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Subseries: Issues Files

OA/ID Number: 29158
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Global Warming (2 of 2) - 1990 [6]

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Withdrawal/Redaction Sheet (George Bush Library)

Doc. No. / Type	Subject/Title	Date	Restriction	Classification
01. Paper	From Committee on Earth Sciences Re: U.S. Global Change Research Program Options paragraphs redacted (7 pp.)	n.d.	P-5	
02. Memo	From David Bates to POTUS Re: Recommendations of the DPC Working Group on Global Change for President's 1990 Environmental Program (5 pp.)	11/29/89	P-5	
✓ 03. Memo RIP	From D. Allan Bromley to POTUS Re: Meeting w/President Gorbachev [redacted] (11 pp.)	11/27/89	(b)(1)	

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File Location: Global Warming (2 of 2) - 1990 [6]

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6 December 1989

Dr. D. Allan Bromley
Science Advisor to the U.S. President
Executive Offices of the President
Washington, DC 20500

Dear Dr. Bromley:

In an article in the 20 November 1989 issue of *Newsweek*, John Sununu referred to the new climate-change modeling research by Washington and Meehl (1989) at the National Center for Atmospheric Research (NCAR). (Another editorial, also on 20 November, in *The Wall Street Journal*, incorrectly quoted results from the same research.) When I saw the *Newsweek* article, I telegraphed Dr. Sununu and invited him to call me if he wanted more information on our experiments. In our ensuing telephone discussions about the state of climate modeling and our research, he suggested that I contact you directly.

My purpose in writing you, therefore, is to correct the media statements and to clarify the conclusions to be drawn from the model results at NCAR. Our modeling group is one of the few research groups that has successfully coupled a global atmospheric model to a global dynamical ocean model. The ocean model is driven by heat fluxes to and from the atmosphere, by wind forcing, and by salinity differences caused by atmospheric precipitation and evaporation. Although the coupled model can experience many problems from lack of constraints, its advantage is that it can be used to examine climate sensitivity to a gradual increase of carbon dioxide in addition to an instantaneous doubling of carbon dioxide.

The Wall Street Journal's editorial says that we have "cut in half" our estimates of climate change. This assumption is erroneous for the following reasons. In previous climate-change experiments, we used a simple, mixed-layer upper ocean with a thickness of 50 m. Although such an ocean model does not include vertical or horizontal heat transport mechanisms and other important ocean processes (such as mixing with intermediate and deep ocean layers), it does include some important aspects of the seasonal heat storage in the upper oceans, that is, heat is stored in summer and released in winter. The GISS model used by James Hansen is an example of a simple, mixed-layer model with a specified poleward flux of heat from the tropics.

Because of the prohibitive expense in running our new model with a dynamical ocean to equilibrium, we cannot say exactly what the new equilibrium would be, but it certainly would be larger than the value quoted in *Newsweek*. In fact, we have run it farther than reported in the referenced article and it continues to show globally averaged warming in the oceans and atmosphere. Our research and that of NOAA's Geophysical Fluid Dynamics Laboratory have revealed new insights into global warming. Previous studies indicated that land and ocean areas usually warm, but our recent studies show, for the first time, that some ocean regions actually cool. In our experiments with a gradual increase of carbon dioxide, the lands are warmer and in certain regions the North Atlantic and North Pacific Oceans are cooler—a pattern similar to that observed by Karoly (1989). Although our coupled dynamical models are not precise enough for climate prediction, they yield behavior patterns heretofore unseen in other model studies with simple oceans, and this behavior is only one part of a myriad of climate

To Dr. D. Allan Bromley

8 December 1989

Page 2

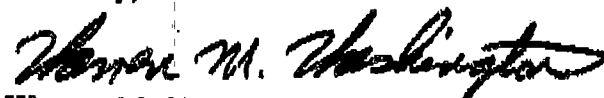
system interactions we are beginning to explore. The simplified picture of using some globally averaged warming number is not meaningful for the observations or for the models. The large-scale regional patterns that appear are likely to be quite complex with a great deal of natural variability.

The *Wall Street Journal* editorial also recommended that George Bush, John Sununu, Bill Reilly, Congress, and the governors gather together on C-SPAN to hear top climate modelers discuss and "settle" the issues surrounding the greenhouse effect. We do not believe that this is the best method of dealing with scientific uncertainties. Rather, we should consider the recommendations to be made in 1990 by the Intergovernmental Panel on Climate Change (IPCC)—a study involving worldwide experts on climate change. We at NCAR are participating in this IPCC study, as well as in intercomparisons of models under the Department of Energy's Carbon Dioxide Program. Both efforts are extremely critical to our understanding of what the models are really telling us.

Your statements to the press and public indicate that you are an advocate of global-change research. We urge your continued support. Climate modelers must continue to refine the uncertain aspects of physical processes, such as clouds, and to improve resolution.

If you would like more information, please call me at (303) 497-1821; my FAX number is (303) 497-1137.

Sincerely,



Warren M. Washington, Director
Climate & Global Dynamics Division

Enclosures

cc: John Sununu
Nancy Maynard
Richard Anthes
Peter Gilman
Ari Patrinos
Michael Riches
Robert Serafin
Deborah Stirling

References:

Karoly, D., 1989: Northern Hemisphere temperature trends: A possible greenhouse gas effect. *Geophys. Res. Lett.*, in press.

Washington, W.M. and G.M. Meehl, 1989: Climate sensitivity due to increased CO₂: experiments with a coupled atmosphere and ocean general circulation model. *Climate Dynamics*, 4, 1-38.

SCIENCE

Is It All Just Hot Air?

New computer models question the severity and timing of the greenhouse effect

How worried should we be about the greenhouse effect? Last week British Prime Minister Margaret Thatcher, hardly an eco-freak, called on the United Nations to adopt a binding treaty restricting emissions of gases that threaten to warm the planet, causing deadly floods and food shortages. Yet just the day before, at an international meeting in a Dutch seaside resort, only 30 of the 65 nations in attendance supported a Dutch proposal to freeze the level of emissions of greenhouse gases by the end of the century and cut them 30 percent by 2005. Japan, the Soviet Union, China and the United States—which together account for 58 percent of the world's output of these gases—agreed only that stabilizing them "should be achieved as soon as possible."

Environmentalists lambasted the empty statement as "either a failure of nerve or a cynical ploy," as Brooks Yeager of the National Audubon Society put it. Perhaps, but it also reflects the uncertainty of greenhouse science. Predictions of global warming rest on the observation that certain gases—carbon dioxide (CO₂), nitrous oxides, methane, chlorofluorocarbons (CFCs)—act like glass in a botanical greenhouse, trapping heat and thus warming the planet. That much remains unquestioned: a greenhouse of some magnitude is coming some time. The debate turns on three points:

■ Have greenhouse gases affected our weather yet?

■ How much will temperatures rise once greenhouse gases in the atmosphere reach twice their current levels, around 2030? A degree, or an apocalyptic 5.5 degrees?

■ How long does it take for the mercury to shoot up?

For answers, climatologists turn to computer models. But these mathematical formulations are crude approximations at best, as the modelers are the first to admit. For instance, greenhouse contrarians charge, the models do not even "predict" the past very well. Gases released since the

19th century should have warmed the planet 3 degrees Celsius, according to the models—but the world has warmed no more than half a degree. The discrepancy may be due to a delay between the emission of greenhouse gases and their warming effect, a delay determined in part by how much CO₂ the oceans absorb and by how long it takes the waters to warm up. But critics don't accept that. "The most conservative climate model overestimated warming by a factor of six," says climatologist Patrick Michaels of the University of Virginia. "Isn't that enough to give you pause about [forecasts of] the end of the world?"

Although computer models say greenhouse warming has begun, the data are controversial. Climatologist James Hansen of NASA's Goddard Institute for Space Studies, using global-temperature data covering the last 100 years, concludes that the greenhouse effect has indeed kicked in: the readings have gone up an average of 0.4 degree Celsius. But skeptics argue that the tiny warming is due largely to urban heat islands—cities heating their surroundings. And since the thermometers are on land they may not reflect the (mostly watery) planet as a whole. "Ocean temperatures show no change since the 19th century," contends geophysicist Richard Lindzen of Massachusetts Institute of Technology.

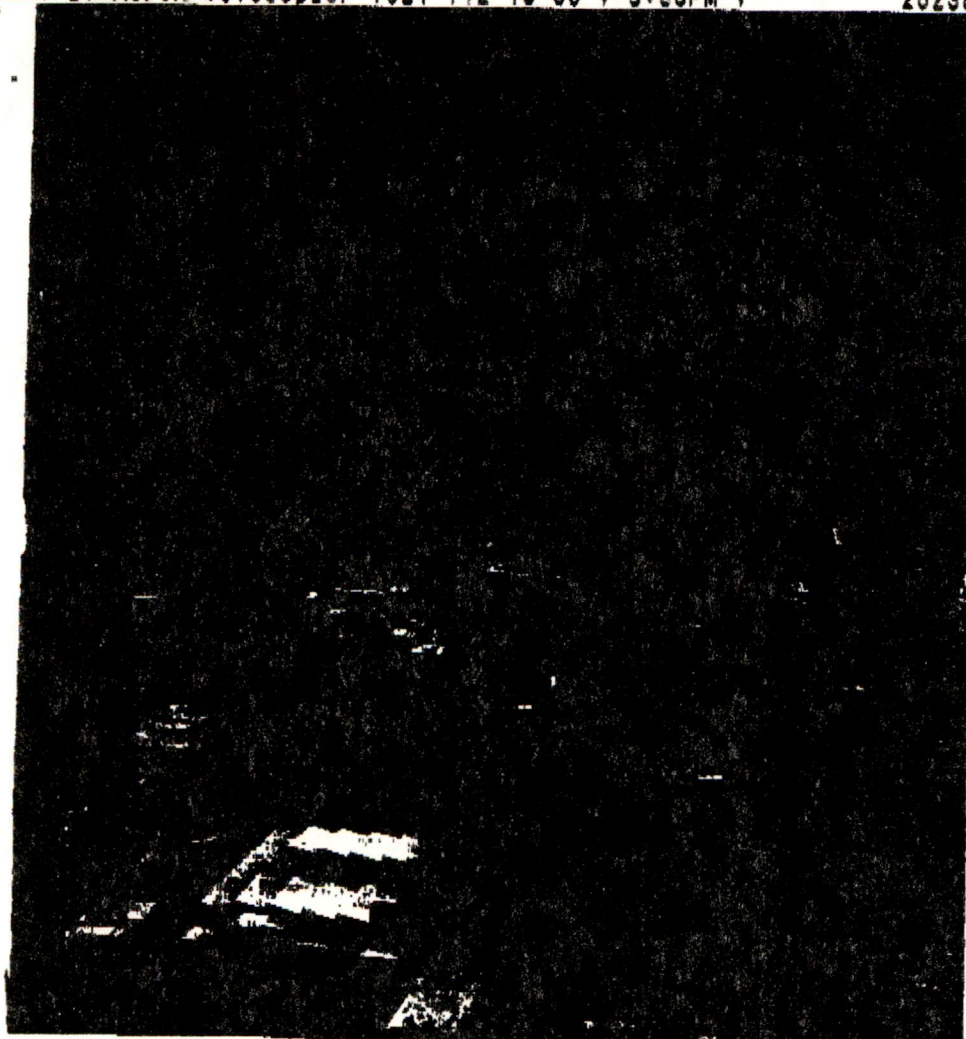
Therma station New data, however, strengthen the case for the greenhouse. Next month, at a meeting of the American Geophysical Union, mathematicians from AT&T Bell Labs will report that, by ruling out other explanations of global warming—from chance to solar oscillations—they were able to conclude that "there is a 99.99 percent chance that the warming and the CO₂ rise are causally related," says David Thomson. And researchers from Ohio State University announced this month that ice cores from a glacier in Tibet show that Central Asia has warmed 1 to 3 degrees Celsius in the last 100 years—something that cannot be attributed to warm cities.

The more pressing question is what the

Winnipeg 60: Polluted Mexico City

climate will be like by, say, 2030. To answer that, researchers are making their models more realistic. In one recent fine-tuning, researchers led by J.F.B. Mitchell of the British Meteorological Office rewrote their equations to simulate clouds containing ice crystals, not only water vapor as before. The effect: overcast increases, which cools the world just as does a passing cirrus on a July afternoon. The result, the BMO group wrote in the journal *Nature*, is a global warming of 1.5 degrees Celsius, not the 3 to 5.5 degrees predicted by most current models. (In Fahrenheit, that's a warming of 3.4 degrees, rather than 5.4 to 9.9 degrees.)

White House chief of staff John Sununu (an MIT-trained engineer) and science adviser D. Allan Bromley (a physicist) have seized on this result to argue against taking steps to mitigate the greenhouse. "You do not establish policies on the basis of incomplete models," Sununu told *Nrwwazek*. "We have the time and obligation to find out what's going on. We're going to do the right thing. We want to know what the right thing is." True enough. But the White House may be taking more comfort from the new results than is warranted. V. Ramanathan a University of Chicago geophysicist not noted for apocalyptic rhetoric, explains that cloud behavior "involves about 25 different interactions, and our models simulate only one or two. When we



ALLEN KUMBLI—PICTURE GROUP

Keeping a Weather Eye on the Mercury

Even sophisticated formulas used to predict the greenhouse can't account for all of nature's forces. Several variables may make the climate mild or hellish.



LARRY DOWNING—NEWSWEEK
More data, please: **SUNUNU**

Silver Linings

Clouds: Higher temperatures increase evaporation and hence clouds, which are made of water vapor and help cool the planet.

Volcanoes: Eruptions spew tiny particles into the atmosphere that deflect sunlight, causing cooling.

Plankton: Warmth and extra CO₂ might promote the growth of these tiny marine organisms, which absorb CO₂ and take it out of circulation.

Oceans: Their heat-absorbing capacity might delay warming for more than a century.

Start Building an Ark

Sea ice: Once it starts to melt, less sunlight will be reflected away, exacerbating the warming.

Acid rains: Sulfur dioxide, which causes acid rain, also cools the earth. Controlling acid rain might thus accelerate the greenhouse effect.

Permafrost: Warming might melt the frozen soil, releasing buried methane—a greenhouse gas.

Soil: Warming ordinary soil would increase the rate at which bacteria convert dead organic matter into CO₂, intensifying the man-made greenhouse.



JACKSON CHEN—NEWSWEEK
Sore warnings: **Hansen**

have all 25 in there, greenhouse predictions may get worse."

Caution like Sununu's may be prudent; unbridled optimism is not. He cites another new study that lowers projections of greenhouse warming. Warren Washington and Gerald Meehl of the National Center for Atmospheric Research in Boulder, Colo., used more sophisticated simulations of the oceans' circulation and heat exchange than did earlier computer runs. In their worst-case scenario—an overnight doubling of CO₂—the pair found that the world would warm 1.6 degrees Celsius within 30 years, again a more mild greenhouse. But Meehl points out that their model did not run long enough to show all the warming CO₂ would produce. Some remained bottled up in the great heat sink of the ocean. (The seas absorb most of the CO₂ produced on the planet.) Running the models out another few decades would produce more heating. Says Meehl, "It may take longer to see climate change, but you do see it."

