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Transient flowmaps for vertical pipe flow

Abstract

Measurements were conducted in a vertical pipe with an inner diameter of 51.2 mm and a length of about 3 m for air/water bubble and slug flow. The use of a wire-mesh sensor allows a high resolution of the gas fraction data in space (about 2 mm) as well as in time (2500 frames/s). From these data time averaged values for the two-dimensional gas fraction profiles decomposed according to a large number of bubble size classes were calculated. This allows to extract data for the radial gas fraction profiles for a given range of bubble sizes as well as data for local bubble size distributions. The measurements were done for up to 10 different inlet lengths and for about 100 combinations of gas and liquid volume flow rates. This allows to generate flow pattern maps in dependence on the distance between the gas injection device and the wire-mesh sensor, i.e. flow pattern maps for varying L/D. For the distinction between the different characteristics of the flow objective criteria developed from the measured radial gas fraction profiles and the measured bubble size distributions were used. The figures 2 and 3 show examples for such flow maps. The small figures illustrate the time averaged (10 s) distribution of the gas fraction over the pipe cross section. At figure 1 the injection of the gas from 19 capillaries is clearly to see. The data will be used for the development of models for the forces acting on a bubble in a shear field of the liquid flow and models for bubble coalescence and break-up.

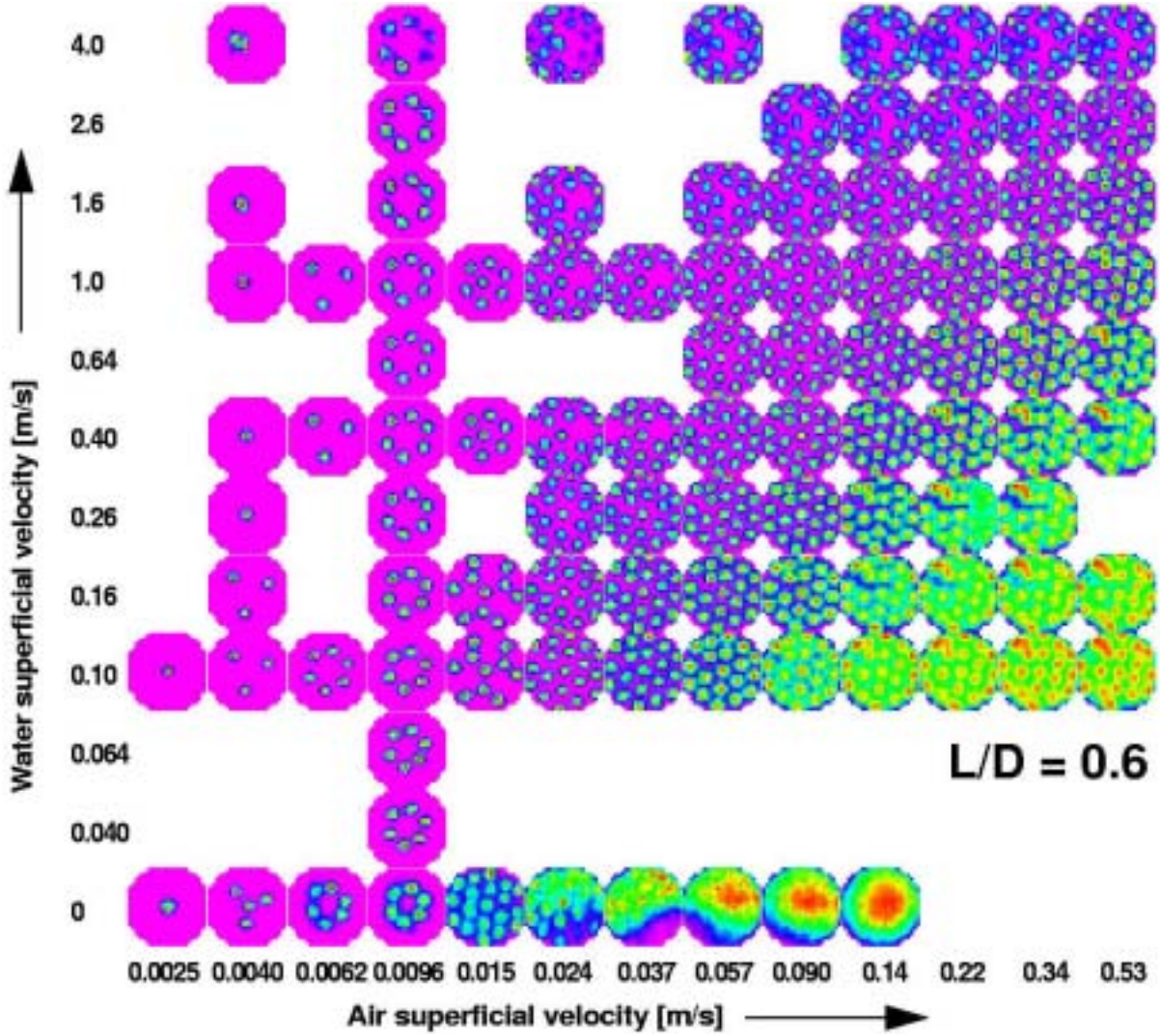

Fig. 1 Relative gas fraction distribution close to the gas injection

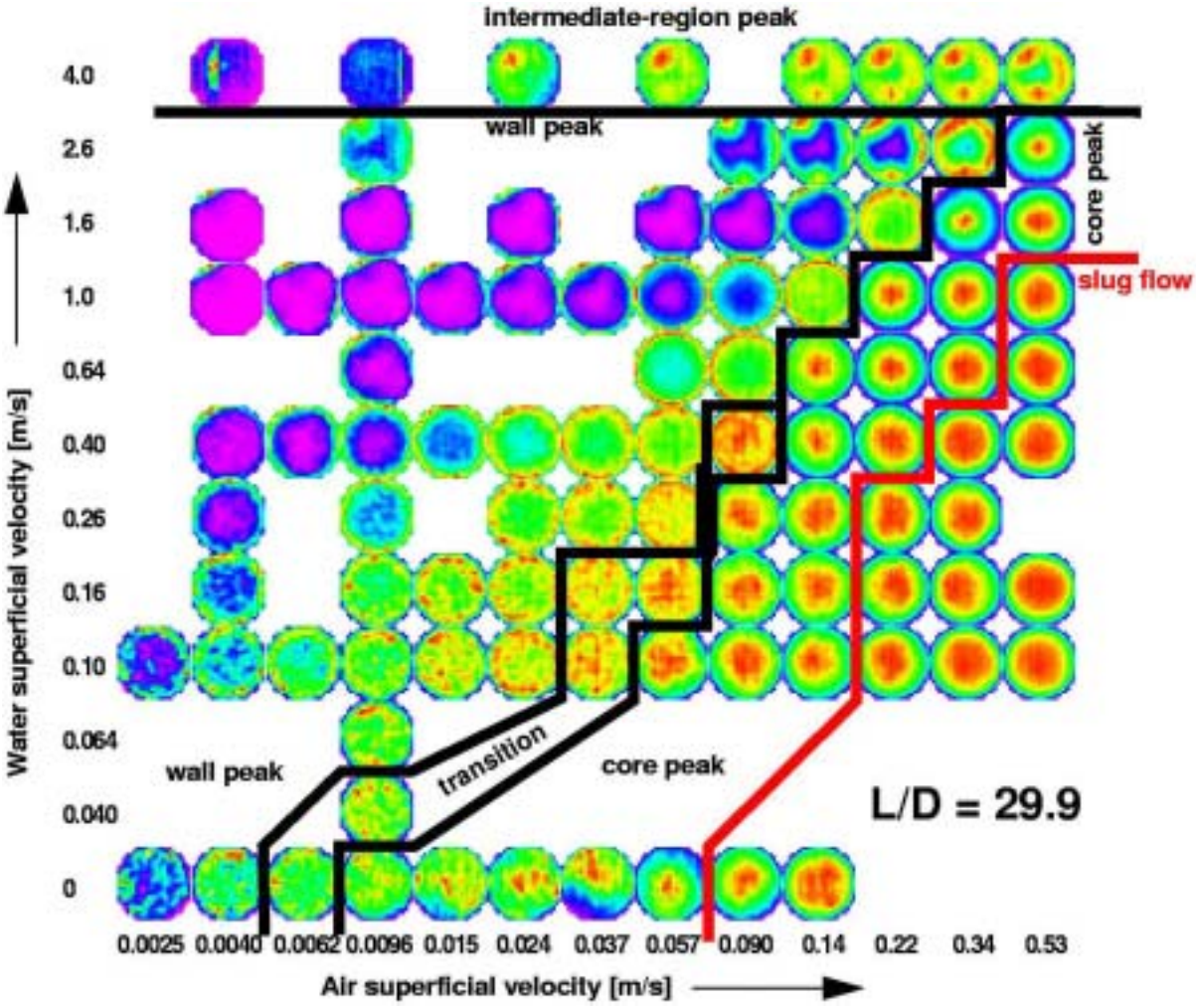

Fig. 2 Flow pattern map at about 1.5 m above the gas injection

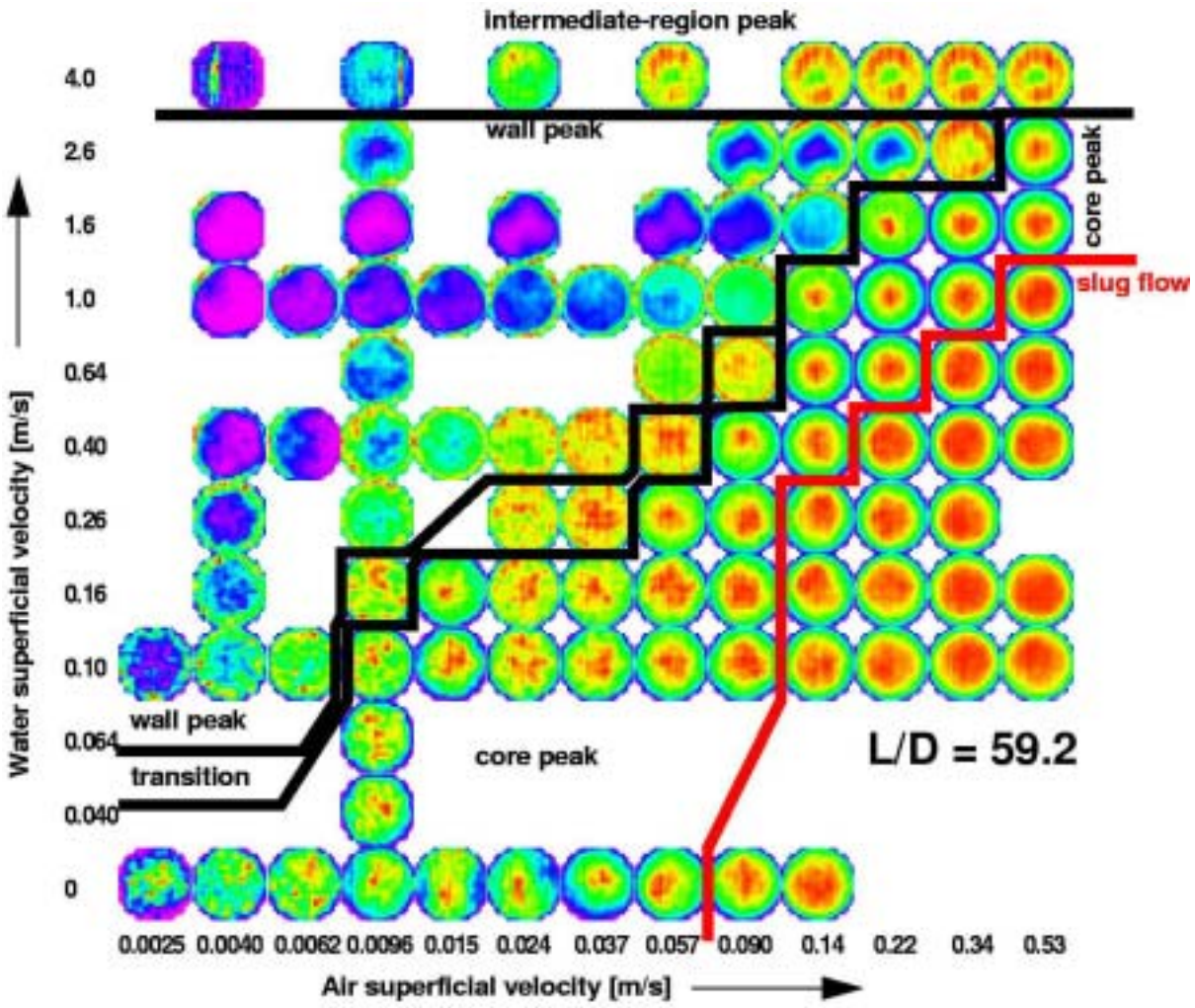

Fig. 3 Flow pattern map at about 3 m above the gas injection