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Ensemble Risk Assessment in Support of the 2016 NEO Science Definition Team

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ABSTRACT

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Asteroid threat assessment requires the quantification of both the likelihood of an impact and the resulting consequences across the range of possible events. The Asteroid Threat Assessment Project at NASA Ames Research Center is developing a modernized probabilistic asteroid impact risk (PAIR) model to perform such assessments and increase understanding of the near-Earth object (NEO) risk in support of NASA's Planetary Defense Coordination Office. The model combines improved physical modeling of the impact process with a Monte Carlo framework to represent the uncertainties associated with potential impact properties and their effects on resulting damage levels. The entry and fragmentation process is explicitly modeled for each impact case to compute the atmospheric energy deposition, which is then used to generate improved estimates of the resulting blast overpressure, thermal radiation, and tsunami hazards. The hazard consequences are weighted by size-dependent impact frequencies to produce quantitative estimates of the impact risk.

In the context of a global ensemble risk assessment, we will show how high-fidelity simulations have been used to update engineering tsunami risk models, how improvements in air blast propagation can be reflected in the risk assessment, and how use of the full result distributions can lead to improved insights. Specifically, we will present the application of the PAIR model in support of the NASA's 2016 NEO Science Definition Team, and show how the risk estimates have changed since the 2003 SDT. For example, changes in the NEO population estimates have reduced impact frequency predictions, and the updated tsunami model predicts lower coastal inundation. In addition, higher fidelity modeling of the energy deposition, blast propagation, and damage assessment not only change the specific risk estimates, but also allow for a broader range of damage metrics. Lastly, we will present probability distributions of the impact risk, which describe the range of possible consequences.

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