Stormy weather Even increases of a degree or two can have unpleasant effects. Droughts would be more likely. Storms would be more severe and frequent, because the atmosphere holds more energy. Agricultural belts would shift, possibly causing crop failures. Although many skeptics argue that crops would thrive on the extra CO₂, in fact plants have responded to past CO₂ increases by developing fewer of the tiny pores that breathe in this gas. Most worrisome, while a mild greenhouse may not be a great place to live, no one can rule out the chance of a hellish tomorrow. "Although a 1-degree warming is much more probable," says climatologist (and skeptic) Robert Balling of Arizona State University, "it is ludicrous to say 5.5 degrees cannot happen."

But when? Current inhabitants of the White House don't have to worry. Because the oceans absorb so much heat, it will be decades before the world gets appreciably hotter because of CO₂ already locked on the planet—unless some of the unknown forces that shape climate bring on more warming more quickly (table). Says climatologist Michael Schlesinger of the University of Illinois, "Our children will ask why their folks didn't do something about greenhouse warming when they had the chance."

That leaves society with a painfully familiar choice: how to act in the face of uncertainty. As NCAR climatologist Stephen Schneider puts it in his new book, "Global Warming: Can we base trillion-dollar decisions about global economic development strategies on ... these admittedly cloudy crystal balls?" He says yes—procrastinating would be reckless. But MIT's Lindzen recommends wait-

ing, since "most of these questions will be on significantly surer ground in five years." Other experts think 10 or 20 years is more like it, and that what we learn is as likely to point to a worse greenhouse. Says Mohammed El-Ashry of the World Resources Institute, a Washington think tank, "When we waited for more research on acid rain, we ended up realizing that everything we knew 10 years earlier was true." And waiting exacts a price. Gradually replacing oil with solar energy, for instance, is much less painful than a sudden switch. And the longer greenhouse gases are emitted, the more warming we may ultimately confront.

How we respond to the greenhouse threat will depend not only on science but also on the palatability of the required changes. The industry-sponsored Global Climate Coalition opposes singling out American companies to "cure" the greenhouse. Ford Motor Co., for instance, points out that U.S. passenger cars account for 1.2 percent of global CO₂ emissions; doubling fuel efficiency would cut that to .6 percent. "It would throw industry into a tailspin and have minimum environmental impact," argues Ford's Kelly Brown. But vehicles account for 32 percent of America's CO₂ emissions; utilities, for 34 percent. Of course, America alone cannot stop the greenhouse, but if a rich, technologically advanced nation won't put its own house in order, then developing countries—potentially worse greenhouse villains—have a perfect excuse to do nothing.

Foreign aid: Changes that would mitigate the greenhouse would actually bring other benefits. Energy conservation reduces dependence on imported oil; fuel-efficient cars and planting trees clean the air. Some changes would improve competitiveness. At least the Japanese, whose models show a temperature increase of 1.5 to 3 degrees Celsius by 2030, seem to think so. They are researching ways to recycle CO₂, released in industrial processes, develop energy sources to replace fossil fuels and capture CO₂ by using marine algae to "fix" it.

For those who fear that the greenhouse will arrive—and no responsible scientist denies that possibility—it seems imperative to take immediate steps to mitigate it. For those who fear such changes, it seems more prudent to postpone action until the effect is indisputably upon us. The Bush administration has budgeted \$250 million this fiscal year for climate modeling, money that would go to both scientific camps. Some of the uncertainties might be resolved by the next world climate conference, in late 1990. But the debate will not be over by then. Society will have to face its demons and decide which it fears most.

BRAXTON BRIDLEY with MARY HANER
in Washington. LARRY WILSON in New York
and Bureau reports



from the sea: Mussel magnified three times

ENVIRONMENT

Showdown at Mussel Beach

Marauding crustaceans terrorize Great Lakes

It may lack the girth of the Blob or the menacing chirp of Hitchcock's birds, but the zebra mussel is staging a classic creep-show routine on the western shores of Lake Erie. The striped freshwater clam invaded North America just three years ago, when a European tanker flushed its ballasts into Lake St. Clair. Since then, populations have spread through the Detroit River and into Lake Erie at a clip of 160 miles a year. The prolific crustaceans are now antombing boat hulls and beaches, disrupting a large fishing industry and clogging waterlines that support cities and factories. Unless the invasion is stopped, experts speculate, 28 million people could lose their water supplies within five years.

For Great Lakes fishermen, the immediate threat is not the thumb-size grown-ups but the subvisible larvae they spawn by the tens of thousands. Off the shores of Toledo and Cleveland and near Leamington, Ont., a single cubic meter of water often contains a half-million mussel larvae. "I don't think it has reached its peak even there," says Gerry Mackie, a biologist at the University of Guelph. The voracious youngsters have increased water clarity threefold—but they've done it by gobbling up the plank-

ton and algae that support the rest of the aquatic food chain. Food shortages are already affecting the walleyed pike, a perchlike species that accounts for most of Ohio's \$500 million sports-fishing industry and is harvested commercially in Canada. This year Ohio's catch will be off by an estimated 600,000 fish (down from 4.9 million to 4.3 million), and Canadian fishermen say the walleyes they're catching are smaller than usual.

That's just the beginning. Mature zebra mussels use tough, threadlike membranes to latch onto hard surfaces in layered colonies, and they seem particularly fond of the huge intake pipes that provide water supplies throughout the Great Lakes Basin. The town of Monroe, Mich., had to ban

lawn sprinklers this summer, after the crustaceans colonized its 30-inch-wide, 10-mile-long intake pipe, reducing its capacity by a third. Mussel-bound waterlines have brought a halt to development in the town of West Lorne, in southwest Ontario, and caused a series of equipment failures at the Ford Motor Co.'s Windsor (Ont.) Casting Plant, where engine blocks are cast from molten iron.

Ford officials were able to kill the invaders with 300-pound doses of chlorine, leaving cleanup crews to contend with mountains of malodorous dead. But municipal officials have to think about purity as well as quantity. Since chlorine and mussel proteins can mix to form suspected carcinogens, Monroe officials are trying to develop a whirling scrubber that will unseat the intruders mechanically. Other communities are trying to concoct filters that will keep the mussels from entering the pipes in the first place. These devices will cost an estimated \$50 million apiece, and dozens of towns may require them. "Many of us are moving quickly to contain this mussel," says Michael Donahue of the Great Lakes Commission, an eight-state consortium of governments. "But I can tell you that the cost will be much more than the Exxon oil spill."

Natural predators may offer the best hope of all. No amount of garlic or butter will turn a zebra mussel into restaurant fare, but the striped pests have turned up in the stomachs of several species of fish. Diving ducks like them, too, and large flocks will spend the next two months in the Great Lakes, en route from Canada to the southern United States. Let us hope they're hungry.

CHEFFREY COWLEY with
LOUIS AQUILAS in Detroit

REVIEW & OUTLOOK

Chill Out

We keep reading that the debate over the greenhouse effect is "settled" and that all "serious" scientists subscribe to it. Such a strong sense of consensus in science is a remarkable thing, no matter what the subject. We continue to wonder, though, if the greenhouse debate is really over.

In January, for instance, the New York Times publicized a study which reported that there has been no warming trend in the United States over the past century. Scientists at the National Oceanic and Atmospheric Administration reported that since 1855, the climate in the U.S. has grown neither warmer nor colder, wetter nor drier. The chorus quickly responded that the U.S. results are an anomaly, and that when a wider sample came in, its theory would be vindicated.

A wider sample has just arrived. Three MIT scientists—Reginald Newell, Jane Hsiung and Wu Zhongxiang—recently processed ocean-temperature data taken all over the world by merchant mariners since the mid-19th century. Their results were summarized in the current issue of Technology Review: "One of the most striking results suggested by the data is that there appears to have been little or no global warming over the past century." The computer models that foretell a greenhouse effect predict that there already should have been about a 1.8 degree rise in global temperature. But that hasn't happened. Also, the unorthodox MIT report has been virtually ignored. Science may still be about surveying all the available facts but, increasingly, public policy isn't.

Today, much public policy, especially as practiced by many environmental advocates, is mainly about making doubters or opponents reluctant to challenge the consensus. Strobe Talbot of Time magazine, for example, recently announced that "no respectable scientist denies" the greenhouse phenomenon.

No doubt, participants of all stripes in the policy game these days, have become frustrated at their inability to enact their agendas. What seems to sometimes work, though, is whipping up a kind of mass-media fervor behind one's ideas. The danger in this is that it may cause the public to think that science is now primarily about politics, and in politics about half the people usually think that you're not talking the truth.

widely credited with launching the highly politicized crisis atmosphere around the greenhouse question. Mr. Hansen went before a congressional committee and said that he was 99% sure that the earth was getting warmer, and he had "a high degree of confidence" that warming was caused by the greenhouse effect. This of course got the desired effect—tremendous press play. But some of Mr. Hansen's scientific colleagues were dismayed.

In an article titled "Hansen vs. the World on the Greenhouse Threat," the journal Science reported that Mr. Hansen's colleagues found his greenhouse assertions "unforgivable," largely because of their absolutist certitude. (But absolutism ("no respectable scientist denies") is a commandment of modern environmentalism.)

Mr. Hansen is a highly respected modeler, but he resists acknowledging the possibility of shortcomings in his computer creation. However as models have begun to grow slightly more realistic recently, the greenhouse predictions have varied enormously. Researchers at the National Center for Atmospheric Research have cut their greenhouse prediction in half. Lacking empirical confirmation of their primitive models, scientists and environmentalists have adopted a fallback position. They say the greenhouse effect may or may not be serious, but we should take insurance precautions anyway. But the cost over 20 years has been estimated to run between \$1 trillion and nearly \$4 trillion.

The final greenhouse argument is that it is far cheaper to address the problem now, than later, when information is more reliable. This recalls to mind the 19th-century scientists who worried that the world was running out of coal.

Maybe there's a way out of this:

Let's put all the relevant policy players in a room together—George Bush, John Sununu, Bill Rieilly of EPA, Congress and governors. They'll listen while the top academic climate modelers discuss the available evidence around the greenhouse effect. The public will watch on C-SPAN. And when it's over, the politicians can go before the microphones and tell us what they think is "settled" about global warming and, most important, how much they want to spend on it. We agree with the absolutists. Time is money. Let's settle it.



THE ROCKEFELLER UNIVERSITY

1230 YORK AVENUE • NEW YORK, NEW YORK 10021-6399

December 12, 1989

The Honorable John H. Sununu
Chief of Staff to the President
The White House
1600 Pennsylvania Avenue
Washington, D. C. 20500

Dear Governor Sununu:

You probably have seen the accompanying item by Leslie Roberts which appeared in the November 24th issue of Science. It is highly critical of the report of the George C. Marshall Institute concerning the Greenhouse Effect and is strongly supportive of the more extremist group which wishes our country to take the lead, essentially overnight, in a vast and expensive shift in our use of fossil fuels. The article is not only highly biased in favor of the extremist groups which it quotes extensively but gives a grossly distorted representation of our own report. Among other things our report was carefully reviewed by experts who have spent a number of years in following atmospheric changes that might lead to a significant greenhouse effect in the immediate future.

The responses to the editor of Science of the group responsible for the Marshall Report as well as responses from other scientists who are aware of the issues involved are also appended to this letter. It is our hope that the editor of Science will have the courtesy to publish them in a forthcoming issue of Science. I am also enclosing an editorial written by John Maddox which appeared in the November 24th issue of Nature and which adopts a viewpoint close to that contained in our report from the Marshall Institute.

It seems very strange that a group of scientists should express such vehemence in connection with a plan that would have our own country take the lead in turning back the clock for many decades. In fact, it is not very clear who would follow us.

We remain interested in this issue and will continue our study.

Best regards.

Sincerely,

Fred Seitz
Frederick Seitz

Activity in the other direction includes visits to the Soviet Union, under the same program, by a half-dozen American sociology lecturers. Among them are Neil Smelser of the University of California at Berkeley and Kohn of Johns Hopkins, who will be going to Moscow in December. Soviet universities are also soliciting American Fulbright lecturers.

Kohn adds that Cornell University has made a unique arrangement with Igor Kon, the Soviet Union's leading expert on U.S. sociology, who will have a 2-week-per-year visiting professorship. Kon, says Kohn, has managed to keep abreast of the field while working at an institute in Leningrad—mainly by obtaining review copies of American books. He cleverly managed to convey the meat of the scholarship by beginning and ending his reviews with "Marxist diatribes," says Kohn. So knowledgeable is the Soviet sociologist that when he came to the ASA convention in August 1988, he was able to identify the main accomplishments of every author to whom he was introduced.

Kohn has also been involved in initiating a series of joint conferences, which have been in the planning stage since before Gorbachev took over. IREX and the ASA are supplying funds to support five U.S.-Soviet conferences that are being held alternately in the United States and the Soviet Union. The first, in 1987, was a conference on sociology and the psychology of work, held in Vilnius. This December there will be a conference in Moscow on public opinion research.

All this cross-fertilization—indeed, the blossoming Soviet interest in sociology generally—is regarded as good news both for the discipline and for U.S. Sovietologists in particular. Shelley notes that "academic positions for sociologists trained in Soviet studies have gone unfilled in recent years" and expects that to change.

Further, William V. D'Antonio, head of the ASA, says he hopes eventually to see U.S. students doing graduate work in the Soviet Union.

For its part, the ASA is looking toward bringing over another crop of Soviet students next year, this time including political scientists and economists, with the cooperation of the American Political Science Association and the American Economics Association. "Soviets are acknowledging that American sociology is where it's at," says D'Antonio. Shelley agrees. She reports that the United States—where sociology is a heavily quantitative field—was chosen as the destination for the 17 students because "French sociology is seen as too qualitative and German sociology too philosophical."

■ CONSTANCE HOLDEN

Global Warming: Blaming the Sun

A report that essentially wishes away greenhouse warming is said to be having a major influence on White House policy

A SLIM, UNREFERENCED REPORT that many scientists have dismissed as biased and misleading is said to be at least partly behind the White House's recent temporizing on climate change.

And that is causing consternation among climatologists and other greenhouse experts, who are dismayed that this 35-page document by the George C. Marshall Institute, a Washington, D.C., think tank—rather than one of the massive, carefully researched and reviewed expert reports of the past several years—seems to be holding sway in the upper echelons of the Administration.

The report, "Scientific Perspectives on the Greenhouse Problem," is by three prominent scientists—William A. Nierenberg, director emeritus of Scripps Institution of Oceanography; Robert Jastrow, founder and former director of the Goddard Institute for Space Studies; and Frederick Seitz, president emeritus of Rockefeller University and past president of the National Academy of Sciences. The trio's other major foray into public policy was a vigorous defense of the Strategic Defense Initiative a few years ago.

