

When and how is low- and mid-latitude ionosphere transformed into its auroral counterpart?

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Series of the geomagnetic superstorms in 2003 – 2005 (as well as some previous ones) demonstrated dramatic changes in composition and behaviour of low- and mid-latitude ionosphere. The zones of precipitation of energetic particles located usually within the polar latitudes expanded their area enormously by moving toward equator. Consequently area of excessive content of the NO molecules, which are a direct product of precipitating energetic particles occupied a region of moderate latitudes. Increased solar wind dynamic pressure strongly compressed the Earth's magnetosphere causing precipitation of high-energetic particles from the radiation belts. The so called sub-auroral electrojet system was formed, which affected and transformed regular structure of the ionosphere at moderate latitudes. Therefore low- and mid-latitude ionosphere obtained the specific characteristics of the auroral ionosphere. For example, the visual auroral forms could be observed at such places like Moscow and Chicago. On the other hand this part of the ionosphere continued to be illuminated by strong solar UV radiation, which is much more intense than in the polar regions. Therefore an excessive level of ionization (so called plume of ionization) was formed at the moderate latitudes, which was moved toward the high latitudes by the sub-auroral electrojet. John Foster (Millstone Hill, USA) analyzed such situations concerning upper ionosphere in several publications. However, there is much less information about dynamics of the lower ionosphere at moderate latitudes during the superstorms. In this paper we present detailed analysis of temporal and spatial variations in low- and mid-latitude ionosphere during intense geomagnetic storms and superstorms. Data of riometer and VLF phase measurements together with corresponding satellite observations will be analyzed. A significant North – South and East – West asymmetry in the lower ionosphere variations was revealed during these events. Evident connection between ionospheric disturbances and geomagnetic variations will be demonstrated. Possible interpretation of the observed events will be presented.