

Effect of the nonlinear atmospheric electric parameters at high altitudes on the propagation of lightning return stroke electromagnetic field
Lightning Effects on the Middle and Upper Atmosphere

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In order to investigate the effect of the nonlinear atmospheric electric parameters at high altitudes on the propagation of lightning return stroke electromagnetic field, the troposphere-upper atmosphere electric coupling model is performed by using 2 D Finite-Difference Time-Domain method, considering the electronic thermal effect, ionization and absorption effect in Maxwell's equations. For the lightning return stroke field within the initial microseconds times, our simulated results show that the effect of the nonlinear atmospheric electric parameters below 60 km altitude can be ignored while it has to be considered above 60 km altitude, because the relaxation time below 60 km altitude is about several or tens milliseconds and it is less than 1 ms above 60 km altitude. It is found that the nonlinear effect of the atmospheric electric parameters reduces the field peak value significantly, and lengthens the initial risetime of the field waveform. Therefore, the nonlinear effect of atmospheric electric parameters must be considered for simulating the transient luminous events (TLEs) at high altitudes accurately.

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