Summing up the abundant uncertainties that surround greenhouse models and predictions, the authors say it is too soon to take any actions to reduce greenhouse gases. And by their reckoning, there is little need to. They argue that there is no evidence that the modest temperature rise of 0.5°C that has occurred this century is correlated with emissions of greenhouse gases, and they predict that decreased solar activity in the next century will lead to a cooling trend likely to offset any greenhouse warming. All of this is couched in ample caveats, but the underlying message is that the entire problem has been overblown.

Several scientists are up in arms. Steve Schneider of the National Center for Atmospheric Research, for one, has denounced

the report as a political document. Nearly 6 months after its release, he is still arguing about the report's scientific basis with Nierenberg, via letters.

"Noisy junk science," says Jerry Mahlman, director of the National Oceanic and Atmospheric Administration's Geophysical Fluid Dynamics Laboratory, where one of the major greenhouse models was developed.

A number of other respected climate researchers have suggested that the National Academy of Sciences review the study. The Academy is likely to weigh into the ruckus in some way—a couple of committees are looking at the report—though it will stop short of giving the document a formal review.

At the Environmental Protection Agency, Alan Hecht, deputy assistant administrator in the office of international activities, says he has "real problems" with the study and recently passed a critique of it onto EPA administrator William K. Reilly. As part of this informal review, Hecht asked Schneider for his comments on the report; Schneider's less-than-flattering letter is now circulating in the scientific community and on Capitol Hill, where Sena-

tor Albert Gore (D-TN), for one, is concerned.

The report does have its scientific supporters, including meteorologists like Jerome Namias of Scripps, and Richard Lindzen and Reginald Newell of Massachusetts Institute of Technology—distinguished scientists whose major work is largely outside the greenhouse field. On 23 September, Lindzen and Namias wrote to President Bush extolling the merits of the Marshall report and citing its conclusion that "current forecasts of global warming for the 21st century are so inaccurate and fraught with uncertainty as to be useless to policy-makers."

The message apparently has gotten



High-level proponent. William Nierenberg, one of the authors, briefed White House officials.

through, if not to Bush then to his chief of staff John Sununu, who, it is widely believed, is quite taken with the report. Says Schneider: "Sununu is holding the report up like a cross to a vampire, fending off greenhouse warming."

Just what impact the report has had on Administration policy is difficult to pin down, and Sununu's office is mum on the subject. But it has been widely reported that Sununu tried to block EPA head Reilly from attending an international meeting on climate change at The Hague in early November. At that meeting, the United States refused to commit itself to cutting emissions of carbon dioxide.

Nierenberg, for his part, has been working hard to get the message into the White House. He personally briefed senior Administration staff, including representatives from the White House Office of Cabinet Affairs, the White House Office of Policy Development, the Council of Economic Advisors, and the Office of Management and Budget.

"I was impressed with the report," says Juanita Duggan, special assistant to the President in the cabinet affairs office. "Everyone has read it. Everyone takes it seriously. We have a coherent policy in the federal government that is not inconsistent with the Marshall Institute report."

"It is well worth listening to," adds Paul Roelling, a senior analyst in the White House Office of Policy Development. "They are eminent scientists. I was impressed."

But White House Science Adviser D. Allan Bromley, who was not yet in place when the report was released, seems to be distancing himself from it. "It has a distinguished group of authors, but there is no general consensus on the details and it has not been peer-reviewed," he said in a statement to *Science*.

All the critics concede that the first part of the report is a good description of the scientific uncertainties surrounding predictions of greenhouse warming. And everyone, not surprisingly, agrees with the report's plea for \$100 million for more research.

Where the report veers from the mainstream is with the assertion that the warming trend of the past century was probably caused by increased solar activity and not by an accumulation of greenhouse gases—and that, ipso facto, the greenhouse warming next century will be small, perhaps 1°C.

The basis of the report is an analysis of this 0.5°C warming trend, which, the authors point out, does not follow the curve of rising emissions of greenhouse gases. In-



Leading opponent. A critique of the report by climatologist Stephen Schneider has been widely circulated.

stead, they look for natural causes to explain the rise and find that solar variation mirrors it rather well. The authors' underlying assumption is that if they can break the connection between that 0.5°C rise and accumulating greenhouse gases, then all bets for future warming are off.

No such luck, says Schneider, who thinks they are setting up a straw man. "Could the sun have done it? Sure," he says, adding that a variety of natural phenomena could explain the temperature rise of the last century. But that, he adds, says nothing about the future greenhouse warming.

"There are uncertainties, but I can't think of any combination of them that could conspire to make the problem go away," says NOAA's Mahlman. Hypotheses are fine, he adds, "but to advise the White House on the basis of this type of argument? Give me a break. That is not responsible."

The reason people are worried about greenhouse warming, Schneider, Mahlman, and others say, is not because of the 0.5°C temperature rise during the past century but because emissions of carbon dioxide, chlorofluorocarbons, and methane are clearly increasing. And it is dead certain that if enough of these greenhouse gases are released into the atmosphere, where they trap heat, global temperatures will rise. The only question is how much, and by when.

Then the Marshall Institute pulls out another card. After analyzing the historical record of solar activity, which can be inferred from carbon-14 in tree rings, the authors predict that solar activity will decrease in the next century, leading to a mini Ice Age that will offset any greenhouse warming.

Preposterous, say solar physicists like John Eddy of the University Corporation for Atmospheric Research in Boulder, who calls their extrapolation "very shaky" at best. We simply don't have the ability to predict future solar activity, he says.

Curiously, Eddy was one of the sunspot

experts Jastrow consulted in writing the report. "Bob Jastrow would call me at work and at home on Saturday and Sunday. I would say 'No, no, you can't make that prediction. I was shocked when I saw what came out.'"

Jastrow says the emphasis his colleagues are putting on the solar variability discussion is a "distorted" reading of the report, maintaining, along with Nierenberg, that the solar variation hypothesis is just a minor part of their argument.

"Then why did they put it in?" snaps a senior Academy official.

Their bottom line, Jastrow insists, is simply that no scientific conclusion can be drawn about the future greenhouse warming, "and we have time to find out." They assert that with \$100 million for supercomputers, answers to these questions will be forthcoming in 3 to 5 years, so why not wait before taking precipitous policy action?

"No one in his right mind would say that," counters Hecht at EPA, who, along with everyone else *Science* spoke with, says it will take a decade or more to address these questions.

In 25 years, Mahlman adds, "Congress will still be asking us questions we can't answer. I don't care if you pour \$100 billion at the problem."

The biggest gripe people have with the report is that the authors, in summoning uncertainty to their cause, fail to acknowledge that it cuts both ways. Explains Schneider: "What we don't know is just as likely to make it worse as better."

Solar variability is a case in point. Schneider offers a counter scenario to that in the Marshall Institute report: That during the past 100 years, solar energy output was decreasing rather than increasing. And without that natural cooling, which masked the greenhouse signal, the earth's temperature would have warmed up twice as much. "It's pure speculation," he adds, but since no one really knows what the sun was doing 100 years back, "it is just as likely as theirs." Moreover, says Schneider, if the earth warms up 2° to 4°C, as models usually predict, "it will swamp anything the sun has done in the past 100 years."

John Perry, a meteorologist and staff director of the Board of Atmospheric Sciences and Climate at the National Research Council, agrees. "If the report had just said, in an evenhanded way, 'don't rely on the models because there are hellacious uncertainties,' we all would have applauded. But the way it comes across is that all the uncertainties are on the downside. I don't think that is very democratic."

■ LESLIE ROBERTS



THE ROCKEFELLER UNIVERSITY

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FAX COVER SHEET

TO The Honorable John H. Sununu, Chief of Staff to the President

FAX NUMBER (202) 456-2397

NUMBER OF PAGES FOLLOWING THIS ONE ten

FROM Frederick Seitz

THE ROCKEFELLER UNIVERSITY

FAX NUMBER - 212-570-7559

TELEPHONE NUMBER - 212-570-8423

Originals of the following material will also be mailed.



Dartmouth College HANOVER • NEW HAMPSHIRE • 03755

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December 4, 1989

To the Editor:

Leslie Roberts' article <1> on the Marshall Institute study of the greenhouse problem does not, in my opinion, do justice to the standards of objective reporting usually seen in SCIENCE.

I gave Roberts the names of three prominent meteorologists -- Richard Lindzen, Jerome Namias and Reginald Newell -- who have endorsed the Marshall report's findings on the inadequacies of current global warming predictions. The article mentions their support, but dismisses them with the comment that their major work is outside the field. This is a major misstatement. Lindzen, Namias and Newell have been far more active in the fields of research pertinent to the greenhouse effect than any critic of the Marshall study quoted in the article. This slighting reference to the only supporters of the Marshall report mentioned in the article betrays a bias.

The report's critics quoted by Roberts lay great stress on the matter of solar variability and climate change. Solar variability is an important topic and a personal research interest of mine, but it is not essential to the principal findings of the report. The emphasis on solar variability is a smokescreen thrown up by the critics to conceal the report's main conclusion -- that clouds and oceans introduce enormous uncertainties into the global warming predictions. This view is widely held in the climatology community <2>. The report just published by the UK Meteorology Office, reducing the UKMO estimate of greenhouse warming from 5.2K to 1.9 K as a result of a change in assumed cloud properties, confirms this judgment <3>.

As a recent editorial in NATURE comments, it is "plainly foolhardy to pretend" in these circumstances that climate modellers can predict just what the future course of the greenhouse warming will amount to <4>.

But the vituperative and nonsubstantive nature of some of the criticisms quoted by Roberts (e.g., "noisy junk science") reveals that more than technical issues are involved in the hostile reaction to the Marshall report.

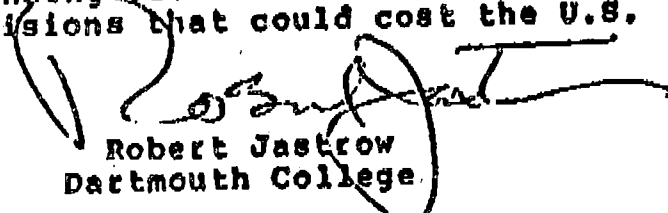
The nature of the hidden issues emerges in the disagreement over the amount of time required to narrow the range of uncertainty in the greenhouse forecasts. Roberts quotes critics of the Marshall report as saying it will take at least 10 years, and possibly decades, to obtain appreciably better results. We have concluded that the models could yield the accuracy needed by policy makers in 3-5 years -- PROVIDED the government accelerates the pace of climate research with a major infusion of funds. The Bush administration has taken a big step in that direction with a

Global Change Research Program budgeted at \$191 million and talk of a further increase to \$250 million.

However, critics of the Marshall report say we can't afford to wait. They would like to see the government move now toward limits on CO2 emissions. That appears to be the policy issue underlying the technical argument.

In our view, the technical facts indicate that early limits on CO2 emission are unnecessary and may be undesirable. A 3-5 year investment in better forecasts will still give the U.S. sufficient time to counter the greenhouse threat if that turns out to be necessary. But if the decision on CO2 limits is made now, and turns out to be the wrong decision because it was based on inaccurate information, the cost to the United States can be staggering. Studies by the Congressional Budget Office and several private groups set the cost to the U. S. of limiting carbon dioxide emissions at \$0.8 to \$3.6 trillion <\$>.

With a price tag like that, a few years of waiting for the fruits of an accelerated research program would seem to be in order. Prudence dictates spending \$250 million dollars to obtain guidance on the wisdom of decisions that could cost the U.S. trillions of dollars.



Robert Jastrow
Dartmouth College

1. SCIENCE 246, 992-993 (1989).
2. For example, C.D. Cess, et al., SCIENCE 245, 513-516 (1989).
3. J. F. B. Mitchell, C. A. Senior and W. J. Ingram, NATURE, 341, 132-134 (1989).
4. NATURE, 342, 339 (1989)
5. Reported in the NEW YORK TIMES, November 19, 1989.



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November 28, 1989

Editor, *Science*
1333 H Street, NW
Washington, DC 20005

To the Editor:

Leslie Roberts' account on the Marshall greenhouse report ("Global Warming: Blaming the Sun," 24 November 1989, p. 992) is a very inaccurate description of what the report says about solar activity and climate.

According to Roberts, the report asserts that "the warming trend of the past century was probably caused by increased solar activity..." Nowhere in the Marshall report can statements be found that would justify Roberts' remark.

The report's approach to the climate impact of solar variability is suitably cautious. It comments correctly that lulls in solar activity have tended to occur every 200 years or so during the last thousand years, quotes findings by Wigley and Kelly that these solar lulls tend to be correlated with cold spells in climate, and concludes, "if the correlation between low solar activity and low temperature continues," a natural cold spell can be expected in the 21st century.

The operative word in this conclusion is "if". The Marshall statement is not a "prediction," as Roberts called it, but a reasonable comment on the meaning of past trends in solar and climate data.

The Marshall report makes an effective argument for careful research into *all* factors causing climate change. Without an accurate assessment of all sources of climate change, we will not be able to infer the component of change caused by manmade greenhouse gases.

Sincerely,



Sallie Baliunas
(617) 495-7415

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November 29, 1989

Letter to the Editor
 SCIENCE Magazine
 1333 H Street, N.W.
 Washington, D.C. 20005

Dear Editor:

This is in response to the "News & Comment" article entitled "Global Warming: Blaming the Sun," which appears on page 992 of SCIENCE, Volume 246, 24 November 1989, written by Leslie Roberts.

I object to both the tone and to much of the material presented as slanted or wrong. Immediately, I dispute the statement in the subtitle. Our report does not wish away greenhouse warming. We make two recommendations. One is that a very large increase be made in resources to study these effects. We would not have made this recommendation if we did not believe that the possibilities were extremely serious.

Our second recommendation, that major policy actions not be undertaken until the implications are better understood, seems to be the source of the various criticisms. More to the point seems to be the interest in the possibility that this report has influenced White House thinking in a major way. This gives rise to a second misstatement of fact -- one that I look at as personal criticism. The article says, "Nierenberg, for his part, has been working hard to get the message into the White House." I have done no such thing. I was not even aware that anyone in the White House had a copy of the report when I received a call to come to Washington from La Jolla, on very short notice, to brief some staff. At great personal inconvenience, I did so, but I must say -- from then until now, I have had no further contact with anyone in the White House.

It is more likely that letters to the president and the White House by such distinguished scientists as Jerry Namias and Richard Lindzen have had at least an equal, if not greater, impact. Despite the report's flat statement to the contrary, Lindzen, Newell, and Namias have made important contributions to the subject, unlike some of the critics cited in the article.

