Cirrus Cloud Thinning

POINT OF INTERVENTION

OVERVIEW

This SRM technology involves thinning the wispy, elongated "cirrus" clouds of high altitudes. It is different from Marine Cloud Brightening (see MCB factsheet[1]), another SRM technique, which aims to thicken or add cloud cover to increase reflection. Cirrus clouds do not reflect a lot of solar radiation back into space, but because they form at high altitudes and cold temperatures, they trap long-wave radiation and have a climate impact similar to greenhouse gases.

Thinning cirrus clouds would be achieved by injecting ice nuclei (such as dust) into regions where cirrus clouds form, making the ice crystals bigger and reducing the cirrus optical depth.[2] Thinning the clouds could, according to researchers Ulrike Lohmann and Blaž Gasparini from ETH Zurich, allow more heat to escape into space and thereby cool the planet.[3] The researchers admit that the ice-nucleating particles that would be seeded into the high-altitude clouds may produce the opposite affect (e.g., it may thicken them, so that even more heat is trapped). Other researchers underscore the risks of unpredictable side effects of cirrus cloud thinning, including large regional and seasonal changes

Will legions of particle-spraying drones be enlisted to cool the planet?

REALITY CHECK

to precipitation, and the differing effects of seeding in the Southern or Northern Hemispheres.[4]

ACTORS INVOLVED

Development in the cirrus cloud thinning (CCT) field is limited to modeling exercises in research institutions. Included in this is China's geoengineering programme – one of the programme's researchers at Zhejiang University recently co-authored a paper on "cocktail geoengineering" with Ken Caldeira (a predominant US-based geoengineering researcher) in which they modeled the impact of using two technologies together: the dispersion of light-scattering particles in the upper atmosphere and the thinning of high cirrus clouds.[5]

IMPACTS

As with all SRM techniques, CCT could have considerable impacts on regional climates. Researchers have found clear evidence that it may strengthen Sahelian rainfall and the Indian monsoon in simulations with combined CCT and CO2 increases.[6] Although CCT is predicted to lower global annual mean change in precipitation, large regional and seasonal changes, including changes to the monsoons, are also shown in models. If CCT were to achieve a cooling effect, it could also cause unwelcome side effects, such as changes in the hydrological cycle and atmospheric circulation. The climate system is complex and highly nonlinear in its behaviour and perturbing one element of it in this way can lead to unforeseen changes.[7]

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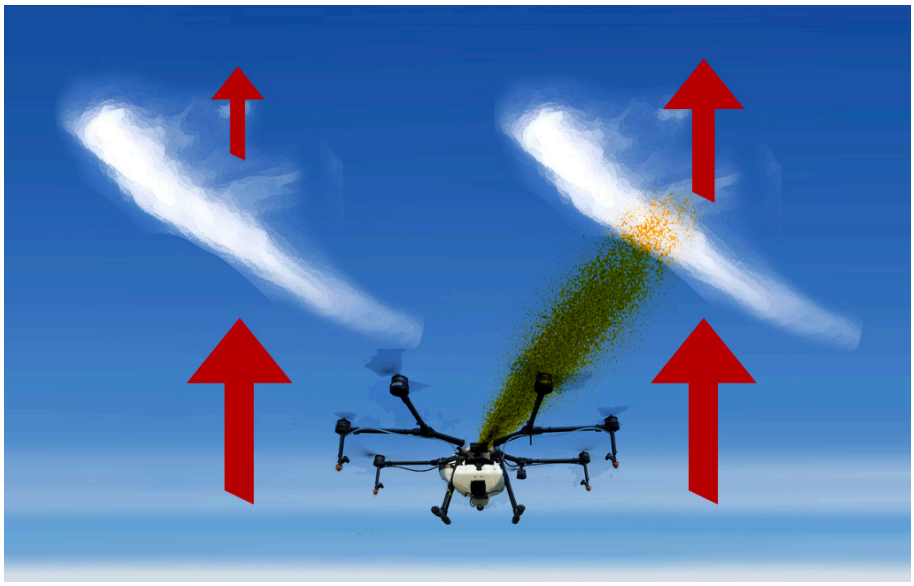
Another potential problem with cirrus seeding would be over-seeding if too many nuclei are injected. In over-seeding, the cirrus clouds would become optically thicker, leading to warming. Simulations with "cirrus cloud thickening" result in a weaker hydrological cycle, exhibiting a behaviour comparable to CO2 doubling alone,[8] which would obviously cause serious harm to ecosystems and human life. The level at which over-seeding occurs is also unclear in current models.

Similarly, seeding would need to be avoided in cloud-free regions with high relative humidity where no cirrus clouds form. Here, seeding could lead to cirrus cloud formation rather than thinning, having a warming effect on the climate (this happens with contrails). These interconnected factors mean that CCT could either increase or decrease global temperatures. The influence of CCT on lower-lying



Cirrus cloud thinning is a theoretical technique for spraying particles into high-altitude clouds that would allow more heat to escape into space.

Cirrus clouds (Hehaden/Creative Commons)

clouds is also poorly understood and could enhance or dampen its effects.[9]

A further concern is that CCT could be operated at a local scale to create climate responses in certain areas. This might be attractive to governments as it could theoretically provide an opportunity to target the suppression of some extreme events, such as heat waves,[10] although today this idea seems far-fetched. Another example of small-scale deployment could be to avoid further melting of Arctic sea ice.[11] This kind of localised deployment could cause serious conflict because it is likely that climate events won't be contained: one country avoiding a heatwave could cause flooding in another or, rather than stopping Arctic ice melt, the technology could be used to melt it completely and open up lucrative shipping routes.

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REALITY CHECK

CCT is a theoretical concept, and research in to its effects is currently limited to climate modeling. Researchers do not even know which substances would effectively seed cirrus clouds. A recent study found that none of the known cloud seeding

strategies could achieve a significant cooling through CCT, due to complex microphysical mechanisms that limit the climatic response. The study concludes that its results do not support previous findings that cirrus cloud seeding could be an effective geoengineering method.[12]

FURTHER READING

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The Big Bad Fix: The Case Against Climate Geoengineering, http://etcgroup.org/content/big-bad-fix

SOURCES

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