MATHEMATICAL SIMULATION OF ATMOSPHERE DYNAMICS AND DUST FORMATIONS AT HIGH-POWER VOLCANIC EXPLOSIONS

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The purpose of the present research was: 1) development of the physical-mathematical model to predict in result of volcanic explosion both the gasdynamic phenomena and the distribution dynamics of ashes and dust particles dropped out on the ground surface and those which are in the atmosphere; 2) research of the factors and processes which influence on the transfer of ashes particles in the atmosphere; 3) development of the computer code to realize the numerical simulation of volcanic explosion and the obtaining of results on dust distributions for different time moments.

The physical model involves the consideration of explosive wave formation and its propagation, rising motion of the explosion area in the atmosphere containing dust particles, rise and settling of volcanic ashes and dust particles. This model is based on separate description of the processes of volcanic ashes transfer and the processes of area evaluation perturbed by the gasdynamic motion. To approximate in space the set of gasdynamic equations the explicit second-order accurate TVD-scheme was used. For transition from n-th to $n+1$-th time step, the two-stage Runge-Kutta TVD-scheme was applied which is also second-order accurate in time. The problem was considered in rectangular Cartesian coordinate system in three-dimensional space. To describe the motion and interaction of dust particles with local air stream the model of discrete particle-representatives was used.

On the basis of developed physical-mathematical model, the computer code was created and simulation of typical volcanic explosions of different yield with the ejection of ashes and dust is carried out. Results of time evolution of volcanic explosion and distributions of dust particles dropped out and those, which are in the atmosphere, are analyzed. These results show that volcanic explosion with the energy yield about 1000 Gt of trotyl equivalent and mass ejection about $3 \cdot 10^{15}$ t leads to the consequences of catastrophic character. At the time moment about 30 min the dust loading of the atmosphere reaches the radius more than 2000 km.

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