In response to John Perry's remark on the climate models, we agree that "...there are hellacious uncertainties..." which is one of the major reasons

Letter to the Editor
SCIENCE Magazine
November 29, 1989
Page 2.

for our recommendation on policy, but I disagree when Perry says that all the uncertainties we present are on the downside. If I were to criticize our report today, it would be for having presented a 0.5°C rise in temperature as a fact when a variety of evidence now makes it seem questionable. Having attended the most recent meeting of the Climate Diagnostics Workshop, I am certain that most working climatologists believe that there has been no significant increase in temperature in the last one hundred years. There were one hundred and fifty attendees and only two papers were directly on global warming. It is not a happy circumstance to note that none of these people were quoted in the SCIENCE article. The only reason that the Namias and Lindzen letters were cited is that I transmitted them to the reporter. Other communications with a similar point of view were not cited nor were their authors interviewed either.

To respond to the remark "snapped" by an unnamed "senior Academy official" about the influence of possible solar variations, it is correct that it was discussed -- but only as an example of the many ill-understood possible contributions to the problem, among which remain water in the form of vapor and clouds (which is the most difficult), the other greenhouse gases, colloidal particles, and turbidity.

Despite Steve Schneider's trivial comment about solar variations, much good work is being done that gives a positive indication of the influence of solar variations, even back over the last century. A paper on the subject covering the atmospheric temperature over the oceans presented by Newell at the Climate Diagnostics meeting showed such an effect. Another paper by C.D. Keeling, analyzing his famous data set, also shows the influence of solar variation and is being prepared for publication.

What I found very perplexing was the repetitious references to the Academy. I was chairman of the Academy committee that submitted the 1983 report on global warming that is the most complete that has been published and is still being widely referenced. It was put forward during the discussions at the same White House meeting where the Marshall Report was summarized. Fred Seitz, Dick Lindzen, Jerry Namias, and I are all members of the Academy, and while we do not speak for the Academy, we do make for a certain presence and it was only natural for me to include the Academy's findings in the White House briefing.

Sincerely,

William A. Nierenberg
William A. Nierenberg



RICHARD S. LINDZEN
SLOAN PROFESSOR OF METEOROLOGY

December 1, 1989

COLY
To the editors, Science Magazine

Re: Global Warming: Blaming the Sun

Leslie Roberts' article "Global Warming: Blaming the Sun" (Science, November 24, 1989) is misleading on several counts. It should first be noted that one of the authors of the Marshall Institute Report, William Nierenberg, also prepared the major NRC report on the topic (the most massive of the 'carefully researched and reviewed expert reports' Roberts refers to). The three scientists referred to as supporters of the report, are reported to be scientists 'whose major work is largely outside the greenhouse field.' It is hard to know what is meant by this. Virtually no one I know of has devoted his or her career to the 'greenhouse field.' However, each of the scientists mentioned (Newell, Namias and myself) has published more papers on climate dynamics in the refereed professional literature than have any of the other figures mentioned in the article. In the letter by Namias and myself that is referred to by Roberts, we simply endorsed the major conclusions of the Marshall report: namely, that *first*, no evidence for the existence of the 'greenhouse effect' can be found in the temperature records of the last 100 years; and *second*, current forecasts of global warming for the 21st Century are so inaccurate and fraught with uncertainty as to be useless to policy-makers. We still endorse these conclusions. As to the importance of research, no one suggests that five years will bring absolute certainty on the issue of the warming, but it seems unreasonable to insist that we can't reduce the degree of uncertainty substantially in roughly this period.

I personally do not know why the discussion of solar effects was included in the report; it certainly was far from central to the main arguments. It would be difficult to argue with the contention attributed to Schneider, Mahiman and others, that 'the only question (concerning the warming) is how much, and by when.' However, what is omitted from such contentions is the plausible possibility that the answer to the question 'how much' may turn out to be very little. It is over this possibility that much current debate centers. To be sure, even five years of debate cannot settle such an issue, but research might.

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Disentangling the greenhouse

Continuing uncertainties about the working of the greenhouse enhancement give the lie to those demanding, at a meeting last week in the Netherlands, that the details of an international convention should be settled on the spot.

Melbourne

Everybody seems to know that this is the part of the Earth's surface at which the Antarctic ozone hole reaches furthest north. While the observations of anomalous springtime ozone depletion outside the Antarctic Circle covers only a single season (this time last year), people seem convinced that this will be the bench summer of total block, of warmth without tan (see *Nature* 340, 290-291; 1989). Australians do not lightly forgo such pleasures, which is why some wonder how long-lasting will be the resolve to keep ultraviolet away from skin.

But even in literate Australia, the confusion between the ozone hole and what is strictly the supposed enhancement of the normal greenhouse effect by atmospheric constituents opaque to infrared is as profound as elsewhere. There may be rough justice in that. The springtime Antarctic ozone hole, the reality of which seems well attested by this season's observations, is at least a sign that a measurable property of the atmosphere is affected by the rate at which unwanted refrigerants are discharged to the atmosphere. If chlorofluorocarbons (CFCs) can affect the ozone layer, why should not the much more copious releases of other greenhouse gases, such as carbon dioxide, affect the climate?

The confusion is nevertheless a threat to good causes, some of which are also green. CFCs are greenhouse gases in their own right (and, molecule for molecule, are more effective than CO₂). But to a first approximation, ozone depletion, whatever its cause, does not affect the climate or even the weather. To a second approximation, of course, ozone depletion (and so CFCs) affect both climate and weather through the changed variation of temperature with altitude — the tropopause is lowered — but the consequences cannot easily be predicted quantitatively let alone disentangled from the data.

How can the distinction between the ozone hole and the enhancement of the greenhouse effect best be established as a part of general knowledge? Much might be done by the direct measurement of the spectrum of solar ultraviolet radiation reaching the surface of the Earth at different places and seasons. The most obvious practical impediments are those of calibration, which, in the absence of data from the past, must necessarily be abso-

lute. Even so, it is remarkable that so little has so far been said about the flux of ultraviolet light reaching the surface of the Earth in even recent years. Paradoxically, if it were shown that ozone depletion means extra ultraviolet, it would be easier to separate that from the direct enhancement of the greenhouse.

While there should by now be no doubt that the next practical step should be the negotiation of an international convention to restrict the release of all greenhouse gases, the more obscure impediments to understanding and prediction remain as obscure as ever. It is maddening that the big uncertainties seem to change only slowly with the passage of time. Two stand out. The climate models can incorporate what is called average cloudiness, but the effect of real clouds, with real edges, on the heat balance in the troposphere could be qualitatively different. In principle if not in magnitude, the uncertainties are like those of estimating the role of clouds in nuclear winter (see *Nature* 318, 99; 1985). That must remain a problem.

The other big uncertainty, at least so far as the greenhouse enhancement due to CO₂ is concerned, remains that of knowing the fate of whatever fraction of the atmospheric content is dissolved in the oceans every year. Increased conversion to inorganic carbon would be benign, solution as bicarbonate in a steadily deepening layer of warm water above the oceanic thermocline would be the opposite. That issue has been endlessly discussed, but there are few who at this stage would put their hands on their hearts and say they know the quantitative truth.

Even relatively operational questions, that of the movement of CO₂ within the oceans for example, are unresolved. That is nicely illustrated by an attempt last year, by Peter C. Brewer and Catherine Coyet of the Woods Hole Oceanographic Institution and David Dyssen of the Chalmers Institute of Technology at Gothenburg, to measure the northwards flux of CO₂ in the North Atlantic (*Science* 246, 477; 1989). The North Atlantic is usually supposed to be a substantial sink for the gas, which is supposed to be carried northwards by oceanic currents. But measurements across the Florida Gulf and at three stations along the 25th parallel in mid-Atlantic lead to the conclusion that while there is a substantial northerly transport, that is almost but not quite offset by trans-

port in the opposite direction. The net northwards flux, at 260 million tonnes a year, is just over one per cent of the flux in either direction, or just under 5 per cent of the annual production of this greenhouse gas. This is much smaller than expected.

What can be the explanation? One is that the data may be insufficient. Three sets of measurements of CO₂ concentration with depth are not many, although the authors of the study have used previous survey data to interpolate between their stations. Another is that, while CO₂ will be released as the lower waters of the Gulf Stream reach the surface, it will be reabsorbed from the atmosphere as the Gulf Stream cools, reducing the partial pressure of the gas. Still another is that expectations are not yet fulfilled because there has not been enough time, since the onset of rapid greenhouse gas production half a century ago, for the deep waters of the North Atlantic to have travelled as far north.

In the circumstances, it must plainly be foolhardy to pretend just what the future course of the enhancement of the greenhouse effect will amount to. Better and more measurements will help, although none will be decisive. But if more were known of the variation of CO₂ concentration with latitude in the deep waters of the Atlantic, it might at least be possible to guess when transport into the North Atlantic atmosphere would become substantial. That would provide a means of telling just how quickly the international convention must be negotiated and brought into effect.

Questions such as these were plainly in the minds of some of those attending last week's meeting in the Netherlands, one of several meetings planned as preparation for the more formal diplomatic conferences to be held next year. Governments such as the British were pilloried, but unfairly, for having asked that the details of a convention — the date at which the further accumulation of greenhouse gases should be halted, for example — should await further study. That, of course, is entirely sensible. It is in nobody's interests that the economic disruption an international convention will certainly bring should be accelerated. It is not that there is nothing else to talk about, the demand on behalf of developing countries for fair shares in any quota system there may be for one thing.

John Maddox

NOTE:

THIS SHEET HAS BEEN PREPARED FOR THE PRESIDENT AND HIS IMMEDIATE STAFF ONLY. IT HAS NOT BEEN PROVIDED TO AGENCY REPRESENTATIVES.

**U.S. GLOBAL CHANGE RESEARCH PROGRAM
Funding Summary
(dollars in millions)**

<u>Agency</u>	<u>1989</u>	<u>1990</u>	<u>Original CES Request 1991</u>	<u>Appeal Level 1991</u>
National Aeronautics and Space Administration				
Budget Authority	409	489	746	661
Outlays	387	458	587	550
National Science Foundation				
Budget Authority	39	51	110	103
Outlays	20	42	79	76
National Oceanic and Atmospheric Administration				
Budget Authority	9	18	105	87
Outlays	6	14	76	64
Department of the Interior				
Budget Authority	5	11	49	44
Outlays	5	10	47	42
Department of Energy				
Budget Authority	20	45	66	66
Outlays	10	29	52	52
Environmental Protection Agency				
Budget Authority	18	17	26	26
Outlays	5	14	20	20
U.S. Department of Agriculture				
Budget Authority	18	33	47	47
Outlays	18	33	47	47
Total				
Budget Authority	519	663	1,149	1,034
Outlays	451	601	908	851

DEPARTMENT OF COMMERCE
 DEPARTMENT OF ENERGY
 DEPARTMENT OF THE INTERIOR
 ENVIRONMENTAL PROTECTION AGENCY
 NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
 NATIONAL SCIENCE FOUNDATION
 UNITED STATES DEPARTMENT OF AGRICULTURE

DIRECTOR'S REVIEW - FY 1991 BUDGET
 (dollars in millions)

Issue 1: U.S. Global Change Research Program (USGCRP)

Summary: This issue paper includes all seven agencies involved in the USGCRP but, in particular, NASA's Mission to Planet Earth (MTPE). MTPE (space-based research) represents roughly 75 percent of this interagency research effort.

	Enacted	GRH	Agency Request	Rec. 1991	Rec. Delta From GRH Dollars	Rec. Delta From GRH Percent
	1990	1991	1991	1991		
Space-based	454	471	724	639	+168	+36
Earth-based	163	170	403	351	+182	+206
TOTAL BA	617	641	1127	990	+350	+54
O	583	627	908	829	+202	+32

- o **FY 1990:** the enacted funding level is currently estimated to be \$617 million. This increase above the \$192 million in the FY 1990 Budget is due primarily to the inclusion of previously approved NASA programs (e.g., Space Station polar platform) and Congressional actions.
- o **FY 1991:** the request (as approved by the Committee on Earth Sciences) totals \$1127 million, an increase of \$486 million, or 76 percent, over the FY 1991 GRH Base. OMB Staff recommend a funding level of \$990 million, an increase of \$350 million, or 54 percent, over FY 1991 GRH Base.
- o **Issues:** The major issues to be decided are the initiation of the NASA Earth Observing System (EOS), the degree of EOS international cooperation, the level of Earth-based research, and the question of early scientific benefits.

Evolution of the Program: Over the past decade, there has been an increasing interest in studying the Earth as an integrated system from a multidisciplinary perspective. This interest has been sparked by concern that human activities were causing global-scale impacts, and the development of satellite and computer systems had reached the point where this type of ambitious study is possible. For example:

- o In the early 1980s, NASA began planning a mission known as "Global Habitability" intended to examine the Earth as an integrated set of complex processes.
- o In May 1986, a NASA science advisory committee (the Bretherton Committee) produced a report entitled "Earth System Science: A Program for Global Change". The report outlined an ambitious, multi-agency research plan, including the development of the Earth Observing System (EOS), which had been under study by NASA for several years.
- o Shortly after the publication of the Bretherton report, OMB staff conducted the first crosscut of earth science research. This crosscut showed that the U.S. was planning to invest roughly \$1 billion in earth science research over the next five years, with little or no coordination.
- o In February 1987, the OSTP established the Committee on Earth Science (CES) to develop a coordinated "global change" research program.
- o In August 1987, the Sally Ride Report (NASA) entitled "Leadership and America's Future in Space" outlined four space leadership initiatives, including Mission to Planet Earth (MTPE). The MTPE program included polar, equatorial, and geostationary space observation platforms to build a long-term environmental data base.
- o President Bush endorsed Mission to Planet Earth on several occasions during the campaign, including (Marshall Space Flight Center, 9-29-87):
 - "Let us remember as we chase our dream into the stars that our first responsibility is to our Earth, to our children, to ourselves. Yes, let us dream, and let us pursue those dreams, but let us first preserve the fragile and precious world we inhabit.", and
 - "George Bush endorses "Mission to Planet Earth," an initiative put forth by Dr. Sally Ride in a report to the NASA Administrator."

- o The need for improved global observation was endorsed by President Bush on several additional occasions after the election, including:
 - "...we ask all countries to combine their efforts in order to improve observation and monitoring on a global scale." (June 1989 G7 Economic Summit Communique), and
 - "A major national -- and international-- initiative is needed to seek new solutions for ozone depletion, global warming, and acid rain. This initiative-- Mission to Planet Earth-- is a critical part of our space program." (July 20, 1989 speech marking the 20th anniversary of the first U.S. lunar landing)
- o In 1988, the CES, working closely with OMB, developed a global change research strategy document that was submitted to the Congress with the Reagan FY 1990 Budget. In August, 1989, the CES published a detailed and prioritized research implementation plan.

Goals and Objectives of the U.S. Global Change Research Program: The goal of the USGCRP is to establish the scientific basis for national and international policy formulation related to natural and human-influenced global change. Accomplishing this goal will require significant improvements in observing, understanding, and predicting the complex and integrated processes that constitute the Earth system.

