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A ROADMAP TOWARD A PLANETARY SUNSHADE FOR SPACE-BASED SOLAR
GEOENGINEERING

Abstract

The objective of this paper is to present a roadmap for the technology development toward a Planetary Sunshade System, a space-based solar geoengineering project aimed at reversible solar radiation modification to mitigate global warming.

Earth's climate change is mostly due to the increasing concentration of greenhouse gases in the atmosphere, which leads to a general rise of the temperatures. To mitigate this, a space-based geoengineering infrastructure has been previously proposed to reduce the oncoming solar irradiance, by placing a 'solar light umbrella', called Planetary Sunshade System, between the Sun and the Earth.

To address the full development of a Planetary Sunshade System, a technology roadmap is needed which consider a step-by-step high-level plan of technology design, mission planning, launch preparation,

international cooperation, highlighting the multi-phase development strategy from initial design to final deployment.

First, the roadmap phases for in-Earth production and deployment are outlined in chronological order. Subsequently, an architectural framework is introduced to foster international cooperation and drive progress across the complex issues involved. The analysis of technology development begins with the current technology readiness level, encompassing system design and factors such as mass, dimensions, area, and the total number of solar-sail satellites. A ground demonstrator is proposed to execute pre-launch testing procedures and validate the system.

The mission planning then investigates launch windows and operations for precursor Earth missions and the fully deployed Planetary Sunshade System. Logistic aspects, including in-space assembly of the fully deployed system, are also examined. Finally, launch preparation is discussed encompassing heavy launcher design, facilities, production and launch sites.

The proposed roadmap not only provides a starting point for the design and development of the Planetary Sunshade System but also a critical analytical tool for evaluating the feasibility of direct climate action from space. Through this paper, we aim at establishing the groundwork for a future Planetary Sunshade endeavour, and at contributing to the broader discussion on space-based climate action.