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THE POPULATION OF SMALL NEAS

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ABSTRACT

Every two years I re-assess the completion of NEA surveys and from that estimate the size-frequency distribution of NEAs, from the largest (~10 km diameter) down to the smallest detected by surveys, only a few meters across. The number of large NEAs (D > 1 km) is by now well established at just under 1,000 objects, and not likely to be revised much. The greatest uncertainty lies in the smaller range, from ~100 m diameter down to about 10 m, below which bolide and meteor data yield more reliable numbers. The recent Chelyabinsk event and newer estimates of bolide frequency by Brown et al. (Nature 503, 238-241, 2013) suggested that my 2012 population estimate was too low by a factor of several in that size range. For the new estimate, based on re-detection statistics of existing surveys from 2012 to 2014, I improved the computer survey model to simulate a duration of 20 years, rather than the previous 10, and also imposed a continuously improving survey over time to more closely match the real surveys. I fixed the variable survey by setting the limiting magnitude of the survey simulation to improve by 2 magnitudes over the twenty year interval. The method used is to run the computer simulation in terms of a single independent variable, $dm = (v_{\mathrm{lim}} - H)$, using a sample of 100,000 simulated orbits matching the observed distribution of NEAs. The completion versus *dm* of the simulated survey can be tabulated, as can the "re-detection ratio" for the final two years of the simulation. The re-detection ratio is the ratio of detected objects that were already "discovered" prior to the two-year test period to the total number detected during that interval, new discoveries plus re-detections. Actual completion always lags below the re-detection ratio, since the easiest NEAs are discovered first and re-detected more often and the more difficult ones. The re-detection ratio versus *H* magnitude for the actual surveys over the last two years was tabulated and used to "calibrate" the computer simulation, that is to relate the parameter *dm* in the simulation to *H* magnitude of the actual surveys. Once calibrated in this way, an estimate of completion versus *H* magnitude is obtained, and this completion curve

can be defined and extrapolated over a much wider range of H (or dm) than the re-detection ratio can be measured. With the completion curve so calibrated to H, we can then estimate the total number of NEAs in each half-magnitude size bin simply as $n(H) = n_{\mathrm{disc}}(H)/C(H)$. We present here the latest analysis, using survey statistics from 2012 to 1014 and the improved computer model based on twenty years with varying limiting magnitude, and find that our population estimate of small (2 to 20 m diameter) NEAs agrees extremely closely with the bolide flux estimates of Brown et al. (2013), so the discrepancy appears to be resolved and the population well determined over the entire size range from the largest NEAs (10 km) down to meter-sized “annual event” objects.

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