PDC2015
Frascati, Roma, Italy

- ☐ **Planetary Defense – Recent Progress & Plans**
- ☐ **NEO Discovery**
- ☐ **NEO Characterization**
- ☐ **Mitigation Techniques & Missions**
- ☒ **Impact Effects that Inform Warning, Mitigation & Costs**
- ☐ **Consequence Management & Education**

IAA-PDC-15-05-01

New Risk Assessment and Early Warning of Airbursts from Small NEOs

Mark Boslough (Sandia National Laboratories),
Peter Brown (University of Western Ontario), and Alan Harris (MoreData! Inc.),

ABSTRACT

We present a new risk analysis of airbursts, which we define as events in which small (meters to tens-of-meters in diameter) asteroids deposit most of their energy in the atmosphere as large bolides and where the total energy is comparable to or greater than small nuclear explosions (>0.1 kilotons of TNT). The risk from airbursts is higher than previous assessments for two reasons. First, they are more frequent than previously thought. Our Tunguska-class (~40 meters) population (and impact frequency) estimate has doubled, and Chelyabinsk-class (~20 meters) has increased by a factor of 2.6. Second, asteroid airbursts are significantly more damaging than previously assumed. In most cases, they more efficiently couple energy to the surface than nuclear explosions of the same yield.

NEO risk assessments published in the 1990s concluded that the largest asteroids (> 1 km) dominated the hazard. Even though large NEOs represent only a tiny fraction of the population because of a power-law size distribution, the potential for global catastrophe means that the contribution from low-probability, high-consequence events is large. This conclusion led to the Spaceguard survey, which has now catalogued nearly 90% of these objects, none of which is on a collision course. The survey has reduced the assessed near-term statistical risk from this fraction by more than an order of magnitude because completion is highest for the largest and most dangerous. The relative risk from objects in the tens-of-meters size range would therefore be increasing even if their absolute assessed risk were not.

Uncertainty in the population of airburst-class NEOs remains quite large, and can only be unambiguously reduced by expanded surveys focused on objects in the tens-of-meters size range to improve the population estimates. One strategy would be to design surveys to count small NEOs making close passes in statistically significant numbers. For example, there are about 25 times as many objects of a given size that pass within the distance of geosynchronous orbit than collide with the earth, and 2000 times as many pass within a lunar distance (accounting for gravitational focusing). An asteroid the size of the Cheylabinsk impactor (~20 m) could potentially be observed within geosynchronous orbit every two years and within lunar orbit nearly once a week. A Tunguska-sized asteroid (~40 m) passes within a lunar distance several times a year. A survey optimized to

discover and count these objects would rapidly reduce the uncertainty in their populations. An additional benefit would be early warning of an imminent impact to give authorities time to issue evacuation or take-cover instructions in circumstances for which there would be no time the prevent an impact.

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under Contract DE-AC04-94AL85000.

****