1D HYPERBOLIC MODEL FOR COASTAL WAVES

Yen-Chung HUNG, LAMA - Chambéry **Maria KAZAKOVA**, LAMA - Chambéry
Gaël RICHARD, INRAE - Grenoble **Julien CHAUCHAT**, LEGI - Grenoble

In the context of climate change, the risks of flooding and coastal erosion are increased by numbers of extreme weather events. In France, for example, erosion affects a quarter of the metropolitan coasts. It is therefore essential to develop reliable, accurate and operational models to describe these phenomena. In developing a process-based model, an important issue is the connection between the coastal hydrodynamics and the processes of sediment transport. Before dealing with the morphodynamic part, it is essential, in the first place, to construct a model with accurate description of the water wave propagation in the coastal zone, where wave dispersion and wave breaking are crucial to coastal erosion. We will present the development of 1D hyperbolic hydrodynamic model which is capable of capturing wave breaking phenomenon.

Following the steps of [1] and [2], we mimics the large-eddy simulation (LES) where the horizontal velocity is decomposed into two terms, a filtered term including the large-scale turbulence, and a residual term. The depth-averaging procedure is then applied to the filtered incompressible Navier-Stokes equation to reduce dimension and hence reduce the computational time of numerical simulations. Next, Shearing and turbulence effect in breaking waves are taken into account by a new variable called enstrophy. The enstrophy can characterize the large-scale turbulence and is used to indicate when the wave breaks. Enstrophy production is handled with a turbulent viscosity hypothesis and enstrophy dissipation is governed by an empirical law. Moreover, non-linear terms, which arise from the non-hydrostatic pressure, with mixed space-time third derivative which necessitates an elliptic step in the numerical resolution and which can be found in the Serre-Green-Naghdi equations is now replaced by a depth-averaged quantity. Such technique proposed in [2] is applied here to obtain a hyperbolic structure, which has advantage of being numerically less costly and providing improved dispersive properties.

Références

[1] M. Kazakova and G. L. Richard. A new model of shoaling and breaking waves : one-dimensional solitary wave on a mild sloping beach. *Journal of Fluid Mechanics*, 862 :552–591, 2019.

[2] G. L. Richard. An extension of the boussinesq-type models to weakly compressible flows. *European Journal of Mechanics - B/Fluids*, 89 :217–240, 2021.

Contact : `Yen-Chung.Hung@etu.univ-smb.fr`