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Airburst Warning and Response

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It is virtually certain (probability > 99%) that the next destructive NEO event will be an airburst. Planetary defense is usually assumed to have the primary goal of maximizing the number of lives saved, but it can be argued that more emphasis should be placed on maximizing the *probability* of saving lives. For the latter goal, it is far more effective to create an early warning and civil defense plan than a mitigation plan that involves deflecting a large NEO. Because early warning and civil defense will almost certainly be needed long before the first deflection is ever required, the credibility of the planetary defense community and its recommendations will be put to its first serious test by an airburst. Successful response to an airburst event will make it much more likely that recommendations for mitigation by deflection will be accepted by decision makers and the public. Focusing more attention on the second goal will, as a side effect, benefit the primary goal.

Airbursts are local events and unlikely to create international conflict if they have been predicted in advance, so early warning can generate goodwill and trust leading to cooperation for large NEO mitigation. If airburst recommendations save lives, those lives are very likely to be citizens of nations other than those responsible for the warnings. Conversely, if we ignore the airburst threat and there is an event with casualties, future mitigation recommendations are much more likely to be ignored. Moreover, if an imminent Tunguska-class impactor were observed but not recognized because of the insufficient observational resources or inadequate period between observations, the resulting criticisms and conspiracy theories could irreparably damage our credibility. Airburst "mitigation" by early warning and civil defense should be taken more seriously for that reason, if no other.

A reasonable approach would be to use computational models to generate "lookup tables," reduced-order models, or scaling laws to generate maps of damage on the surface and convolve with uncertainty footprints based on astronomical observations and orbital dynamics projections. This method would be used only to issue warnings associated with airbursts that are virtually certain to happen ("8" on the Torino Scale or undefined if smaller than 20 m). Such an alert would provide the time, coordinates, and a scale number indicating maximum possible damage at the epicenter. Such a system could be implemented to provide maps showing contours based on the convolution. The system would need to be very fast and automatic, and therefore based on simulation output that is linked to orbital output. The threat maps would be analogous to the National Hurricane Center's operational hurricane maps, which explicitly include uncertainty. Local authorities would then issue instructions based on the alert. Civil defense would be the responsibility of the target nation (just as foreign nations use the NHC alerts without requiring further US help).

The warning could also contain maps showing locations from which one could safely view the event, and where it would appear in the sky--even if over the horizon. This would create the opportunity to obtain images, video, and other useful data from smaller events, helping validate models and improving our understanding of the airburst process. It is highly likely that the first events with such warnings would not be threats at all, but opportunities for science and amateur astronomy. The optimal and most likely outcome would be a series of harmless 2008-TC3-class events, a few of which would be observable and documented. This would lead to positive media coverage, increased awareness of the threat, more confidence and respect for the predictive capabilities of our community, better response to subsequent serious civil defense warnings, more support for planetary defense activities, and ultimately--more lives saved.

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