SUGGESTED MODELS FOR CALCULATION OF THE PROBABILITIES OF DETECTION OF NEAR-EARTH OBJECTS IN DIFFERENT SKY REGIONS

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Introduction: The problem of asteroid-comet hazard was studied in many papers. The number of near-Earth objects (NEOs) with a diameter greater than 1 km and 40 m is estimated to be a thousand and one million objects, respectively [1]. Migration of bodies to the Earth from different regions of the Solar System and probabilities of their collisions with the Earth were studied, for example, in [2-4]. In order to organize observations of dangerous objects that could collide with the Earth, it is important to know better to which sky regions it is need to pay more attention during observations, to compare the effectiveness of detection of NEOs of various sizes by different ground and projected space telescopes, and also to estimate the possible origin (and hence composition) of NEOs moving in considered orbits. In [5] we discussed such problems and proposed an approach for construction of celestial maps of the probability distribution of the appearance and detection of objects approaching the Earth.

Models of the probability of appearence and detection of NEOs in the celestial sphere: For construction of the probability of appearence and detection of NEOs in different sky regions, it is proposed to use the simulated distribution of NEOs over their orbital elements and masses, taking into account the observational selection of orbits and masses, as well as the results of computer simulation of migration small bodies from different regions of the Solar System. Such probability is proposed to be calculated not only for all NEOs, but also separately for NEOs having different origins, as well as for NEOs that travel at a short distance from the Earth and for objects that can collide with the Earth. The probability of appearence and detection of NEOs of various sizes in different sky regions is proposed to be studied not only for observations from the Earth, but also from several areas to which space telescopes for observations of NEOs are planned to be launched. The comparison of the distribution of the discovered NEOs by their orbital elements corrected by taking into account the observational selection with similar calculated distributions of bodies coming from different regions of the Solar System will allow one to estimate the role of different NEOs replenishment sources (asteroids, comets, trans-Neptunian objects) for various orbital elements of NEOs and for various sky regions. This comparison will allow one to better understand the typical composition of NEOs in different orbits. After the probabilistic selection of the orbital elements and the star magnitude of a celestial body (based on the distribution of the simulated NEOs over their orbital elements and masses), it is proposed first to take into account the distance from the observer to the body in order to calculate the positions of the body in orbit at which it can be observed at ideal observation conditions. Then this interval, if it is non-zero, needs to be specified taking into account sky brightness near the considered body and the telescope's ability to observe this region of the sky. While considering simulated NEOs coming from different regions of the Solar System, one must take into account their different typical albedo, since the absolute magnitude of the celestial object depends not only on its size, but also on the albedo. Suggested studies can allow one to understand at what time intervals it is better to observe NEOs with a considered telescope, and to find better locations of space telescopes.

Calculations of sky brightness: While construction of the algorithm of calculation of the probability of detection of an object on the celestial sphere, it is possible to use the codes [6] for calculation of sky brightness for given coordinates and characteristics of the telescope, the region of the observed sky and the observation time. These programs were used in [7] for comparison of the effectiveness of observations of microlensing events by various international telescopes used for the search for exoplanets by microlensing method. The algorithm for calculation of sky brightness used in [6] can be adapted to the use of observational data of Russian telescopes (including ISON-NM and ISON-SSO telescopes) based on the analysis of images taken by these telescopes.

The work was supported by the Program of the Fundamental Studies of the Presidium of RAS N 28 as a part of Russian state program for GEOKHI N 00137-2018-0033.

References: [1] *Handbook of cosmic hazards and planetary defense* / Ed. by J.N. Pelton and F. Allahdadi. Switzerland: Springer International Publishing (2015) 1127 p. [2] Ipatov S. I. and Mather J. C. (2004) *Advances in Space Research* 33: 1524-1533 (http://arXiv.org/format/astro-ph/0212177). [3] Ipatov S. I. and Mather J. C. (2006) *Advances in Space Research* 37: 126-137 (http://arXiv.org/format/astro-ph/0411004). [4] Ipatov S. I. and Mather J.C. (2007) *Proceedings of the IAU Symposium No. 236 "Near-Earth Objects, Our Celestial Neighbors: Opportunity and Risk"* / Ed. by G.B. Valsecchi and D. Vokrouhlicky, p. 55-64 (http://arxiv.org/format/astro-ph/060972). [5] Ipatov S.I., Elenin L.V. (2017) *Ecological bulletin of research centers of the Black Sea economic cooperation*, №4, issue 3, p. 69-75, in Russian. [6] Ipatov S.I. and Horne K. (2014) *LPS XLV*, Abstract #1390. [7] Ipatov S. I. et al. (2014) *Proceedings of the IAU Symp. No. 293 "Formation, detection, and characterization of extrasolar habitable planets"* / Ed. by N. Haghighipour. Cambridge University Press, p. 416-419 (http://arxiv.org/abs/1308.6159).