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Immersed boundary Eulerian-Lagrangian 3D simulation of pyroclastic density currents: numerical scheme and experimental validation

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Pyroclastic density currents are ground hugging, hot, gas-particle flows representing the most hazardous events of explosive volcanism. Their impact on structures is a function of dynamic pressure, which expresses the lateral load that such currents exert over buildings. In this paper we show how analog experiments can be matched with numerical simulations for capturing the essential physics of the multiphase flow. We used an immersed boundary scheme for the mesh generation, which helped in reconstructing the steep velocity and particle concentration gradients near the ground surface. Results show that the calculated values of dynamic pressure agree reasonably with the experimental measurements. These outcomes encourage future application of our method for the assessment of the impact of pyroclastic density currents at the natural scale.