The effect of corona space charge layer at ground level below thunderclouds on peak return stroke currents

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The presence of a corona space charge below electrified clouds is well documented in the scientific literature (Satndler and Winn, 1979; Chauzy and Raizionville; 1982). Small objects and vegetation go into corona when the background electric fields exceeds about 2 - 5 kV/m. The space charge generated by corona limits the electric field at ground level to value close to the above threshold field. For example, much higher electric fields are measured over water where the generation of corona is limited. The thickness of the corona space charge layer above ground may extend from a few tens of meters to a few hundreds of meters (Willett et al., 1999) depending probably on the type of vegetation, man made structures, topographical features and the conductivity of the soil. Chauzy and Soula, (1989) showed that this corona space charge layer can influence not only the static field generated by the thundercloud but also the field signature caused by a lightning flash. In this paper we show that, depending on their thickness, corona space charge layers can also influence the charge per unit length at the ground end of the leader. The charge distribution on the leader channel is determined by the background electric field that exists below the thunder cloud. Since the space charge layer controls the vertical electric field profile close to the ground, the charge per unit length at the tip of the leader channel located close to ground is also influenced by the space charge layer. One can show that as the thickness of the space charge layer increases the charge per unit length at the ground end of the leader channel decreases. Since the peak return stroke current is determined by the charge per unit length of the leader channel the study indicates that the return stroke peak currents are also influenced by the corona space charge layers.

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