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Risk Estimation Of Threatening Asteroids

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ABSTRACT

The risk that a threatening asteroid poses to populations on the ground is driven by the impact damage severity and the impact location. In general, both factors are subject to large uncertainties that pertain to physical properties (e.g., size, density, etc.) and the orbital solution for the asteroid. The Probabilistic Asteroid Impact Risk (PAIR) assessment tool samples the statistical distributions of all uncertain elements and uses Monte Carlo simulations to calculate the risk distribution associated with a given asteroid. The orbital uncertainty is sampled to provide potential impact locations in the form of an impact corridor. Impact velocity and entry angle are additional parameters that are obtained from orbital uncertainty sampling. Physical properties are assigned based on distributions representing the asteroid population or observations of the threatening asteroid that constrain the range of possible property values. The resulting risk distribution can be queried for threat

characteristics such as minimum, mean, and maximum expected risk. It also yields information about the spatial risk distribution for this impact scenario. The spatial risk distribution illustrates regions of highest risk, accounting for the local impact probability, impact consequences, and population density. Here we demonstrate this risk estimation approach for threatening asteroids using the example of the fictitious impactor 2019 PDC. Such analysis provides a quantitative basis for the work of decision makers and disaster managers. It may further find application in areas such as mitigation mission planning where projected post-mitigation risk can be compared to pre-mitigation levels as a means of cost-benefit analysis for mitigation options.

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