Geophysical Research Abstracts
Vol. 17, EGU2015-6658, 2015
EGU General Assembly 2015

Motion and energy dissipation of secondary electrons, positrons and hadrons correlated with terrestrial gamma-ray flashes

Christoph Koehn (1) and Ute Ebert (1,2)

(1) Centrum Wiskunde en Informatica, Amsterdam, The Netherlands, (2) Technical University, Eindhoven, The Netherlands

Thunderstorms can emit high-energy particles, photons with energies of up to at least 40 MeV, leptons (electrons, positrons) and hadrons (neutrons and protons) with energies of tens of MeV. Some of these events have been correlated with negative lightning leaders propagating upwards in the cloud. For particular lightning events we show that photons, leptons and hadrons can reach ground altitude as well as satellite altitude, and we present the number as well as the spatial and energy distribution of photons, leptons and hadrons.
We have reviewed the latest literature on cross sections for collisions of photons, leptons and hadrons with air molecules and have implemented them in our Monte Carlo code.
We initialize a photon beam with the characteristic energy distribution of a TGF at thunderstorm altitude and we use the Monte Carlo model to trace these photons; we include the production of secondary electrons through photoionization, Compton scattering and pair production, the production of positrons through pair production as well as the production of neutrons and protons through photonuclear processes. Subsequently we calculate the motion and energy dissipation of these leptons and hadrons with the feedback of electrons and positrons producing new photons through Bremsstrahlung and through positron annihilation at shell electrons.
Additionally we provide analytic estimates for the energy losses of photons, leptons and hadrons in the energy range between 0.03 eV and 100 MeV based on the relevant cross sections. We provide the spectral analysis of how many photons, leptons and hadrons will reach ground or satellite altitude and what their energies are, depending on the initial photon energy. This is of particular interest because of campaigns measuring fluxes of all these species at 0 and 500 km altitude without knowing the actual energies of initial electrons converting into photons within a thundercloud.