariance k_{fs} based on the kinetic theory of granular flows. The dispersion effect due to particles transport by turbulent fluid motion is modelled by a drifting velocity appearing in the interfacial momentum transfer term. We compare numerical results with this closure with experimental datas for sediment laden flows. We reproduce qualitatively the experimental features of the flow : the horizontal sediment velocity lag and the dispersion of particles by the fluid turbulent motion.