Can geoengineering cool the climate?

Jan 28, 2009 3 comments

Engineering the Earth

The first numerical study to compare different geoengineering schemes and determine how good they might be at reversing manmade climate change has been released by researchers at the University of East Anglia (UEA) in the UK.

They say that injecting the skies with aerosols to reflect incoming sunlight might offer great short-term potential but that such a plan also carries large risks. The team recommends instead that land-based carbon storage is the most effective solution over the long term. (*ACPD* **9** 2559).

"What we've created is a clear, analytical framework for comparing different geoengineering options; hopefully this can be a guide future research," said lead author Tim Lenton of UEA's School of Environmental Sciences.

From Hollywood to East Anglia

The idea of controlling local weather conditions by the large-scale engineering of the environment came to prominence during the Cold War when the US and the Soviet Union both researched the concept for military ends. In the past few years global climate engineering has started to move out of the realm of science fiction as atmospheric carbon dioxide (CO_2) levels continue to rise despite international emission reduction targets. Proposals have been eclectic in characteristic and scale: from increasing the Earth's reflectivity or "albedo", to deploying large-scale shields between the Earth and the Sun.

John Latham of the National Center for Atmospheric Research in Boulder, US said, "The geoengineering community believes the chance of achieving the necessary reductions in CO_2 to avert likely catastrophe are virtually zero, so it is necessary and responsible to examine alternative ways of stabilizing global temperature."

The trouble with the geoengineering at the moment, according to the UEA researchers, is the lack of quantitative framework for evaluating projects. What's more, they suggest that the enthusiasm of certain proponents has created a skewed view, where a handful of schemes are surrounded by bold but unsubstantiated claims.

"If we failed to keep the process [geoengineering] going — perhaps due to political unrest — we would leave the planet open to the Sun's full force"

Tim Lenton, University of East Anglia

Quick fix

At the most basic level, Earth's surface temperature is governed by a balance between incoming solar radiation and outgoing terrestrial radiation. For a series of different geoengineering schemes, the UEA researchers calculate the impact on this radiative balance by considering the global energy balance and the climate's response to rapid changes in CO_2 levels.

The researchers find that increasing the reflectivity or "albedo" of the atmosphere offers by far the greatest potential to cool the climate by 2050. One mechanism for doing this — put forward last year — is to spray low-lying clouds with sea salt to act as condensation nuclei and enhance cloud cover. According to this latest research, a more effective measure is to aim higher by firing aerosols into the stratosphere, in the same process as volcanic activity.

Steven Salter of the University of Edinburgh, who was involved in the "cloud-salting" proposal, told *physicsworld.com*, "I welcome this new study as it is represents a much needed aspect of geoengineering; the more rigid testing our idea receives, the more we can develop it."

The major risk, however, with these short term "Sun block" approaches is that failure to keep engineering projects in good repair would expose Earth to a rapid jump in temperature. "You are effectively masking the effect of a warming climate system," Lenton told *physicsworld.com*, "if we failed to keep the process going — perhaps due to political unrest — we would leave the planet open to the Sun's full force."

Century scale

Over longer timeframes, the researchers suggest removing CO_2 from the atmosphere through schemes like planting trees, carbon capture and storage, and fertilizing the oceans. Perhaps surprisingly, existing activities that add phosphorus to the ocean may have greater carbon sequestration potential than running expensive schemes to add iron or nitrogen.

The most favoured solution is bioenergy, described by Lenton as a "win-win" option. Carbon from the burning of bio-waste is converted into "biochar" before being returned to the soil. Lenton told physicsworld that he will take this research forward by comparing their predictions with the established climate models of the Hadley Centre.

This year the School of Environmental Sciences at UEA will be launching a new centre to bridge the gap between their research and national policy. These results will also be feeding into a Royal Society study to be published later in the year.

David Mitchell, a researcher at the Desert Research Institute, US, said, "Geoengineering should not viewed as an alternative to mitigation, but as a means of buying time. If geoengineering is seriously considered by any government, this may affect other countries and perhaps a new committee by the UN is needed to regulate this new capability."

About the author

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3 comments

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1 **erichj**
Jan 30, 2009 2:56 AM
McGaheysville, United States

Biochar Soil Technology

Senator / Secretary of Interior Ken Salazar has done the most to nurse this biofuels system in his Biochar provisions in the 07 & 08 farm bill,
www.biochar-internat...newlegislation.html
Below are my current news & Links to major developments;

Biochar, the modern version of an ancient Amazonian agricultural practice called Terra Preta (black earth), is gaining widespread credibility as a way to address world hunger, climate change, rural poverty, deforestation, and energy shortages… SIMULTANEOUSLY!

POZNAN, Poland, December 10, 2008 - The International Biochar Initiative (IBI) announces that the United Nations Convention to Combat Desertification (UNCCD) has submitted a proposal to include biochar as a mitigation and adaptation technology to be considered in the post-2012-Copenhagen agenda of the UN Framework Convention on Climate Change (UNFCCC).

Modern Pyrolysis of biomass is a process for Carbon Negative Bio fuels, massive Carbon sequestration,10X

Lower Methane & N2O soil emissions, and 3X Fertility Too.
Every 1 ton of Biomass yields 1/3 ton Charcoal for soil Sequestration, Bio-Gas & Bio-oil fuels, so is a totally virtuous, carbon negative energy cycle.

