PDC 2025
Stellenbosch, Cape Town, South Africa

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○ **Disaster Management & Impact Response**

Kinetic energy estimation of ton-TNT scale impacts based on well-known events

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Keywords: Kinetic Energy, Airburst, Radiation, Meteoroid, Fireball

Solar System objects impact Earth's atmosphere daily, but their small size makes them undetectable before atmospheric entry. To better understand these impactors, we need multi-instrument observations of their disintegration phase [1].

In this study we explore several methods of measuring the pre-atmospheric mass of meteoroids with well-known trajectory, at the source of ton TNT-scale atmospheric impacts [2]. On this scale, the impact is less likely to cause an airwave signal which can be detected instrumentally, or the estimation methods carry high uncertainty [e.g. 3, 4], hence, their mass is poorly constrained.

To assess the robustness of the energy estimation methods, we first collected meteoroid-derived measurements from the literature. We found that the radiation of the object is the most commonly measured property of the event [2]. Thus, the analysis focused on the optical energy signature of the objects. Most of the bolides did not have their total radiated energy estimated, hence, this was obtained based on the published light curve. Next, their kinetic energy was computed based on given estimates of velocity and mass.

We derived an empirical relation between source energy and optical energy. We found a good correlation between entry kinetic energy and light radiation during deceleration, which holds regardless of fragmentation and ablation profiles.

The next step would be to extend this relation to more frequent, lower-energy impactors, and use it to calibrate complementary equipment (e.g. radiometers [5] or lightning mappers), to constrain size-frequency distribution of atmospheric impacts.

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