Press Release: Geoengineering could disrupt rainfall patterns

A geoengineering solution to climate change could lead to significant rainfall reduction in Europe and North America, a team of European scientists concludes. The researchers studied how models of the Earth in a warm, CO2-rich world respond to an artificial reduction in the amount of sunlight reaching the planet's surface. The study is published today in *Earth System Dynamics*, an Open Access journal of the European Geosciences Union (EGU).

Tackling climate change by reducing the solar radiation reaching our planet using climate engineering, known also as geoengineering, could result in undesirable effects for the Earth and humankind. In particular, the work by the team of German, Norwegian, French, and UK scientists shows that disruption of global and regional rainfall patterns is likely in a geoengineered climate.

"*Climate engineering cannot be seen as a substitute for a policy pathway of mitigating climate change through the reduction of greenhouse gas emissions,*" they conclude in the paper.

Geoengineering techniques to reduce the amount of solar radiation reaching the Earth's surface range from mimicking the effects of large volcanic eruptions by releasing sulphur dioxide into the atmosphere to deploying giant mirrors in space. Scientists have proposed these sunlight-reflecting solutions as last-ditch attempts to halt global warming.

But what would such an engineered climate be like?

To answer this question, the researchers studied how four Earth models respond to climate engineering under a specific scenario. This hypothetical scenario assumes a world with a CO2 concentration that is four times higher than preindustrial levels, but where the extra heat caused by such an increase is balanced by a reduction of radiation we receive from the Sun.

"*A quadrupling of CO2 is at the upper end, but still in the range of what is considered possible at the end of the 21st century*," says Hauke Schmidt, researcher at the Max Planck Institute for Meteorology in Germany and lead author of the paper.

Under the scenario studied, rainfall strongly decreases – by about 15 percent (some 100 millimetres of rain per year) of preindustrial precipitation values – in large areas of North America and northern Eurasia. Over central South America, all models show a decrease in rainfall that reaches more than 20 percent in parts of the Amazon region. Other tropical regions see similar changes, both negative and positive. Overall, global rainfall is reduced by about five percent on average in all four models studied.

"*The impacts of these changes are yet to be addressed, but the main message is that the climate produced by geoengineering is different to any earlier climate even if the global mean temperature of an earlier climate might be reproduced*," says Schmidt.

The authors note that the scenario studied is not intended to be realistic for a potential future application of climate engineering. But the experiment allows the researchers to clearly identify and compare basic responses of the Earth's climate to geoengineering, laying the groundwork for more detailed future studies.

"*This study is the first clean comparison of different models following a strict simulation protocol, allowing us to estimate the robustness of the results. Additionally we are using the newest breed of climate models, the ones that will provide results for the Fifth IPCC [Intergovernmental Panel on Climate Change] Report*," explains Schmidt.

The scientists used climate models developed by the UK Met Office's Hadley Centre, the Institut Pierre Simon Laplace in France, and the Max Planck Institute in Germany. Norwegian scientists developed the fourth Earth model used.

Volcanic eruptions, such as the one of the Karymsky volcano (Russia) in 2004, release sulphur dioxide to the atmosphere, which has a cooling effect. Geoengineering an 'artificial volcano' to mimic this release has been proposed as a solution to global warming. (Credit: Alexander Belousov)

Information for editors

This research is presented in the paper 'Solar irradiance reduction to counteract radiative forcing from a quadrupling of CO2: Climate responses simulated by four Earth system models' to appear in the EGU Open Access journal *Earth System Dynamics* on 06 June 2012.

The scientific article is available online at www.earth-syst-dynam.net/3/63/2012/esd-3-63-2012.pdf

The discussion paper (not peer-reviewed) and reviewers comments is available at www.earth-syst-dynam-discuss.net/3/31/2012/esdd-3-31-2012-discussion.html

The team is composed of H. Schmidt (Max Planck Institute for Meteorology, Hamburg, Germany [MPIMet]), K. Alterskjær (University of Oslo, Oslo, Norway [UIO]), D. Bou Karam (Laboratoire des Sciences du Climate et l'Environnement, Gif-sur-Yvette, France), O. Boucher (Met Office Hadley Centre, Exeter, UK [Met Office] and Laboratoire de Météorologie Dynamique, Institut Pierre Simon Laplace/CNRS, Paris, France), A. Jones (Met Office), J.E. Kristjansson (UIO), U. Niemeier (MPIMet), M. Schulz (Norwegian Meteorological Institute, Oslo, Norway), A. Aaheim (Cicero, Oslo, Norway), F. Benduhn (Max Planck Institute for Chemistry, Mainz, Germany [MPIC]), M. Lawrence

(MPIC and Institute of Advanced Sustainability Studies, Potsdam, Germany), and C. Timmreck (MPIMet).

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Contacts

Hauke Schmidt
Max Planck Institute for Meteorology
Hamburg, Germany
Tel: +49-40-41173-405
Email: hauke.schmidt@zmaw.de

Bárbara T. Ferreira
EGU Media and Communications Officer
Munich, Germany
Tel: +49-89-2180-6703
Email: media@egu.eu