Geophysical Research Abstracts, Vol. 7, 05097, 2005
SRef-ID: 1607-7962/gra/EGU05-A-05097

New Optical Technique for Particle Image Velocimetry: Application to Turbulence Modulation in high –concentration Suspensions.

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Sediment concentrations within particle-laden gravity driven flows vary widely and can reach extremely high values, for example in hyperconcentrated river flows, debris flows, pyroclastic flows and turbidity currents. In all these flows, our current understanding of the interactions between particles and flow dynamics is rudimentary if not absent. In particular, we possess no data or predictive models that explain the limiting conditions of turbulence modulation in such high-concentration flows.

To allow the complex links between fluid & sediment to be assessed in high concentration flows, we are using a new experimental technique, based on Particle Image Velocimetry system, the competence of which have been extended to a 2-phase configuration: the liquid is tracked by seeding particles and the sediment particles, providing the bulk suspension, are traced by fluorescent grains. These phases are simultaneously traced using two digital cameras equipped with two different lens filters, allowing each phase to be independently quantified. However, to date, the DPIV system has been restricted to low-concentration suspensions, as the system is not able to track properly solid particles above a concentration of $\sim 10^{-4}$. We have overcame this limit so as to work at high particle concentrations by using a set of sediment particles and liquid that have perfectly matching refractive indices: hence, the particles become invisible in the liquid, yet still form a high concentration flow. A few fluorescent particles are then added to the whole mass of invisible ones, to track the motion of the sediment. A first series of experiments is conducted in a mixing box, in which turbulence is generated by the vertical oscillation of a horizontal grid. The turbulence generated in such

a box is isotropic, with no mean shear flow. We will present this new technique as well as the first results of quantifing the modulation of the turbulence structure as the particle concentration of a suspension increases.