Multiphase Realizations of Turbulence Models

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Multiphase and turbulent flows are important in a range of engineering applications. In both cases, model equations can be determined from averaging the equations of hydrodynamics, with closure terms entering to truncate the approximation heirarchy. Forms for these closure terms may be derived by a variety of means, such as experiment or high resolution numerical simulation. Certain general desiderata also exist, such as the stability and dissipativity of the model equations.

The present paper investigates the relationship between turbulent and multiphase models. In particular, writing a simple k-epsilon turbulence model as a hyperbolic relaxation system naturally limits the strength of turbulent diffusion terms and demonstrates that the system is globally dissipative. The stability of this treatment is investigated using an extension of Whitham's method to the case of multiple finite damping constants, and extensions to an adaptive treatment of multiphase turbulent flow discussed.