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Machine-learning based multi-scale model for shock-particle interactions OISHIK SEN, University of Iowa, SOREN TAVERNIERS, San Diego State University, PRATIK DAS, University of Iowa, GUSTAAF JACOBS, San Diego State University, H.S. UDAYKUMAR, University of Iowa — Macro-scale computational models for shock-particle interactions require closure laws for the drag and subgrid-scale pseudo-turbulent stresses on particles. Traditionally, closures for drag are provided via semi-empirical models developed from expensive physical experiments, which are often limited in parameter spaces. In recent years, drag and the pseudo-turbulent stresses on particle clusters have been learned using machine-learning techniques from *in silico* experiments of high-fidelity particle-resolved computations of shock-particle interactions. In this work, we compare macro-scale simulations which employ machine-learned, simulation-derived drag and pseudo-turbulent stresses with those that use phenomenological drag laws for closure. The macro-scale simulations study the evolution of a cloud of aluminum particles with volume fraction of 4 % under a shock of Mach number, $Ma = 3$. The results are compared against particle-resolved meso-scale simulations of shock-particle interactions. It is shown that the macro-scale computations which employ machine-learned drag and SGS laws capture the dominant flow features such as shocks, expansion fans, and the vortical structures accurately. Furthermore, the locus of the center of mass of the particle cloud obtained from the macro-scale simulations are also shown to be in good agreement with the meso-scale particle-resolved computations.

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