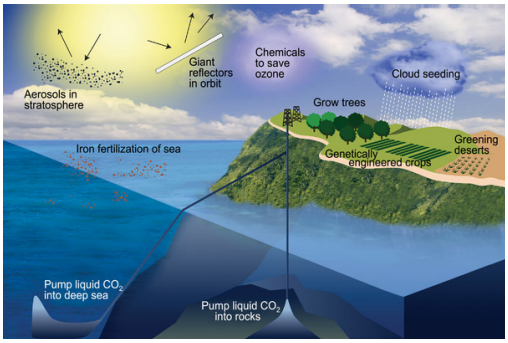
Is it time to invest in entrepreneurial geoengineering?



Geoengineering and carbon storage proposals: Some aim to reduce incoming solar radiation, others to remove atmospheric carbon dioxide and sequester it underground, in the oceans or in vegetation.

Credit: Kathleen Smith/LLNL

This 1966 photo shows the crew and personnel of Project Stormfury, which investigated whether seeding tropical cyclones with silver iodide would weaken them.

Credit: NOAA/GOES

Government research and development has its limits: Time, money and bureaucracy can all hamper the timely progress of research. As a result, many federal agencies are looking to private companies to help drive new innovation and keep costs down — but it's never that simple. Two current hot-button topics — returning humans to space and geoengineering — highlight a range of issues related to how private and public investment in science can coexist. Last month, we looked at NASA's push toward privatization. This month, we focus on geoengineering — altering earth systems to reduce warming or modify weather.

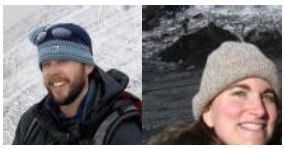
Homeland Security eyes hurricanes

After a hiatus of decades, geoengineering is once again a hot topic, says Kelly Klima, a graduate student in engineering and public policy at Carnegie Mellon University in Pittsburgh, Pa. In particular, there has been a resurgence of interest by the federal government in the possible benefits of weather modification, Klima says, spurred by the devastation wrought by Hurricanes Katrina and Rita in 2005, as well as research, including a 2006 study published in Science, that suggests a link between warming sea-surface temperatures and increasing average hurricane intensities.

The back-to-back devastating hurricane seasons of 2004 and 2005 suggested that hurricanes might be a threat to national security, especially as the climate warms, and by 2008, the Department of Homeland Security (DHS) began investigating ways to work with scientists to not only mitigate on-land damage from hurricanes, but possibly to reduce their intensity or alter their paths. In February of that year, DHS' Science and Technology Directorate sponsored a workshop with NOAA's Earth System Research Laboratory to identify viable paths to take. The conclusions of the workshop, published in March 2008, were to embark on a modest plan of action: Develop models of certain concepts, narrow those to a few for further testing, and then narrow further to determine one concept that would be worthy of first small-scale and then larger-scale testing.

After the workshop, DHS began by creating Project HURRMIT, an effort to model and determine the effectiveness of some of the most promising hurricane mitigation ideas, such as cloud seeding or wave-driven upwelling pumps, based on numerical simulations and actual historical hurricane data. DHS had also established a separate department-wide program in 2009, called FutureTECH, which was aimed at establishing partnerships between the federal government and the private sector, national laboratories, university scientists and other research groups to develop cutting-edge technologies in line with the department's assessment of its future needs. Although largely focusing on detecting human-made threats, one of FutureTECH's areas of "innovative research" was on hurricane mitigation.

But although the modeling has continued, DHS has pulled back from its plans to investigate new technologies and field tests for weather modification. One reason, says William Laska, program manager at DHS' Science and Technology Directorate, may be that the terms "geoengineering" and "weather modification" are still distasteful to both scientists and



members of other government agencies. When DHS began approaching these different groups about the possibility of investigating and funding technologies for hurricane modification, “waving the modification/mitigation flag, we got a lot of doors slammed in our face,” Laska says. Furthermore, he adds, “there’s still a sour taste from Stormfury” — a government project that lasted from the early 1960s to the early 1980s and investigated the possibility of seeding clouds with silver iodide to weaken tropical cyclones, but produced inconclusive results.

As a result of this resistance to federal research into geoengineering, Laska says, DHS decided to focus more on basic research to understand hurricanes — particularly the impact of aerosols and cloud microphysics — rather than on developing technologies or methods to modify them. That dovetails nicely with NOAA’s hurricane prediction research, he says, because NOAA hasn’t done a lot of research specifically into aerosols’ effect on hurricanes. “The knowledge we’re gaining is going to better help NOAA predict changes in hurricane intensity, and give the [Federal Emergency Management Agency] more time to evacuate people, to do what they need to do,” Laska says.

