Mathematical Modeling of Forest Fire Initiation with the Allowance for the Rad

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Mathematical modeling of forest fire initiation with the allowance for the radiative - convective heat and mass transfer and two temperatures of medium

Ii connection with the estimate of ecological and climatic impacts of forest fires the prediction of the process influence on forest phytocenoses and ground layer state of the atmosphere is of interest. Considering that natural investigations of these problems are merely impossible, methods of mathematical modeling are urgent. The forest canopy is considered as a homogeneous two temperatures, reacting, non - deformed medium. Temperatures of condensed (solid) and gaseous phases are separated out. The first includes a dry organic substance, moisture (water in the liquid-drop state), condensed pyrolysis and combustion products (coke, ash), and mineral part of forest fuels. In the gaseous phase we separate out only the components necessary to describe reactions of combustion (oxygen, combustible products of pyrolysis of forest fuels and the rest inert components). The solid phase constituting forest fuels has no intrinsic velocity, and its volumetric fractions, as compared to the gaseous phase, can be neglected in appropriate equations. It is considered that 1) the flow has a developed turbulent nature, molecular transfer being neglected, 2) gaseous phase density doesn't depend on the pressure because of the low velocities of the flow in comparison with the velocity of the sound, 3) forest canopy is supposed to be non-deformed porous medium. To describe the transfer of energy by radiation diffusion approximation is used, while to describe convective transfer controlled by the wind and gravity, we use Reynolds equations. The research is done by means of mathematical modeling of physical processes. To obtain discrete analogies a method of control volume is used. Calculation method and program have been check. The boundary-value problem is solved numerically using the method of splitting according to physical processes. In the first stage, the hydrodynamic pattern of flow and distribution of scalar functions are calculated. The system of ordinary differential equations of chemical kinetics obtained as a result of splitting is then integrated. A discrete analog for equations is obtained by means of the control volume method using the SIMPLE - like algorithm. In this paper the assignment and theoretical investigations of the problems of large forest fire initiation due to the natural and technogeneous catastrophes, the transition surface forest fire to the crown one and forest fire spread were carried out. The results of solution of these problems are discussed in detail.