MODELLING THE EFFECT OF SOLAR AND GEOMAGNETIC ACTIVITY ON THE ELECTRIC CURRENTS IN THE GLOBAL ATMOSPHERIC ELECTRICAL CIRCUIT

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We study theoretically the global atmospheric electrical circuit (GAEC) maintained by the totality of thunderstorms and electrified clouds on the Earth, as a system influenced by solar and magnetosphere processes. Recently GAEC is treated as an important factor in the climate formation and changes. A significant role in the hypothetical link between GAEC and climate play the ionosphere-ground current (with typical density 2 pA per square meter), and its variations. These are caused by a diversity of inner and outer factors. We theoretically examine the benefit of two factors to variability of the ionosphere-ground current. The first factor (A) is the presumed long-term dependence of the stratospheric and tropospheric conductivity from the solar activity, caused by the inverse modulation of the cosmic ray flux. The second factor (B) is the dawn-dusk potential difference across each polar cap, due to the solar wind. This difference modifies the ionospheric potential at polar latitudes, thus can cause superimposed diurnal variations of ionosphere-ground current, which are sensitive to solar wind variations. To study the role of factors (A) and (B), we propose a 3D global-scale steady-state model of the electric current density distribution in GAEC. A model of atmospheric conductivity is used with respect to geographical coordinates. Our results show that factors (A) and (B) cause different types of variations of the ionosphere-ground current at high and at low latitudes. At equatorial latitudes it is larger by few percent in solar maximum than during the minimum, while at polar latitudes it is larger during solar minimum. The variability of the ionosphere-ground current shows an increase with the altitude. While at tropospheric heights it is close to that at the surface, in the strato/mesosphere it is much larger. At high latitudes the variability examined shows an enhancement due to factor (B).

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