SCALING RELATIONS FOR RADIATION EFFECTS DUE TO IMPACTS OF LARGE COSMIC OBJECTS.

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Introduction: Radiation produced due to the deceleration of a cosmic object in the atmosphere and due an emission of a plume of vapor generated by crater-forming impacts is one of the main dangerous consequences of a crater-forming impact. This thermal radiation can be strong enough to be dangerous to people, to ignite fires and even to melt rocks. The effects of the radiation may be estimated based on the data on nuclear explosions [1] or based on the especially elaborated model [2].

Recently, numerical simulations of the impact of 300-m-diameter asteroids (similar to the asteroid Apophis) have been carried out, in which the equations of radiative transfer, added to the equations of gas dynamics, were included [2]. Both the stage of the flight through the atmosphere and the impact on the ground were considered. The same approach was used in [3] to conduct 3D numerical simulations of the impacts of stony and icy bodies 300 m, 1 km, and 3 km in size with various impact angles and velocities. The emphasis is placed on the calculation of radiation fluxes on the ground and assessment of thermal effects.

Based on these simulation results scaling relations for the most important parameters of the radiation field are constructed. Thorough impact risk assessment is a significant computational challenge and motivates the need for simplified approaches and fast damage calculators, which can use suggested scaling relations.

Estimated parameters. The maximal thermal exposure, the duration of radiative pulse, the thermal exposure and the radiation flux spatial distribution were approximated as well as a ratio of thermal radiation energy incident on the ground to the kinetic energy of impacting cosmic object. The value of radiation efficiency takes into account only the energy incident on the ground, and total luminous efficiency will be at least two times larger if the plume radiates upward the same amount of energy as downward. The areas of fire ignition are considered.

Suggested scaling relations are similar to the point source function, and corresponding effective radiative altitude is estimated as well as position of maximal thermal exposure.

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