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Numerical simulation of upward/downward turbulent bubbly flow with microbubble-fluid interactions. ALFREDO SOLDATI, CRISTIAN MARCHIOLI, Dipartimento di Energetica e Macchine, University of Udine — Direct numerical simulation of low-Reynolds-number turbulence ($Re_\tau = 150$) is coupled to Lagrangian tracking to study the behavior of 220 μm bubbles in a vertical upward/downward turbulent channel flow. Bubble velocity and concentration statistics provide evidence of bubble preferential segregation in high-speed regions for upflow and low-speed regions for downflow. Fluid velocity statistics show that the main effect of bubbles is to increase/decrease the liquid flow rate (and, in turn, the turbulent fluid velocity fluctuations and the Reynoldss stresses) in case of upflow/downflow. Significant flow rate variations were observed, even at void fraction of O(0.0001). In the upflow case, the non-uniformity of bubble distribution along the wall-normal direction limits the flow rate increase; due to the strong bubble accumulation near the walls, the hydrodynamic push induced by bubbles on the fluid occurs mainly in the near-wall region, where it is immediately counterbalanced by an increase in the wall shear. This two competing effects tend to reduce the efficiency of the turbulence modulation mechanisms. In the downflow case, analysis of the fluid velocity profiles indicates that, on average, bubbles do not significantly modify the statistical features of the flow structure.

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