DEMETER Observations of Electron Precipitation by Lightning-generated Whistlers and VLF Transmitter Signals

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Abstract

Precipitation of energetic electrons by externally injected lightning-generated whistlers and VLF transmitter signals is believed to be a dominant loss mechanism for energetic electrons in the inner belt and slot regions. This precipitation can be observed as spectral signatures corresponding to narrow frequency bands of transmission, or as temporal signatures in response to transient whistler wave packets or on/off transmissions. The wave and energetic electron instruments on the DEMETER spacecraft provide the high sensitivity, and high energy resolution required for such observations. In this paper, we present recent DEMETER observations of both lightning- and transmitter-induced precipitation.

Summary

While the relative role on a global basis of different type of waves (or waves from different sources) in the loss of radiation belt electrons can in the end only be assessed with global modeling of wave-induced diffusion, it is extremely important for such models to be data-driven, so that crucially important quantitative components are based on experimental data. In this connection, and specifically for the inner belt and slot regions, observations of discrete bursts of electron precipitation, induced by simultaneously measured discrete wave packets, allow the quantification of the pitch angle scattering coefficients. The DEMETER IDP instrument, with its high geometric factor and energy resolution, uniquely allows such quantification, while most energetic particle instruments on other spacecraft are targeted for the measurement of auroral fluxes and do not detectably respond to relatively low levels of precipitation in ducted by wave packets in the inner belt and slot regions. In this paper, we report on DEMETER observations of both discrete transient bursts of precipitation induced by lightning-generated whistlers, as well as broadly and continuously enhanced regions of precipitation induced by the totality of lightning activity in localized storms. We also discuss results of recent experiments of ON/OFF transmissions from powerful VLF transmitters during DEMETER overpasses of the expected precipitation regions in both the hemisphere of the source and the conjugate hemispheres.