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QUANTIFYING SPACECRAFT DEMISE BYPRODUCTS IN THE ERA OF MEGA-CONSTELLATIONS

Abstract

The number of orbiting bodies has significantly grown in an unrestricted and unregulated manner over the last years. That trend is emphasized by the already implemented plans of building large on-orbit infrastructures of microsatellite mega-constellations and by the arrival of active debris removal solutions, leading to a predictable increase in reentry rates. However, the effect of spacecraft demise on Earth's atmosphere is yet lightly studied and the long-term impact on the sustainability of the mesosphere and its underlying layers remains unknown.

This research establishes the first Molecular Dynamics (MD) simulation set to thoroughly understand the dynamics of LEO reentry and resolve the byproducts generated in mesospheric reactions. Considering the case study of a mega-constellation, the byproducts generated from a standard micro-satellite composition are identified and quantified. Resorting to publicly available reentry forecasts, conclusions are drawn by quantifying the increase of such byproducts above the natural levels defined by meteoroid reentry.