MODELING THE RELAXATION OF EARLY VLF PERTURBATIONS ASSOCIATED WITH TRANSIENT LUMINOUS EVENTS

CHRISTOS HALDOUPIS 1, ´Agnes Mika 2, and Sergey Shalimov 3

1. Physics Department, University of Crete, Heraklion, Crete, Greece
   email: chald@physics.uoc.gr
2. BMT ARGOSS B.V., Marknesse, The Netherlands
3. Institute of Physics of the Earth, and Space Research Institute, Moscow, Russia

Studies show that Early VLF perturbations, characterized by abrupt signal onsets and long recoveries, occur often in relation with Transient Luminous Events (TLEs), that is, sprites, sprite halos, and elves. Also, most of the Early VLF events are attributed to forward scattering of sub-ionospheric VLF transmissions incident upon horizontally elongated disturbances of elevated ionization in the upper D region between about 70 and 90 km. This concept is supported by the similarity of Early VLF event recoveries to those of LEPs (Lightning induced Electron Precipitation events), which are due to electron density enhancements in the upper D region caused by lightning and whistler-induced precipitation of radiation belt electrons. Here, the simplified Glukhov-Pasko-Inan (GPI) model, that has been developed for LEP investigations, is applied to simulate Early VLF event recoveries observed simultaneously with sprites in the D region. The present study shows that: 1) Early VLF events with long (short) recoveries are likely to come from higher altitudes of about 80 to 90km (lower altitudes of about 70 to 80 km) and under conditions of low (high) electron density elevations relative to ambient values, 2) although negative ion and positive cluster ion production plays a role in electron density relaxation at lower heights, the electron-single ion dissociative recombination is likely the key process at upper D region heights that defines the relaxation of Early VLF perturbations, and 3) the estimated electron density increases responsible for Early VLF events reach typical values between 104 and 105 cm^{-3} in the upper D region ionosphere.

Early VLF events, sprites, transient luminous events

Christos Haldoupis, Physics Department, University of Crete, Heraklion, Crete, 71003 Greece, tel: 0030-281039422, fax: 0030-2810394201, email: chald@physics.uoc.gr