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Temporal evolution of Saturn lightning activity during Saturn's change of season in spring equinox 2009

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Abstract

Saturn Electrostatic Discharges or SEDs are measured by the Cassini/RPWS (Radio and Plasma Wave Science) instrument from 1 to 16 MHz. In August 2009, Saturn's northern (southern) hemisphere enters spring (autumn) 7-year-long season. The RPWS instrument, has so far recorded more than a dozen storms since the spacecraft's orbital insertion in 2004. Lasting for several months, each storm consisted of episodes with a periodicity lasting close to one Saturn rotation (about 10 hours and 40 minutes), which start/stop when the SED cloud enters/leaves the radio horizon.

Many of these SED storms raged at 35° South, dubbed the storm alley. The true temporal evolution of Saturn lightning rates is influenced by observational parameters like spacecraft distance and attitude, antenna choice and RPWS receiver modes with different integration times. In this contribution, we describe two methods to obtain the temporal evolution of Saturn lightning flashes in all SEDs episodes from the end of the year 2007 (Storm F) to the middle of the year 2010 (Storm I). The first method (denoted by *I*) determines the 'true' number of SEDs above a selected threshold of 0.8 dB using a normalization procedure [3] that is based on the spacecraft distance and on the RPWS receiver survey mode regardless of different integration times, attitude, antenna choice, etc. The second method (denoted by *II*) estimates the total number of SEDs and validates the 'true' number of SEDs obtained from the first method. The latter method, *II*, uses generalized extreme-value distribution (EVD) functions to find the best-fit EVD to intensity distribution [3] of each SED episodes observed during the Cassini equinox mission (2007-2010). The extracted SEDs using the computer algorithm of [1] can be seen as extreme events above a threshold.

We discuss the following issues. (1) The temporal evolution in smaller scale of weeks to months to larger scale of years. (2) How the normalized intensity (flash rates) determined from the first method, method *I*, are varying in the course of the storm. (3) Whether the total number of SEDs determined from the second method, method *II*, shows a hidden periodicity in it, and if there are dynamical processes in a thunderstorm deep in Saturn's atmosphere that could be somewhat regular or not; (4) We propose the total number of SEDs from second method, method *II*, as an independent measure (from observational parameters) for the activity of Saturn lightning. (5) Using planetary comparative meteorology, we briefly explain the temporal evolution of the derived lightning flash number on Saturn in terms of lightning on Earth.

Acknowledgements

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References

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