Paper ID: 65402
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19th IAA SYMPOSIUM ON VISIONS AND STRATEGIES FOR THE FUTURE (D4)
Innovative Concepts and Technologies (1)

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SOLAR SAILS AS SUNSHADES AT THE SUN-EARTH L1 POINT COULD BE A REALISTIC SYSTEM TO CONTROL GLOBAL TEMPERATURE

Abstract

Space-based geoengineering has rarely been studied from a practical point of view, considered unrealistic as a near-future alternative to fight climate change. This presentation evaluates the feasibility of implementing a space sunshade in the vicinity of the first Lagrange point of the Sun-Earth system by the middle of the century. The analysis considers the necessary technological development, the possible trajectories for the shades, and an approximation of the size and cost of the system. It is strongly dependent on possible optical properties of future solar sails, so both an optimal and a more conservative alternative are described. With the latter, the shade will be formed by $1.5 \cdot 10^9$ sailcraft with a sail area of $2500m^2$ and a total mass of $8.3 \cdot 10^{10}$ kg. In the optimal case, the total mass is $3.4 \cdot 10^{10}$ kg. It is argued that the sailcraft could be launched to a 2000 km altitude orbit, from where they will travel for about 600 days to the equilibrium point using solar radiation pressure. The total cost of the mission is estimated to be five to ten trillion US dollars for a 1 degree C temperature decrease, based on a launch cost of 50 USD/kg. However, the cost to society, environment and global economy could be two to three orders of magnitude larger, if global temperature increase cannot be controlled by limiting greenhouse gas emissions. There are two main technological challenges for this to become a reality: the low TRL of the solar sails proposed and the necessary development in the launch vehicle industry given the dimensions of the mission.