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A composite luminous and dark flight model allowing strewn field prediction

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As of today, instrumentally observed meteorite falls account for only 37 recovered meteorite cases, with derived Solar System orbit, out of 65098 registered meteorite names. To bridge this knowledge gap, a number of fireball networks have been set up around the globe. These networks regularly obtain thousands of records of well-observed meteor phenomena, some of which may be classified as a likely meteorite fall (Sansom et al. 2019). A successful recovery of a meteorite from the fireball event often requires that the science team can be promptly directed to a well-defined search area. Here we present a neat Monte Carlo model, which comprises adequate representation of the processes occurring during the luminous trajectory coupled together with the dark flight (Moilanen et al. 2021). In particular, the model accounts for fragmentation and every generated fragment may be followed on its individual trajectory. Yet, the algorithm accounts only for the mass constrained by the observed deceleration, so that the model does not overestimate the total mass of the fragments on the ground (and this mass may also be retrieved as zero). We demonstrate application of the model using historical examples of well-documented meteorite falls, which illustrate a good match to the actual strewn field with the recovered meteorites, both, in terms of fragments' masses and their spatial distribution on the ground. Moreover, during its development, the model has already assisted in several successful meteorite recoveries including Annama, Botswana (asteroid 2018 LA), and Ozerki (Trigo-Rodríguez et al. 2015, Lyytinen and Gritsevich 2016, Maksimova et al. 2020, Jenniskens et al. 2021).

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