國立中山大學應用數學系
學術演講

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講　題：High-resolution simulations of gravity currents in geophysics

時　間：2020/11/03（Tuesday）14:10 ~ 15:00

地　點：理學院四樓理 SC 4011 教室

茶　會：15:00 於理 SC 4010 室 (系辦公室)

Abstract

Gravity currents are flows driven by the density differences in natural environments and engineering applications as a heavier fluid intrudes into a lighter one in a predominantly horizontal direction. Examples of gravity currents include sea breezes, thunderstorm outflows, pyroclastic flows, powdersnow avalanches, river plumes, reservoir transport sedimentation and so on. The density differences behind such flows result from hydrostatic pressure gradients with variations in temperature, dissolved materials or suspended compositions within fluids. In this talk, two ubiquitous phenomena of gravity currents happened in physical oceanography and in hydraulics are respectively illustrated and investigated by the high-resolution Navier-Stokes simulations. Both the direct numerical simulations and the large eddy simulations were employed. (I) In physical oceanography part, the problem, i.e. cylindrical gravity currents in a rotating system, is a classic one in physical oceanography and geological fluid dynamics influenced by the Coriolis forces. The notable examples are the unstable meanders of the Gulf Stream and of the Kuroshio. In those situations, the warm current interacts with the cold current forming an isolated circulation due to the Earth's rotation as the geostrophic equilibrium is established. Different rotating effects used to capture the flow morphology with contraction-relaxation motions are discussed. (II) In hydraulic part, the problem, i.e. interactions between gravity currents with immersed obstacles, is mainly concerned. Knowledge of propagation of gravity currents is important in predictions of sedimentation, which controls the transport of sediments depending on the bottom topography or man-made hydraulic facilities. In these two cases, different kinds of flow morphology are quantified by the flow-field data; including the velocity field, vorticity field, concentration distributions, energy budgets, and force responses.

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