Geophysical Research Abstracts
Vol. 16, EGU2014-5715-1, 2014
EGU General Assembly 2014

Modeling the plasma chemistry of stratospheric Blue Jet streamers

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Stratospheric Blue Jets (SBJs) are upward propagating discharges in the altitude range 15–40 km above thunderstorms. The currently most accepted theory associates SBJs to the development of the streamer zone of a leader. The streamers emitted from the leader can travel for a few tens of kilometers predominantly in the vertical direction (*Raizer et al., 2007*). The strong electric fields at the streamer tips cause ionisation, dissociation, and excitation, and give rise to chemical perturbations. While in recent years the effects of electric discharges occurring in the mesosphere (sprites) have been investigated in a number of model studies, there are only a few studies on the impact of SBJs. However, chemical perturbations due to SBJs are of interest as they might influence the stratospheric ozone layer.

We present results of detailed plasma chemistry simulations of SBJ streamers for both day-time and night-time conditions. Any effects of the subsequent leader are not considered. The model accounts for more than 500 reactions and calculates the evolution of the 88 species under the influence of the breakdown electric fields at the streamer tip. As the SBJ dynamics is outside the scope of this study, the streamer parameters are prescribed. For this purpose, electric field parameters based on *Raizer et al. (2007)* are used. The model is applied to the typical SBJ altitude range 15–40 km. The simulations indicate that SBJ streamers cause significant chemical perturbations. In particular, the liberation of atomic oxygen during the discharge leads to a formation of ozone. At the same time, reactive nitrogen and hydrogen radicals are produced which will cause catalytic ozone destruction.

Reference:
Raizer et al. (2007), J. Atmos. Solar-Terr. Phys., 69 (8), 925–938.