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Impact of High-Energy Particle Precipitation on the Upper Atmosphere

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Various forms of high energy particle precipitation into atmosphere present a coupling process between atmospheric layers and near-Earth space, where energy input into atmosphere is often controlled not only by the original source of the particles, but also by interactions occuring in the inner magnetosphere. Here we first review shortly the impact of energetic particles in atmosphere in general, and present the current status of knowledge in chemical variations of atmosphere caused by these particles, including galactic cosmic rays, solar protons and electrons of magnetospheric origin. The effects are both direct and indirect by first generating chemically active minor constituents of the atmosphere, such as odd nitrogen and odd hydrogen, which in turn can affect atmospheric ozone via catalytic reactions either directly in-situ, or after transport in atmosphere to lower altitudes and lower laitudes. Then we discuss recent advance in studying the effects of high-energy electron precipitation (EEP) in atmosphere, the global role of which still is quantitatively largely unknown. Recent published research has shown evidence about energetic electron precipitation causing statistically significant decrease of upper stratospheric and mesospheric ozone during extended periods of time, so that one would need to include EEP as a process in general atmospheric circulation models, if we want to understand our atmosphere as a whole. It is pointed out how importantly we need new measurements characterizing more accurately the energy and flux, as well as spatial and temporal variations of the energetic electron precipitation, both at high and subauroral latitudes. Such new data would be given by the Japanese ERG satellite mission. Combined studies using ground-based measurements and theoretical modeling together with ERG mission measurements, are outlined.

キーワード: high-energy particle, energetic electron precipitation, atmospheric chemistry, magnetosphere, ionospheric modelling, ERG satellite
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