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FORMATION OF IONS UNDER THE ACTION OF COSMIC RAYS IN HUMID AIR *)

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Information about the distribution of ion concentrations in the troposphere at altitudes up to 40 km is of great theoretical and applied importance, since the participation of ions in physico-chemical processes determines the dynamics of the formation of the charge of the troposphere and clouds. The analysis of the processes leading to the accumulation and change of sorts of ions is necessary in connection with the determination of background conditions for the development of various types of atmospheric discharges and discharges used in plasma chemical technologies. Moreover, knowledge of the ionic composition of the atmosphere is required when modeling plasma aerodynamics devices, when it is necessary to create a plasma region at altitudes where the processes of ionization due to radon in the surface layer of the atmosphere are not very effective.

The most important role in the formation of ions in the troposphere is played by ionization processes involving cosmic rays. The calculations used data on the amplitude dependence of the ionization rate Q(h) by cosmic rays in the altitude region, where there is no ionization due to processes involving radon.

The purpose of this study is to determine the altitude dependence of the concentration of ions formed in the troposphere in a calm geomagnetic environment under the influence of cosmic rays and radioactive radiation from the soil surface in a humid atmosphere. The obtained results are necessary for controlling the processes of formation of layered thunderclouds and artificial stimulation of precipitation [1].

To calculate ion concentrations, a kinetic model was developed, including 47 components and 149 reactions. For this purpose, the KINET software package was used. It is shown that the ionization of air by cosmic rays at altitudes from 5 to 35 km leads to the formation of a plasma consisting mainly of $H^+ \cdot (H_2O)_4$ and $O_2^- \cdot (H_2O)_2$. Ion concentration maxima are observed at altitudes from 10 to 15 km under conditions of minimal magnetic rigidity.

These results differ sharply from the results of model calculations for dry air. They make it possible to create realistic models of cloud charging and supplement the conclusions of works [1–2] in which estimates were made for dry air.

The obtained data on the distribution of ion concentrations in the troposphere make it possible to implement plasma regions for artificial stimulation of precipitation without the use of expensive chemical reagents.

References

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