Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM07-28 会場:302 時間:5 月 25 日 17:00-17:15

太陽高エネルギー粒子による中層大気中での微量化学種の変動：オゾンと硝酸
Variation of trace chemical species induced by solar energetic particles in the middle atmosphere: ozone and nitric acid

中井 陽一 [1*] ; 望月 優子 [1] ; 丸山 真美 [1] ; 秋吉 英治 [2] ; 今村 隆史 [2]
NAKAI, Yoichi[1*] ; MOTIZUKI, Yuko[1] ; MARUYAMA, Manami[1] ; AKIYOSHI, Hideharu[2] ; IMAMURA, Takashi[2]

[1] 理研仁科加速器研究センター, [2] 国立環境研究所
[1]RIKEN Nishina Center, [2]National Institute for Environmental Studies

Influences on the terrestrial environment of super solar flares have attracted interests recently. In a super solar flare, a large amount of protons, X-rays, gamma-rays etc. emitted from the surface of the sun intrude into the terrestrial atmosphere, which is called a solar energetic particle (SEP) event. In particular, high-energy protons come down to the stratosphere. The SEP protons can induce dissociation of nitrogen molecules. A part of dissociated nitrogen atoms contribute to increase of odd nitrogen oxides (NOx) and reactive odd nitrogen spices (NOy). Consequently, the SEPs influence the ozone concentration through the chemical reactions in the atmosphere.

We have performed simulations for variation of chemical composition in SEP events by solving a large number of rate equations for concentrations of chemical spices without taking into account of transport processes, i.e., simple Box-model simulations. More than 70 chemical spices including ions and about 480 chemical reactions are adopted in the present simulation. A large number of ionic processes including recombination in the stratosphere were treated for the first time to our knowledge.

We assume that the energy deposits from the SEP protons to the chemical species determine the yields of prompt products. As a result, we can consider the prompt products to be generated from nitrogen and oxygen molecules of major components of the air. The estimation of the energy deposit is carried out using the calculations of ion-pair creation by the SEP protons [1]. For the yield estimation of the prompt products, the G-values are used [2,3], where the G-values are given by amount of products per absorbed energy of 100eV. During a SEP event, we deal with both the photochemical reactions and the reactions induced by the SEP protons in the simulation. Variation of chemical composition in a SEP event is estimated as a difference between the result of the simulation including the processes triggered by the SEP protons and that by taking account of only photochemical reactions.

In this talk, we will mainly report the results by our Box-model simulation for the variations of ozone and nitric acid for the SEP event observed in October-November 2003.

References

[1] C.H. Jackman et al., Atmos. Chem. Phys. **8**, 765 (2008).
[2] C. Willis and A. W. Boyd, Int. J. Radiat. Phys. Chem. **8**, 71 (1976).
[3] H. Mätzing, Adv. Chem. Phys. LXXX, 315 (1991).