DETERMINATION OF METEOROIDS DYNAMICAL PROPERTIES FOR TERRESTRIAL STREWN FIELDS BY NUMERICAL MODELING

M. Bronikowska[1], N. A. Artemieva[2,3], K. Wünnemann[4], W. Szczuciński[1] [1]Institute of Geology, Adam Mickiewicz University in Poznań, Maków Polnych 16, 61-606 Poznań, Poland (malgorzata.bronikowska@amu.edu.pl) [2]Institute of Dynamics of Geospheres, Moscow, Russia, [3]Planetary Science Institute, Tuscon, Arizona, USA, [4]Museum für Naturkunde, Leibniz Institute for Evolution and Biodiversity Science, Berlin, Germany

Introduction: Strewn fields resulting from the disruption of cosmic bodies during their flight through the atmosphere must exist on all planets with a gaseous envelope. On Earth several of them have been unequivocally identified, such as Morasko, Kaali, Sikhote-Alin. Existing physical models of meteoroid interaction with the atmosphere [1] enable to determine entry parameters of such crater-forming events.

Methods: To constrain meteorites dynamical properties of terrestrial strewn fields we combine atmospheric entry models with the simulation of impact crater formation. First, we integrate numerically standard equations for ablation and deceleration [2]. To simulate the disruption process, we modified the widely used Pancake model [2]: if dynamic loading exceeds meteoroid internal strength, it is transformed into an expanding cloud of fragments with constant density. We use the factor 3.5 relative to the meteoroid initial radius to stop the expansion. Then the position, velocity and mass of each big fragment (>0.1% initial meteoroid mass) in the cloud is defined by Monte Carlo methods with the prescribed cumulative mass-frequency distribution. Later on, these fragments move independently to the ground and some of them may be subjected to another fragmentation cycle. To estimate crater diameters on the ground we use pi-scaling method [3] with material-dependent scaling parameters determined from the suite of 2D impact models. We use vertical velocities and masses of impacting fragments to simulate impact processes with the iSALE2D hydrocode [4-6].

Results: To exclude non-suitable entry parameters for studied terrestrial strewn field (Kaali, Morasko, Sikhote-Alin), we use two criteria: based on: 1) the observed number of craters 2) the biggest crater diameter. Due to Monte Carlo procedures in our algorithm, every set of pre-entry parameters is used ~100 times to minimize the influence of random factors on the obtained results.

Table 1. Entry parameters which are considered as probable for the Morasko strewn field. For each entry mass, we determined the initial velocity and the entry angle resulting in a crater strewn field with 7 – 10 impact craters with the biggest one being 80 - 100 meters in diameter.

Entry mass [tons]	Entry velocity [km/s]	Trajectory angle [°]	Average number of craters	Diameter of the biggest crater
600	16 - 17	41 - 43	8 - 10	80 - 83
700	16 - 18	36 - 40	7 - 10	82 - 84
800	16 - 18	33 - 38	7 - 10	80 - 86
900	16 - 17	32 – 35	7 - 10	81 - 86
1000	16 - 17	31 - 34	8 - 10	80 - 88
1100	16 - 17	30 - 32	9 - 10	82 - 87

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