EMSEV 2012
Gotemba Kogen Resort, Gotemba, Japan
October 1–4, 2012
Abstract 3-06p

Possible mechanism of the seismic related TEC perturbation.

V.M. Sorokin, A.K. Yaschenko, Yu.Ya. Ruzhin

Puskov Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation (IZMIRAN), Russian Academy of Sciences, Troitsk, Moscow Region, 142190, RUSSIA.

We are proposed mechanism of the appearance of local large-scale seismo-ionospheric anomalies in Total Electron Content (TEC). The obtained results confirm the proposed mechanism of seismo-ionospheric effects by the perturbation of the electric current in the global electric circuit. Analysis of the observational data and theoretical investigations show that enhancement of seismic activity produces DC electric field disturbances in the ionosphere with magnitudes up to 10 mV/m. These disturbances occupy an area of the order of several hundred km in diameter above the earthquake region. DC electric field enhancements arise in the ionosphere up to 10 days before earthquakes. Moreover, quasi-stationary electric field on the Earth surface in the earthquake epicenter area does not exceed the background value. The key role in seismo-ionospheric coupling belongs to the electromotive force (EMF) which is included in the global atmosphere – ionosphere closed electric circuit. The EMF is located in the lower atmosphere including the surface of lithosphere. The external EMF is excited in a process of vertical atmospheric convection and gravitational sedimentation of charged aerosols and radioactive elements in the near – ground level of the atmosphere. Aerosols are injected into the atmosphere due to intensified soil gas elevation in the lithosphere during the enhancement of seismic activity. These phenomena can be caused by the growth of seismic related DC electric field in the ionosphere. The increase of the electric field leads to intensification of ionospheric currents flowing in a thin conducting layer and a release of Joule heat in the disturbed region. The thermal flux q radiated by a thin conducting layer with the integral conductivity Σ in the horizontal electric field E is of the order of $q : \Sigma E^2$. Assuming $\Sigma = 3 \div 30 mho/m$, $E = 6 mV/m$ we obtain $q = (10^{-4} \div 10^{-3}) W/m^2$. One of the main sources of the ionosphere heating is the solar short wave radiation ($\lambda < 1026 \mathring{A}$). The thermal flux to ionosphere q_0 driven by the absorption of this radiation above 100 km is about $q_0 = 10^{-3} W/m^2$ and may be varied by several times to the both sides of this value. Comparison of q and q_0 shows that the Joule heating of the ionosphere over the earthquake preparation zone supplies a considerable fraction of total thermal balance in the ionosphere. Therefore, this heat source influence decisively on the ionosphere state. The heating effects of the pre-earthquake processes on TEC of the ionosphere are considered below.

At the altitudes above 200 km the ionosphere is isothermal. In the altitude range from 100 km to 200 km there is a positive gradient of temperature. Presence of this temperature gradient due to thermal conductivity results in downward directed thermal flux. The source of Joule heating is located in the layer of 120 to 150 km. Therefore a heating of the upper ionosphere layers can be realized only at presence of gas motion in the vertical direction. Thus, the thermal energy injected in the lower ionosphere is transferred to the top region due to gas motion. In this process gas is gradually heated during its approach to the heat source. This process characterizes the thermal interchange in the upper atmosphere and determines the temperature altitude distribution in this region. Ionosphere heating leads to modification of TEC over seismic region. Our calculations show that growth DC electric field value up to $6 \div 8 mV/m$ result in increase in TEC up to $50 \div 100$%. Consequently, the total TEC variations is a result of two processes both the plasma drift in an electric field and the ionosphere heating by this field.