

Influence of the local ionization sources on ionospheric densities in Titan's upper atmosphere

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Abstract

Titan holds the most complex ionosphere in the Solar System, as revealed through flybys of the moon by Cassini since Fall 2004. The current understanding is that on the sunlit side, the ionosphere is produced mainly by EUV solar radiation, while on the darkside the sources of ions include ionization by precipitating electrons as well as transport from the sunlit side. How differently do these processes influence the ionospheric densities? Is transport also influencing densities on the sunlit side?

To address these questions, we have analyzed ion densities from the Ion and Neutral Mass Spectrometer (INMS) data from 16 close flybys of Titan's upper atmosphere. Looking at the local ionization frequencies associated with the two primary ions, N_2^+ and CH_4^+ , calculated from an empirical model, we discuss their influence on ion number densities for both short-lived and long-lived ions at altitudes below 1200 km and interpret our findings in terms of ion source. For a given N_2 local ionization frequency, we found that certain ions, such as CH_5^+ , have higher densities on the dayside than on the darkside. We explain that this is due to the structure of the N_2 photo-absorption cross-sections beyond the N_2 ionization threshold, which allows CH_4 ionization at lower altitudes. We present detailed modeling results to support our interpretation.