



## IEAGHG Information Paper; 2013-IP18: Latest Research on Geo-Engineering

A recent article in Scidev.Net (<http://www.scidev.net/global/earth-science/news/concerns-grow-over-effects-of-solar-geoengineering.html>) reviews three reports on geo-engineering that have recently been published and aims to summarise the status of the results.

The author of the review article suggests that the latest studies on solar geoengineering to tackle climate change reinforcing the case for a global governance system and further study before deployment, as they show that the approach may have little effect on preventing rainfall changes in the tropics — and may even lead to widespread drought in Africa.

There are several geoengineering initiatives that plan to tackle climate change by cutting incoming sunlight, through methods such as spreading reflective aerosols in the stratosphere. However the authors of a study published in *Nature Geoscience*<sup>1</sup> in April conclude that without also removing carbon dioxide from the atmosphere, such plans would fail to fully mitigate change in rainfall in the tropics. Using a series of climate models, the authors show that even if global temperatures do not rise, the rise in carbon dioxide alone will disrupt rainfall patterns. This is because much future rainfall change in the tropics is expected to happen independently of surface warming; instead it will be driven by a shift in atmospheric vertical motions, induced by a rise in carbon dioxide.

"Our atmosphere is continuously trapping and losing heat through infrared radiation from the sun. This is what drives circulation of the atmosphere that is responsible for rainfall," says Steven Sherwood, co-author of the study and a meteorologist at the Climate Change Research Centre, University of New South Wales, Australia.

"Increased carbon dioxide traps more infrared radiation, which heats up the atmosphere", adds Sandrine Bony, lead author of the study and a climatologist at the Pierre & Marie Curie University in Paris, France.

The expected changes in tropical rainfall vary greatly from region to region. "But whatever the changes, societies globally are vulnerable to them," she says.

"This study shows that many different models are pointing in the same direction," says Guojun Gu, a meteorologist at the University of Maryland, United States, who was not involved in this paper and is sceptical about the benefits of geoengineering.

Meanwhile another study, published in *Nature Climate Change*<sup>2</sup> in March 2013 finds that aerosol projects could badly affect some areas of the developing world and calls for further study to assess possible impacts before consensus on global governance can be reached.

Spraying fine particles into the upper atmosphere could cause calamitous drought in the Sahel region of Africa, the authors report. They note that major volcanic eruptions — which act as natural geoengineering models as they spew fine particles into the atmosphere — in the northern hemisphere from 1900 to 2010 preceded three of the four driest summers in the region. But rainfall may increase in the Sahel region if fine particles were spread in the southern hemisphere, they say. The authors conclude that "a global governance agreement for geoengineering is essential before any practical geoengineering system is deployed".

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<sup>1</sup> Robust direct effect of carbon dioxide on tropical circulation and regional precipitation by Sandrine Bony <http://www.nature.com/ngeo/journal/v6/n6/full/ngeo1799.html>

<sup>2</sup> Asymmetric forcing from stratospheric aerosols impacts Sahelian rainfall by Jim M. Haywood et al can be found at ,



"It is clear that reducing greenhouse gases emissions is the first, most fundamental, and most essential element of reducing harms from climate change," says Edward Parson, a law professor and co-director of the Emmett Center on Climate Change and the Environment at the University of California, Los Angeles. "Geoengineering is at best a partial or second choice."

In another paper, published in *Science*<sup>3</sup> (March 2013), Parson and David Keith, a physicist at Harvard University, argue for internationally coordinated and transparent research on geoengineering.

"In our paper we do not advocate geoengineering," Parson says. "Instead we advocate research into geoengineering so the capability is available and tested. Recognising that geoengineering may cause harm, and that it cannot reverse all effects of climate change, does not negate the value of having the capability available."

In conclusion it seems that solar geoengineering needs further research not just on the techniques to be employed but on their climate impacts. The main conclusion that I can draw is that they do not replace the need for reducing global CO<sub>2</sub> emissions levels through measures such as CCS. This reinforces the need for the work IEAGHG does.

John Gale  
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<sup>3</sup> End the Deadlock on Governance of Geoengineering Research by Edward A. Parson and David W. Keith can be found at:

<http://www.sciencemag.org/content/339/6125/1278.full?ijkey=t7rwNcALBSmow&keytype=ref&siteid=sci>