**The atmospheric response to energetic electron precipitation from the outer radiation belt**

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Information about the energetic electron precipitation (EEP) from the radiation belt into the atmosphere is important for assessing the ozone variability and dynamics of the middle atmosphere during magnetospheric and geomagnetic disturbances. Energetic electrons from the radiation belt penetrate the polar middle atmosphere during geomagnetic disturbances and enhance ionization rates there which leads to the formation of reactive odd nitrogen and hydrogen oxides and ozone depletion. The magnitude of the ozone destruction depends not only on the intensity of EEP but also on season when it happens.

In this work, we study mesospheric ozone depletion due to precipitating energetic electrons with energies from keV up to relativistic energies about 1 MeV during different seasons. The electron properties are acquired from the NOAA POES satellites observations in 2003. The accurate values of energetic electron fluxes depending on their energy range are one of the most important problems for calculating atmospheric ionization rates, which, in turn, are considered for estimating ozone depletion in chemistry–climate models. Despite the importance of these processes for the polar middle atmosphere, the parameters of precipitating of energetic electrons are still insufficiently studied. In order to better understand EEP and related processes in the atmosphere, it is important to have many realistic observations of EEP in order to correctly characterize their spectra. Invading the atmosphere, precipitating energetic electrons, in the range from tens of keV to relativistic energies of more than 1 MeV, generate bremsstrahlung, which penetrates into the stratosphere and is recorded by detectors on balloons. However, these observations can be made only when the balloon is at stratospheric heights. Near-Earth satellites, such as the polar-orbiting operational environmental satellites (POES), are constantly registering precipitating electrons in the loss cone, but are moving too fast in space. Comparing the results of EEP measurements on balloons and onboard POES satellites in 2003, we propose a criterion that makes it possible to constantly monitor EEP ionization at stratospheric heights using observations on POES satellites.

 For estimation of ozone depletion we use a one-dimensional radiative-convective model with ion and neutral chemistry. As one of the main results, we show that, despite the intensity of EEP-induced ionization rates, polar mesospheric ozone cannot be destroyed by EEP in summer in the presence of UV radiation. In wintertime, the maximum ozone depletion, at altitude of about 80 km, can reach up to 80% during strong geomagnetic disturbances. In fall and spring, the maximum ozone depletion is less intense and can reach 20% during strong geomagnetic disturbances. Relation of EEP induced maximum mesospheric ozone depletion depending on geomagnetic disturbances and seasons have been obtained.

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**References:**

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