Atmospheric Impacts of a Close Cometary Encounter

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Although a close encounter with a comet is extremely unlikely, a significant perturbation to the flux of Earth-bound dust from a comet's close passage could have huge implications for both the chemistry of the atmosphere and climate. For example, following the close passage of Comet Halley to Earth in A.D. 536, dark skies, reduced day lengths and a protracted global cooling were reported [1], for which an extraterrestrial disturbance is likely to be at least partly responsible. Indeed, the recent encounter of Comet Siding Spring with Mars provided evidence that the risks posed by such an event are significant [2].

We have run sensitivity simulations using the Whole Atmosphere Community Climate Model (WACCM) with an elevated Meteoric Input Function (MIF) to investigate such an encounter – specifically, Comet Halley in A.D. 536.

The simple analytical model developed by Moorhead et al. [3] has been incorporated into an atmospheric chemical ablation model to provide the MIF of several meteoric metals (Na, Fe, Si and Mg) in the mesosphere and lower thermosphere (70-120 km) for input into WACCM. Key effects of this additional input on the chemistry of the upper atmosphere and the metal layers have been explored in the simulations; the possibility of a temporary, planet-wide radio blackout and effects on mesospheric and stratospheric ozone chemistry have been assessed. In addition to any effects on atmospheric chemistry, WACCM will also be used to provide insight into the impacts of a high dust flux on the Earth's climate.

References

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[2] Schneider, N. M., et al. (2015), MAVEN IUVS observations of the aftermath of the Comet Siding Spring meteor shower on Mars, Geophys Res Lett, 42(12), 4755-4761.
[3] Moorhead, A. V., P. A. Wiegert, and W. J. Cooke (2014), The meteoroid fluence at Mars due to Comet C/2013 A1 (Siding Spring), Icarus, 231, 13-21.