Electric field (Ez) and vertical Maxwell current density (Jz) at the ground are unquestionably in intrinsic physical dependence upon electric potential of the ionosphere and electrical conductivity of the atmosphere above the measuring site. Although the ionosphere potential and atmosphere conductivity variation in polar regions fundamentally depend on solar wind changes, the response in high latitudes of the Ez and Jz to solar wind variability has been for a long time considered doubtful. Diversity of the solar wind influences and problems with separating the notorious noise of meteorological origin in local and global thunderstorm activity scale, still are difficult obstacles in gathering the knowledge about response of electrical elements of the lower atmosphere to the magnetosphere and ionosphere changes induced by solar wind. Such a response has been statistically demonstrated, e.g., strong influence of IMF components of solar wind on Ez recorded in polar site is shown by comparing differences between the actual Ez daily changes and the fair weather average Ez diurnal variation which followed there the Carnegie curve (Frank-Kamenetsky et al., 2001). The cases of Ez and Jz reaction to magnetosphere and ionosphere changes have been previously reported but most often without detailed references to the situation produced by solar wind and Earth's magnetic field interaction and to the global electric circuit interference (Apsen et al., 1988; Michnowski et al., 1991).

In this paper we present events that may give evidence for possible solar wind effects on Ez and Jz as observed at the ground in Polish polar station Hornsund (Spitsbergen: \( \phi = 77.0^\circ \), \( \lambda = 15.5^\circ \)) at specific helio-geophysical circumstances. A considerable number of such events have been recorded during fair weather conditions with a view to the paucity of such meteorological conditions. Some selected individual cases are presented and preliminarily discussed. Their examination was performed using the station recordings of the geomagnetic field components, ionosphere absorption measured by riometer, and a set of meteorological parameters. The data have been used, moreover, from IMAGE net of stations with simultaneous magnetometer and riometer recordings for an estimation of position of electrojet and the data from satellite recordings of solar wind parameters, which allow also to estimate approximately the extra-troposphere changes of ionosphere potential above the station.
The examined variations of Ez extend the results reported by Apsen et al. (1988) by showing their dependence in the sign and magnitude during the preliminary and expansion phase of substorms upon station location in respect to actual state of magnetosphere-ionosphere system. E.g., it was noticed that in the expansion phase, the Ez values decrease with the growing indications of riometers which correspond to injection of energetic electrons, increasing the conductivity in the ionosphere and partly of the atmosphere below.

The dynamic spectral analysis of the examined variables shows common properties or differences in the electric field fluctuations with the associated magnetic pulsations in relation to field aligned currents and the phase of substorm development (Kleimenova et al., 1995). Distinct relation of the Ez and Jz fluctuations with the oscillations of ionosphere absorption was found during expansion phase of substorms.

At the sudden commencement of strong magnetic storms, the positive and large Ez enhancements were recorded after large jump in the interplanetary magnetic field (IMF) and other parameters of solar wind. E.g. on July 15, 2000, after such very large change, the Ez and Jz jumped during fair weather to the values more than two and half times larger than the previous quiet values persisting for a long time. Hornsund, during very large Bz component of IMF, was located then under the projection of polar cap region (Nikiforova et al., 2002).

A further extension of the analysis of Ez and Jz variations in polar regions, by the use of geospace and global electric circuit data, can bring a better understanding of the observed couplings of the lower atmosphere with the upper atmosphere regulated by solar wind changes.

References:


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