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Particle simulations of optical emissions in sprite streamers

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The optical emission rates of sprites in the mesosphere contain important information on the discharge process. A precise understanding of the process is needed in order to estimate perturbations of sprites to the composition, density and temperature of the mesosphere. For this purpose, a particle code has been developed to study electric discharges in the atmosphere. The code simulates the development of discharges from seed ionization through electron avalanches into streamers. The code is based on the particle-in-cell (PIC) technique for updating the electron velocities and their positions and for calculating the self-consistent spacecharge fields. A Monte Carlo technique (MC) is used for simulating interactions with the ambient atmosphere including excitation and emission rates. The code is in 2D cylindrical coordinates, giving realistic spatial variations of the fields during the initial stages of a discharge presented here. The simulations of optical emission rates are compared to recent high-speed imaging observations of sprites, which allow for a simple and robust estimation of the instantaneous emission rate in streamer heads. The presentation will discuss electric fields, electron energetics and optical emission rates in the streamer head region.