A numerical study of the three-dimensional interaction between breaking-induced vortices and nearbed large-scale vortical structures

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We study, on the basis of dedicated numerical simulations, the vortex-vortex interactions observed during laboratory experiments, where a single regular water wave traveling over a discontinuous rigid bed promotes the generation of both nearbed and surface vortices (Brocchini et al., 2022). Simulations have been run by means of a 3D large-eddy simulation (LES) multiphase flow model, with surface tension effect being taken into account for the small-scale micro-structures and the Cartesian cut-cell method being used for the rough bed. The wave paddle movement is employed in the LES numerical wave tank to replicate the experimental setup. The results confirm much of the dynamics observed during the laboratory experiments (e.g. vortex evolution, mechanisms driving the interactions, role of wave nonlinearity), but also allow for inspection of flow features that could not be characterized during the laboratory experiments, like the 3D structure of the vortices and the air entrainment. These will be the main focus of our presentation at the workshop.

References

Brocchini, M., Marini, F., Postacchini, M., Zitti, G., Falchi, M. & Xie, Z. (2022). Interaction between breaking-induced vortices and nearbed structures. Part 1: experimental and theoretical investigation. *J. Fluid Mech.* **940,** A44, doi:10.1017/jfm.2022.260.