Center for Environmental & Applied Fluid Mechanics

Speaker: Professor S. Balachandar (University of Florida)
Title: *"Interplay between turbulence and particles in environmental flows"*

Date: **Friday, September 16, 2011**
Time: 11:00 a.m.
Location: Gilman Hall 50 (Marjorie M. Fisher Hall)

The intensity and sustained propagation of environmental flows such as, turbidity currents and powder snow avalanche, depend on the interesting interplay between suspended particles and turbulence. The suspended particles drive the flow and are the source of turbulence in such currents, while the flow turbulence enables resuspension of particles from the bed. If resuspension dominates over deposition the intensity of the current can increase, thereby further increasing resuspension and resulting in a runaway current. On the other hand, stable stratification due to suspended sediment concentration can damp and even kill turbulence, resulting in massive deposits.

The three control parameters are the flow Reynolds number, the Richardson number and the non-dimensional suspension settling velocity.

In this talk we present results from direct numerical simulations of various configurations of continuous turbidity currents. The model is applied to study turbulence modulation due to changes in Richardson number and settling velocity, and its effects on the transport capacity of suspended sediment. The results indicate the existence of conditions for total suppression of near-bed turbulence. Under these conditions, sediment in suspension rains out passively on the bed, even though the upper layer may remain turbulent. The above scenario provides a reasonable explanation for the formation of massive turbidities in scenarios of slope change of the bed or loss of lateral flow confinement. A general criterion for sudden onset of total turbulence suppression is obtained from theoretical consideration and compared with simulation and laboratory results and field observations.

The key mechanism that dictates the rate of resuspension of particles is the effective hydrodynamic force that rolls/lifts the particle from the bed into the bulk. Much of the existing resuspension models are empirically driven. An essential building block to our understanding and physics-based modeling of resuspension is to consider the problem of forces on a particle in a turbulent boundary layer on a rough bed. Time permitting, our recent work in this direction will also be presented.

Bio

Professor S. "Bala" Balachandar is currently William F. Powers professor in the Department of Mechanical & Aerospace Engineering at the University of Florida. Before joining University of Florida, he was a professor in the Department of Theoretical & Applied Mechanics at the University of Illinois, at Urbana-Champaign. Professor Balachandar's expertise is in computational multiphase flow, environmental fluid mechanics, direct and large eddy simulations of transitional and turbulent flows, and integrated multiphysics simulations of complex problems. He is a fellow of the American Physical Society and the American Society of Mechanical Engineers. He received the Francois Naftali Frenkiel Award from American Physical Society (APS) Division of Fluid Dynamics (DFD) in 1996 and the Arnold O. Beckman Award and the University Scholar Award from University of Illinois. In 2003, Bala's student Prosenjit Bagchi won the coveted Andreas Acrivos Dissertation Award for best Doctoral Thesis from APS-DFD. He was an associate editor of the ASME Journal of Fluids Engineering and currently is the associate editor of the International Journal of Multiphase Flow. He is also the board member of the International Conference on Multiphase Flow and serves on the external advisory board of Sandia national Laboratories engineering sciences program.