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A multiscale, multiphysics simulation method for rarefied gas flows DAVID KESSLER, ELAINE ORAN, CAROLYN KAPLAN, Naval Research Laboratory — We present a coupled multiscale, multiphysics solution algorithm, CM^3, for rarefied gas flows. The method uses a general solution of the compressible fluid-dynamics equations that incorporates stresses and heat fluxes calculated directly using the Direct Simulation Monte Carlo (DSMC) method. The CM^3 is designed to solve transition-regime flows at a much lower computational cost than possible by directly solving the Boltzmann equation. The CM^3 is tested on a low-speed, Rayleigh flow and a thermal Fourier flow for several Knudsen numbers. Velocity, temperature, shear stress, and heat flux profiles compare well with DSMC solutions. We discuss the algorithmic details that are necessary to implement a true multiscale method, building upon the conceptual framework of E & Engquist's (2003) heterogeneous multiscale methods.

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