GC2024-STP024

Acceleration and losses of the outer radiation belt energetic electrons during period of long duration auroral activity

Vladimir Kalegaev[1] , Galina Basilevskaya[2] , Nataliya Vlasova[1] , Dmitry Grankin[3] , Danil Gruzdov[1] , Andrey Demekhov[4] , Alexandra Ivanova[1] , Ksenia Kaportseva[1] , Irina Mironova[3] , Irina Myagkova[1] , Tatiana Popova[4] , Eugeny Rosanov[3] , Yulia Shugay[1] , Tatiana Yahnina[4]

[1] Skobeltsyn Institute of Nuclear Physics, Moscow State University , Russia
[2] Lebedev Physical Institute , Russia
[3] St. Petersburg State University , Russia
[4] Polar Geophysical Institute, Apatity , Russia

Solicited talk

klg@dec1.sinp.msu.ru

Complex study of the coupling dynamical processes in the chain: Solar Corona-Solar wind – Earth's magnetosphere – outer radiation belt – ionosphere/atmosphere, has been studied based on multi-satellite and on-ground measurements. Prolonged magnetospheric compression during period 10-16.10.2017 produces moderate magnetic storm and multiple substorm activations, that were responsible for wave activity and significant changes in trapped energetic electrons population.

Variations on high-energy electron fluxes were obtained from measurements of spacecraft located in the interplanetary medium and in polar and near-equatorial orbits inside the magnetosphere. Geostationary GOES-15 satellite found a drop of 2 MeV electron fluxes during the main phase of the magnetic storm and consequent gradual restoration during recovery phase. VAP-A satellite demonstrated particle fluxes recovery in the wide energy range from about of 100 keV to 4 MeV and more. If lover energy electrons were restored just after storm maximum, relativistic electron fluxes remain depleted and approached pre-storm levels with delay of about several days; the more energy, the more time delay.

In parallel, strong precipitation of energetic electrons with E>100 keV were detected by polar NOAA/POES and Meteor-M2 satellites. They were also detected during the LPhI balloon experiment in the Murmansk region. Precipitation occurred in the beginning of the magnetic disturbances and continued during all the period under consideration. According to measurements of electron fluxes on the polar satellites Meteor M2 and POES, it is shown that the precipitation cover a large area of near-Earth space: by the L-parameter and by MLT.

Magnetospheric magnetic field changes during multiple substorms and related wave activity become the main causes of electron losses. The VLF wave activity recorded during the time period under study aboard the Van Allen Probes spacecraft was the source of intense precipitation of energetic electrons (100-300 keV) in the morning sector of the magnetosphere. EMIC waves in the evening sector of the magnetosphere were also recorded as Pc1 pulsations at the Lovozero station, produced precipitation of ring current protons and relativistic electrons. Adiabatic changes of the magnetosphere as well as competition between acceleration and loss processes due to auroral and wave activity produced complicated dynamics of the energetic electron fluxes in the inner magnetosphere. Substorm activations and VLF waves compensate quickly the loss of trapped particles with energies about 100 – 300 keV. Reduced particle fluxes with energies of 700 keV and higher are not restored immediately. Ongoing substorms gradually accelerate energetic electrons to higher energies, leading to an increase in particle fluxes of relativistic and subrelativistic energies.

This study is supported by RScF Grant № 22-62-00048.