CORONA DISCHARGE WAVES IN THUNDERCLOUDS AND THE FORMATION OF IONIC CHANNELS

Losseva, T.V., Fomenko, A.S., Nemtchinov, I.V.
Institute of Geospheres Dynamics, , Russian Academy of Sciences, , Leninsky pr. 38-1, Moscow 119334, Russia

Measurements of the electric field strength in thunderclouds persistently give values by an order of magnitude lower than the breakdown threshold of the pure air. Models of the lightning propagation through the thundercloud usually start with the existing highly conductive channel in the cloud of rather large length and rather thin, at the end of which the field is already enhanced due to the charge redistribution along the channel and thus the channel may increase its length due to streamers and the leader formation. It is not clear how such the long highly conductive channel may be formed.

It is well known that the droplets, ice particles, hailstones or snowflakes may enhance the electric field and produce the corona discharge. We assume that in a small part of the thundercloud an exceptionally high concentration of large hailstones or (and) water drops is formed and the onset-strength of the corona discharge becomes smaller than the background electric field. Polarization of this hot spot (high conductivity and high ionization rates) produces charges at opposite sides of this volume. The increased electric field initiates the corona discharge in other parts of the cloud with normal sizes of hailstones and water droplets. The high conductivity channel increases its length. The corona discharge front moves as a wave.

We describe this non-stationary problem by Poisson equation which is solved simultaneously with a simplified set of kinetic equations for ions, small charged particles and (at high electric fields) electrons, including ionization due to electronic impact, attachment and formation of positive ions, and charging of small particles in addition to their normal charging in the thundercloud due to non-inductive charging mechanisms. A simple analytical model of such a wave is developed. 3D numerical simulations are fulfilled.

Abstract Submission Form

2004 National Radio Science Meeting

Abstract: losseva16181

Date Received: September 24, 2004

1. (a)
Tatiana Losseva
38 Leninsky pr., bldg.1
Moscow, Russian Federation
119334 Russia
losseva@idg.chph.ras.ru

(b) +7(095)939-79-55

(c) +7(095)137-65-11

2. H - Waves in Plasma
3. (a)
4. C - Contributed Paper
5. No special instructions