Effects of Gravity Wave Density Fields on Sprite Initiation

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Sprite development and location relative to the parent lighting discharges are strongly affected by the spatial structure of the neutral density of the atmosphere, since the electric breakdown threshold is lowered in regions of density depletion [São Sabbas, 2003]. Thus streamer channels constituting sprites may initiate at multiple locations offset from the causative discharge, possibly accounting for the multiple simultaneous sprites observed to occur laterally displaced from the underlying causative discharge. The main source of inhomogeneities in the mesosphere is gravity waves, which transport energy and momentum from the troposphere into the middle and upper atmosphere. In order to understand the coupling of mechanical/thermal and electrical energy deposition in the atmospheric system by gravity waves and lightning induced optical phenomena, such as sprites, we have investigated the effects of gravity waves density fields in the electric breakdown process that initiate sprites. We adapted the model of São Sabbas [2003] to simulate the spatio-temporal evolution of the lightning induced quasi-electrostatic field in the mesosphere when gravity waves are present. Gravity wave density perturbations were computed for a number of representative convective plume geometries using the Vadas Vadas and Fritts [2004] model.