The right dose of geoengineering could reduce climate change risks, study says

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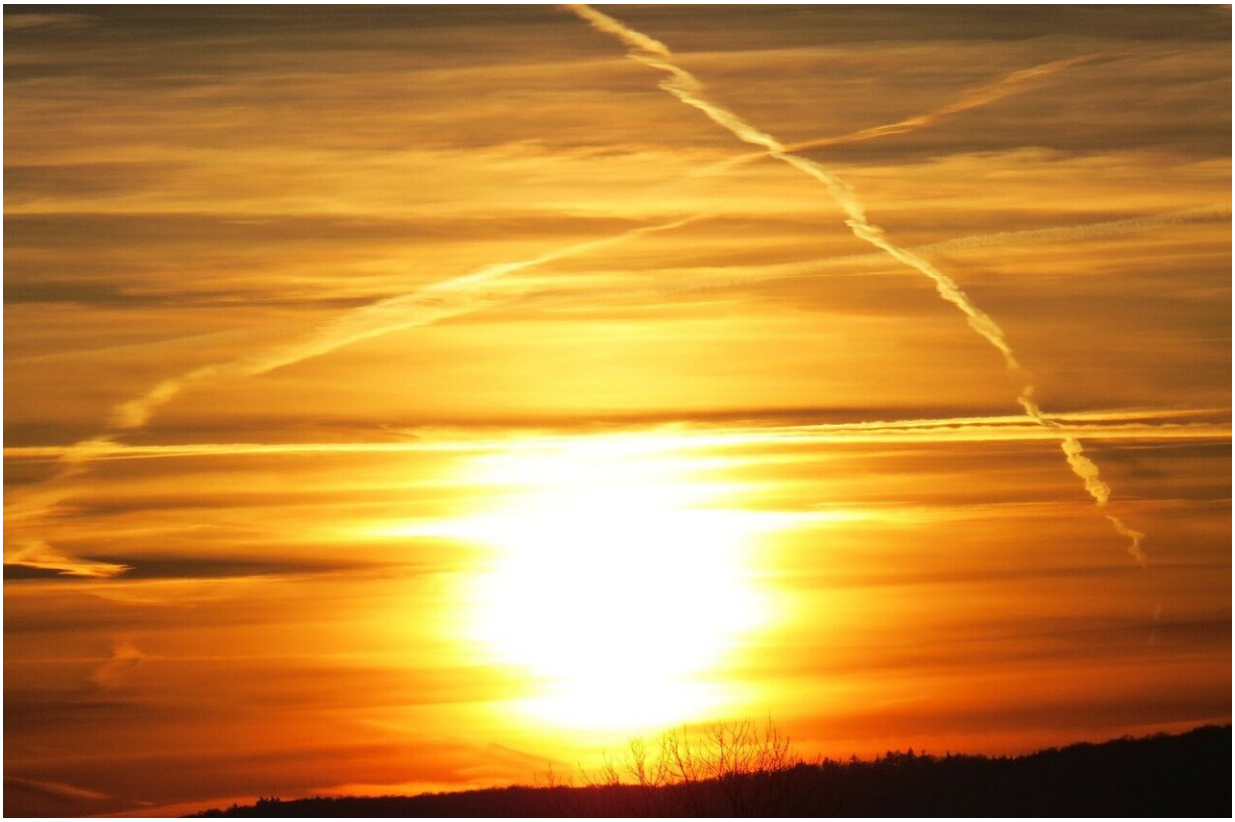

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Stratospheric aerosol geoengineering is the idea that adding a layer of aerosol particles to the upper atmosphere can reduce climate changes caused by greenhouse gases such as carbon dioxide.

Previous research shows that solar geoengineering could be achieved using commercially available aircraft technologies to deliver the particles at a cost of a few billion dollars per year and would reduce global average temperatures. However, the question remains whether this approach could reduce important climate hazards at a regional level. That is, could it reduce region-by-region changes in water availability or extreme temperatures?

Results from a new study by UCL and Harvard researchers suggest that even a crude method like injecting sulphur dioxide in the stratosphere could reduce many important climate hazards without making any region obviously worse off.

The findings, published today in *Environmental Research Letters*, used results from a sophisticated simulation of stratospheric aerosol geoengineering to evaluate whether the approach could offset or worsen the effects of climate change around the world. How these effects differed under different temperature scenarios was also tested.

The team found that halving warming by adding aerosols to the stratosphere could moderate important climate hazards in almost all regions. They saw an exacerbation of the effects of climate change in only a very small fraction of land areas.

Lead author, Professor Peter Irvine (UCL Earth Sciences), said: "Most studies focus on a scenario where solar geoengineering offsets all future warming. While this reduces overall climate change substantially, we show that in these simulations, it goes too far in some respects leading to about 9% of the land area experiencing greater climate change, i.e. seeing the effects of climate change exacerbated.

"However, if instead only half the warming is offset, then we find that stratospheric aerosol geoengineering could still reduce climate change

overall but would only exacerbate change over 1.3% of the land area."

The team emphasise that solar geoengineering only treats the symptoms of climate change and not the underlying cause, which is the build-up of CO2 and other greenhouse gases in the atmosphere. It should therefore be considered as a complementary approach to emissions cuts as a way to address climate change.

The study is a follow-up to a paper published last year in *Nature Climate Change* showed similar results when solar geoengineering was approximated by simply turning down the sun. That prior study begged the question: would the results hold up with a more realistic simulation using injection of sulphur dioxide, the simplest known method of solar geoengineering.

"Our results suggest that when used at the right dose and alongside reductions in greenhouse gas emissions, stratospheric aerosol geoengineering could be useful for managing the impacts of climate change. However, there are still many uncertainties about the potential effects of stratospheric aerosol geoengineering and more research is needed to know if this idea is truly viable," added Dr. Irvine.

The team used data from the Geoengineering Large Ensemble Study, which used a sophisticated climate-chemistry model to simulate the climate response to a hypothetical deployment of stratospheric aerosol geoengineering. In this model study, sulphur dioxide was released at different latitudes in the Tropics to produce a layer of aerosols tuned to keep temperatures steady under an extreme global warming scenario.

The researchers focused on changes in mean and extreme temperature, changes in water availability and changes in extreme precipitation, i.e. climate variables that determine key climate risks.

Previous work suggested that stratospheric aerosol geoengineering could lead to a substantial weakening of monsoons and an intensification of drought. However, the authors found that in those regions where halving warming with stratospheric aerosol geoengineering exacerbated change, it increased water availability rather than reduced it. This suggests that concerns that stratospheric aerosol geoengineering could lead to aridification and drought could be misplaced.

Co-author, Professor David Keith (Harvard's Engineering and Applied Sciences and Kennedy school), said: "Early research with climate models consistently shows that spatially uniform solar radiation modification could significantly reduce climate risks when combined with emissions cuts. But, should we trust the models? Uncertainties are deep and no single result is trustworthy, but this paper is a step towards more realistic modelling from injection to regional impacts."

The team are now researching the projected effects of stratospheric aerosol geoengineering on the water cycle in more depth to try to understand the potential benefits and risks to society and ecosystems.

More information: 'Halving warming with stratospheric aerosol geoengineering moderates policy-relevant climate hazards' , *Environmental Research Letters* (2020). DOI: 10.1088/1748-9326/ab76de

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