

Estimation of the effect of sprite streamers on upper stratospheric ozone chemistry

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We estimate the concentration change, caused by a sprite streamer, of ozone in the upper stratosphere and mesosphere. The streamer has an intense electric field and high electron density at its head where a large number of ions and atoms are produced through electron impact on neutral molecules. After the propagation of the streamer, ozone density is expected to be perturbed (by a few percents at altitude of 40-50 km) through ion-neutral chemical reactions related with these active particles. The production rate of ions and atoms is evaluated based on the electron kinetics model when the electric field and electron density in the streamer head are given. A one-dimensional model of the neutral and ion composition of the middle atmosphere, including the effect of the sprite streamer, is used to evaluate the ozone density change and to study the cause of an increase or decrease of ozone and of its altitude dependence. For validation of our estimation, we include some of excited states of NO, CO and OH into the 1D chemical model and calculate the intensity of optical emissions radiated by these radicals, which can be detected by satellite observations.