Geophysical Research Abstracts, Vol. 8, 02521, 2006
SRef-ID: 1607-7962/gra/EGU06-A-02521

Studying turbulence modulation –in gravel-bed rivers - with invisible particles.

C. Choux, J. Best and W.D.M. McCaffrey,
School of Earth and Environment, Earth Sciences, University of Leeds, U.K., (choux@earth.leeds.ac.uk / Fax: 00-44-113-343-5259 / Phone: 00-44-113-343-5199)

Sediment concentrations within rivers and other particle-laden gravity driven flows vary widely and can reach high values, for example in hyperconcentrated rivers, turbidity currents, debris flows, and pyroclastic flows.

In all these flows, our current understanding of the interactions between particles and flow dynamics is rudimentary at the best. 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 the Particle Image Velocimetry (PIV) system.

However, to date, the PIV 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 overcome this limit so as to work at higher 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 fluid with the laser system.

A first series of experiments has been 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. Grid generated turbulence is analogous to turbulence created by stresses generated when a flow travels above a

rough bottom, such as gravel-bed rivers. The particle concentration in the liquid and the frequency of oscillation of the grid are our two varying parameters.

We perform a series of particle motion analyses, looking at the spatial and temporal variation of the particle motion, as the particle concentration and frequency of oscillation increases. We show that the frequently-used averaging techniques of the vertical and horizontal component of the velocity over time and space are not valid.