Compressible multiphase flows in an ALE framework

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Multiphase flows are of great interest in many applications. These are flows where particles (or droplets) are embedded as one or multiple phases in a continuous medium that might be chemically evolving. The number concentration of particles is prohibitively high in many situations to track them in a Lagrange manner. In these situations, an Eulerian treatment of the particles is necessary in which particle effects are parameterized. This approach uses coupled sets of Euler equations for both the medium and particle phases. The Eulerian approach is very challenging from a subgrid-scale modeling perspective in that the issues associated with unresolved fluid mixing are compounded by the unresolved interactions of the particles between themselves and the fluid.

This presentation describes a new approach that uses an Arbitrary Lagrangian Eulerian (ALE) technique to simulate these flows in domains that are also allowed to evolve. This method is being developed in conjunction with "DNS" direct numerical simulations at the particle scale O(1mm). This allows the interactions of O(10-100) particles to be analyzed and their interactions to be parameterized in the macro scale of the ALE method.