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Smoothed Particle Hydrodynamics method to study water wave breaking and runup

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The problem of determining solitary waves runups is of great interest in studying coastal effects of tsunamis. A relationship between the runup and wave height, for non-breaking waves, exists in the literature (Synolakis, 1987). Nevertheless, it is difficult to predict the runup for breaking waves. Our study aims to numerically determine the runup law for breaking waves. Therefore, we developed a numerical model based on the Smoothed Particle Hydrodynamics method (SPH) in order to study the transformation of a wave propagating over a constant depth and encountering a sloping beach. SPH is a meshfree method, where all fluid quantities are carried out by points, and is very suitable for problems involving large deformations and moving interfaces. Originally developed for astrophysical problems, this numerical method proved its efficiency to simulate free surface flows.
The formalism requires to consider fluid being slightly compressible and that pressure is to be evaluated from density variations through a state equation. Our SPH code has been validated with general hydrodynamic flow problems (laminar flows, dam breaking, solitary wave runup on vertical wall, ...) using experimental or theoretical results coming from literature. Depending on problem parameters (the slope of the beach, wave amplitude, water depth,...), wave breaking can be observed and runup can be determined with the use of our numerical program.