The USGCRP is unique among federal interagency research programs in several respects:

- It is broad in scope, including research on the changes (i.e., physical, biological, chemical, etc.) in the Earth's components (i.e., atmosphere, oceans, etc.) and the outcome of these changes (i.e., global warming, ozone depletion, drought, etc.) that occur on timescales of decades to centuries.
- Because of this decadal timescale, a majority (70-80 percent) of the current program can directly address climate issues.
- It includes basic as well as applied research. The basic research is aimed at advancing the underlying science. The applied research is directed more toward specific problem solving or agency mission concerns.

The need for such an approach is necessary to be able to respond to unforeseen future environmental issues. For example, had NASA and NOAA not invested in small, but long-term, efforts in ozone research there would not have been the talent or knowledge to understand the radical seasonal decreases of stratospheric ozone in the Antarctic over the past several years.

The USGCRP is divided into seven interdisciplinary science elements that represent the new integrated approach to Earth system science (see Figure 1). The USGCRP goals, objectives, science elements, and priority framework were developed in collaboration with the National Academy of Sciences and other related international science organizations. Each of the seven agencies has a specific role and resources to contribute to the program. Both the national and international research communities recognize the quality and maturity of this planning effort and view the U.S. as a leader in this area.

Note: The USGCRP does not include research on mitigation (e.g., energy conservation) or adaptation (e.g., agricultural practices). The federal budget includes significant and important R&D on these objectives as well, but these activities are more directly in support of individual agency missions and are independent of the USGCRP program.

Discussion of the FY 1991 Proposed Research Program: The USGCRP is composed of a space- and earth-based component.

Space-based (NASA) Research: The FY 1991 NASA Mission To Planet Earth program includes four elements: several ongoing satellite and research programs, the Earth Observing System (EOS), Earthprobes, and Attached Payloads on the Space Station Freedom.

EOS: EOS is designed to provide a time series of environmental data monitored from space. The EOS program actually consists of three components: space-based platforms (spacecraft) and remote sensing instruments, a large data management system, and support for individual researchers to analyze the data.

- o NASA is proposing that the space-based monitoring instruments be mounted on two platform series in polar orbit (EOS A and B). Each platform series would support a variety of specialized monitoring instruments. The platforms would provide a centralized power sources, orbital positioning, and communications capabilities for all the attached instruments. Because of the size and polar orbit of the platforms, they would be launched on large expendable launch vehicles (Titan IV).

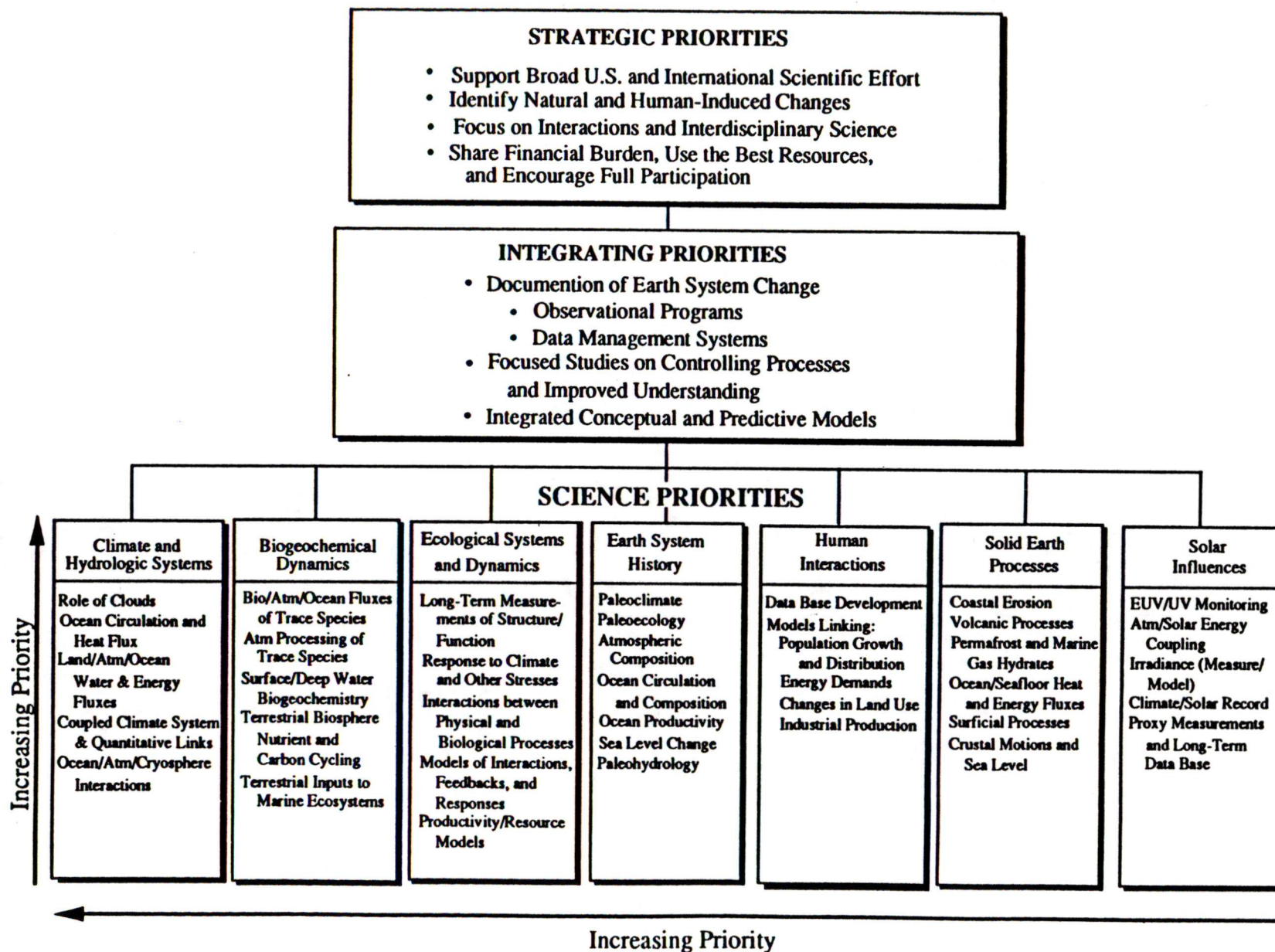


Figure 1

U.S. Global Change Research Program Priority Framework

- EOS-A instruments will measure atmospheric, land, and ocean surface features (i.e., vegetation, ocean phytoplankton, surface temperature, clouds, precipitation, and sea ice) using visible and infrared detectors.
 - EOS-B instruments will focus primarily on surface features measurable by radar techniques (i.e., ocean circulation, atmospheric-ocean gas exchanges, and stresses in the Earth's crust.) but will also include several infrared instruments to observe the atmospheric chemistry of important greenhouse gases that can not be accommodated on EOS-A.
 - Each platform series would provide 15 years of data (because the useful life of each platform is only five years, a total of three platforms will be needed for each series, flown at five year intervals). EOS-A and B series would be staggered at two year intervals to provide the maximum simultaneity of data observations.
- o NASA has conducted several trade studies and scientific reviews to examine data requirements and to determine the kinds of instruments and the number and size of platforms needed to satisfy these requirements. The two series platform design was chosen primarily based on the requirement to provide simultaneously collected data within 15 years and the availability and cost of launch vehicles. Figure 2 illustrates the Eos instruments, the diverse physical parameters being measured, and some examples of simultaneity requirements.
 - o Several other designs (smaller and more numerous platforms) were examined by both NASA and the Europeans but the current designs, in addition to providing better coverage, proved to be roughly the same or less cost depending on the particular configuration. Instrument selection was done by peer review and took over two years. It was one of the most complicated scientific peer reviews ever undertaken.
 - o The EOS program also has undergone a non-advocacy technical review which resulted in several program changes, including a reduction in instruments, simplified the management structure, and standardized the platforms and instruments configurations over the 15 year mission life (no upgrades).
 - o Planning for EOS has been done actively with the Europeans and Japanese who have proposed to contribute two additional platforms, as recommended in the MTPE concept. Several proposed U.S. research instruments will fly on these foreign platforms and the European platform will support operational meteorological instruments from NOAA.

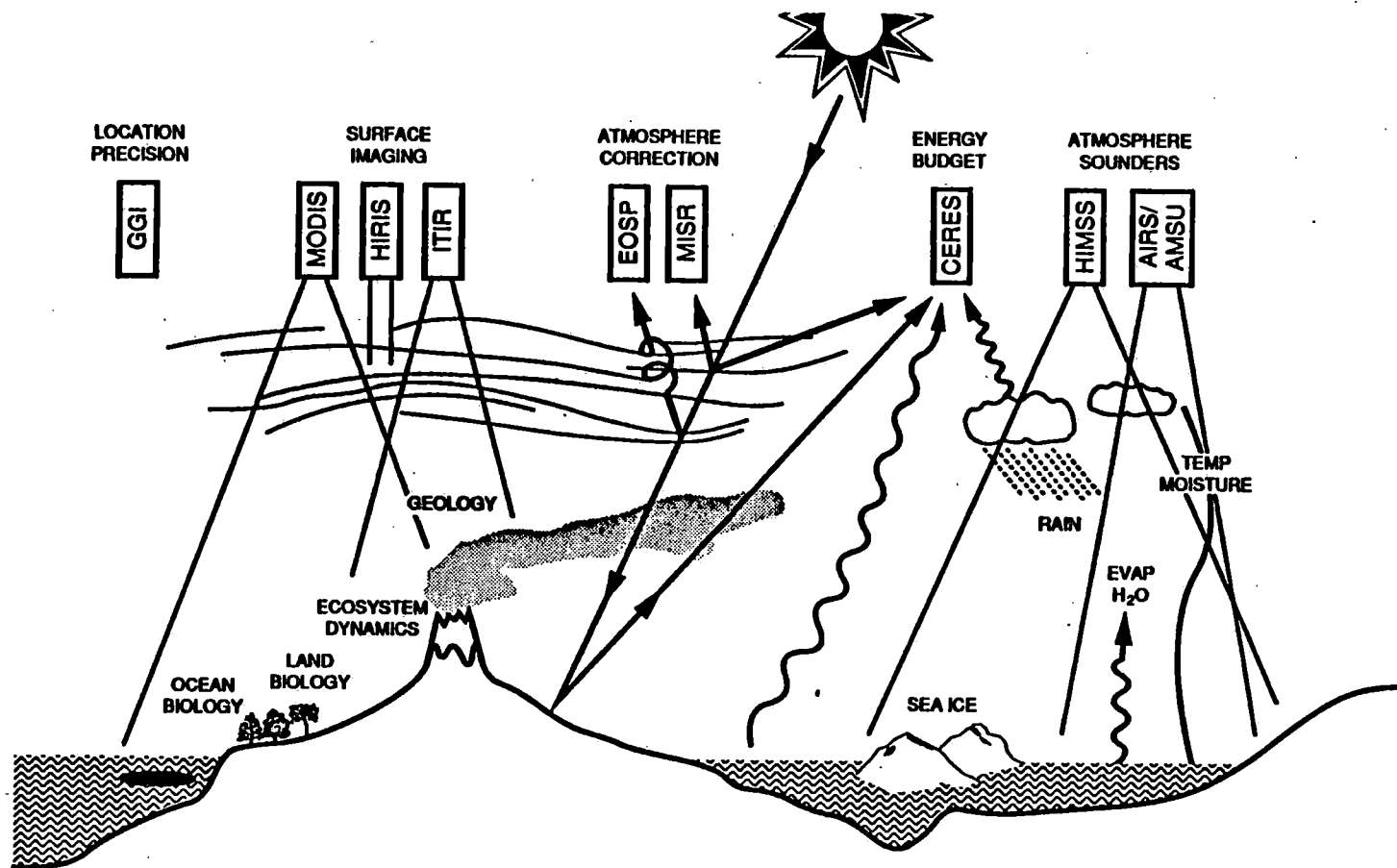


Figure 2

EOS-A Simultaneity Requirements

- o Vegetation changes (insolation and drying) occur on timescales of about 1 hour.
- o Atmospheric changes (turbulence, clouds, aerosols) occur on timescales of 10's of seconds.
- o To provide the necessary interpretation precision, reduce the complexity and cost of analysis, surface imagers (land, bio, oceans) and atmospheric correction instruments should fly on the same platform to register conditions, location, and time.

- M*
- o EOS is not just a space hardware program. Two-thirds of the program cost is for scientific data analysis, modeling, and the data distribution system, providing significant contributions even prior to the flight program. The other third is for the remote sensing instruments and platforms. In fact, the platforms are estimated to be less expensive than other comparable space platforms (e.g., the Hubble Space Telescope, Gama Ray Observatory, etc.).

Earthprobes: The Earthprobes program is aimed at undertaking innovative (low-cost and low-risk) approaches to fly small instruments as soon as possible. For example, the first Earthprobe is a \$20 million (including launch vehicle) instrument to measure global ozone concentrations.

Space Station Attached Payloads: The Attached Payloads will be a series of instruments designed to monitor environmental parameters (e.g., stratosphere aerosols, lightning, and the Earth's radiation budget) in the equatorial regions under the path of the Space Station.

Ongoing Programs: The last element of the NASA MTPE concept is the near-term NASA satellite missions and research programs already approved and funded (i.e., TOPEX, Upper Atmosphere Research Satellite, etc.). Although all of these projects will contribute to near-term improvements, they are focused on specific processes and collect data at widely different time scales (many separated by several years).

Table 1 illustrates NASA's proposed schedule for all four elements of Mission to Planet Earth and other related satellite missions.

Earth-based (interagency) Research: The earth-based programs encompass all seven science elements identified in the USGCRP priority framework. A total of six federal agencies sponsor research in this activity. Many of these programs are dependent on the data collected by NASA's Earth Observing System or provide ground-based data needed to calibrate the space data. Nearly all of these efforts have some element of international coordination, represent the broad spectrum of research activities necessary to address this issue, and can provide near-term incremental improvements to modeling capabilities prior to the development of the global data set from space. Table 2 lists some of the ongoing and proposed earth-based programs. The individual agency contributions include:

- o Department of Commerce/National Oceanic and Atmospheric Administration (NOAA) has nineteen programs focused on ocean and climate modeling, atmospheric trace gases fluxes, and data management. These activities are consistent both with NOAA's agency mission and its resources.
- o Department of the Interior (DOI) has twenty-three programs focused primarily on the hydrologic and geologic processes.
- o Department of Energy (DOE) has twelve programs focused on carbon dioxide and other greenhouse emissions and the climate's response to these emissions.
- o Environmental Protection Agency (EPA) has six programs focused on research to assess, evaluate, and predict ecological, environmental, and human-health consequences of global change, including the feedback of these changes on regional air and water quality.
- o National Science Foundation (NSF) has twenty programs that support all areas of the earth, atmospheric, and ocean sciences. These university-based fundamental research programs are focused on earth-based studies on regional and global scales, large scale field programs, and development of environmental models, including ocean circulation, and energy/greenhouse gas/water fluxes between the biosphere, atmosphere, and oceans.
- o U.S. Department of Agriculture (USDA) has fourteen programs focused on assessing the effects of global change on the agricultural food and fiber production system and forest ecosystems of the U.S. and world wide, including soil moisture and erosion, energy/carbon/water cycles, and forest fire severity.

