A STEP TOWARD SAVING OUR ARCTIC

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Our biosphere and geosphere use a different clock than we do, one that measure time in decades and centuries, not in minutes and hours. Climate change makes this clear. Humanity has never confronted a problem of this kind or magnitude before. We do not know how long it will take us to respond to the two major threats we now see:

- increasing climate change, driven at a high rate by global warming;
- rising acid levels in our ocean, already well documented.

There certainly will be further threats, as the human population and our influence on the Earth grow. But at this early stage, in an era that will probably last centuries, we cannot know them all. We do not understand our world well enough. But we cannot simply delay.

We should accept the *possibility* that anthropogenic carbon emissions could trigger a climatic tipping point, such as interruption of the Gulf Stream in the Atlantic. To avoid this, current thinking urges an all-out effort to shrink the human atmospheric-carbon footprint. But many energy authorities believe this task will take a century or more. If that; our fossil fuel burning is accelerating, not declining.

Given our lack of options we need to consider relatively low-tech, low-expense experiments to accelerate our understanding of climate science. These could lead to restoring the climate we prefer – changing the climate on purpose instead of by mistake, as we are doing now. Smart changes could return us to our earlier, milder world.

The Arctic: Our First Focus

The two clear threats of global warming and ocean acidity develop over different time scales. Very roughly, ocean acidification is growing at a time rate of some 50 years, as presently observed. The oceans circulate well, so the effects spread around the globe quite evenly.

We think of global warming as an effect in our atmosphere, since carbon dioxide builds up there. But the atmospheric warming also heats the oceans. This warming is not uniform, though, for many complex reasons. Sunlight falls most weakly in the Arctic and Antarctic, yet these areas show the greatest rate of change due to air and ocean warming.

In the Arctic particularly, the warmer ocean melts ice, exposing more ocean, which is darker than the ice. So the ocean absorbs more sunlight than before. Very simply, this and other effects are warming the Arctic particularly more than other regions – several Centigrade in the last 30 years.

This means the Arctic is particularly vulnerable. The Antarctic’s think ice sits mostly on land, so melting does not expose as much of the darker ocean as in the Arctic. The whole subject is complicated, but the conclusion is not: the Arctic seems the best place to use advanced methods of restoring the climate to that we had only decades ago.

If we understand climate well enough to predict that global warming will be a problem, then plausibly we also understand it well enough to address the problem by direct means. But the central issue is that we do not have time to waste.

Many predict that we will see more severe warming effects in the Arctic and globally within a few decades. Ocean acidification takes longer, suggesting a simple priority:

- begin with regional, reversible experiments to define the science;
- learn from these how well we understand our climate;
- look for cooling effects;
- stop the warming to buy time;
- deal with ocean acidification separately; and
- focus on what we can do now, not what we can do eventually.

We do not have “eventually” – nature works at its own pace.

A Particulate Shield Experiment

But how to begin?

Perhaps the simplest idea uses the suspension of tiny (less than one micron), harmless particles at such altitudes that they will rain out within, say, six months. These will reflect mostly ultraviolet rays, which have a lesser role in plant growth than the lower frequencies, yet carry more energy, which heats when it is absorbed.

This describes a scientific experiment, designed to understand the complex climate system; it is not the beginning of an engineering project.

A first test could be over the Arctic, since the warming there is considerable. There the atmospheric circulation patterns tend to confine the deployed particles, sweeping them around the pole but not far southward. The general method seems clear:

- deploy the particles by airplane in the Spring;
- measure the cooling below, using local sensors and space monitoring of the sea ice;
- detect if the present retreat of sea ice toward the North Pole slows or even reverses. This will be a clear, visual signature that the region is cooling; and measure to see if ground temperatures will give more refined understanding. The particles can rain or snow out in fall, ending the experiment in predictable fashion.
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One could use just enough of the tiny particles to create a readily measurable shielding effect. An initial experiment could occur north of 70 degrees latitude, over the Arctic Sea and outside national boundaries. The particles would reflect most UV rays back into space. They would reduce warming and stop some of the harm of UV rays to plants and animals, as a side effect. Robust photosynthesis would still occur in the tundra, fueled by the visible spectrum.

