Assessment of a subgrid-scale model for convection-dominated mass transfer for initial transient rise of a bubble

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Abstract

The mass transfer between a rising bubble and the surrounding liquid is mainly determined by an extremely thin layer of dissolved gas forming at the liquid side of the gas-liquid interface. Resolving this concentration boundary layer in numerical simulations is computationally expensive. Subgrid-scale models mitigate the resolution requirements enormously and allow approximating the mass transfer in industrially relevant flow conditions with high accuracy. However, the development and validation of such models is difficult as only integral mass transfer data for steady-state conditions are available. Therefore, it is difficult to assess the validity of the sub-grid models in transient conditions. In this contribution, we compare the local and global mass transfer of an improved subgrid-scale model for rising bubbles (Re = 72-569 and Sc = 10ˆ2-10ˆ4) to a single-phase simulation approach, which maps the two-phase flow field to a highly-resolved mesh comprising only the liquid phase.

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