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Model Comparisons with Cassini Era Saturn Electrostatic Discharges (SEDs)

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Abstract

Detections of radio bursts from atmospheric lightning by the Cassini RPWS (Radio and Plasma Wave Science) instrument provide information about Saturn's ionosphere. As the radio waves must pass through the ionosphere on their way to the spacecraft, the determination of the low-frequency cutoff in the radio spectrum yields an estimate of the peak electron density, N_{MAX}, at that point and time. This diagnostic is currently the only method by which the complete diurnal variation of Saturn electron densities can be measured remotely.

Voyager era SED measurements found N_{MAX} to vary by two orders of magnitude throughout the Saturn day – from ~10^3 cm^{-3} at midnight to ~10^5 cm^{-3} at noon – and such a variation could not be reproduced by models. Diurnal variations in N_{MAX} derived from Cassini measurements are typically smaller, with nighttime electron densities approaching 10^4 cm^{-3}. Using the Saturn-Thermosphere-Ionosphere Model (STIM), a state of the art global circulation model of Saturn's upper atmosphere, we present the first direct model comparison with modern era SED measurements, and attempt to resolve the discrepancy between previous model calculations and SED-derived diurnal variations of N_{MAX}.