Should geoengineering be used to address global warming?

If humans heated the earth, perhaps our technology can cool it, too. A look at the science of geoengineering and how it might be used to address global warming.

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A crop-duster airplane spews a cargo of salt over Prachauab Khirikhan, Thailand, in an attempt to seed the clouds and cause it to rain. This is an example of geoengineering being used to address global warming.

Sukree Sukplang/Reuters

By Gregory M. Lamb, / Staff writer / May 3, 2010

The time for barely muffled chuckles and rolled eyes is over. Scientists, ethicists, and legal experts are now quite soberly thinking about how humans should mess with the world's climate – with the goal of keeping it as close to what we are used to as possible.

But as it stands today, geoengineering – as climate modification is being called – is little more than a shopping bag full of sometimes outrageous-sounding proposals and theories. Little is known about whether they would work in the real world.

Deciding which geoengineering ideas to test – and how to do it safely – presents a huge stumbling block. The effects could be global, but getting all nations to agree on any particular measure could prove to be a Herculean task.

At a conference in northern California in late March, one group of about 175 experts has begun trying. Modeling their effort on a 1975 conference that set voluntary standards for recombinant DNA research, the Asilomar International Conference on Climate Intervention Technologies, held in Pacific Grove, Calif., aims to establish a set of "norms" or accepted practices to guide scientists in testing geoengineering ideas. The hope is that these will provide a road map to binding international standards.

The need for rules is nearing. Some are already calling geoengineering "a bad idea whose time has come."

"There's definitely a shift under way from [geoengineering] being a sort of science-fiction oddity to [it being] something that is a strategy being considered," says Jamais Cascio, an environmental futurist and a research fellow at the Institute for the Future in Palo Alto, Calif.

Mr. Cascio's book on geoengineering, "Hacking the Earth," was published last year. At least two more books on the subject will be published this spring.

Britain's top scientific organization, the Royal Society, recently released an in-depth study on it. Both the British Parliament and US Congress are conducting investigations.

Geoengineering amounts to "research on whether there is an insurance policy" that could be cashed in as a last resort if other efforts fail, says Margaret Leinen, CEO of the nonprofit Climate Response Fund in Washington

Actually, by emitting huge amounts of greenhouse gases, human activity is already resetting Earth's thermostat. Climate scientists say that a warming of several degrees Celsius worldwide is very likely this century.

To counter the ill effects of such rapid warming, political leaders are trying to forge agreements to cut the emissions of greenhouse gases, often called "climate mitigation."

Governments are also beginning to look at ways to adapt to living in a warmer world, with its other possible effects such as changes in rainfall patterns (droughts and floods), more intense storms, and rising sea levels.

Geoengineering presents a third way to try to alleviate the problems.

But when discussing modifying Earth's climate, most scientists strongly emphasize two points: Such schemes should be attempted only after careful consideration and only as a last resort if disastrous climate changes begin to be felt. And they should never be a substitute for reducing emissions. At best, geoengineering represents a "thumb in the dike" – a temporary and partial solution. As Cascio puts it: "It's a stay of execution, not a pardon."

Even considering those reservations, some environmentalists remain far from persuaded. Geoengineering amounts to "an act of geopiracy," says the Swedish Society for Nature Conservation. "There is no reason for the governments or peoples of most of Africa, Asia, and Latin America to trust that the governments, industries, or scientists of the biggest carbon-emitting states will protect their interests."

Plans to modify the world's climate fall into two basic categories: One approach would reduce the amount of sunlight taken in by Earth and its atmosphere – sometimes called Solar Radiation Management (SRM). About 70 percent of sunlight is absorbed by Earth and its atmosphere, while the remaining 30 percent is reflected back into space. If just 1 percent more sunlight were reflected, Earth would cool by a measurable amount.

Other ideas concern removing carbon dioxide from the atmosphere, directly offsetting carbon dioxide emissions. (See sidebar at left.)

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Perhaps the best-known sun-blocking concept involves lacing the upper atmosphere with particles of sulfur to make it more reflective. Real-world experience suggests that such a technique could work.

In 1991, for example, Mt. Pinatubo in the Philippines erupted, sending plumes of sulfates and other particles high into the atmosphere, which reflected more sunlight back into space. The resulting condition cooled Earth by about 1 degree F. for the next year. A little more than a century earlier, an even more massive eruption of the Krakatoa volcano in Indonesia probably had an even larger effect on world temperatures. Depending on how long it continues, the volcanic eruption in Iceland will doubtless have a similar effect.

Mimicking this "volcano effect" could produce rapid cooling, although sulfur particles would have to be sent into the atmosphere on a regular basis to maintain the effect. If the program had to be discontinued, the cooling effect would quickly wear off and warming would spike upward.

Because SRM options don't actually remove CO2 from the air, they also don't address global warming's so-called evil twin: ocean acidification. As levels of CO2 in the atmosphere rise, more CO2 is absorbed by oceans, making them more acidic. If acid levels rise enough, coral reefs and shellfish could die off. Eventually, the entire oceanic food chain could be threatened.

All geoengineering fixes present the possibility of unexpected problems, says Michael MacCracken, chief scientist for climate-change programs at the nonprofit Climate Institute in Washington. Each solution will have downsides. "There's no such thing as a free lunch," he says. "There's just different lunches."

That's why "daring to go in and change the climate is something that someone has to be very cautious and careful and humble about," he says,

Efforts to regulate how geoengineering would be tested – let alone employed – are in their infancy, says David Victor, a political scientist at the University of California at San Diego who studies international environmental regulation.

"I think the problem is that the geoengineering technologies are all over the map, so nobody is really sure where these efforts would begin," he says.

For example, the idea of dumping iron particles at sea to increase its ability to grow more algae that would in turn absorb more CO2 may be regulated to some degree by existing international laws, Dr. Victor says. "It's clear that dumping stuff in the oceans willy-nilly is outside what is legal."

But many SRM techniques present a legal "blank slate," he says. "In my view, the really tough [legal] issues arise from tinkering with the sun, with incoming solar radiation."

While some research, such as computer models, can be done in the laboratory, real-world testing eventually would have to be done. Scientists learned the effects of nuclear bombs on the atmosphere, for example, only when they observed actual test explosions, he points out.

While testing does pose risks, transparent research – in which test results and data are freely and openly shared among the world's scientists and overseen by governments – presents the best way forward, some say.

The alternative is that unscrupulous research might go on "in the shadows," Victor says. "You want to lay down a pattern of behavior" now, he argues, one that sets out what is acceptable – and what isn't.

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