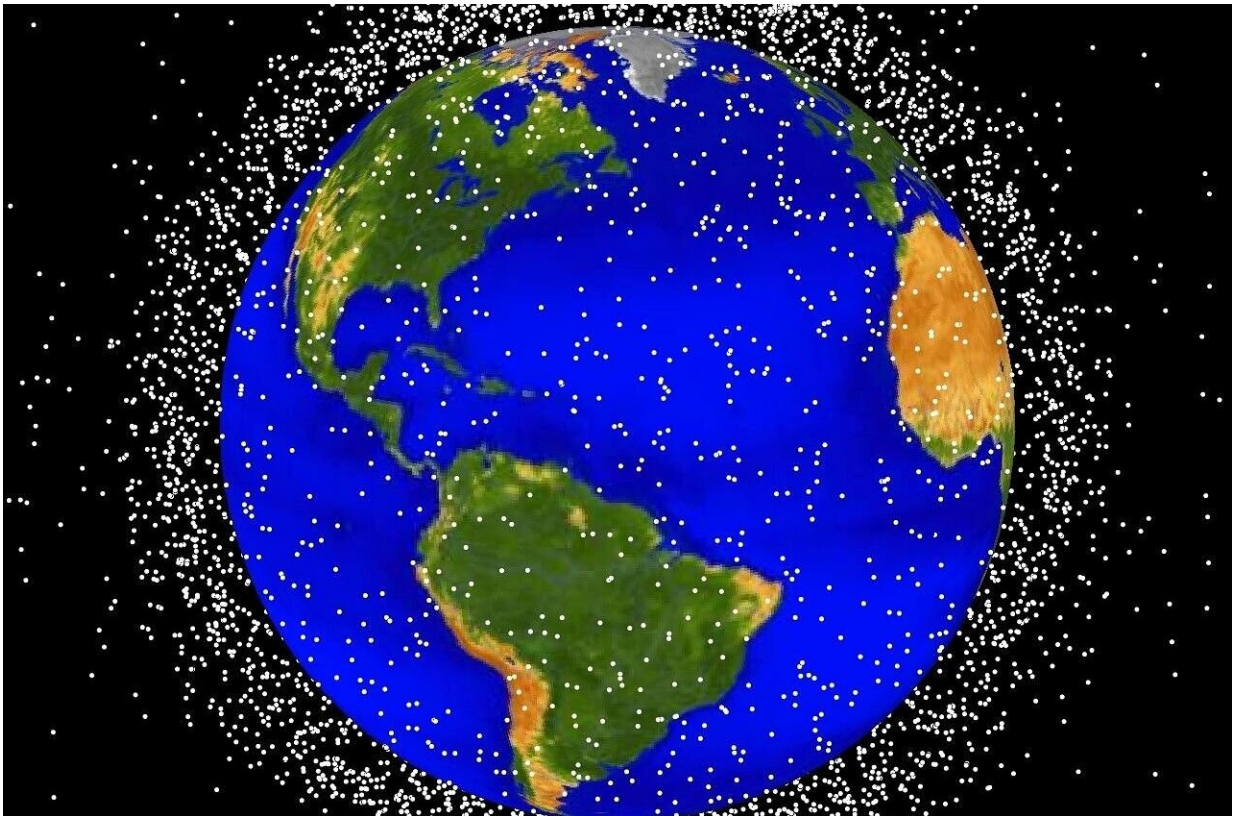# Researchers release open-source space debris model

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Credit: Pixabay/CC0 Public Domain

MIT's Astrodynamics, Space Robotics, and Controls Laboratory (ARCLab) announced the public beta release of the MIT Orbital Capacity Assessment Tool (MOCAT) during the 2023 Organization for

Economic Cooperation and Development (OECD) Space Forum Workshop on Dec. 14. MOCAT enables users to model the long-term future space environment to understand growth in space debris and assess the effectiveness of debris-prevention mechanisms.

With the escalating congestion in low Earth orbit, driven by a surge in satellite deployments, the risk of collisions and space debris proliferation is a pressing concern. Conducting thorough space environment studies is critical for developing effective strategies for fostering responsible and sustainable use of space resources.

MOCAT stands out among orbital modeling tools for its capability to model individual objects, diverse parameters, orbital characteristics, fragmentation scenarios, and collision probabilities. With the ability to differentiate between object categories, generalize parameters, and offer multi-fidelity computations, MOCAT emerges as a versatile and powerful tool for comprehensive space environment analysis and management.

MOCAT is intended to provide an open-source tool to empower stakeholders including satellite operators, regulators, and members of the public to make data-driven decisions. The ARCLab team has been developing these models for the last several years, recognizing that the lack of open-source implementation of evolutionary modeling tools limits stakeholders' ability to develop consensus on actions to help improve space sustainability. This beta release is intended to allow users to experiment with the tool and provide feedback to help guide further development.

Richard Linares, the principal investigator for MOCAT and an MIT associate professor of aeronautics and astronautics, expresses excitement about the tool's potential impact: "MOCAT represents a significant leap forward in orbital capacity assessment. By making it open-source and

publicly available, we hope to engage the global community in advancing our understanding of satellite orbits and contributing to the sustainable use of space."

MOCAT consists of two main components. MOCAT-MC evaluates space environment evolution with individual trajectory simulation and Monte Carlo parameter analysis, providing both a high-level overall view for the environment and a fidelity analysis into the individual space objects evolution. MOCAT Source Sink Evolutionary Model (MOCAT-SSEM), meanwhile, uses a lower-fidelity modeling approach that can run on personal computers within seconds to minutes. MOCAT-MC and MOCAT-SSEM can be accessed separately via GitHub.

MOCAT's initial development has been supported by the Defense Advanced Research Projects Agency (DARPA) and NASA's Office of Technology and Strategy.

"We are thrilled to support this groundbreaking orbital debris modeling work and the new knowledge it created," says Charity Weeden, associate administrator for the Office of Technology, Policy, and Strategy at NASA headquarters in Washington. "This open-source modeling tool is a public good that will advance space sustainability, improve evidence-based policy analysis, and help all users of space make better decisions."

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