Center for Fluid Mechanics Seminar

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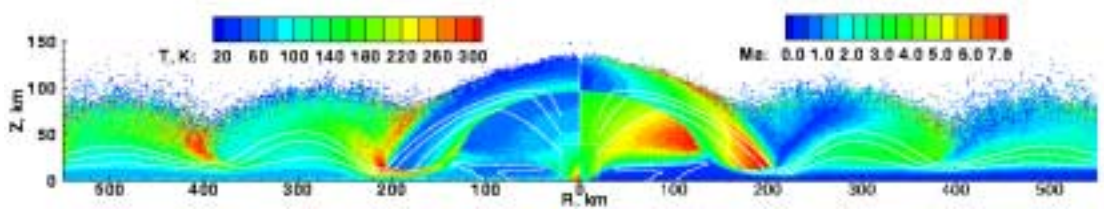
DSMC Modeling of Gasdynamics, Radiation and Fine Particulates in Ionian Volcanic Jets

Abstract

We have been involved with modeling near-continuum flows in which a detailed understanding of the complex physics is essential. When multiple species, radiation and particulate condensation are involved, it becomes difficult to even write down the Boltzmann equation to be solved. One then must resort to direct simulation of the intermolecular interactions.

Our most advanced models of the detailed physics of volcanic plumes on Jupiter's moon Io are presented. Two types of low density axisymmetric sulfur dioxide (SO2) plume flows are modeled using the direct simulation Monte Carlo method (DSMC). Thermal radiation from all three vibrational bands and overall rotational bands of SO2 molecules are examined. The radiation features are studied both by calculating infrared emission spectra along different lines-of-sight through the plume and the DSMC modeled emission images of the whole flow field. It is found that most of the radiation originates in the vicinity of the vent. A high resolution vent vicinity flow was obtained by multi-domain sequential calculation to better study the radiation signature. Two-phase (gas/dust) flows are briefly discussed. The simulation results are compared to the existing observation data. Other than the calculated general shape of the plumes, the calculated average SO2 column density over a Pele-type plume is in agreement with observations. The simulation results also show interesting gas-dynamic features such as the multi-bounce shock structure around Prometheus-type plumes and the frost depletion by plume scouring on the day-side of Io.



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Barus & Holley, Room 159, 4:00pm