Table 1
Schedule for Mission to Planet Earth and Related Satellite Missions

<u>Mission</u>	<u>Purpose</u>	<u>Launch Date</u>
Currently in Orbit		
Lageos-1/2 (NASA)	Solid Earth	1975/1983-90s
Nimbus-7 (NASA)	Meteorological	1970s-1991
ERBE (NASA)	Radiation Budget	1984-1992
GEOSAT (DOD)	Solid Earth	1980s-1991
MOS (European)	Meteorological	1988-1991
POLAR (NOAA)	Meteorological	1970s-00s
GOES (NOAA)	Meteorological	1970s-00s
LANDSAT (NOAA)	Land/Bio Processes	1970s-00s
SPOT (Foreign)	Land/Bio Processes	1980s-00s
DMSP (DOD)	Meteorological	1970s-00s
METEOSAT (European)	Meteorological	1970s-1995
Approved and Funded		
UARS (NASA)	Atmospheric Chemistry	1991-1993
TOPEX (NASA)	Ocean Circulation	1992-1995
NSCAT (NASA)	Ocean Circulation	1995-1998
ERS-1 (European)	Land/Bio Processes	1990-1993
JERS-1 (Japan)	Land/Bio Processes	1992-1995
ADEOS (Japan)	Oceans Circulation	1995-1998
Radarsat (Canada)	Land/Bio Processes	1994-1999
Shuttle-based Insts. (NASA)	Earth System Science	1991-2000s
New Proposals (1)		
Earthprobes 1 (NASA)	Ozone Monitor	1993
Earthprobes 2 (NASA)	Ozone Monitor	1995
Earthprobes 3 (NASA)	Ozone Mointor	1997
Earthprobes 4 (NASA)	Ocean Circulation	1995
Earthprobes 5 (NASA)	Ocean/Bio Processes	1992
Earthprobes 6 (NASA)	Tropical Rainfall	1997
EOS-A (NASA)	Earth System Science	1997-2011
EOS-B (NASA)	Earth System Science	1998-2011
EPOP (European)	Earth System Science	1997-2000s
JPOP (Japan)	Earth System Science	1998-2000s
Attached Payloads (3,NASA)	Atmos. Chem./Radiation	1998-2000s

(1) The key to these new proposals and the problem with the ongoing programs is the simultaneous collection of these various environmental parameters.

Table 2
 Example of Major Approved and Proposed U.S. Global Change Research Program Earth-based Programs

<u>Mission</u>	<u>Agencies (1)</u>	<u>Purpose</u>	<u>Schedule</u>
Approved and Funded			
GEWEX (2)	NASA, NOAA, NSF, DOE	Clouds/Radiations	1990-1999
WOCE	NASA, NSF, NOAA, DOI	Ocean Circulation	1989-1997
ARCCS (2)	NASA, NSF, NOAA, DOI	Sea Ice Change	1989-1996
TOGA	NASA, NSF, NOAA, EPA	Ocean/Atm Fluxes	1985-1990s
GTC	NASA, NSF, NOAA	Tropospheric Chem.	1986-2000s
GOFS/JGOFS (2)	NASA, NSF, NOAA, DOI, DOE	Ocean Fluxes	1989-1990s
LMER	NASA, NSF, DOE, USDA	Carbon Cycle	1989-1990s
RIDGE	DOI, NSF	Seafloor Heat Flux	1990-1999
CEDAR	NSF	Atmos. Coupling	1988-1995
LTER (2)	NSF	Ecosystem	1985
Proposed			
GLOBEC	NASA, NSF, NOAA, EPA, USDA	Ecosystem	1992-1990s
MHAR	DOE, EPA, NSF, USDA	Human Interactions	1991
DMI	DOE	GCM Intercomparison	1991
LANDATA	NASA, NSF, DOI	Coastal Erosion	1991
GEM	NASA, NSF	Solar Flux	1991-1996

- 1: Most of these programs rely on partnerships with NASA's space-based programs.
- 2: Augmentations are being requested for these programs in the FY 1991 request.

Science Benefits from the Proposed Program

It is extremely difficult to predict in advance the results from a long-term program of scientific research. Moreover, because of the very nature of earth processes, it will require many years of observations in order to develop a sound understanding and predictive capability. Thus, forecasts of science improvements are subject to uncertainty. Science improvements may take longer to realize than expected, on the other hand, major improvements could be achieved relatively soon (as was the case with the Antarctic Ozone Hole).

The CES believes that its proposed program will result in major improvements in process analysis and modelling, as early as three to five years after launch of the first EOS platform, or shortly after the year 2000. The CES believes that important improvements in our understanding of specific global change issues will be achieved sooner since each science element will focus on the following highest priority research needs:

- Climate and Hydrological Systems: addresses the roles of clouds in the Earth's energy budget, redistribution of energy by ocean circulation, and the Earth's water cycle. For example, clouds may drastically lessen global warming and the oceans may be able to store most of the additional heat trapped by greenhouse gases. NASA's ERBE, TOPEX, and EOS missions, NOAA's meteorological satellites, DOE climate model activities, and NSF's basic research all contribute to this element. There are also several interagency and international programs (e.g., GEWEX, WOCE, TOGA, etc.).
- Biogeochemical Dynamics: addresses the flux of trace gases between the atmosphere, biosphere, land, and oceans. For example, ocean phytoplankton may lessen global warming by trapping carbon from the burning of fossil fuels for millions of years. NASA's Upper Atmosphere Research Satellite and NSF's CEDAR program contribute to this science element.
- Ecological Systems and Dynamics: addresses the response of biological and ecological communities to greenhouse gases and the impact of these responses on the physical climate system. For example, many ecological communities help regulate global warming by consuming greenhouse gases but they could also be damaged by changes in the climate. Experiments aboard the Space Shuttle, EOS, and NSF's LTER program contribute to this science element.

- Human Interactions: addresses the linkage between human activities and environmental change. For example, the impact of man's use of land, water, and other resources on the environment and the impact of these changes on man. The interagency (DOE, EPA, NSF, and USDA) MHAR proposal for FY 1991 is specifically focused on these issues.
- Earth System History: addresses the reconstruction of the Earth's past climates and environments through ice cores, fossils, pollens, and geology. For example, the natural variability of climate over millions of years can be identified by gas concentrations trapped in ice cores, as well as the impact on the environment from these climate changes. NSF's Ice Coring Experiment and DOI's paleoclimate programs contribute to this element.
- Solid Earth Process: addresses the erosion and wetland loss caused by sea level rise and the contribution of volcanoes to greenhouse gases. NASA's LAGEOS and EOS satellites contribute to this element.
- Solar Influences: addresses the long-term records of solar output and the coupling of energy between atmospheric regions. For example, the climate changes as a function of solar cycles, as does the production and destruction of ozone. The GEM (NASA, NSF) and EOS (NASA) program focus on these issues.

Baseline Projection and Discussion of Alternatives

GRH Baseline: The FY 1990 budget request for the USGCRP totaled \$656 million, an increase of 26 percent over the FY 1989 level. Even though the request was divided among seven agencies in five different Appropriations bills, the Congress approved the request in full. The enacted level was reduced by the application of across-the-board reductions for drugs, GRH sequester, and the distribution of a general reduction in NASA. At the GRH baseline level, the government, would spend nearly \$3.5 billion on global change research over the next five years.

	<u>Actual</u>			<u>Pres. Req.</u>	<u>Post-Seq.</u>	<u>Agency Request</u>	<u>GRH Baseline</u>			
	<u>1987</u>	<u>1988</u>	<u>1989</u>				<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1994</u>
Space-Based	NA	NA	409	483	454	724	471	488	503	518
Earth-Based	NA	NA	110	173	163	403	170	176	181	186
TOTAL BA	NA	NA	519	656	617	1127	641	664	684	704
O	NA	NA	460	615	583	908	627	650	672	691

USGCRP FY 1991 Budget Request: The CES has been an effective interagency coordinating committee and recently submitted a recommendation for the FY 1991 USGCRP based on the prioritization of the individual agency requests. At the request of OMB, the CES produced five possible FY 1991 funding scenarios. After the initial OMB review of these five options, the CES was asked to examine three additional options at lower funding levels, related to different assumptions regarding NASA's EOS program. After review and consolidation of these eight options, four possible funding alternatives were chosen for this paper.

Withdrawal/Redaction Sheet

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Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
01. Paper	From Committee on Earth Sciences Re: U.S. Global Change Research Program Options paragraphs redacted (7 pp.)	n.d.	P/5	

Collection:

Record Group: Bush Presidential Records
Office: Chief of Staff, White House Office of
Series: Sununu, John, Files
Subseries: Issues Files
WHORM Cat.:
File Location: Global Warming (2 of 2) - 1990 [6]

Open on Expiration of PRA
 (Document Follows)
 By *JL* (NLGB) on 10/28/05

Date Closed: 12/17/2004	OA/ID Number: 29158-006
FOIA/SYS Case #: 1998-0004-F[1]	Appeal Case #:
Re-review Case #: 2005-0426-S	Appeal Disposition:
P-2/P-5 Review Case #:	Disposition Date:
AR Case #:	MR Case #:
AR Disposition:	MR Disposition:
AR Disposition Date:	MR Disposition Date:

RESTRICTION CODES

Presidential Records Act - [44 U.S.C. 2204(a)]

- P-1 National Security Classified Information [(a)(1) of the PRA]
- P-2 Relating to the appointment to Federal office [(a)(2) of the PRA]
- P-3 Release would violate a Federal statute [(a)(3) of the PRA]
- P-4 Release would disclose trade secrets or confidential commercial or financial information [(a)(4) of the PRA]
- P-5 Release would disclose confidential advice between the President and his advisors, or between such advisors [(a)(5) of the PRA]
- P-6 Release would constitute a clearly unwarranted invasion of personal privacy [(a)(6) of the PRA]

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- (b)(8) Release would disclose information concerning the regulation of financial institutions [(b)(8) of the FOIA]
- (b)(9) Release would disclose geological or geophysical information

Alternative #1 (CES Recommendation): The CES recommended funding level for FY 1991 is \$1127 million, an increase of \$486 million or a 76 percent increase over the FY 1991 GRH Baseline. Total five-year funding would be \$12 billion, \$8.5 billion above the baseline. It includes full funding of an aggressive NASA Mission to Planet Earth program, with EOS-A launch in FY 1997, EOS-B launch in FY 1999, full funding for 6 Earthprobes (1992 to 1997), and a comprehensive, complementary earth-based program.

	GRH		Impact on Baseline			
	Base		1991	1992	1993	1994
Space-based	471	+0	+252	+640	+1451	+1798
Earth-based	170	+0	+234	+389	+530	+611
Total BA	641	+0	+486	+1028	+1981	+2409
O	627	+0	+280	+720	+1407	+2037

PROS:

- o Represents a very aggressive research program that fully addresses the goals and objectives outlined in the USGCRP research plan.
- o Would demonstrate a strong U.S. leadership position on environmental issues.
- o Represents a well-balanced program, with significant near-term activity (ongoing projects plus Earthprobes), as well as longer-term work (EOS-A and -B).
- o Includes a significant degree of international cooperation, with the Japanese and European platforms and earth-based research.
- o The vast majority of these programs have been reviewed for merit by the scientific community and are technically and scientifically ready to proceed.

CONS:

- o An extremely ambitious schedule, particularly for the NASA EOS program, with significant technical and management challenges.
- o The funding requirement would be very difficult to meet (roughly \$8.5 billion above the baseline over the next five years).

Alternative #2 (PAD Recommendation): The funding level for this alternative for FY 1991 is \$990 million, an increase of \$349 million, or 54 percent, over the FY 1991 GRH Base. Total five-year funding would be \$11 billion, \$7.5 billion above the baseline. The alternative provides for EOS-A launch in FY 1998, EOS-B launch in FY 2000, funding for 5 Earthprobes (1992 to 199), and a relatively robust earth-based component.

	<u>GRH</u>		<u>Impact on Baseline</u>					
	<u>Base</u>		<u>1991</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1994</u>
Space-based	471	+0	+168	+421	+1253	+1634		
Earth-based	170	+0	+182	+284	+466	+535		
Total BA	641	+0	+350	+704	+1719	+2169		
0	627	+0	+201	+508	+1139	+1768		

PROS:

- o At this significant level, this alternative would be a major positive Presidential initiative, and would still allow for significant international cooperation.
- o Initiates EOS on a slightly less ambitious schedule (six months slower) than Alternative #1, in view of the technical and management challenges (e.g., data management).
- o The science benefits would be similar to those of Alternative 1, except that expensive large-scale field experiments would be deferred in favor of a series of less costly regional-scale experiments.
- o The ongoing program, plus the Earthprobes program, could provide important early scientific benefits.

CONS:

- o Requires roughly \$7.5 billion dollars above the baseline over the next five years.
- o Under this alternative, the European platform, which is proposed for launch in FY 1997, would be in orbit a year sooner than EOS-A.
- o Some Members of Congress have already criticized NASA for not planning to launch the first EOS platform until FY 1997. A FY 1998 launch may compound this criticism.

Alternative #3 (Increased International Cooperation and Accelerated Early EOS Program):

The funding level for this alternative is \$973 million, an increase of \$332 million, or 52 percent, over the FY 1991 GRH Base. Total five-year funding would be \$9.5 billion, \$6 billion above the baseline. This alternative represents several significant shifts in the strategy proposed by the CES. This alternative was developed as a mechanism to seek additional foreign contribution and to address the National Space Council's concern of increasing the near-term science return. Under this alternative:

- o EOS-A would be initiated in FY 1991, with a launch date of 1998, rather than 1997 as proposed by NASA and the CES.
- o The budget would initiate a new (as yet undefined) program, early EOS, consisting of several individual satellites, to further increase near-term data collection. The program would be specifically focused on global warming science issues, such as the role of clouds and ocean-atmosphere fluxes.
- o In addition, the Administration would seek even greater international participation in the EOS-B phase of the program, including the possibility of foreign funding of EOS-B platform development, or alternatively, flying U.S. EOS-B instruments on foreign platforms.
- o The budget for Earthprobes and the earth-based research would be the same as Alternative #2.

	<u>GRH</u>		<u>Impact on Baseline</u>			
	<u>Base</u>		<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1994</u>
Space-based	471	+0	+150	+468	+1001	+1603
Earth-based	170	+0	+182	+284	+466	+535
Total BA	641	+0	+332	+752	+1467	+2138
O	627	+0	+188	+515	+1060	+1645

PROS:

- o Would provide a strong statement of the President's leadership on environmental issues, particularly the need for early scientific returns.

- o The new, early EOS program could provide additional near-term contributions, address Congressional criticism that EOS provides little near-term science improvements, and promotes the use of low-cost, low risk flight opportunities.
- o Provides a greater opportunity for foreign participation, including financial participation from the lesser developed countries (LDCs), even if only at a small dollar level.
- o All of the countries of the world would benefit from this research and should appropriately share in the cost and could facilitate later cooperation on mitigation actions.
- o Could take advantage of elimination of any redundant instruments among the U.S., European, and Japanese platforms and/or the elimination of NOAA operational instruments from the European Polar Platform.

