EGU2020-11487
https://doi.org/10.5194/egusphere-egu2020-11487
EGU General Assembly 2020

The mechanism of the origin the NBE (CID) and the initiating event (IE) of lightning due to the volume phase wave of EAS-RREA synchronous ignition of streamer flashes

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In an article by *Kostinskiy et al. (2019)* proposed the mechanism of the origin and development of lightning from initiating event to initial breakdown pulses (termed the Mechanism). The Mechanism assumes initiation occurs in a region of a thundercloud of 1 km^3 with electric field E > 0.4 MV/(m□atm), which contains, because of turbulence, numerous small "E_{th}-volumes" of 0.001-0.0001 m^3 with E ≥ 3 MV/(m□atm). The Mechanism allows for lightning initiation by two observed types of initiating events: a high power VHF event called an NBE (narrow bipolar event or CID), or a weak VHF event. According to the Mechanism, both types of initiating events are caused by a group of relativistic runaway electron avalanche particles passing through many of the E_{th}-volumes, thereby causing the nearly simultaneous launching of many positive streamer flashes, *Kostinskiy et al. (2019)*.

In this report, based on the Meek's criterion for the initiation of streamers (*Raizer, 1991*) at different heights of lightning initiation and taking into account the number of all background electrons, positrons and photons of cosmic rays with energy ε < 10^{12} eV (*Sato, 2015*) crossing E_{th}-volumes sizes of E_{th}-volumes are specified (3□10^{-4}-3□10^{-5} m^3). The report also showed that synchronous injection with a high probability of relativistic electrons into such small E_{th}-volumes requires of relativistic runaway electrons avalanches to be initiated by extensive air showers with energies ε > 10^{15} eV, which would supply (injected) 10^5-10^7 secondary electrons into a turbulent region of a thundercloud with a strong electric field.

References

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