Atmospheric Electricity of Rocky and Icy Planetary Environments

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Although some planetary missions have provided valuable data for atmospheric electricity studies, the characterization of the electric environment of several planets remains noticeably incomplete. The existence of electrical discharges on Venus, for example, challenges our models of the Venusian atmosphere because whistler-mode waves attributed to lightning signatures have not been confirmed in the optical range. The presence of lightning on Titan remains uncertain even after Cassini flybys and in situ measurements made by the Huygens Probe. After several missions to the red planet, the Geophysical and Environmental Package of ExoMars is the first module to include dedicated payload for atmospheric electricity in situ measurements of the Martian environment. Therefore, studies rely mostly in laboratory experiments and information of Terrestrial atmospheric electricity.

We present a comparative planetology study of atmospheric electricity of rocky and icy planetary environments, including Venus, Mars, and Titan. After summarizing a few scenarios and specific parameterization of each environment, we discuss the major discharging processes, energy budgets, flash rates, and atmospheric and surface dielectric properties. Finally, we address some consequences for electromagnetic wave propagation in the ionospheric cavity and for the global electric circuit of those planets.