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Corona point discharges from grounded rods under high background electric field

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During the formation of thunderclouds, simultaneous macrophysical and microphysical processes cause the separation of charges inside the cloud, forming the electrical structure of storm clouds. As a result of that, the electric field at the ground level can change significantly. Irregularities on the surfaces of grounded structures can provide conditions for corona discharges that generate ions and form a space charge layer at ground level.

In this work, we investigate the features of corona point discharges from grounded conductive rods installed in three different sites. In all of them, we measured current along the grounded rod under high background electric field conditions or during its fast changes caused by lightning strikes. The current signals reveal pulses with a fast rise time (tens of nanoseconds) and slow decay (hundreds of nanoseconds), with polarity compatible with the background electric field. Comparing laboratory experiments with the results in the field, we observed that positive discharges required a lower electric field threshold than negative discharges. Their pulse frequency is also equivalent to one-tenth of the pulse frequency of negative discharges, for a similar electric field level.

In one of the sites, one current sensor coupled to a grounded rod, 1.5 m above a roof, was installed in a site located at an altitude of 2525 m, near a ski-station. We observed a large number of events, and we were able to correlate the frequency of the pulses with the electric field, as well as evaluate the effect of the wind on the discharges. In the other two sites, the rods were placed near the ground and on the roof of a conventional building. Pulses were registered on some occasions when there was lightning activity nearby, either before or after lightning events. Previous works on this topic correlate the electric field with the average current flow, and on this work, we evaluate the pulse frequency and electric field. This investigation is relevant for understanding the production of corona and space charges from high structures.