CONS:

- o Establishing in the budget process a new, as yet undefined, early EOS program could undermine the credibility of this initiative and the CES interagency program.
- o The current program already has substantial near-term scientific activity. It simply may not be feasible to accelerate the science any further.
- o Europe and Japan have proposed contributing a total of \$2.5 billion for Mission to Planet Earth. This contribution includes their own space platforms and instruments and flying several U.S. instruments. It may be unrealistic to expect any substantial additional participation from these sources, or from other countries.
- o Further slippage of the EOS-A schedule will increase criticism of this initiative.
- o Deletion of funding for the EOS-B platform would leave Mission to Planet Earth somewhat undefined, because the exact configuration of the space-based component would depend on what arrangements could be worked out with potential international partners to fly U.S. payloads. NASA will appeal deferral of EOS-B.

Alternative #4 (Defer and Re-study EOS): The funding level for this alternative is \$855 million, an increase of \$214 million, or 33 percent, over the FY 1991 GRH Base. Total five-year funding would be \$5 billion. This alternative funds 5 Earthprobes, and provides a smaller increase for earth-based programs, but defers the EOS decision for one year pending further review of the EOS program, as well as a more detailed analysis of alternatives. For example, some believe that the EOS program might be more cost effective, and perhaps provide earlier science benefits, if certain instruments were flown separately rather than placed on the EOS platform.

	GRH		Impact on Baseline			
	Base		1991	1992	1993	1994
Space-based	471	+0	+69	+7	+41	+78
Earth-based	170	+0	+145	+205	+279	+307
Total BA	641	+0	+214	+212	+320	+385
O	627	+0	+128	+221	+289	+340

PROS:

- o Allows time for a further consideration of the EOS program issues, such as data management and platform configurations.
- o Would be responsive to concerns likely to be raised by Senator Gore (and perhaps others) that the current EOS project is too expensive and too late (monitoring capability would not be on-line for another 5-10 years).
- o Provides a 33 percent overall funding increase over the GRH Base, and still provides some near-term scientific benefits from ongoing activities, Earthprobes and earth-based research.

CONS:

- o EOS has already been extensively reviewed by the scientific community and found to be technically sound and cost effective.
- o A delay in EOS, however justified, could result in criticism of the President's leadership on environmental issues, his commitment to the USGCRP and Mission to Planet Earth, and the loss of foreign contributions.

- o A deferral of EOS likely could lead to a loss of potential support for the Space Station and Manned Space Exploration programs because of the perceived near-term importance of global change research among many Congressional supporters of the space program.
- o CES agencies (especially NASA) will strongly appeal and the agencies' continued participation in the CES interagency process could be jeopardized.

OMB Staff Recommendation: OMB Staff believe that improved understanding of the Earth system is an important national objective and, accordingly, have strongly supported the USGCRP process. The CES member agencies have invested an extremely large amount of time and energy in developing this interagency program, and as a result, the U.S. is far out in front of any other nation's planning efforts. The USGCRP represents an excellent opportunity for President Bush to demonstrate high quality, national and international, leadership on environmental issues.

However, the USGCRP, and in particularly NASA's MTPE, request is difficult to accommodate in the current fiscal environment. Even the lowest USGCRP funding options submitted to the OMB by the CES, requested several billions of dollars over the next five years. OMB staff have worked very hard with the CES to lower this request. However, staff believe that a robust program of research will require significant budget increases.

On balance, Staff recommend Alternative #2, which includes:

- o An aggressive near-term program of Earthprobes and other satellite investigations.
- o Initiation of EOS, with launch of the first EOS-A platform in 1998.
- o Provides significant international cooperation and roughly doubles the funding for earth-based research.

- o Recommend, prior to execution of the FY 1991 Program, that the President's Science Advisor, working with the CES, undertakes the following tasks:
 1. Request a formal review of the proposed FY 1991 USGCRP by the National Academy of Sciences.
 2. As part of that review, specifically task the Academy to review EOS, as well as possible alternatives, to ensure that the proposed project is technically ready, cost-effective, and will provide the greatest possible scientific return on the investment.

Possible Reaction: The CES agencies will accept the Staff recommendation. Alternative #2 will be viewed by most Congressional observers and the public as an ambitious Administration initiative. Some members, such as Rep. Green and Senator Mikulski, will object to the FY 1998 launch and argue that it should be sooner. Others, such as Senator Gore, will argue that the program, particularly EOS, does not provide enough near-term information for policy decisionmaking. Staff believe that Alternative 2 falls in the middle of these opposing positions. Alternative 2 provides a significant level of near-term research and observations (e.g., many ongoing satellite mission, earth-based research and field experiments, and Earthprobes) with little delay in the launch of EOS.

Withdrawal/Redaction Sheet

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Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
02. Memo	From David Bates to POTUS Re: Recommendations of the DPC Working Group on Global Change for President's 1990 Environmental Program (5 pp.)	11/29/89	P/5	

Collection:

Record Group: Bush Presidential Records
Office: Chief of Staff, White House Office of
Series: Sununu, John, Files
Subseries: Issues Files
WHORM Cat.:
File Location: Global Warming (2 of 2) - 1990 [6]

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Re-review Case #: 2005-0426-S.	Appeal Disposition:
P-2/P-5 Review Case #:	Disposition Date:
AR Case #:	MR Case #:
AR Disposition:	MR Disposition:
AR Disposition Date:	MR Disposition Date:

RESTRICTION CODES

Presidential Records Act - [44 U.S.C. 2204(a)]

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THE WHITE HOUSE

WASHINGTON

November 29, 1989

MEMORANDUM FOR THE PRESIDENT

FROM: DAVID Q. BATES
D. ALLAN BROMLEY



SUBJECT: Recommendations of the DPC Working Group on
Global Change for President's 1990
Environmental Program

ISSUE

The Cabinet-level DPC Working Group on Global Change was first convened in October to formulate and coordinate United States policy on global warming and other selected environmental issues. The Working Group was recently assigned the task of developing options to fulfill the President's campaign pledge to host an international conference on the environment and to seize the initiative on the international environmental agenda. The group has developed a consensus recommendation for a series of three events to be held during 1990.

BACKGROUND

A. Campaign Pledge -- during the campaign you pledged to hold during your first year in office an international conference on the environment:

"In my first year in office, I will convene a global conference on the environment at the White House. It will include the Soviets, the Chinese, the developing world as well as the developed. All nations will be welcome -- and indeed, all nations will be needed..."

"The agenda will be clear. We will talk about global warming. We will talk about acid rain. We will talk about saving our oceans, and preventing the loss of tropical forests. And we will act."

B. IPCC Activity -- the U.S. participates in the U.N. Intergovernmental Panel on Climate Change (IPCC) as the principal international forum to address the issue of global warming:

-- Key working groups are chaired by Great Britain on science, the Soviet Union on effects and the United States on response strategies.

-- U.S. will host the third plenary session of the IPCC in February, 1990, in Washington. The IPCC will meet in plenary session a final time in August, 1990, at which the completed reports of the working groups will be presented, leading up to the Second World Climate Conference in November, 1990.

-- You have stated that you expect the IPCC deliberations to lead, upon completion of the IPCC reports, to the negotiation of a framework convention on climate change.

RECOMMENDATIONS

The following series of events recommended by the Working Group on Global Change was developed within the context of the U.S. commitment to the IPCC and the accomplishments of the Administration on global warming (set forth in greater detail at Appendix A).

It should be noted that you will announce your budget in the State of the Union on January 30, 1990, which will include a number of environmental initiatives related to global warming. It is strongly suggested that the package described below be announced either in the State of the Union or in a major address directly before or after the State of the Union, whichever is appropriate.

I. The President's 1990 Environmental Initiative

The three events recommended below are packaged as a 1990 Presidential environmental initiative culminating in the President's International Conference on the Conservation of Nature.

A. Address to the February, 1990 IPCC plenary session in Washington

-- speech would explain U.S. policy on global climate change and promote the enormous investment the United States has made both in understanding the scientific elements of global climate change and in beginning to take mitigating action.

-- opportunity to assert the U.S. leadership role on global climate change and reinforce the U.S. commitment to the IPCC as the principal forum for addressing the problem.

B. White House meeting on international environmental research

-- attended by international delegations composed of the chief science official, chief economics official and chief environmental official from each nation.

-- focus of the meeting would not be on any particular environmental issues but on advancing the quality and understanding of the analytical tools for confronting environmental problems. Result would be a common integrated approach for use in future negotiations on environmental problems.

-- all or any parts of the deliberations could be attended by the President.

C. President's International Conference on the Conservation of Nature

-- President to host an international conference, in the tradition of Teddy Roosevelt, focused on the twin goals of the conservation of nature and sustainable development.

-- emphasis on energy conservation, biological diversity, reforestation, wetlands and oceans, highlighting as models successful domestic programs, international ventures (e.g., the pending U.S.-Brazil agreement for assistance in the management of Brazilian national forests, banning of ivory imports, and debt-for nature swaps), and future initiatives (e.g., the reforestation initiative to be announced in the State of the Union and the America the Beautiful initiative to be included in the 1991 budget).

-- significant "thousand points of light" voluntary component to be included.

-- approach separates the volatile issues of atmosphere and global warming from the event with which you will be most closely identified.

II. Timing (see attached calendar)

A. IPCC Plenary Session: date fixed, February, 1990.

B. White House Meeting on Environmental Research: Spring, 1990, date to be determined.

C. President's Conference on the Conservation of Nature: Spring - Summer - Fall, 1990, date to be determined.

III. Additional Initiative

The Working Group also discussed the issue of hosting the first negotiating session of the international framework convention on climate change. The United States has agreed to participate in the negotiations, yet has made no decision to serve as host. The United States, in our capacity as chair of the Response Strategies Working Group under the IPCC, hosted a "workshop" to begin discussions of the likely elements of a framework convention. It is suggested that the United States may wish to host the negotiations for the framework convention, which are not scheduled to begin until after the Second World Climate Conference in November, 1990 (which for practical purposes means not until 1991), and announce that decision at an appropriate time.

PROS

- decision to host the framework convention and, by extension, an early announcement of the decision, could give the U.S. leverage and an element of control in the negotiation process, allowing the U.S. to promote concepts such as market mechanisms, emissions trading and offset policies.

- hosting the "Washington Convention" would put the U.S. in a leadership role on international environmental issues.

- concern that any delay on a decision within the U.S. government will result in the U.S. being bypassed by another nation acting faster.

CONS

- no international consensus on the legal instrument to be employed for the framework convention. The legal instrument could range anywhere from model employed to negotiate the Law of the Sea Convention to a model less intrusive on national sovereignty. Unwise to host a negotiating session for a framework convention before the U.S. knows what the convention will be.

- consensus that the framework convention will be extraordinarily difficult to negotiate and could easily result in a document that the U.S. could not sign.
- would place enormous pressure on the United States to commit to economically injurious reductions, arrived at politically, of emissions for which there are no known substitutes at this time.
- unique mix of Congressional, interest group, and media interplay that would surround a "Washington Convention" would make any discipline or control over U.S. negotiating positions all but impossible.

In the discussion of this issue within the Working Group, a majority of your advisors expressed the opinion that in the very near future, namely after the February IPCC plenary session, the United States will be in a better position to gauge the direction of the IPCC and the legal instrument to be employed in negotiating the framework convention, and that it would better serve U.S. interests to postpone a decision on hosting the convention until that time.

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THIS FORM MARKS THE FILE LOCATION OF ITEM NUMBER 2
LISTED IN THE WITHDRAWAL SHEET AT THE FRONT OF THIS FOLDER.

1990 ENVIRONMENTAL CALENDAR
(Dates and Events in Bold are Fixed)

January	State of the Union
February 5-8	IPCC Plenary Session (Presidential Address)
March-April	*White House Meeting on Environmental Research
April 22	Earth Day *President's International Conference on Conservation of Nature
May 8-16	Conference on "Action for our Future" - Bergen
May	*White House Meeting on Environmental Research
July 9-11	G-7 Economic Summit
July	*White House Meeting on Environmental Research or President's International Conference on Conservation of Nature
August	Final Plenary Session of IPCC - Stockholm
September-October	*President's International Conference on Conservation of Nature
November 12-13	Second World Climate Conference - Geneva

* Represents Alternative Dates for Events

U.S. ACTIONS ALREADY UNDERWAY TO CUT GREENHOUSE GASES

In the first 11 months of the Administration, the U.S. has already taken several actions unilaterally which, in addition to being meritorious in their own right, will reduce CO₂ emissions and address the global warming problem.

- o The Administration's proposed Clean Air Act, by significantly reducing pollution from coal-fired power plants and placing a permanent cap on emissions, creates a powerful incentive for conservation. This alone could reduce CO₂ emission by several percent a year. No other nation has adopted such an ambitious clean air strategy.
- o The Administration's action to increase required corporate average fuel efficiency (cafe) standards to 27.5 miles per gallon will cut CO₂ emissions from automobiles.
- o The Administration has not only called for a worldwide phase out of CFC's by the year 2000, but the Administration's February 9th budget included a unilateral fee on CFC emissions, which will sharply reduce U.S. production and emissions of CFC's. The CFC fee has been adopted by the Congress. Scientists believe that CFC's are responsible for 20% of the greenhouse problem. In addition, the Administration has proposed expanding the Montreal Protocol to cover additional greenhouse gases which deplete the ozone layer.
- o The Administration has sharply increased funding for global climate change research. The fiscal year 1990 budget contains almost \$1/2 billion for this effort, a 21% increase over 1989 levels. We expect another increase in the FY 1991 budget, with the amount to be determined. No other nation is spending nearly this much on research.
- o The Administration is now developing a national energy strategy, to be released in April. One of the clear goals in developing the strategy is to increase energy conservation.
- o Clean coal technologies proposed by the President in his Clean Air proposal and federally funded will reduce the production of greenhouse gases which are a by product of current, older technologies. Current technologies can add approximately 3% to greenhouse gas production per plant.
- o The President's proposed alternative fuels program for automobiles has the potential to reduce CO₂ emissions from automobiles.

- o The Administration is preparing a major reforestation initiative for possible inclusion in the State of the Union address. The initiative will include funding of approximately \$175 million annually under a program called "America the Beautiful." This program will encompass a national partnership for tree planting. We hope to work hand in hand with state and local governments, foundations, corporations, and private citizens to reforest urban and rural areas, on public and private lands.

