

Topics (T)

Space Technology for Climate Adaptation and Mitigation [2] (6B)

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PLANETARY SUNSHADES FOR SOLAR RADIATION MANAGEMENT: A NONINVASIVE,
FEASIBLE, AND AFFORDABLE CLIMATE EMERGENCY INSURANCE OPTION

Abstract

It is probable that current efforts, as well as those planned for the coming decades, will be insufficient to reduce greenhouse gas (i.e., CO₂ and other) emissions enough to prevent widespread critical damage to the environment, society, economy, and human life. Success is far from assured, even if all measures to reduce and compensate for emissions and other detrimental forcing effects are successfully implemented as soon as possible. Therefore, complementary methods to control the Earth's temperature through geoengineering should be considered in concert with all established greenhouse forcing reduction strategies. Preliminary analyses have shown that a planetary sunshade orbiting around a solar radiation pressure (SRP) Displaced (Sun-Earth) Lagrange 1 point (SEDL1) that could reduce enough incident solar radiation to limit the Earth's average, annual, global temperature increase is feasible. This geoengineering strategy could significantly augment greenhouse forcing reduction efforts on the ground and allow them sufficient time to take effect for the world to achieve its goals in terms of maximum tolerable overshoot global warming, to prevent the triggering of climate tipping points, and ultimately to proceed towards pre-industrial greenhouse effect levels by further eliminating CO₂ from the atmosphere which likely is only feasible in the long-term. Relevant technologies needed to emplace such a planetary sunshade, solar sails in particular, have advanced rapidly in recent years, indicating that implementation of this approach is likely technically feasible in the mid-term instead of the far-term. Solar sails offer not only an occulting aperture for solar flux reduction but are also capable of prolonged station keeping (positioning control) at SEDL1 for the long mission lifetimes that would be necessary to support such an ambitious goal. Also, by definition, a solar sail-based sunshade does not tamper at all with Earth's ecological systems; it can be turned off quickly and the side effects of launching space hardware are understood and can be significantly optimized. If catastrophic climate change becomes unavoidable, the costs of building a planetary sunshade may be significantly less than the costs of inaction, both financially and morally. Further, the development of the key technologies and flight operations of solar sailing is already well under way.