Space traffic management beyond 100 megameters

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ABSTRACT

The authors establish which artificial satellites enter the volume of space farther than 100 megameters from the geocenter. We define our region of interest in this way since no existing terminology is satisfactory. “Cislunar” technically includes low-Earth orbit (LEO). Only one artificial satellite is high enough to be considered Earth-Moon “barycentric.” “Circumterrestrial” is synonymous with geocentric. Simplified General Perturbations computer code equates “near-Earth” to a geocentric anomalistic period of less than 225 minutes; but in planetary defense parlance, near-Earth means a perihelion of less than or equal to 1.3 astronomical units. “Deep-space” definitions are correspondingly disparate.

Where the official Satellite Catalog sanctioned by the United Nations lacks an entry, we assign unofficial Committee on Space Research designations without a catalog number. Unlike LEO, many of the payloads we identify become lost soon after their owners abandon them. Some of the operations debris go missing right after launch. Due to low probability of Earth return, the authors exclude planetary orbits and interstellar trajectories from this analysis. However, we include heliocentric orbits due to possible Earth return. For example, although in heliocentric orbit, International Cometary Explorer should return to Earth’s vicinity in 2029.

After categorizing these artificial satellite orbits, we assess who has “custody.” In this paper, custody does not imply ownership or control, but simply knowledge of where a satellite is. “Lost” means insufficient data to acquire with a capable instrument like the United States Space Surveillance Telescope.

Finally, we recommend guidelines for advancing from mere awareness of this region to real space traffic management. Suggestions include expert software, disposal orbits, specialized analysts, unconventional sensors, higher-fidelity propagation, and international cooperation.