Simulations of meteorites and micrometeorites interactions with the Earth atmosphere

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The individual components of interplanetary matter are a rich source of information to better understand the processes associated with the origin, structure and evolution of star systems (Solar system). Particles of cosmic origin interacting with Earth's atmosphere are statistically significant in the form of meteoroids. The main component is dust, respectively micrometeorite particles whose statistical flow is 40 000 +/- 2000 t/year. The particles pass through complex dynamics in the atmosphere, which defines their next physical state, location and the probability of impact on the surface. Our goal is to model the interaction of objects with the Earth's atmosphere and make their localization more effective.

In the simulation we focus on two 3D models (in the .stl format) of Košice meteorite fragments and one 3D model of a micrometeorical particle of Russian origin (Novaya Zemlya, T. Kohout personal communication). By using a 3D model of the fragments, we can use the real shape of the objects to define their aerodynamical resistance properties more specifically. The modeling of the interaction of the meteoroid particles with the Earth’s atmosphere is provided by a virtual wind tunnel in software Micro CFD (Computational Fluid Dynamics). The outputs of the software are the values of the drag coefficient of the real object shape depending on the orientation of the flight and the particular rotation of the model meteoroid. The Meteor Trajectory program (Kornoš et al., 2015) provides the actual modeling of the trajectory in the atmosphere. It is aimed at defining the dark phase of the body's flight, implementing the acquired values of the drag coefficient and the Standard atmosphere model into the calculation. In addition, the program allows us to rotate the body by choosing its random or gradual rotation. The final output of the program is the actual trajectory of a particular object and the coordinates of the impact area with it's uncertainty.

In our work we focus on the results obtained by modeling and on the relevance of the used method. The calculated coordinates of the modeled impact area are compared with the real location of the particular fragment. At the same time, we look at the horizontal shift of micrometeoric particles in the atmosphere. From the data obtained we can describe the influence of atmospheric flow on dust particles. The results can help us to better locate and provide subsidiary capture or collection on the Earth's surface.