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Acceleration of high-energy particles in geospace and influence of the energetic particles on the terrestrial atmosphere

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Geospace is filled with high-energy particles. Magnetic reconnection and wave-particle interaction such as whistler-mode wave play important roles to accelerate and produce the high-energy particles. Such high-energy particles enter the terrestrial atmosphere along the magnetic field lines through polar regions. The precipitated energetic particles heat up and ionize the upper atmosphere, leading to increase HOx and NOx components though ion chemistry in the thermosphere, mesosphere, and even in the upper stratosphere in some highest energy case. The HOx and NOx are well known as ozone depleting substances through catalytic chemical reaction cycle. If the enhanced NOx are transported down to the stratosphere due to the polar vortex, the life-time of NOx is extended and its influence on the terrestrial atmospheric environment is supposed to be not negligible. In this sense, the solar activity is seamlessly related to the terrestrial environment. In STEL, Nagoya University, we have launched a new project team for this issue. The aim of this project is to understand the fundamental processes of particle acceleration and chemical/dynamical interactions between the high-energy particles and atmospheric molecules based on satellite observations, ground-based observations, and numerical simulations. We will utilize ground-based meteor radar, millimeter-wave spectrometer, sky imager, sodium lidar, and satellite ERG in order to obtain a comprehensive view of the solar forcing on the terrestrial environment in connection with the high-energy particles. In addition, we will collaborate with UCLA and LASP/UBC to handle the dataset obtained by Van Allen Probes for radiation belt, THEMIS, MMS for magnetosphere, SDO for Sun under the framework of JSPS program for Advancing Strategic International Networks to Accelerate the Circulation of Talented Researchers. In this presentation, we will discuss more detailed plan and strategy of this project.

Keywords: particle acceleration, environmental change, Aeronomy, solar physics, atmospheric chemistry