**Lightning-induced Effects in the Ionosphere and Radiation Belts**

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Intense electromagnetic and quasi-electrostatic fields released as a result of lightning discharges are now known to significantly disturb the lower ionosphere, as evidenced in the form of high-altitude luminous glows known as sprites, elves, and gigantic jets, as well as terrestrial gamma-ray flashes. The highly nonlinear physical mechanisms of the production of such high altitude optical emissions have been under study for the last decade, or so, with steady progress made in uncovering the highly complicated and variable observed properties. With the basic mechanisms of the phenomena understood, current research aims at determination of the effect of these phenomena on the lower ionosphere on a global scale, by using extensive ground- and satellite-based observations to assess global occurrence rates. Especially important in this context is the lack of understanding of the properties of the parent lightning discharges that lead to the different high-altitude manifestations.

Electromagnetic impulses released in lightning discharges have been known to propagate to long global distances in the Earth-ionosphere waveguide, while continually leaking upward to the radiation belts in the form of whistler-mode waves. While it has been known for some time that such whistler-mode waves can pitch angle scatter and precipitate energetic radiation belt electrons, there is now increasingly extensive evidence that this effect may be a dominant contributor to electron loss in the inner belt and slot regions.

In this paper, we provide an overview of lightning-induced effects in the radiation belts and the lower ionosphere, discussing both previous and recent experimental results, as well as our present understanding of the underlying physical mechanisms, and potential importance on a global scale.