MMM SEMINAR SERIES

Eulerian-Lagrangian simulations of low-Mach number droplet-laden turbulent flows; from droplet combustion to turbulent cloud simulation

Bamdad Lessani

South Dakota School of Mines & Technology

The Eulerian-Lagrangian approach has been a well-established method for the simulation of low-Mach number droplet combustion for over 20 years, but it has been only recently adopted for the cloud physics simulations. The very large number of cloud droplets, compared to the number of droplets in benchmark test cases of fluid mechanics, and the scale dispartiy between the size of the Eulerian computational grid and the Lagrangian micro-droplets, are among the challenges that need to be addressed for successful application of this method to cloud simulations.

The extension of a numerical approach, initially developed for low-speed combustion, to cloud modelling will be discussed. The mathematical equations and the numerical algorithm will be presented. In low-Mach number formulation, the density is variable in the continuity, momentum and energy equations, and the buoyancy force is directly calculated via the density variations in the momentum equation with no Boussinesq approximation. By neglecting the effect of acoustic waves, the low-Mach solver has a computational speed comparable to incompressible solver. The pressure in the momentum equation is decoupled from the density, and it is calculated via an elliptic Poisson equation. The numerical details for the calculation of pressure field (odd-even decoupling, parallelization, ...),
spatial discretization of the convective and diffusive terms, and the time marching algorithm will be presented in details.
Finally, initial thoughts on the modelling of subgrid-scale fluctuations of the Eulerian field seen by Lagrangian droplets will be discussed.

Thursday, 9 May 2019, 3:30pm

Refreshments 3:15 PM

NCAR-Foothills Laboratory, 3450 Mitchell Lane, FL2-1022, Large Auditorium

This seminar will be webcast live at:
http://ucarconnect.ucar.edu/live

Recorded seminar link can be viewed here:
https://www.mmm.ucar.edu/events/seminars