GC2024-STP023

Relationship between dipolarizations and Energetic Electron injections at the Geosynchronous orbit

Maria A. Shukhtina[1], Victor A. Sergeev[1], Alexander V. Nikolaev[1], Nikita A. Stepanov[2]

[1] St Petersburg University
[2] Arctic and Antarctic Research Institute

maria-shukht@yandex.ru

Energetic Electron (EE) injections at the geostationary orbit have been studied since the beginning of space era, and very soon their relationship with magnetic dipolarizations was established. It is also well known that particles intrude into the inner magnetosphere on the nightside, creating non-dispersed injections in the Substorm Current Wedge (SCW) region, and then drift azimuthally with their own drift speed, forming dispersed injections. EE injections are an important source of the outer radiation belt, they affect the spacecraft equipment, the radio communication and, more globally, the space weather. Betatron/Fermi acceleration during dipolarization are considered as the main acceleration mechanisms, but this point still is not well studied.

The aim of our work is to study the relationship between injections and dipolarizations inside and outside the SCW based on joint particle and magnetic data of GOES 13, 14, 15 spacecraft, each pair separated by 2 hours MLT. We selected clear dipolarizations at the most westward GOES 15 when it was in the pre-midnight sector, and studied the EE reaction at GOES 15 itself and at two other more eastward spacecraft. 45 events with data available for at least two spacecraft, GOES 13 and GOES 15, were considered. Good correlation of the dipolarization magnitude at GOES 15 with increment of substorm MPB index shows that GOES 15 was in the BBF stopping region.

In our study we used the EE fluxes dependence on the local magnetic field (hodogram) technique. It showed that 1) inside the SCW EE fluxes grow with B_z whereas outside the current wedge these fluxes are independent of local B_z, giving the opportunity to separate data inside and outside the injection region. 2) EE dynamics is the result of two processes: injections and drift shell crossing. Injections occur on some background level, characteristic for the given B_z value, and this level depends on the past geomagnetic activity; 3) on the geostationary orbit the injection process is effective mostly for electrons with energy<200 keV (was known before), for higher energies drift shell crossing prevails.

Our analysis showed that correlations of (ΔMPB) with the peak EE fluxes at energies 30-200 keV is higher than with increment of these fluxes, pointing that during the injection a new particle population comes. However, these correlations are also rather low, ≤0.6. Also we demonstrate that (ΔMPB) growth mostly increases the fluxes of electrons in the range 50-100 keV.