This idea exploits our expanding understanding of the climate system. It also uses our historical knowledge of the marked cooling driven by sulfate aerosols sent into the high altitude air by volcanoes, in the last several centuries. But sulfates interact chemically with the high altitude air. We can avoid that by using less chemically reactive particles, such as diatomaceous earth. Our aim should be to edit the incoming sunlight, not to interfere with our atmosphere's chemistry.

We can regard these ideas, and the scientific knowledge we gin from such experiments, as tools in a possible future technology. There could be many variables in such a climate technology, including particle size, particle nature, altitude deployed (and therefore duration in the atmosphere), and much else. We very probably do not even know all the major influences we will find.

If such an Arctic experiment works, it could tell us much about how to possibly arrest Arctic warming and reverse the loss of sea ice. Since few people live there, any side effects could be minimal. By placing the particles at a high altitude, we can arrange for the first experiments to end when they rain out into the sea, after the main heating during Arctic summer has passed.

Repeating this over several years, to advance our understanding of how our vastly complex climate works, would advance the science. Public discussion could run in parallel, giving a sense that this momentous issue is being freely aired.

This idea is only the first step in making climate science, which has always been passive, into an active science. Astronomy was like this, until the space program began to give us the power to explore the planets, a half century ago. We now do experiments on the soil of Mars, the atmosphere of Jupiter and Venus. With direct measurement comes a new era in any science. All of particle physics has a similar history.

This is not a new transition in scientific style. But it is unique. We will live inside the experiment. We have far more at stake.

Diagnosing global climate change is only the beginning. Restoring the stable climate we are losing is the long range goal. But the science comes first.

Saving the Arctic is the first, trial step. If we find that the pace of forced global climate change is unacceptably high, we could then put this idea to work globally, with all deliberate speed. There could be other side effects on the vastly larger global scale, and we would have to monitor the entire process very carefully. Some effects could be positive. Lessening UV would lower skin cancer deaths, now about a million per year. Crops under less UV grow better and yield more food, especially in the tropics.

The main thrust of all this is to carefully use our ability to attack warming at its roots – incoming sunlight now, carbon dioxide later.

The climate system has great inertia and stirs slowly, but once altered, has a powerful momentum. It will be a good idea to have methods like these on the shelf to deploy quickly. Methods studied this way would be ready for use if the global environment worsens.

Given signals that the scarier scenarios of a warming climate might be soon upon us, we could act soon. Such preparations can also establish the political ground for widespread action. Humanity needs to get used to the idea of acting in this wholly new fashion, assuming our role as true stewards of the Earth. Given the magnitude of the possible threat to all societies, such preparations are merely prudent, not radical.

Costs seem readily attainable – perhaps a few hundred of millions of dollars for an Arctic experiment. High altitude trials over the open ocean are little constrained by law or treaty, so show-stopper politics may be avoided. The first stages will be scientific experiments, not vast engineering projects.

We hope that a favorable experiment could change the terms of the global warming debate for the better. As economist Robert Samuelson recently said, "The trouble with the global warming debate is that it has become a moral crusade when it's really an engineering problem. The inconvenient truth is that if we don't solve the engineering problem, we're helpless."

END

NOTE: On Saturday, November 18th- Sunday, November 19th, 2006, a secret meeting was held in order to review the subject of geoengineering and to discuss this subject without the public or the press in attendance. NASA required that this meeting be held in secret.

On Monday, November 20, 2006, 9:00 A.M. – 12 Noon a public meeting was held at Stanford University, (Main Carnegie Seminar Room, in Palo Alto, California, by the Carnegie Institution-Department of Global Ecology), on Geoengineering, in order to review some of the subjects discussed in the previous secret meeting. Several guests that had presented information or spoken in the secret meeting came to this public meeting to present their personal opinions and offer some insight into their presentations at the closed meeting.

One guest that spoke at Monday's meeting was Gregory Benford, Department of Physics & Astronomy, University of California, Irvine. A copy of Gregory Benford's meeting handout is provided above for your information.