

SPACE DEBRIS SYMPOSIUM (A6)  
Mitigation and Standards (4)

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IMPACT OF SOLAR FLUX MODELING ON SATELLITE LIFETIME PREDICTIONS

**Abstract**

The number of objects in low Earth orbits (LEO) is increasing. Especially in the densely populated region of the Sun-synchronous orbits near 800 km, the so called Kessler syndrome will lead to a further increase of objects due to mutual collisions. In order to counteract this effect, several measures are recommended by the Space Debris Mitigation Guidelines of the UN Committee on the Peaceful Uses of Outer Space (UNCOPUOS). One of these guidelines states that the long-term presence of spacecraft in LEO should be limited after the end of the mission. If the direct de-orbit, followed by a controlled re-entry of the spacecraft, is not possible, the spacecraft should be transferred to an end-of-life (EOL) orbit with a limited residual lifetime. The IADC recommends the residual lifetime of the spacecraft on its EOL orbit not to exceed a maximum of 25 years.

In order to define the residual lifetime of a spacecraft on a certain orbit, a propagation has to be performed, considering all major perturbations. The orbital decay is mainly driven by atmospheric perturbations, affecting the orbit's eccentricity and semi-major axis and thus the orbital altitude. The magnitude of the residual drag of the atmosphere depends on many parameters, for example the spacecraft mass, geometry, the composition of the upper atmosphere, etc.

In this paper the influence of different modeling approaches for the future solar flux estimation with respect to the orbital decay shall be investigated. Within the new version of ESA's Debris Mitigation Analysis Tool DRAMA, this option is included as an input for the Orbital Spacecraft Active Removal (OSCAR) tool. The future solar flux index value may, for example, be assumed to be at a constant level, which is also stated by the ECSS standard (ECSS-E-ST-10-04C). However, it is also possible to model the future solar flux as a replication of an exemplary past solar cycle. Another possible method is to derive a

best-guess estimation based on currently available measurement data of the solar flux. Different example spacecraft shall be analysed with respect to their residual lifetime, comparing the different approaches in future solar flux modeling.