Motion of the Chelyabinsk meteor in the Earth's atmosphere

Y. Bondarenko[1] and Y. Medvedev[1]

[1]Institute of Applied Astronomy, RAS

We have developed a dynamical model that allows one to study the motion of asteroids and comets in the Earth's atmosphere, to determine the probable impact areas, to calculate the energy emitted as a result of falling, to estimate the major factors of damage, and also to determine the parameters of the heliocentric orbit before the entry into the Earth's atmosphere. Software has been developed to implement the model. Using this software, the motion of the Chelyabinsk meteor was simulated. A study of evolution of its orbit before the collision with the Earth was carried out.

One of the software advantages is the ability to save the results of the computation in a .kml file that allows one to display three-dimensional geospatial data in Google Earth. We can show the obtained trajectory of the meteor, the projection of the trajectory on the Earth's surface, the impact areas of the fragments, as well as the position of the airburst and the nearest settlements.

Parameters of the heliocentric orbit of the meteor before entering the Earth's atmosphere, calculated using the developed software are close to the parameters obtained by other authors. The trajectory parameters with their accuracy at the moment of the meteor airburst are in good agreement with the U.S. Government sensor data on fireballs. To estimate the parameters of impact areas, the fragments of different radii were taken. It is found that the impact areas of the meteor fragments are only within few kilometers from Lake Chebarkul.