Sun 'umbrella' tethered to asteroid might help mitigate climate change

July 31 2023

Credit: Brooks Bays/UH Institute for Astronomy

Earth is rapidly warming and scientists are developing a variety of approaches to reduce the effects of climate change. István Szapudi, an astronomer at the University of Hawai‘i Institute for Astronomy, has proposed a novel approach—a solar shield to reduce the amount of sunlight hitting Earth, combined with a tethered, captured asteroid as a counterweight. Engineering studies using this approach could start now

to create a workable design that could mitigate climate change within decades.

The paper, "Solar radiation management with a tethered sun shield," is published in *Proceedings of the National Academy of Sciences*.

One of the simplest approaches to reducing the global temperature is to shade the Earth from a fraction of the sun's light. This idea, called a solar shield, has been proposed before, but the large amount of weight needed to make a shield massive enough to balance gravitational forces and prevent solar radiation pressure from blowing it away makes even the lightest materials prohibitively expensive.

Szapudi's creative solution consists of two innovations: a tethered counterweight instead of just a massive shield, resulting in making the total mass more than 100 times less, and the use of a captured asteroid as the counterweight to avoid launching most of the mass from Earth.

"In Hawai‘i, many use an umbrella to block the sunlight as they walk about during the day. I was thinking, could we do the same for Earth and thereby mitigate the impending catastrophe of climate change?" Szapudi said.

Incorporating a tethered counterbalance

Szapudi began with the goal of reducing solar radiation by 1.7%, an estimate of the amount needed to prevent a catastrophic rise in global temperatures. He found that placing a tethered counterbalance toward the sun could reduce the weight of the shield and counterweight to approximately 3.5 million tons, about one hundred times lighter than previous estimates for an untethered shield.

While this number is still far beyond current launch capabilities, only 1%

of the weight—about 35,000 tons—would be the shield itself, and that is the only part that would have to be launched from Earth. With newer, lighter materials, the mass of the shield could be reduced even further. The remaining 99% of the total mass would be asteroids or lunar dust used as a counterweight. Such a tethered structure would be faster and cheaper to build and deploy than other shield designs.

Today's largest rockets can only lift about 50 tons to low Earth orbit, so this approach to solar radiation management would be challenging. Szapudi's approach brings the idea into the realm of possibility, even with today's technology, whereas prior concepts were completely unachievable. Also, developing a lightweight but strong graphene tether connecting the shield with the counterweight is crucial.

More information: István Szapudi, Solar radiation management with a tethered sun shield, *Proceedings of the National Academy of Sciences* (2023). DOI: 10.1073/pnas.2307434120

Provided by University of Hawaii at Manoa