

Electrical processes in planetary atmospheres

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Abstract—Observations of lightning at distant planets shows that some atmospheres have the right meteorological conditions to generate charge in their clouds. Lightning-induced chemical effects could be relevant for the origin of life, and lightning is also helpful in providing a marker of strong atmospheric motion. In addition to charge separation processes leading to electrical discharges, ionisation by cosmic rays provides a charge source in all planetary atmospheres, which may be augmented by other processes, for example, natural radioactivity. Free ions and electrons in atmospheres can influence clouds and hazes; this is particularly important in atmospheres distant from the Sun such as Neptune and Pluto, where there is little other energy input. Lightning or other charge separation mechanisms can combine with atmospheric ionisation to allow atmospheric current flow, and in some cases to form a global electric circuit. The consequence of a global electric circuit is the transfer of charge throughout an atmosphere, connecting lightning-generating regions with charge-sensitive processes a long way away. In this talk I will describe the range of planetary environments in which electrostatics is likely to be significant. There is clearly a more detailed understanding available of planets within our solar system, but I will also mention some of the exciting possibilities suggested for exoplanetary atmospheres.