THE METHOD OF ANALYZING THE COMPLEX OF SPORADIC METEOROIDS

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Introduction: Currently, much attention is paid to the study of systems of sporadic meteoroids [1, 2]. One of the most important tasks of meteor astronomy is the construction of a model of sporadic meteor bodies (SMB) complex in the neighborhood of the Earth's orbit [3]. The practical value of such a model is defined by the possibility to use it in geophysical and space researches and meteor radio communication [4]. From the theoretical point of view, the importance of this model is that it serves as a basis for establishing the distribution of SMB in the Solar System [5]. The reasons for the construction of the model are the results in ground-based observations of meteors using photographic and radio methods as most accurate and statistically supported ones, the achievements in physics of meteor phenomena in the Earth's atmosphere, and methodological developments [6].

Methods: One of the possible methods of simulating the stationary SMB complex at heliocentric distance r with a mass m greater than some given mass m_0 is the determination of parameters of meteor bodies flux density over the celestial sphere. It is well known that there is no method of recording meteor phenomena that could allow simulating the flux of meteor bodies with a mass greater than minimum recorded value [7]. The parameters such as brightness and amplitude of a reflected signal higher than a certain level may be determined from observations of meteor flux [8]. Accounting the influence of Earth's movement and attraction on SMB flux density [9] provides the distribution of flux density in the heliocentric coordinate system. Thus, the method of simulating SMB complex developed in this paper presents a system of heliocentric radiants and velocities distribution according to the analytical dependencies.

Results: As a result, for the distribution function of heliocentric velocity $f(v)$ and its variance $d(f)$, the analytical dependencies on the angle of heliocentric elongation as well as the dependence of heliocentric radiants on elongation and azimuth angle are determined. The problem of constructing a model of sporadic meteor bodies complex may be considered as solved. To assess the approximation adequacy, the model velocity distributions are compared with the ones produced on the basis of observations. Besides, the dependencies of heliocentric velocity and the variance of this velocity distribution on elongation angles are compared in 2 ways: with the ones produced from observations and with the developed model. As one of the conditions, this work considers meteor bodies distribution model in the narrow mass range. As a rule, such meteoroids generate meteors recorded using a single observation method.

Discussion: The disadvantage of the specified simulation method considering the whole SMB complex as unified is the impossibility to simulate multi-modal conditional distributions of heliocentric velocities. This multimodality is caused by the complicated structure of SMB complex which in its turn is determined by the distribution of probable parental bodies, comets, and asteroids. The disadvantage may be overcome by dividing, based on some assumptions, the whole SMB complex into groups, applying the above-mentioned scheme to each group separately, and superposition of the models with corresponding weighting functions.

Conclusions: Another interesting problem is finding the dependence between averaged distributions of heliocentric velocities on elongation. As the value $f(v)$ is by definition an inverse value of the Earth's major semi-axis, the analysis of distribution of this value for comets and asteroids may provide some information both to solve this problem and to determine new parameters of the dependence of radiant distribution on heliocentric distance, which is very important for the construction of the SMB complex for the whole Solar System and the study of large-scale material mixing at the early stages of the Solar System [10].

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