NEAR-EARTH ASTEROID/METEOROID IMPACTS: PROSPECTS FOR LINKING TELESCOPIC OBSERVATIONS WITH RECOVERED METEORITES

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Introduction: The recent discovery of asteroid 2008 TC_3, its predicted and observed impact over Sudan 20 hours later, and subsequent recovery of meteorites [1] may seem to be a remarkably lucky event, but it is actually the forerunner of what should be an increasingly common occurrence due to previously unrecognized and increasing capabilities of the current Spaceguard Survey and plans for future Near-Earth Asteroid (NEA) surveys. NEAs of diameter 4 m (the size of 2008 TC_3) strike the Earth annually (1.5 m objects strike monthly) [2]. An incoming 4 m object is brighter than the limiting magnitude of current Spaceguard Survey telescopes for 1 to 2 days. The survey is limited to the night sky, favoring the northern hemisphere and locations away from the galactic plane and the Moon, typically covering ~35% of the celestial sphere. A decade ago, this fraction of the sky was covered on a monthly basis but it is now mapped several times a month. Thus the current survey has a chance approaching 10% of observing an annual impactor as an astronomical object and predicting an accurate impact location and time. So the survey, as currently operating, may detect an event like 2008 TC_3 roughly once a decade; monthly impactors cannot be detected so far out, but there are more of them, so they are likely to be found at least as frequently. Larger NEAs (> 30 m diameter), possibly capable of doing damage on the ground approaching that done by Tunguska a century ago, should all be bright enough long enough in advance to be detected in time to provide short-term warning, provided that they come from the 35% of the sky that is being mapped.

Future Prospects: Fairly minor enhancements to the current Spaceguard Survey could significantly enhance the discovery rate of meteorite infalls. These could include enhancement of southern hemisphere observing, mapping closer to the Sun, and improving detection algorithms in starry fields. Current telescope allocation procedures are not yet optimized for quick response to ensure that astronomical observations for physical properties are obtained before impact; unfavorable weather conditions could also inhibit timely observations. Notification channels should be fine-tuned to enhance the chance that an impact itself can be observed from space, from aircraft, and from the ground.

There are plans for markedly enhancing the Spaceguard Survey, including the Pan-STARRS and LSST projects. When (and even if) they will go on-line is uncertain. Current plans are that LSST would "cover the sky" (35% of it) about once every 5 nights and it would be capable of detecting all monthly impact events, for the meteoroids coming from that fraction of the sky. Provided such objects yield meteorites, we may eventually expect meteorites linked to astronomical objects to be potentially recoverable on land on an annual basis, even though the majority will land in the ocean.

References: [1] Jenniskens P. et al. 2009. *Nature* 458:485-488. [2] Brown P. et al. 2002. *Nature* 420:294-296.