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AIR INJECTION IN VERTICAL WATER COLUMN. SIMULATION WITH VOLUME OF FLUID (VOF) AND EULERIAN TWO-FLUID METHODS

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Abstract. An experimental two-phase flow test was proposed to study the accuracy of different multiphase methods.The test consists of a vertical thin column initially filled with water where air is suddenly injected through a set of small holes from the bottom. Depending on the air flow rate, the air swells and removes a large amount of water and bubbly, drop and segregated multiphase flow regime are evidenced. Experimental data is collected, and numerical simulations are performed employing the Eulerian Two-Fluid method as well as three different approaches based on the Volume of Fluid (VOF) method. Many turbulence models are also addressed, and the accuracy of 2D and 3D simulations is investigated. For the Eulerian approach, the standard model assuming disperse flow (bubbly or drop) and the dynamic rheology blending method are evaluated. Regarding the VOF method, the standard formulation with static and dynamic mesh refinement (AMR), and the Piecewise Linear Interface Construction (PLIC) method are investigated. The unsteady incompressible models are solved in OpenFOAM-7. The numerical and experimental results were compared in depth in terms of the interface location in time and the final water displacement. Results allow concluding that the Eulerian method leads to acceptable results in terms of water displacement only if the blending model is added. On the other hand, all VOF methods gave very good results in terms of interface capturing and water displacement. In this sense, standard VOF was the best in terms of computing time, but significant refinement was needed to improve the accuracy of results, thus largely increasing the computational effort. Although the accuracy was improved by using AMR tools, the computing time increased more than 2 times with respect to homogeneous static grids with the same level of refinement. On the contrary, PLIC method displayed very good accuracy even for coarse grids. This method was the best in terms of accuracy and computing time ratio.