THE END HEIGHT OF FIREBALL AS A FUNCTION OF THEIR RESIDUAL KINETIC ENERGY

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Abstract

Previous analyses of meteoroid compositional groupings have utilized the end height of fireballs as a diagnostic tool. From an observational perspective this definition is straight forward, but from a theoretical viewpoint there are problems with using this operational definition. These include:

a) Dependence of end height on slant range due to extinction for long optical paths;

b) Minimum mass sensitivity effects due to ablation, gross fragmentation, etc.;

c) Limiting wavelength and amplitude detection due to sky brightness, response of the emulsion, etc.;

d) Theoretical predictions of an optically thick radiation field at low altitudes for high velocity entry (Biberman et al., 1980).

In order to realistically assess the estimated geometric uncertainty of + 1km in the observed end height, a theoretical definition of the end height of meteoritic fireballs is proposed using the results from the integral radiation efficiency model of REVELLE (1980). Three photographed and recovered meteorites, Pribram, Lost City and Innisfree are used as a calibration for this proposed definition. These three fireballs were calculated as having about 99% of their pre-atmospheric kinetic energy removed prior to the dark flight phase. Assuming that a fixed fraction of the initial kinetic energy will remain at the end height, a prediction of the theoretical end height can be made directly.

This definition has been used to evaluate the end height of all fireballs that were deduced by WETHERILL and REVELLE (1981) as being "meteoritic". In almost all cases the theoretical values are lower than the observed values, in some cases being as much as 5km lower. A preliminary summary table of results is given below.

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Evaluation of fireball end heights with $\sigma = 0.02^2/km^2$, H = 8 km and $D_e = 4.60$.

Fireball Name/Number	[1] (g) m_∞	cos Z_R	(km/sec) v_∞	(km/sec) v_e	(km) z_e	(km) Observed end Height
PN39113A	$7.4.10^3$	0.93	14.9	8.0	21.7	26.6
PN39409	$7.2.10^2$	0.74	31.7	6.6	52.1 (40.8)[2]	39.9
PN39499	$6.2.10^3$	0.23	12.4	7.0	31.0	36.6
PN40503	$2.7.10^6$	0.62	20.9	11.7	16.0	21.5
PN40590 (Lost City)	$6.0.10^4$	0.62	14.2	3.5	19.3	19.9
PN40617	$1.0.10^4$	0.52	13.2	4.6	24.3	26.3
Pribram	$1.4.10^6$	0.69	20.89	7[3]	18.4	13.3
Innisfree	$2.0.10^4$	0.92	14.54	2.59	19.6	19.9

Legend

1 Mass values have been assigned by either the entry model values given in REVELLE (1979) (Lost City, Innisfree and Pribram), by photometric mass given in CEPLECHA and MCCROSKY divided by 13 (WETHERILL and REVELLE, 1981) (40503), or by three times the initial dynamic mass given in WETHERILL and REVELLE (1981) (39113A, 39409, 39499 and 40617).

2 Alternative value assuming $\sigma = 0.01$ at high velocity for large bodies (BIBERMAN et al., 1980).

3 Originally estimated as 10 ± 7 km/sec (see REVELLE, 1979).

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