Paper ID: 40543
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15th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Joint Small Satellite/Space Debris Session to promote the long-term sustainability of space (10-B4.10)

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TO LAUNCH OR NOT TO LAUNCH - RESPONSIBILITIES OF SMALL SATELLITES FOR A SUSTAINABLE SPACE ENVIRONMENT

Abstract

The launch traffic to low Earth orbits (LEO) is undergoing a drastic change. Driven by technology miniaturization, new data processing capabilities, but also a generally more open space, small satellites have grown tremendously in popularity during the last years. Starting in 2013, their annual launch rate has jumped from some tens to steadily over hundred per year. Forecasts predict these numbers to rise further. On the one hand, this development is highly welcome as reduced hardware and launch cost, compared to classically large satellites, bring new actors and subsequently new life into the historically rather slow-progressing spaceflight industry. On the other hand, the increase in the number of objects causes concern towards the possible small satellites' contribution to the orbital debris environment, driven by the fact that most of the small satellites are not equipped with propulsion systems and therefore can perform neither end-of-life nor collision avoidance manoeuvres. To assess the impact of small satellites on the space debris environment, a large set of long-term projections have been performed. For this, the University of Southampton's DAMAGE (Debris Analysis and Monitoring Architecture to the GEO Environment) and the Institute of Space System's LUCA (Long Term Utility for Collision Analysis) tools have been used. In the simulations, payloads were split into two sub-groups: small satellites and the background population. For the background population, a repeating cycle of launches performed between 2005 and 2012 and a full adherence to space debris mitigation guidelines were assumed. The small satellites where superposed to the background population. The simulations were performed parametrically, varying small satellite launch traffic characteristics, such as the number of objects launched, their preferred release altitudes, and their abilities to perform post mission disposal and collision avoidance manoeuvres. Additionally, some background traffic variations, such as their numbers and mitigation guideline adherence, were undertaken. The simulation results were analysed in regards to the statistical impact of small satellites on the environment, using different evaluation criteria. From this analysis, those parameters that have the largest influence on the environment evolution were deduced. Additionally, the analysis shows that despite their small sizes and low masses, small satellites had a statistically significant impact on the space debris environment evolution in all run scenarios, including one in which the small satellite launch traffic as of today is mimicked. Therefore, small satellite manufacturers and operators need to be aware of their responsibility for sustaining the low Earth environment.