But this focus on basic research could one day lead the government back to geoengineering. As part of its new effort, DHS has enlisted six scientists, including retired NOAA scientist Joseph Golden, who worked on Project Stormfury, to participate in its Hurricane Aerosol Microphysics Program (HAMP). In May, Golden outlined the HAMP project at the American Meteorological Society’s conference on Hurricanes and Tropical Meteorology in Tucson, Ariz. He emphasized that HAMP is in an early stage and will focus on gathering observations and running model simulations. Only if the results are promising, he noted, might “later phases” of the program include actual storm seeding trials. Laska, cautiously, confirms those plans, but emphasizes that “we want to keep away from saying we’re modifying hurricanes.”

You build it, we buy it

Even if the federal government is not ready to develop geoengineering techniques, there are some privately developed technologies that are far enough along that they might be worthy of the government’s investment, Klima says. Many scientists agree that one technology — which can both modify weather and mitigate climate change — is the farthest along, she notes: a wave-driven deep-ocean pump that pumps warm surface waters down and draws cold nutrient-rich water up from the depths of the ocean. This simultaneously creates a sink for carbon dioxide by encouraging the growth of carbon-consuming phytoplankton and cools the surface waters. Reducing sea-surface temperatures, many scientists think, would decrease the intensity of many tropical cyclones. One company, Atmocean, Inc., has already developed such a pump and has conducted several small-scale field tests.

The trouble is the implementation of that modification — and that might be where the federal government comes in, Klima says. She has modeled and compared the effectiveness of more modest hurricane mitigation efforts — such as installing corrugated aluminum shutters on buildings — with more large-scale hurricane modification techniques, in terms of reducing overall damage. Mitigation efforts were in many cases as cost-effective as modification, but if the wind-wave pumps were installed in the path of an advancing hurricane, they could more significantly reduce the storm’s impact, she reported at the American Geophysical Union’s 2009 fall meeting in San Francisco, Calif. But a small company like Atmocean, Inc., doesn’t have the resources to oversee the installation of such pumps prior to an impending storm, an effort that would require large-scale coordination and timing. “Hurricane modification would take a big entity like the federal government,” Klima says.

Who should tinker with climate?

While Congress and governments worldwide wrestle with whether and by how much to reduce carbon emissions to slow the pace of climate change, entrepreneurs are seeing an opportunity on the mitigation end.

The international talks on climate at Copenhagen, Denmark, in December 2009, which failed to come up with a strong international consensus on how to reduce global carbon dioxide emissions, may provide new momentum to private-sector development of geoengineering technologies that could mitigate climate change. Some scientists, such as Harvard University geochemist Daniel Schrag, who is also an advisor to President Barack Obama on climate change, and climate scientist David Keith of the University of Calgary, in Alberta, Canada, have been increasingly pushing for governments to consider large-scale geoengineering options, at least as stopgap measures for an already changing climate.

Such options include injecting the excess carbon into the deep ocean or under the seafloor, engineering a giant bloom of microscopic “plants” called phytoplankton in the open ocean to absorb the carbon from the atmosphere, and injecting sulfates into the upper atmosphere to reflect light and shade the planet. But there is a great deal of uncertainty and concern about the possible negative impacts of such schemes. Sulfate injection, for example, could cause droughts. Another option, brightening low-lying clouds to reflect sunlight, could also affect precipitation and temperatures. And ocean fertilization to promote the growth of algae to capture carbon dioxide, for example, could have adverse effects on ecosystems. In recent years, attempts by private firms such as Planktos and Climos to conduct large-scale for-profit ocean fertilization projects — selling credits for removing carbon dioxide — failed due to environmental concerns and running afoul of international regulators.

In late March, about 175 scientists, environmentalists and policy experts gathered in Monterey, Calif., to discuss guidelines for controlled geoengineering at the Asilomar International Conference on Climate Intervention Technologies. One of the questions the participants wrestled with was what role private investment might play in geoengineering. Given the huge uncertainties about everything from what kinds of activities might help/do harm to who would have oversight over each part of the process, the prospects of a burgeoning industry of for-profit geoengineering startups have more than a few people nervous.

But leaving the development of geoengineering solely in the hands of governments is also problematic, as government funding — and the attendant bureaucracy — can mean the research proceeds agonizingly slowly. Some sort of public-private partnership will therefore likely be needed to move geoengineering forward.

Carolyn Gramling

geoengineering climate change hurricanes weather Climate science and society politics congress government featured

Publication Date: *Monday, August 2, 2010 - 08:33*