# Geoengineering: a quick fix with big risks

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Radical steps to engineer Earth's climate by blocking sunlight could drastically cool the planet, but could just as easily worsen the situation if these projects fail or are suddenly halted, according to a new computer modeling study.

The experiments, described in the June 4 early online edition of *The Proceedings of the National Academy of Sciences*, look at what might happen if we attempt to slow climate change by "geoengineering" a solar filter instead of reducing carbon dioxide emissions. The researchers used a computer model to simulate a decrease in solar radiation across the entire planet, but assumed that that the current trend of increasing global carbon dioxide emissions would continue for the rest of this century.

"Given current political and economic trends, it is easy to become pessimistic about the prospect that needed cuts in carbon dioxide emissions will come soon enough or be deep enough to avoid irreversibly damaging our climate," said co-author Ken Caldeira of the Carnegie Institution's Department of Global Ecology. "If we want to consider more dramatic options, such as deliberately altering the Earth's climate, it's important to understand how these strategies might play out."

Although the term "geoengineering" describes any measure intended to modify the Earth at the planetary scale, the current study focuses on changes that reduce the amount of solar radiation that reaches the planet's surface. Several methods to accomplish this have been suggested, from filling the upper atmosphere with light-reflecting sulfate particles to installing mirrors in orbit around the planet.

According to the model, even after greenhouse gases warm the planet, geoengineering schemes could cool off the Earth within a few decades to temperatures not seen since the dawn of the industrial revolution. This is good news, according to Caldeira and lead author Damon Matthews of Concordia University in Montreal, Canada, because it suggests there is no need to rush into building a geoengineering system before it is absolutely necessary.

However, the study also offers some bad news. If any hypothetical geoengineering program were to fail or be cancelled for any reason, a catastrophic, decade-long spike in global temperatures could result, along with rates of warming 20 times greater than we are experiencing today.

“If we become addicted to a planetary sunshade, we could experience a painful withdrawal if our fix was suddenly cut off,” Caldeira explained. “This needs to be taken into consideration if we ever think seriously about implementing a geoengineering strategy.”

Caldeira and Matthews believe that lower temperatures in a geoengineered world would result in more efficient storage of carbon in plants and soils. However, if the geoengineering system failed and temperatures suddenly increased, much of that stored carbon would be released back into the atmosphere. This, in turn, could lead to accelerated greenhouse warming.

Reduced solar radiation not only affects temperatures in the simulations, but also global rainfall patterns. In a model run with no simulated geoengineering, warmer temperatures resulted in more rainfall over the oceans, while increased carbon dioxide levels caused a decrease in evaporation from plants’ leaves, and consequently a decrease in rainfall over tropical forests. In contrast, the geoengineering scenario—which had lower temperatures but the same high levels of carbon

dioxide—resulted only in a decrease in tropical forest rainfall.

“Many people argue that we need to prevent climate change. Others argue that we need to keep emitting greenhouse gases,” Caldeira said. “Geoengineering schemes have been proposed as a cheap fix that could let us have our cake and eat it, too. But geoengineering schemes are not well understood. Our study shows that planet-sized geoengineering means planet-sized risks.”

Caldeira feels it is important to develop a scientific understanding of proposed geoengineering schemes. “I hope I never need a parachute, but if my plane is going down in flames, I sure hope I have a parachute handy,” Caldeira said. ”I hope we’ll never need geoengineering schemes, but if a climate catastrophe occurs, I sure hope we will have thought through our options carefully.”

Source: Carnegie Institution