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Hybrid modeling of time-dependent solar wind–comet interactions

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Global hybrid plasma modelling of cometary environments is an essential tool in understanding the global implications of point measurements performed by the Rosetta probe in the vicinity of 67P/Churyumov-Gerasimenko. A 3-D, global hybrid plasma model, including the effects of plasma-driven ionization of cometary neutrals, has been employed to model an approximation of 67P's environment around perihelion conditions. Model inputs include solar wind upstream parameters, a simple cometary neutral model and a H_2O^+-bound photochemistry.

In this work we present results on the responses of a cometary plasma environment when impinged upon by a time-dependent solar wind. Stepwise upward and downward density changes as well as linear ramps are investigated, along with tangential discontinuities in the interplanetary magnetic field. As the production rates of cometary ions are coupled to solar wind parameters through e.g. charge exchange and electron impact ionization, solar wind variations create non-trivial transient phenomena in the cometary environment. Implications for CME impacts and tail disconnection events are explored, giving insight on how these events may appear in the observational datasets (magnetometer, ion spectrometer) from past missions and from Rosetta.