AE24A-05 Dynamics of a complex streamer structure

Back to: Nikolai Lehtinen

Tuesday, 16 December 2014 05:00 PM - 05:15 PM
Moscone West
3024

Streamer corona formation and propagation is an important process in the development of lightning. In order to understand its dynamics, the streamer front velocity is calculated in a 1D model with curvature. We show that streamers may only propagate only the presence of mechanisms such as electron drift, electron diffusion and photoionization. The results indicate, in particular, that: (1) the effect of photoionization on the streamer velocity for both positive and negative streamers is mostly determined by the photoionization length, with a weaker dependence on the amount of photoionization; (2) the electron drift may increase the velocity of the negative streamers but has an opposite effect on the positive streamers; (3) the contributions of photoionization and electron diffusion to the velocity are decreased for positive curvature, i.e., convex fronts, while the contribution of electron drift is independent of curvature. These results are used in a fractal model in which the front propagation velocity is simulated as the cluster growth probability [Niemeyer et al, 1984, doi:10.1103/PhysRevLett.52.1033]. In the case when the photoionization is the main mechanism which determines the streamer propagation, the emerging transverse size of the streamers is of the order of the photoionization length, and at the larger scale the streamer structure is a fractal similar to the one obtained in a diffusion-limited aggregation system.

Authors

Nikolai Lehtinen
Stanford University
University of Bergen

Nikolai Ostgaard
University of Bergen

Umran Inan
Koc University
Stanford University

View Related Events

Session: Atmospheric and Space Electricity General Contributions IV

Section/Focus Group: Atmospheric and Space Electricity

Day: Tuesday, 16 December 2014