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Space carrying capacity assessment and allocation (10-E9.4)

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LOW EARTH ORBIT CAPACITY THRESHOLDS INVESTIGATION FOR A SUSTAINABLE USE OF THE SPACE ENVIRONMENT

Abstract

The increase in the number of orbiting objects, being them controllable or uncontrollable, is expected to significantly affect space operations in the near future. This is particularly true in the Low Eart Orbit (LEO) region, where the population of debris is increasing because of new fragmentations, while, on the other hand, the advent of large constellations has accelerated the growth of the number of active missions. Therefore, careful mission design together with the implementation of mitigation guidelines and policies are essential to regulate the evolution of space environment and to avoid the proliferation of derelict objects around the Earth. In this view, in recent years, international discussion is ongoing on how to assess space capacity and how this concept could be improved and exploited to define actionable thresholds to be used to define specific mission requirements. This work aims at analysing the threshold of orbital capacity, investigating the evolution of the space environment with long-term simulation scenarios defined in terms of launch traffic, explosions rate, and disposal strategies. In this context, a risk metric, considering the likelihood and associated severity of fragmentations of the satellite(s), is used to measure the impact of each mission on the environment and subsequent space capacity consumption. The metric is applied to each mission and in each scenario, both at the beginning and at the end of the simulation, to evaluate the change in total capacity consumption. The latter is further investigated in terms of type of in-orbit objects analysed (e.g., payloads, constellations), orbital areas in which they are located (e.g., altitude slots), and eventual designated post-mission disposal strategy, along with its reliability. Several scenarios, based on historical trends or on extrapolation of current behaviours, are considered, subjected to Monte Carlo simulation, and compared to understand the relevance of each parameter and their adherence to a sustainable evolution of space.