Geophysical Research Abstracts
Vol. 21, EGU2019-7672, 2019
EGU General Assembly 2019

3D simulations of impulsive free surface flows using the Lattice Boltzmann Method

Stefano Miliani (1), Pietro Prestininzi (1), Michele La Rocca (1), and Andrea Montessori (2)
(1) Roma Tre University, Department of Engineering, Italy, (2) IAC-CNR, Rome, Italy

The Lattice Boltzmann Method (LBM) is a mesoscopic method founded on the kinetic theory of Boltzmann and has been proven to describe successfully flows of hydraulic interest such as turbulent, multicomponent and multiphase flows. The main advantage of the LBM, compared to more traditional methods of the Computational Fluid Dynamics, are: the simplicity of the set of explicit algebraic equations forming the computational algorithm, the ease of description of complex boundaries and the proneness of the LBM to provide unprecedented parallel scalability on a large number of architectures. Thus, the computational resources available nowadays make the employment of 3D models feasible to study large-scale problems as well.

In this work, a fully 3D LBM model is developed and applied to the simulation of free surface impulsive flows. The evolution of the free surface is here tracked by means of a 3D interface tracking model and coupled to the traditional LBM algorithm. Dam-break events are simulated and LBM numerical results are compared to both analytical and experimental reference results. The latter are relative to symmetrical dam-break, asymmetrical dam-break, dam-break over a triangular obstacle, dam-break with an isolated building and the laboratory model of the Toce river test case. The accuracy of the model is assessed by comparing depth and velocity values, when available, at some gauge locations. The study shows that the LBM provides a remarkably accurate description of the phenomena. The results are very promising for future applications of this kind of models for the study of realistic hydraulic problems.