Charles Mann ("1491") in the Sept. National Geographic has a wonderful soils article which places Terra Preta / Biochar soils center stage.
ngm.nationalgeograph…mann-text

Biochar data base;
terrapreta.bioenergy…

NASA's Dr. James Hansen Global warming solutions paper placing Biochar / Land management the central technology for carbon negative energy systems.
arxiv.org…0804.1126.pdf

The many new university programs & field studies, in temperate soils; Cornell, ISU, U of H, U of GA, Virginia Tech, JMU, New Zealand and Australia.

Given the current "Crisis" atmosphere concerning energy, soil sustainability, food vs. Biofuels, and Climate Change what other subject addresses them all?
Carbon to the Soil, the only ubiquitous and economic place to put it.

This ACS study implicates soil structure as main connection to N2O soil emissions;
a-c-s.confex.com…Paper41955.html

Also:
EcoTechnologies is planning for many collaborations ; NC State, U. of Leeds, Cardiff U. Rice U. ,JMU, U.of H. and at USDA with Dr.Jeffrey Novak who is coordinating ARS Biochar research. This Coordinated effort will speed implementation by avoiding unneeded repetition and building established work in a wide variety of soils and climates.
www.EcoTechnologies.com

Hopefully all the Biochar companies will coordinate with Dr. Jeff Novak's soils work at ARS;
www.ars.usda.gov…people.htm

Biochar should be viewed as soil Infrastructure; The old saw, "Feed the Soil Not the Plants" becomes "Feed, Cloth and House the Soil, utilities included !". Free Carbon Condominiums, build it and they will come.

Erich J. Knight
540 289 9750

2 **DennisA**
Jan 30, 2009 9:25 PM
New Quay, United Kingdom

Geo-engineering

If it ain't broke, don't fix it. In the seventies, geo-engineering was again flavour of the month, including cloud seeding, but then it was to warm up the planet. The language hasn't changed much either, as the title from 37 years ago shows:

From the book “Omega – Murder of the Eco-system and the Suicide of Man , Paul K Anderson, 1971, Controlling the Planet's Climate, J. 0. Fletcher (Rand corporation:

..during the first three decades of this century,(20th), the general trend was toward a growing strength of the northern hemisphere circulation, a northward displacement of polar fronts (outer boundaries of cold masses) in both the atmosphere and the ocean, a northward displacement of pack-ice boundaries and cyclone paths movements of large, rotating wind currents), a weaker development of blocking air masses over the continents, and a pronounced aridity of the south central parts of North America and Eurasia.

Conversely, recent decades have exhibited opposite trends: a weakening circumpolar circulation, southward shifts of ice boundaries and cyclone paths, and increased rainfall in the south central parts of the continents.

These trends were underscored in 1968. It was a year in which Icelandic fishermen suffered losses due to the most extensive sea ice in the last half century, while phenomenal wheat yields from the plains of both Asia and North America due to increased rainfall pushed world wheat prices to a 16-year low.

Since about 1840, a new warming trend has predominated and appears to have reached a climax in this century, followed by cooling since about 1940,irregularly at first but more sharply since about 1960.

The periods of general warming were accompanied by increasing vigour of the westerly circulation in both hemispheres, bringing a more maritime climate to the continents, a northward displacement of cyclone paths, and a pronounced warming of the Arctic.

The recent cooling trend exhibits a reverse pattern: weakened westerly circulation, more variable and southerly cyclone paths, and a colder Arctic.

The largest scale enterprise that has been discussed is that of transforming the Arctic into an ice-free ocean. Three basic approaches have been proposed:

influencing the surface reflectivity of the ice to cause more absorption of solar heat;

large-scale modification of Arctic cloud conditions by seeding;

increasing the inflow of warm Atlantic water into the Arctic Ocean.

BERING STRAIT DAM
The basic idea is to increase the inflow of warm Atlantic water by stopping or even reversing the present northward flow of colder Pacific water through the Bering Strait. The proposed dam would be 50 miles long and 150 feet high

DEFLECTING THE GULF STREAM
Two kinds of proposals have been discussed, a dam between Florida and Cuba, and weirs extending out from Newfoundland across the Grand Banks to deflect the Labrador current as well as the Gulf Stream

DEFLECTING THE KUROSHIO CURRENT
The Pacific Ocean counterpart of the Gulf Stream is the warm Kuroshio Current, a small branch of which enters the Sea of Japan and exits to the Pacific between the Japanese islands.

It has been proposed that the narrow mouth of Tatarsk Strait, where a flood tide alternates with an ebb tide, be regulated by a giant one-way 'water valve' to increase the inflow of the warm Kuroshio Current to the Sea of Okhotsk and reduce the winter ice there.

Remember, this was to warm the Planet. As they say, nothing new under the sun.

3 **roald**
Jan 30, 2009 11:21 PM
Pomerode, Brazil
As yet, nobody has seriously contemplated a drastic reduction on the world population. That is in the root of the many problems humanity has to cope with from now on... It's perhaps politicaly incorrect to talk about that!