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Laminar bubbly flow in a vertical channel[1] JIACAI LU, SOUVIK BISWAS, GRETAR TRYGGVASON, Worcester Polytechnic Institute — Direct numerical simulations are used to examine the buoyant rise of many nearly spherical bubbles in laminar flows in vertical channels. The lift force on spherical bubbles leads to a very simple flow structure in terms of the void fraction distribution and the average liquid velocity. The numerical results show that at steady state the number density of bubbles in the center of the channel is always such that the fluid mixture there is in hydrostatic equilibrium and the velocity is uniform. For upflow, excess bubbles are pushed to the walls, forming a bubble rich layer, one bubble diameter thick. For downflow, bubbles are drawn into the channel core, leading to a wall layer with no bubbles, of a thickness determined by the pressure gradient and the average void fraction. For the downflow, the void fraction profile and the velocity profile can be predicted analytically, but for upflow the velocity increase across the wall-layer must be obtained from the simulations. The behaviour of the bubbles in the middle of the channel, including the slip velocity and their velocity fluctuations, is well predicted by results for homogeneous flows in fully periodic domains.

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