THE CONSTRUCTOR OF ORBITS FOR THE IMPACT EFFECT CALCULATOR.

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Introduction: After the Chelyabinsk event it is evident that not only large space bodies but also ~20 m size meteoroids pose a substantial hazard.The tasks of detecting, cataloging and assessing the probability of a collision are being actively solved in the world. Networks and monitoring systems have been created to detect the dangerous space bodies. The total number of open asteroids approaching the Earth has already exceeded 17500 (http://minorplanetcenter.org). The number of undiscovered potentially hazardous asteroids with sizes from 140 meters to 1 km are more than 20 000 objects, the number ofpotentially dangerous bodies with sizes from 50 m to140 m more than 200 000 objects [1].The impact of these bodies may result in essential damage. For a quick assessment of an impact consequence different Impact Effects calculators are elaborated, the most popular one [2] uses the scaling laws based on the results of nuclear weapon tests [3]. Next-generation Impact Calculatoris based on a modern hydrodynamic model of the interaction of a cosmic body with the atmosphere and the Earth's surface [4]. This model gives possibility to assess all the hazardous factors of collision of the cosmic body with the Earth. The module "The constructor of dangerous orbits", which will be added to Calculator, allows to determine the point and conditions of entry of any space body with a known orbit into the atmosphere orto estimate the orbital parameters by the parameters of a dangerous object (the entry angle, the entry velocity and the time moment).

The constructor of dangerous orbits: This block allows the user to indicate the orbit of a dangerous space body that collides with the Earth and to determine the parameters of approaching the Earth, or to indicate the parameters of the entry of a dangerous body into the atmosphere and restore the orbit of the space body. In the first case, the user specifies six parameters of the Keplerian orbit. Thus the user creates an orbit and pre-determined parameters of the impact. These data permit to determine the location, the speed, the angle of entry. If the density and the size of the object also are determined, the impactor energy is determined. In the second case user is able to define a orbit of the cosmic object based on the time and place of impact, the entry angle , the trajectory direction and the impact velocity.

The perturbations from the Earth, the Moon, the Sun, and the rotation of the atmosphere were taken into account in the numerical model for orbit determination. The constructor of dangerous orbits was tested at the different known meteorite falls (such as Chelyabinsk meteorite, Almahatta Sitta, Novato, asteroid 2014 AA etc.).

27 hazardous asteroids were selected for the test of the orbital module of Impact Effects Calculator. Minimum orbit intersection distance (MOID) for selected asteroids is less than 6378 km ($4.26 \cdot 10^{-5}$a.u.). Thereby a hypothetical approach of an asteroid to the Earth could happen at a distance less than one radius of the Earth. According to the simulation the range of the entry velocities of asteroids into the Earth atmosphere is in the range 11 to 27 km/sec with average value of about 17 km/s. The entry angle and location of the entry into the atmosphere depend on the time of entry of the asteroid into the atmosphere. Simulations show that the uncertainty (variation) of the Keplerian mean anomaly of the asteroid (less than 1degree) changes the entry angle. The variation of the entry angle is large - from 0 to 90 degrees. Such uncertainty in the value of the mean anomaly usually occurs to asteroids with a poorly defined orbit. The motion of Earth on its orbit is the reason for this effect. The simulations of the Chelyabinsk meteoroid, asteroid 2014 AA and asteroid 2008 TC3 entry angles were shown for demonstration of the different mean anomaly of the initial elements effect.

Summary: "The constructor of dangerous orbits" was tested at the different known objects; the influence of input parameters uncertainty was estimated. .

The beta-version of the Impact Effect Calculator is available at the www.AsteroidHazard.pro.

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