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Forced atmospheric-ionospheric effects by precipitation of energetic electrons during a magnetic storm on October, 2017

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Energetic Electron Precipitation (EEP) during geomagnetic disturbances in the period October 10-16, 2017 were associated with different physical mechanisms, which were studied separately. The EEP were detected using balloon observations near Apatity and low-orbiting satellites such as Meteor-M2 and NOAA POES. According to satellite measurements, the precipitation covers a large latitude-longitudinal region in two hemispheres. To reconstruct the energy spectra, satellite energy channels from tens of keV to MeV were used.

To determine the atmospheric-ionospheric response and changes in ozone during precipitation of energetic electrons over the studied period of time, we used calculated ionization rates based on spectra obtained both from satellites and during balloon observations, which were used in a one-dimensional radiation-convective photochemical model with interactive neutral and ionic chemistry. The EEP was supposed to last for several hours. It was found that the greatest contribution to ozone destruction is made by EEP associated with the violation of the first adiabatic invariant, and with EEP associated with EMIC waves, ozone destruction will be minimal. Precipitations associated with violation of the first adiabatic invariant can lead to ozone destruction up to 70%. In all cases, the change in ozone lasts throughout the day, and the next day the ozone is restored to its previous level.

Despite the small amount of ozone in the mesosphere compared to the stratosphere, the study of ozone variations under the influence of solar and cosmic forcing is one of the priority tasks that determines the natural forcing of the atmosphere and climate.

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