Variations of levels of atmospheric electrical and meteorological parameters and natural radioactivity in response to heavy smog due to forest fires

M.S. Cherepnev[1], A.V. Vukolov[1], I.I. Ippolitov[2], M.V. Kabanov[2], P.M. Nagorsky[2], Yu.A. Phalagov[3], S.V. Smirnov[2] and V.S. Yakovleva[1]

[1]Department of Applied Physics, Tomsk Polytechnic University, Tomsk, 634050, Russian Federation
[2]Institute of Monitoring of Climatic and Ecological System SB RAS, Tomsk, 634050, Russian Federation
[3]Institute of Atmospheric Optics, SB RAS, Tomsk, 634050, Russian Federation
Keywords: forest fires, aerosol, light ions, radioactivity.
Presenting author email: maxcherepnev@gmail.com

Extreme weather conditions created in summer in the European part of Russia in 2002 and 2010 and in Siberia in 2004 and 2012 due to forest fires led to the large number of forest and peat fires accompanied by extreme smoke of atmosphere.

Tropospheric aerosol together with greenhouse gases is an important climate-making factor influencing the radiation balance of the Earth. An important mechanism of variations of atmosphere electrical parameters (electric intensity E and polar conductivities $\lambda_{\pm}$) is the change in the number of light ions that are the main charge carriers due to their outflow onto the atmospheric aerosol. Decrease in the number of light ions in their outflow onto aerosol particles should lead to a decrease of $\lambda_{\pm}$ and to an increase of electric field intensity E. Ionization of air molecules in the atmosphere surface layer takes place mainly due to the natural radioactivity.

Based on a joint analysis of the variations of ionizing radiation levels (α-, β-, γ-background) in the atmosphere at heights of 5, 10 m and 25 m and depths of 0.1, 0.2, 0.5 and 1 m in the soil, meteorological and atmospheric electrical parameters in the summer smog due to summer forest fires in Siberia (2012) it was found that an increase of intensively smokiness and related with it decrease of visual range (S_m, Fig. 1, panel 1) and fall of solar radiation flux (I, panel 2) in the visible and UV ranges is followed by a decrease of λ_+ (panel 3) and the level of α-background radiation (panel 4). The clear dependence of β-, γ-background radiation level (panel 5) on S_m was not found.

Analysis of observation data of atmospheric electrical parameters during periods with maximal smog aerosol concentrations in the urban atmosphere surface layer due to long-term forest fires allowed for the first time to find out the effect of daily inversions of the electric field intensity with a changing range of 300 V/m and more in the daytime, of -300 V/m at night (panel 6). The observed effect of daily variations of the electric field in the atmosphere surface layer differs from the known effects by that it was detected in the smog conditions when forest fires covering large areas often for a long time in many regions. The proposed interpretation of this effect does not contradict the well-known diffusion-kinetic model of the ion charge aerosol.

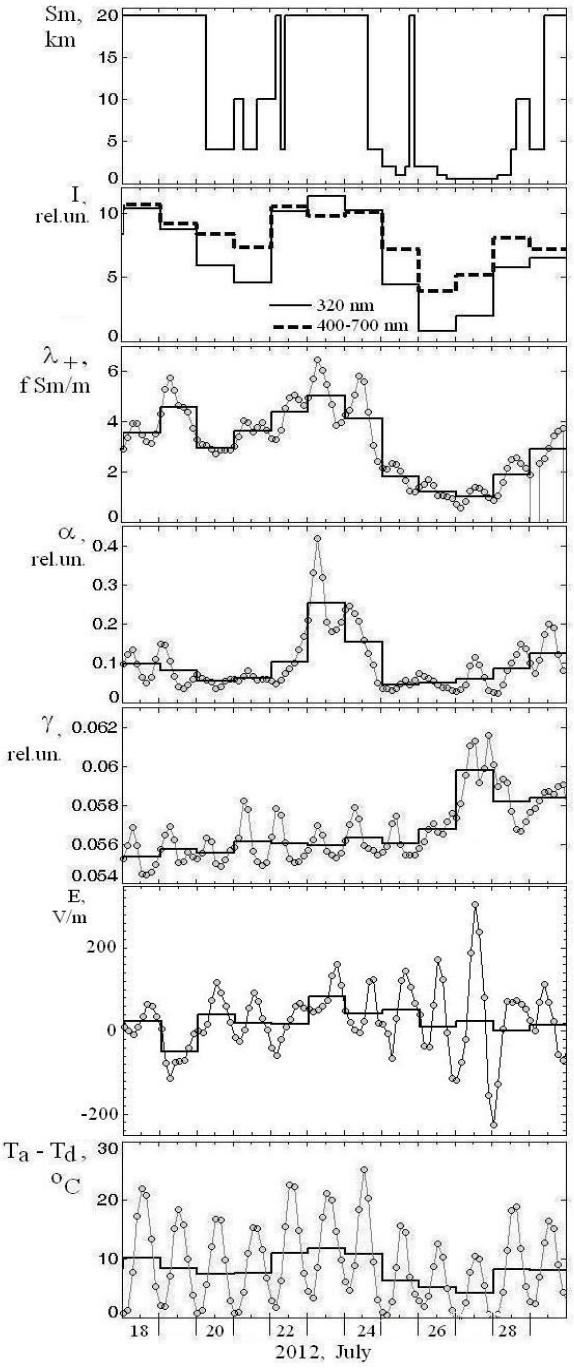

Figure 1. Variations of α-, γ-radiation components and meteorological quantities (S_m, I, λ_+, E, T_a -T_d) during the smog due to summer forest fires