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A volume-filtered formulation to capture particle-shock interactions in multiphase compressible flows GREGORY SHALLCROSS, JESSE CAPECELATRO, Univ of Michigan - Ann Arbor — Compressible particle-laden flows are common in engineering systems. Applications include but are not limited to water injection in high-speed jet flows for noise suppression, rocket-plume surface interactions during planetary landing, and explosions during coal mining operations. Numerically, it is challenging to capture these interactions due to the wide range of length and time scales. Additionally, there are many forms of the multiphase compressible flow equations with volume fraction effects, some of which are conflicting in nature. The purpose of this presentation is to develop the capability to accurately capture particle-shock interactions in systems with a large number of particles from dense to dilute regimes. A thorough derivation of the volume filtered equations is presented. The volume filtered equations are then implemented in a high-order, energy-stable Eulerian-Lagrangian framework. We show this framework is capable of decoupling the fluid mesh from the particle size, enabling arbitrary particle size distributions in the presence of shocks. The proposed method is then assessed against particle-laden shock tube data. Quantities of interest include fluid-phase pressure profiles and particle spreading rates. The effect of collisions in 2D and 3D are also evaluated.

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