FROM ATMOSPHERIC ENTRY TO TERMINATION OR A STREWN FIELD: MODELLING FIREBALL EVENTS AS A SUITE OF INDIVIDUAL TRAJECTORIES.

J. Moilanen[1, 2, 3] and M. Gritsevich[1, 2, 3, 4], [1]Finnish Geospatial Research Institute FGI, Geodeetinrinne 2, FI-02430 Masala, (jarmo.moilanen@nls.fi, maria.gritsevich@nls.fi) [2]University of Helsinki, Faculty of Science, Gustaf Hällströmin katu 2, FI-00014 Helsinki, Finland, [3]Finnish Fireball Network, Ursa Astronomical Association, Kopernikuksentie 1, FI-00130 Helsinki, Finland, [4]Institute of Physics and Technology, Ural Federal University, Ekaterinburg, Russia.

Introduction: When an high velocity object, a meteoroid, enters the atmosphere it can be detected as a light phenomon known as a meteor. A bright meteor, called a fireball, may be a testimony of a meteorite fall. Instrumentally observed meteorite falls provide unique opportunities to recover and analyse unweathered planetary samples supplemented with the heliocentric orbit they had. To recover a meteorite from a fireball event, it is essential that recovery teams can be directed to a well-defined search area. Until recently, a realistic simulation of a meteorite strewn field was difficult, in particular due to many unknowns not directly retrieved from the fireball observations. These unknowns include the number of fragments and their aerodynamic properties, for which the masses of the fragments need to be assumed.

The dark flight Monte Carlo model: The dark flight Monte Carlo model (DFMC) is the first of its kind as it provides an adequate representation of the processes occurring during the luminous trajectory coupled together with dark fligh [1]. This Monte Carlo model has already successfully assisted in several meteorite recoveries.

The model comprises a novel approach to fragmentation modelling that leads to a more realistic fragment mass distribution on the ground. A strewn field simulation for the well-documented Košice meteorite fall in Figure 1. demonstrate good matches to the observations [2, 3, 4]. We foresee that this model could be used to revise the flux of extra-terrestrial matter onto the Earth, as it provides a alternative way to estimate the total mass of meteorite fragments reaching the ground.

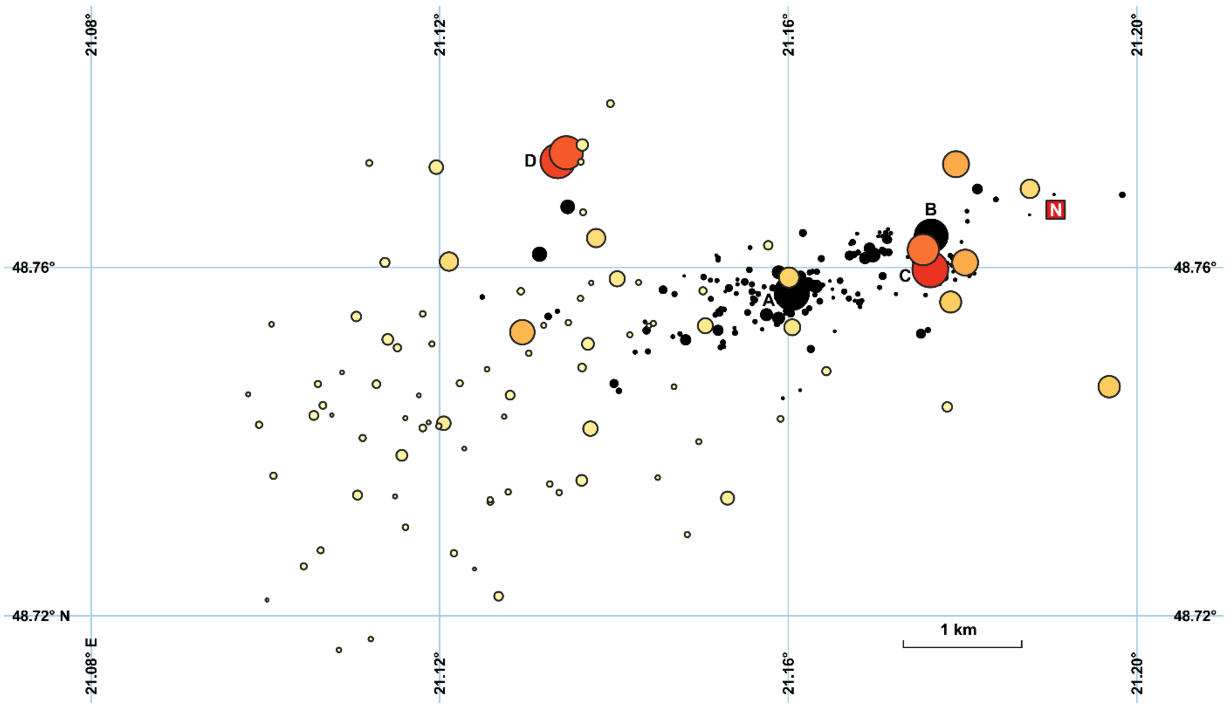

Figure 1. The Košice strewn field. Black solid circles represent the recovered meteorite fragments [3, 4]. The two largest ones have masses of 2.374 kg (A) and 2.167 kg (B). Open circles are the (91) fragments simulated using the trajectory parameters for the beginning height of 68.3 km from [2]. The two largest red circles correspond to 2.344 kg (C) and 2.183 kg (D) simulated fragments and red square (N) stands for the virtual 38.8 kg nominal body.

References: [1] Moilanen J. et al. (2021) *Monthly Notices of the Royal Astronomical Society*, 503:3, 3337-3350. [2] Borovička J. et al. (2013) *Meteoritics & Planetary Science* 48:10, 1757-1779. [3] Tóth J., et al. (2015), *Meteoritics & Planetary Science* 50:5, 853-863. [4] Tóth J. (2020), personal communication.