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Turbulence modulation by microbubbles in channel flow CRISTIAN MARCHIOLI, University of Udine, DAFNE MOLIN, University of Brescia, ALFREDO SOLDATI, University of Udine — In this paper we examine the mutual interactions between small non-deformable bubbles and turbulence in upward/downward vertical channel flow (at shear Reynolds number Re=150). An Eulerian-Lagrangian approach based on pseudo-spectral direct numerical simulation is used: bubbles are momentum-coupled with the fluid and are treated as pointwise spheres subject to gravity, drag, added mass, pressure gradient, Basset and lift forces. Due to local momentum exchange with the fluid and to the differences in bubble distribution, we observe significant increase (resp. decrease) of wall shear and liquid flowrate in upflow (resp. downflow). We propose a novel force scaling, which can help to judge differences in the turbulence features due to bubble presence. Two-phase flow energy spectra show that bubbles determine an enhancement (resp. attenuation) of energy at small (resp. large) flow scales, a feature already observed in homogeneous isotropic turbulence. Bubble-induced flow field modifications, in turn, alter significantly the dynamics of the bubbles and lead to different trends in preferential concentration and wall deposition. In this picture, the lift force plays a crucial role. We analyze all the observed trends emphasizing the impact that the lift force model has on the simulations.

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