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THE POLLUTING POTENTIAL OF SPACECRAFT DEMISE IN THE ATMOSPHERE: TRENDS AND PATHS TOWARDS SPACE SUSTAINABILITY

Abstract

The number of orbiting satellites has increased significantly in an unrestricted and unregulated manner over the last decades, threatening the sustainable access to space. This trend is expected to continue with ongoing plans from the commercial space sector to build mega-constellations of microsatellites in spite of numerous claims of skepticism concerning its impact on ground- and space-based scientific assets [1]. While it is widely understood that most pieces of debris will completely burn during reentry, the effect of satellite demise on Earth's atmosphere has only been lightly studied and the long-term impact remains unknown with possible consequences to the ozone layer [2].

This NASA-funded research presents a first-order approximation on the environmental impact of satellite reentry in the atmosphere, identifying key components driving the pollution footprint such as Aluminum [3,4]. Reentry forecasts [5] are appreciated so as to extrapolate medium- to long-term consequences, and an assessment of putative solutions towards a more sustainable approach to space debris disposal is performed from both legal and technical standpoints.

References: [1] NASA, "Space Station Applications Accepted for Filing, Space Exploration Holdings, LLC (SAT-AMD-20210818-00105)," Report No. SAT-01598 , 2022. [2] Federal Communications Commission, "Space Exploration Holdings, LLC Request for Modification of the Authorization for the SpaceX NGSO Satellite System," Order Authorization IBFS File No. SAT-MOD-20200417-00037, 2021. [3] J. P. Ferreira et al, "Quantifying Spacecraft Demise Byproducts in the Era of Mega-Constellations," in 73rd International Astronautical Congress, France, 2022. [4] J. P. Ferreira et al, "Impacts of Satellite Reentry on Atmospheric Composition in the Era of Mega-Constellations: Molecular Dynamics Simulations," in AGU Fall Meeting 2022, United States of America, 2022. [5] ESA Space Debris Office, "ESA's Annual Space Environment Report," GEN-DB-LOG-00288-OPS-SD, 2022.