Large scale 3D Lattice Boltzmann method for coastal flows: Schematic case of the Eastern English Channel

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ABSTRACT

The LBM method is a relatively recent method. Contrary to the classic methods of finite elements, finite differences and finite volumes which are based on the macroscopic description of the variables, LBM is based on statistical physics to propose a mesoscopic description [1]. The LBM algorithm is of a massively parallelizable nature, especially with GPU technology. This parallelization property makes LBM more efficient, more attractive and the most preferred of classical methods.

Several researchers around the world have applied LBM to their field of application (subterranean flows, hydrodynamics, aerodynamics, multi-physics flows, acoustics, and many others). Similarly, LBM has been applied to coastal flows governed by 2D shallow water type equations [2].

The aim of this work is to extend LBM to 3D coastal flows in order to be able to simulate the characteristics of the flow according to the third dimension. The knowledge of the flow according to the vertical is imposed by the phenomena of the turbulence inseparable from the coastal flows. The 3D version that we propose will also allow simulations of other closely related phenomena.

To accomplish this work, the 3D calculations will be separated into a 2D horizontal calculation (barotropic mode called also external mode), then a 1D vertical one (baroclinic mode, also called internal mode). This mode separation is widely used in the modeling of hydrostatic marine flows. It is justified by the fact that for this type of flow, the horizontal movements are dominating in front of the vertical movements. The proposed scheme will be applied to a 3D flow in a closed basin subjected to a surface wind. In the second phase, we will try to apply these developments to the schematic case of the Eastern Channel

REFERENCES

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[2] Jian Guo Zhou (2004). Lattice Boltzmann Methods for Shallow Water Flows. Springer. ISBN 978-3-540-40746-1.