THREE DIMENSIONAL MULTI-FLUID SIMULATION OF COMET HALLEY. M. Benna[1] and P. R. Mahaffy[1], [1]NASA-Goddard Space Flight Center, Code 915, Greenbelt Road, Greenbelt, MD 20771. E-mail: mehdi.benna@gsfc.nasa.gov.

Introduction: The Cometary Atmosphere Simulator (CASIM) is designed to simulate in 2-D and 3-D the complex interaction between the cometary atmosphere and the hypersonic solar wind using a multi-fluid approach. Our simulator is based on the solution of multi-fluid equations using an efficient adaptive Cartesian mesh. It is designed to use the capabilities of highly parallel super-cluster computers [1].

Simulation of Halley comet: The CASIM code is based on a real-time computational combination of two elements:

- A hydrodynamic element that solves in two dimensions the MHD equations for ion, electron and neutral groups using an adaptive TVD-Lax-Friedrich algorithm.
- A physicochemical element that evaluates the contribution of the chemical reactions and the physical interaction (frictions) of various species in the coma.

Unlike in single fluid schemes, the multi-fluid representation of the ions, electrons, and neutral population gives an improved view of the coupling between those species and the resulting coma boundaries at different spatial scales. The CASIM code has the capability to simultaneously achieve a high resolution in the inner coma and to extend to large distances.

In this paper we present some results of the 3D multi-fluid simulations of the atmosphere of a Halley-type comet with an outgassing dominated by water molecules. In theses simulations we consider a set of parameters globally consistent with Halley's parameters as they were observed during the 1986 flybys. These simulations show in great details the effect of the interaction between the warm solar wind plasma and the colder cometary gas. One of the interesting results of this example is that it reproduces the expected electron temperature profile and showed the expected electron cooling effect by water molecules in the inner coma. We can also see the effect of the elastic collision between ions, electrons, and neutral in shaping the cometary coma.

References:

[1] Benna M. et al. (2004) ApJ, 617, 1, 656-666.

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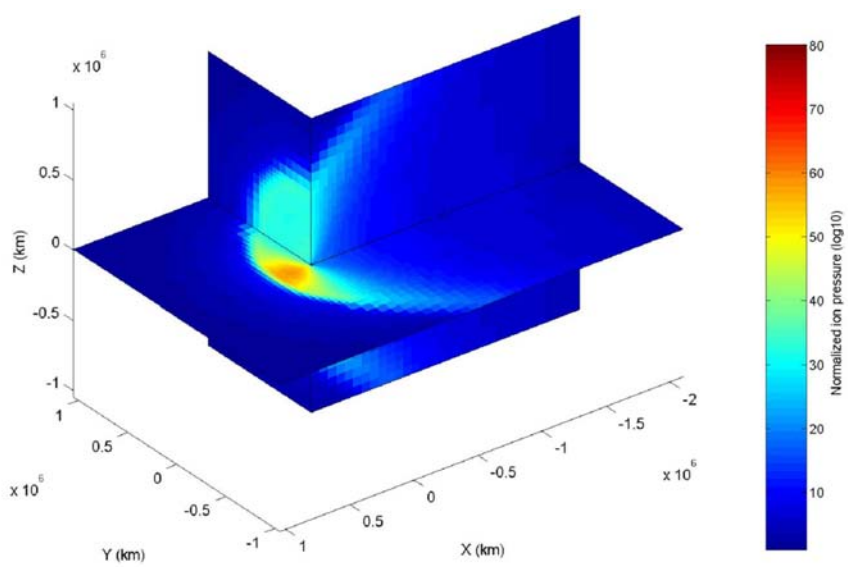

Figure 1: Example of a 3-D CASIM result for a Halley-type comet: Large-scale normalized ion gas pressure.