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Modeling and Risk Analysis (2)

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ENGAGING THE COMMUNITY: THE CO-CREATION OF SPACE DEBRIS MODELS

**Abstract**

In the aftermath of the Ariane 1 upper stage explosive breakup in November 1986, the European Space Agency (ESA) initiated the Space Debris Working Group (SDWG) to study the consequences of space debris. This marked also the starting point for the European model MASTER (Meteoroid and Space Debris Terrestrial Environment Reference). While early versions focused on modelling breakup processes, additional source models in later versions through the 1990s led to a significant increase in the model's complexity. In parallel, space debris mitigation guidelines have been developed, mainly through the technical expertise in the Inter-Agency Space Debris Coordination Committee (IADC). The recognition of the need for space debris mitigation in view of a growing number of space debris in the same orbital regions valuable satellites are operated in, led to the development of means to assess a space mission's compliance with the proposed guidelines. The Debris Risk Assessment and Mitigation Analysis (DRAMA) tool suite is based on MASTER's background population and is being used in the mission design by different entities globally today.

The combination of several factors, including the growing space debris environment; the intensified dependence of our technological society on the space infrastructure; the disruptive changes in the NewSpace era; and the increased domain knowledge attained all contribute to a system of unprecedented and further growing complexity. A possible way to address this challenge is through engaging with stakeholders in space debris modelling and associated risk management practices. In March 2021, ESA hosted the interdisciplinary MASTER Modelling Workshop to discuss modelling aspects with stakeholders, to understand the connected-ness between groups and seek for ways to understand the potential to improve stakeholder involvement in essential areas related to space debris modelling. About 80 participants discussed over three days technical and non-technical aspects related to measurements and model validation; the ways the model output is used by different stakeholders like industry, academia and agencies; as well as modelling future scenarios and potential model improvements by and for the community.

In this paper, the workshop results will be presented and reflected in view of ESA's on-going developments in the Debris Mitigation Facility (DMF, 2020-2023), which combines the MASTER and DRAMA tools. An updated roadmap for those developments aligning the perspectives of the community will be discussed and the current status of the on-going projects reported. The latter includes digitalisation of the mission design and automation of the future environment prediction.