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Time dependent physicochemical model of ionospheric components excitation during auroral events

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The time dependent physicochemical model of the auroral ionosphere is presented. The model describes the excitation processes of electronic-vibrational states of ionospheric plasma components by direct electron impact and the subsequent redistribution of the released energy due to chemical reactions in the local auroral zone at altitudes of 95-250 km. The model makes it possible to simulate the ion composition and electron content of the ionosphere in the electron precipitation zone. Using the model, the height profiles of the concentrations of electrons and ions O_2^+, N_2^+, $O^+(^4S)$, $O^+(^2D)$, O^+, NO^+, N^+ as well as the height profiles of the concentration of excited components $O(^1D)$, $O(^1S)$, $N(^4S)$, $N(^2D)$, $N(^2P)$, $N_2(A^3)$, $N_2(B^3)$, $N_2(W^3)$, $N_2(B'^3)$, $N_2(a^1)$, $N_2(w^1)$, $N_2(a'^1)$ can be computated. Thus, the auroral ionosphere model allows us to obtain a complete picture of the formation of excited atoms and molecules, which are sources of auroral emissions.

An effective method was used to calculate the excitation and ionization rates of ionospheric components. The excitation and ionization rates are related to the realized electron energy by a direct relationship that takes into account all generations of electrons produced in ionization processes. This significantly simplifies the calculation procedure and makes it possible to evaluate the processes occurring in the ionosphere in real time.

The auroral ionosphere model also includes the accurate accounting of the electronic vibrational kinetics of triplet and singlet levels of the excited molecular nitrogen.