Asociación Argentina
de Mecánica Computacional

Mecánica Computacional Vol XXXV, págs. 1105-1105 (resumen)
Martín I. Idiart, Ana E. Scarabino y Mario A. Storti (Eds.)
La Plata, 7-10 Noviembre 2017

ENTRAINMENT IN TEMPORALLY EVOLVING TURBIDITY CURRENTS

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Keywords: Turbidity, Currents, DNS, turbulence, entrainment

Abstract. Turbidity currents are sediment laden shear flows that run along a sloping bed, often submerged beneath a deep layer of quiescent fluid, driven by the excess hydrostatic pressure due to the suspended sediments. Turbidity currents are always turbulent since the suspended sediment particles that drive the flow cannot remain in suspension under laminar conditions. As the turbidity current travels downslope, the flow interacts with the bed at the bottom and with the ambient fluid layer at the top. Ambient fluid entrainment is a fascinating fluid mechanical phenomenon where quiescent ambient fluid is ingested into the current to an active shear flow. As the turbidity current flows downstream over the sloping bed, under a deep ambient of clear fluid, clear ambient fluid is continuously entrained into the turbidity current and the thickness of the current increases. In this work we study the entrainment mechanism taking place between the ambient fluid layer and the turbidity current by means of fully resolved direct numerical simulations. Entrainment is a function of both the local Richardson number, Ri, and the non-dimensional settling velocity of the sediments. Here we consider a model turbidity current that is homogeneous in the streamwise direction. Thus, the effect of entrainment of clear fluid at the top of the turbidity current results in a temporal growth of the current height. With the assumption of streamwise homogeneity we investigate a non-stationary problem where the temporal growth of the height of the turbidity current is monitored in order to evaluate the role of entrainment of clear fluid.