SPACE DEBRIS SYMPOSIUM (A6)
Modelling and Risk Analysis (2)

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INFLUENCE OF SOLAR ACTIVITY ON LONG TERM PROPAGATIONS

Abstract

Long term propagations are used in debris environment models to predict their future evolution. Such results were used to derive the mitigation guidelines of the Inter-Agency Space Debris Coordination Committee (IADC), and also to support the concept of active debris removal with the aim to avoid the long-term proliferation of space debris due to collisional cascading (Kessler syndrome). However, all environment models suffer from uncertainties in the assumptions of input parameters for traffic and perturbation models. One of the main uncertainties is due to the predicted solar activity. A high solar activity increases the atmospheric density. As a consequence, the decay rate is also increased. A low solar activity has the opposite effect and leaves objects in orbit for extended time spans.

In this study, we show the effects of the solar activity predictions on the long term propagation and evolution of the future debris environment using ESA's DELTA tool (Debris Environment Long-Term Analysis). DELTA is a 2- or 3-dimensional, time-dependent, dynamic debris model, with statistical assumptions on launch traffic and release events, and with collision events generated, based on local object densities and collision probabilities. DELTA can take in account a variety of debris mitigation measures and also considers active debris removal.

To validate our tools, we look back into the past and propagate some old objects with real, observed solar activities. For comparison of resulting orbits we propagate the same objects based on predictions of the solar activity that would have been done at a certain epoch in the past. Finally, we consider the effect of applying the commonly used mean solar activity predictions instead of daily values, investigating consequences of the erroneous assumption that mean solar activities generate mean atmospheric densities.