Analysis of Godunov type schemes for rotational fluid flows

Do Minh Hieu, Université Paris 13

Emmanuel Audusse, CEA

Pascal Omnes, Université Paris 13

in this talk, we are interested in the numerical simulation of free surface geophysical flows at large scale where Coriolis effects become dominant. At this scale an efficient discretization of the so-called geostrophic equilibrium, which is characterized by the balance between the pressure gradient and the Coriolis force, is fundamental to achieve accurate numerical simulations [1, 2]. For short time, the linearized system associated to the fluid equations is the wave equation with Coriolis source term. As a first step, we study the 1d case. Thanks to a Hodge type decomposition, we exhibit the kernel of the continuous operator and the behavior of the solution near this kernel. Then, extending the work initiated by Dellacherie and coauthors [3, 4] in the context of low Mach number flows, we study three Godunov type finite volume schemes obtained by modifying the numerical viscosity. In particular we pay attention to the analysis of the discrete kernel and to the overall stability of the schemes. Some numerical results illustrate the purpose.

Références

[1] Bouchut, F., Le Sommer, J., Zeitlin, V., *Frontal geostrophic adjustment and nonlinear wave phenomena in one-dimensional rotating shallow water. II. High-resolution numerical simulations*, JFM, Vol. 514, 2004.

[2] Lukacova-Medvidova, M., Noelle, S., Kraft, M. *Well-balanced finite volume evolution Galerkin methods for the shallow water equations*, JCP, Vol. 221, 2007.

[3] Dellacherie, S., *Analysis of Godunov type schemes applied to the compressible Euler system at low Mach number*, JCP, Vol. 229, 2010.

[4] Dellacherie, S., Omnes, P., Rieper, F., *The influence of cell geometry on the Godunov scheme applied to the linear wave equation*, JCP, Vol. 229, 2010.

Do Minh Hieu, Université Paris 13, 99 av. J.B. Clément, 93430 Villetaneuse
hieudm45@yahoo.com.vn