Most effective climate engineering solutions revealed

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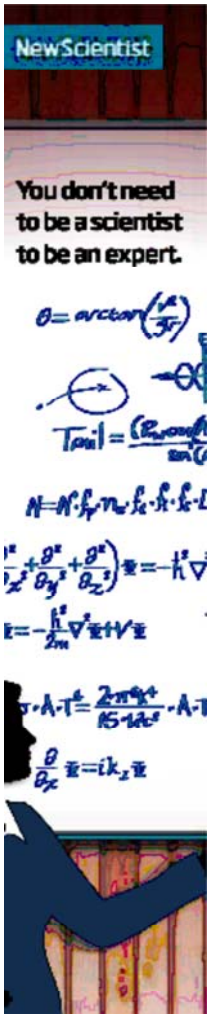

Many scenarios have been proposed to help us engineer our way out of potential climate disaster, and now a new study could point us towards the ones that are most effective.

Tim Lenton of the University of East Anglia, UK, has put together the first comparative assessment of climate-altering proposals such pumping sulphur into the atmosphere to mimic the cooling effect of volcanic emissions, or fertilising the oceans with iron.

"There is a worrying feeling that we're not going to get our act together fast enough," says Lenton, referring to international efforts to limit greenhouse gas emissions. Scientists have reached a "social tipping point" and are starting to wonder which techniques might complement emissions cuts, he says.

Lenton says he is not necessarily advocating engineering the climate, but, faced with a growing trend among his peers, he and colleague Naomi Vaughan decided to provide a comparison of the options that are on the table.

First, Lenton says the exercise shows there is no "silver bullet" – no single method that will safely reverse climate change on its own.

Scrubbers and mirrors

Climate engineering schemes would work by either removing carbon dioxide from the atmosphere, or reflecting solar energy back out into space – both with the intention of lowering global temperatures.

Proposals for removing CO_2 from the atmosphere include planting vast forests, chemically absorbing the gas, or turning agricultural waste into charcoal and burying it.

Reflecting solar energy back into space does not decrease the levels of greenhouse gases in the atmosphere, but lessens their warming effect by reducing the amount of solar energy that gets trapped near Earth's surface. Possible schemes have included space mirrors in orbit around the planet, clouds of sulphur particles in the atmosphere, or ground-based reflectors.

The researchers calculated how effective each scheme is at reducing the amount of solar energy trapped in our climatic system – a measure known as "radiative forcing".

Sunshade risks

If we continue to burn fossil fuels at the same rate as today, the greenhouse effect will boost radiative forcing by 7 watts per square metre of Earth surface by 2100. By some calculations, strict targets to reduce emissions could bring that down by 4 W/m^2.

Lenton's calculations show the only methods powerful enough to have a significant effect in the relatively short term (in the second half of this century) involve placing physical barriers between Earth and the Sun. This would involve either orbiting space mirrors, stratospheric mists of sulphur, or using seawater to make reflective clouds.

But Lenton warns that these options also carry the most risk. A sulphur sunshade could reduce radiative forcing by 3.7 W/m^2, but would have to be continually replenished. If it was allowed to disappear, temperatures could shoot up by as much as 5 °C within decades (*Climatic Change*, DOI: 10.1007/s10584-008-9490-1).

After sunshades, the most effective method is "scrubbing" carbon dioxide out of air and storing it underground. This could reduce radiative forcing by 1.9 W/m^2 by 2100.

Burn it and bury it

Most other methods, including increasing the reflectivity of deserts or fields of crops, and fertilising oceans show little promise or would not have global effects, the study shows. Some, like increasing the reflectivity of roofs in cities, could offer localised relief from climate change.

"There's been far too much focus on iron fertilisation" given its lack of potential, says Lenton. His calculations suggest that the boost which agricultural fertilisers inadvertently give ocean plankton in runoff is probably already more effective that iron seeding is ever likely to be.

A German-Indian project to test iron fertilisation in the oceans was given the go-ahead yesterday after activists had previously halted the ship's departure from port.

Lenton says turning agricultural waste into charcoal and burying it may hold the most promise. Although it would only reduce radiative forcing by 0.4 W/m^2 by 2100, the method is cheap, low tech, and would have the added advantage of fertilising the soil.

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