18th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Modeling and Risk Analysis (2)

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LONG-TERM AND SHORT-TERM EFFECTS OF LARGE NUMBER OF OBJECTS IN EACH ORBITAL ALTITUDE FOR CONSIDERING SPACE ENVIRONMENTAL CAPACITY

Abstract

Long-term and short-term effects of large number of objects in each orbital altitude band are evaluated using a debris evolutionary model for discussing how much objects can be inserted into orbit with ensuring sustainable use of space. We have been evaluating evolutions of cumulative collision probability in each altitude band for many cases such as with and without ADR and PMD, since the total effective number of objects is insufficient to discuss the different situation in each altitude. In this study, large number of objects are inserted in several altitude and both long-term effects and short-term effects are investigated. We evaluated the cumulative collision probability and the number of conjunctions for short-term effects, while the stability of orbital environment is evaluated for the long-term effects. The effects are compared with the baseline case by normalizing with those of the baseline case where no additional large number of objects inserted. We found that when large number of objects are inserted into some lower altitude, the long-term effect is acceptable while unstable self-cascading effect is observed when some objects are inserted into some higher altitude, because not only air density but also currently existing debris objects in those altitude are different. The effects of initial conditions such as number of objects, dispersion of altitude and orbital planes of objects are also investigated, and how to define space environment capacity is discussed.