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# Phase transition energetics-based mass loss modeling of chondritic Near Earth Objects

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*Keywords:* ablation, Near Earth Objects, mitigation, energy deposition, chondrite

Mitigating potentially hazardous asteroids relies on accurate knowledge of their composition and critical physical characteristics such as shape and mass. Ground-based observatories [1] and sample return missions [2] in recent years have focused on such characterization to track Near Earth Objects. Historically, entry speeds of asteroids or mass change due to break-up/airburst have been considered in risk assessment studies as critical parameters [3, 4, 5]. To this effect, most hydrocode simulations that consider energy deposition techniques rely on gross meteor modeling with simplistic spherical shapes while neglecting heat of ablation considerations [6]. This is the general approach for fragment-cloud, pancake and hybrid fragmentation models [7]. Alternatively, aerothermal fragmentation modeling that accounts for meteoritic shape change have typically focused on environmental modeling to understand break-up points primarily due to radiative heating [8]. A physics-based risk assessment could benefit by modeling the environment and material response of typical meteoroidal materials as precursors to fragmentation. A greater focus on the material response to applied environmental heating will be emphasized here.

This work presents a forward analysis of thermal and material response of stony meteorites by accounting for mass loss and shape change effects through a boundary layer formalism. This allows for

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simulations starting from simplistic shapes that could eventually lead to alterations in contours due to ablation. These effects would be characterized through phase transitions of the surface, such as melting and vaporization, in response to aerodynamic heating. Coupled ablation and radiative heating effects have been found to lead to reduced heat transfer coefficients in the computation of meteor mass loss rates [9]. This has the potential to increase ground damage footprints for hazardous impacts. The effort here quantifies the heat transfer coefficient by accounting for ablation assisted by phase transition. The melt and vaporization mediated ablation of chondritic meteors provides essential recession estimates based upon surface environments. The altered mass due to such phenomena would be presented for a H-chondrite meteoritic sample.

**Comments:**
*Oral presentation with full-length manuscript*

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