Withdrawal/Redaction Sheet

(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
03. Memo	From D. Allan Bromley to POTUS Re: Meeting w/President Gorbachev [redacted] (11 pp.)	11/27/89	(b)(1)	

Collection:

Record Group: Bush Presidential Records
Office: Chief of Staff, White House Office of
Series: Sununu, John, Files
Subseries: Issues Files
WHORM Cat.:
File Location: Global Warming (2 of 2) - 1990 [6]

Document Partially Declassified
(Copy of Document Follows)
 By SCS on 6/26/15

Date Closed: 12/17/2004	OA/ID Number: 29158-006
FOIA/SYS Case #: 1998-0004-F[1]	Appeal Case #:
Re-review Case #: 2005-0426-S	Appeal Disposition:
P-2/P-5 Review Case #:	Disposition Date:
AR Case #: 98-0004-F/1 (590)	MR Case #:
AR Disposition: Released in Part	MR Disposition:
AR Disposition Date: 8/16/2013	MR Disposition Date:

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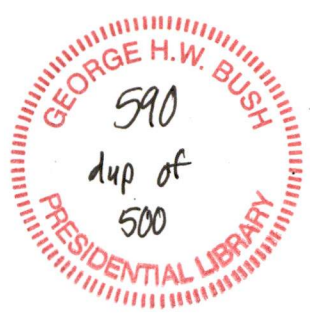
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1989 NOV 27 PM 5:15

THE WHITE HOUSE
WASHINGTON

November 27, 1989



MEMORANDUM FOR THE PRESIDENT

FROM: D. ALLAN BROMLEY

Duan

SUBJECT: Your Meeting with President Gorbachev

My Soviet friends in the science and technology areas have suggested privately to me that Mr. Gorbachev may wish to give matters of the global environment very high visibility during your forthcoming meeting in the Mediterranean.

In particular, given the state of the environment in many Soviet cities (102 of these cities now exceed their own standards by more than a factor of ten), I believe that his emphasis may well be on obtaining U.S. technology and expertise (very much like that required by the Third World) that will enable the Soviet Union to continue widespread burning of fossil fuel, as required in its economy without the current level of concomitant environmental insults.

There are also a number of areas in which the Soviets may well wish to raise other environmental issues with you. Among them are the following:

a. Creation of a Global Fund for Environmental Protection

Background

There has been discussion of such an initiative in Soviet papers recently, and Foreign Minister Shevardnadze has mentioned it on more than one occasion. The statements imply that this proposed fund would be financed from reduced military expenditures reflecting reduced East-West tensions. The Third World would react enthusiastically to such a proposal, as would many of our own citizens.

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*2010-2818-MR
SCS 8/16/13*

Recommendation

As noted following the Noordwijk meeting, I believe that it would be unwise for us to commit to such a fund unless we could target our support to specific areas and activities.

b. Call for a Reduction in Missile Launches and/or Space Shuttle Flights to Minimize Stratospheric Ozone Depletion

Background

The Soviets have long maintained that their space missions do substantially less damage to stratospheric ozone than do ours, because of difference in our lift vehicle exhausts. I do not understand this claim and am trying to get data on it in time for your meeting. It could well be, however, that President Gorbachev will use this environmentally attractive argument to take U.S. competitive pressure off his own space program and economy.

Recommendation

Pending more information on the credibility of the Soviet claims, I cannot give a solid scientific recommendation, but I would certainly resist this proposal in the absence of such reliable scientific information.

c. Call for Strengthening of the U.N. Environmental Program and Creation of Some Kind of International Center for Ecological Aid and/or a Global Environmental Monitoring System

Background

The Soviets are relatively recent entrants in the environmental field, having established their State Committee for the Preservation of Nature only in January 1988. They are preparing a draft of a comprehensive global change program; it first surfaced during this past summer (1989) in informal conversations and, in recent weeks, has been mentioned officially on Soviet television. No detailed information is available as yet as to its content, beyond the general statement that it is "ambitious." Shevardnadze has very recently published a long article on Ecology and Diplomacy in one of the leading Soviet journals. They

may wish to use this meeting to establish, publicly, a more aggressive environmental stance, while simultaneously gaining good P.R.

Recommendation

If this comes up, perhaps you should emphasize our strong support for the U.N. Environmental Program (UNEP) and suggest that the restructured International Institute for Applied Systems Analysis (IIASA) in Vienna, to which I refer below, might represent a first and important step along the lines proposed.

d. Request a Lifting of COCOM Restrictions on the Export of U.S. Supercomputer Hardware and Software Essential to the Modelling of Global Change and of High Technology Pollution Monitoring Equipment

Background

The Soviets have long had an outstanding climate modelling group at Novosibirsk, headed by Academician Marchuk, now president of the Soviet Academy of Sciences. They have, however, been limited, particularly in recent years, by their available computing capacity. These global climate models are among the most demanding computer applications yet encountered in science and technology.

Recommendation

I would recommend against any immediate relaxation of COCOM controls until we were as certain as possible as to the precise technology involved, how it would be used, and what safeguards, if any, we would develop against improper use.

e. Propose a Joint US/USSR Program to Repair Environmental Damage in Eastern Europe

Background

Again, a highly visible political possibility, but one based only on very vague and unreliable rumors.

Recommendation

Would need substantial additional study to define and delimit our obligations in any such program. I cannot help being reminded of the child who kills his parents and then throws himself on the mercy of the court because he is an orphan!

In the **global change research area**, there are a number of specific areas where the Soviets would wish to establish or initiate joint projects.

a. Admission of the Soviet Union to the Ocean Drilling Program (ODP)

Background

The Ocean Drilling Program (ODP) is an international program of basic research in the marine geosciences that utilizes an offshore drilling vessel converted for scientific research. The objective of the ODP is to explore the structure and history of the Earth as it is recorded in the basement rock and overlying sediments accumulated on the seafloor. The program is managed by the National Science Foundation (NSF), which supports over half of the program costs. Six international partners representing 18 nations provide the remainder of the necessary funds. The ODP is the successor to the highly successful Deep Sea Drilling Program (DSDP) which ceased operations in 1983.

After preliminary governmental review and approval in 1985, NSF requested that the Soviet Academy of Sciences consider joining the ODP. A second review by the Administration, however, raised concerns regarding Soviet access to technology used in the ODP. Further discussions with the Soviet Academy of Sciences were terminated in March of 1987.

Since 1987, both the U.S. scientific community and the international partners participating in ODP have reiterated their support for Soviet involvement in the ODP. The Soviet Union is the only country with global geoscience capability that is not a member of the ODP.

In September 1988, the Executive Committee of the ODP, which represents its participating members, unanimously passed the following resolution:

Whereas the USSR has a long and distinguished record of accomplishments in earth sciences, and was an active and valued partner in the International Phase of Ocean Drilling and,

the USSR continues to have an active interest in global earth science as does the Ocean Drilling Program, and

the U.S. Government has not yet offered to enter into a Memorandum of Understanding with the USSR, and recognizing that:

the USSR is still interested in joining ODP as a full member, but the USSR cannot keep the potential commitment open indefinitely,

Therefore: EXCOM reaffirms its previous resolution and recommends that the U.S. Government immediately take appropriate steps to secure full membership in ODP for the USSR.

Recommendation

I believe that it would be in the best interests of both our countries were you to invite the Soviet Union to participate in the Ocean Drilling Program, along the lines initially approved in 1985.

NOTE: I understand the Dr. Michael T. Halbouty plans to discuss this matter with you while he is in Washington November 27-29, and that he will strongly support Soviet participation in ODP. He has already discussed this with Boyden Gray (July 1989).

b. Marine Geological and Geophysical Research in the Arctic Ocean Basin

Background

The polar marine geosciences are evolving rapidly and contribute a broad spectrum of essential research elements to the recent thrust in global-scale studies. The fundamental goal is to integrate the Arctic Ocean Basin into the global perspective of paleoclimate and geology and to develop quantitative models. All aspects of the geology and geophysics of the Arctic Ocean Basin remain largely unresolved. The Arctic ice cover makes marine geophysical and geological field studies extremely difficult. Therefore, we have only the most basic picture of the structure and evolution of the Arctic Ocean Basin and its relation to the surrounding continental areas.

Marine sediments contain a record of tectonic evolution, environmental processes on the adjacent continents, and fluctuations in global climate. A primary objective of marine geological research in the Arctic Ocean is to recover good quality cores (up to 20 meters in length). The geophysical framework must also

be carefully prepared in order that the scientific return be maximized. This involves access to modern research icebreakers and ice platforms and deployment of marine geophysical instrumentation such as multi-channel seismic equipment. In order to advance our knowledge significantly, we require a coordinated marine geological and geophysical effort to address the unresolved questions of global scope:

- Determination of the tectonic evolution of the Arctic Ocean Basin and the origin of its present configuration;
- Determination of the Cretaceous and Cenozoic paleo-oceanographic history of the Arctic region, with emphasis on episodes of widespread anoxia and Cenozoic climatic deterioration;
- Determination of the paleoclimatic history of the circum-Arctic region, with emphasis on the origin, nature, and forcing functions of intense climatic cycles and the history of the last deglaciation.

Proposed Joint Activities

1. Preparation of an overall science plan aimed at the establishment of a geological and geophysical framework for the Arctic Ocean Basin through site-specific, geologic sampling; and
2. Acquisition of sediment cores from mobile platforms (icebreakers equipped for marine geological sampling) in order to establish geophysical "ground truth" and reconstruct the polar sedimentary record.

Recommendation

I have discussed this program with Erich Bloch and his staff at NSF; they strongly recommend it, and I would suggest that you might wish to propose it to President Gorbachev.

NOTE: Senator Ted Stevens of Alaska is a very strong supporter of this initiative and has discussed it with me on two occasions.

c. Arctic Ocean Sea Ice Thickness and Extent

Background

The quasi-permanent Arctic sea ice cover is a significant component of the global climate system.

Climatic-scale variability in its extent or thickness is an important research issue. Sea ice is a primary determinant of the annual surface temperature range because it modulates the energy exchange between the ocean and the atmosphere. Recent reports suggest a significant thinning of sea ice covering the Arctic Ocean. Both the United States and the Soviet Union have compiled information on the extent and concentration of the Arctic sea ice cover. Cooperation in the areas of data exchange, planning of future cooperative experiments, and instrument technique development would yield substantial advances in our understanding of not only sea ice dynamics, but also the internal processes of the Arctic environmental energy budget. Moreover, it would provide a definitive test of the ice-albedo feedback loop, serve as a wide-ranging surface truth experiment for upcoming satellite-based synthetic aperture radar programs, and contribute to a number of interagency Arctic Ocean research objectives.

The following are topics of interest:

-- Sea ice as the climatic modulator of the Eurasian Basin: The Eurasian Basin is a region of seasonally highly variable sea ice concentration, and extremely active heat exchange between the ocean and the atmosphere. Research would involve comprehensive measurements of the surface heat budget and sampling of ice concentration, thickness, mechanics, and thermodynamics, along with the structure of the upper ocean and lower atmosphere over a large grid of stations within a relatively short time period.

-- The thickness and real extent of Arctic sea ice: Thickness and extent are the fundamental parameters that influence processes of high-latitude air-sea interaction important to global climate. Moreover, significant change in climate will affect ice thickness. Satellite data obtained nearly continuously since 1973 provide estimates of sea ice extent. The body of in situ measurements needs to be evaluated in order to estimate changes in sea ice thickness and volume and to complement satellite observations.

Proposed Joint Activities: Meeting of U.S. and Soviet sea ice specialists to review availability of current information on sea ice and to plan future cooperative research.

Recommendation

Again, I have discussed this program with Erich Bloch and his staff and with members of the Federal

Coordinating Council on Science, Engineering and Technology (FCCSET) Committee on Earth Sciences. I would again recommend that you suggest this initiative to President Gorbachev.

d. Meeting of Senior Scientists, Economists and Environmental Ministers on the Topic of Global Change

Background

Following up on our brief discussion of a possible meeting of G-7 science ministers, discussions within the DPC Working Group, and discussions during the Noordwijk conference, there appears to be quite general support for a meeting here in Washington in March or April of 1990, at which delegations composed of the chief science official, the chief governmental economist, and the chief environmental officials of each participating nation would meet to try to develop a comprehensive methodology for national and international use in confronting environmental problems, interrelating all their scientific, economic and environmental components. This would fill a generally acknowledged gap in the current international analytical processes and would lead to a matrix, building upon the U.S. domestic approach to problem solving, for all future negotiations on environmental problems, as well as build a strong foundation for future international cooperation in this area.

There is now a consensus -- following Noordwijk -- that it would be unwise to restrict participation to the G-7 nations only.

Recommendation

I would suggest that you invite President Gorbachev to send his senior representatives in science, economics and the environment to such a meeting.

There are three additional topics that I should mention in connection with your meeting with President Gorbachev. They are the following:

a. Destruction of U.S. and USSR Stocks of Wild Smallpox Virus

Background

Only the U.S. and the USSR have admitted remaining stocks of smallpox virus. All other supplies were

destroyed under U.N. auspices a number of years ago -- with the possible exception of remaining clandestine supplies in Libya and similar areas. We now have the technology -- in three years, and for about \$3 million -- to map the entire genome of this virus so that in the very remote possibility of needing it at some future time, we could recreate it.

As Secretary Sullivan, I believe, has already discussed with you, there is at least the possibility that the Soviets might announce -- for public relations purposes -- their intention to take the lead in destroying their supplies of this virus in the interests of peace and human welfare. This could develop into a significant public relations coup.

Recommendation

I would suggest that you raise with President Gorbachev the possibility of a joint U.S./USSR project to map the genome of the smallpox virus, followed by its total destruction. This would be an excellent example of our two nations acting, once and for all, to remove from the planet what was even recently one of mankind's terrible scourges.

b. The International Institute for Applied Systems Analysis (IIASA)

Background

This international institute based in Vienna was established in the aftermath of the 1973 oil shortage and focused primarily in its early days on energy-related issues. (b)(1)

Some of the more liberal members of the Democratic organization in the Boston area convinced the American Academy of Arts and Sciences, based in Boston, to take over American representation in, and support of, IIASA and over the years have managed to provide some private -- and, more recently, some National Science Foundation -- support for it. The Boston group, led by Senator Moynihan but with strong support from senior members of the Harvard and M.I.T. faculties, is now seeking to have the U.S. formally rejoin in supporting IIASA at the federal level.

(b)(1)

Recommendation

Given the need for better communication with Eastern Bloc countries and the fact that IIASA is an existing East-West entity, I would recommend that we consider renewing our formal support but with the understanding that the mandate of the Institute be changed to that of study of global change problems, rather than the more restricted ones of the past and that its name be changed to reflect its new role. It would take several years to get a new organization into action and conversion of IIASA can be done much more quickly and efficiently.

You might wish to make the offer of reinstating U.S. support conditional on the above mentioned changes.

c. Exchange of Pershing II and SS-20 missiles for Museum Display

Background

Over much of the past year, there have been a series of discussions involving the director -- Martin Harwit -- and staff of the National Air and Space Museum with representatives of the Soviet Union concerning the possibility of an exchange of an American Pershing II and a Soviet SS-20 missile -- committing establishment of a permanent memorial -- in both the U.S. and the USSR to the first nuclear disarmament agreement.

The Department of State and the Department of Defense have agreed to cooperate, and the Army is prepared to offer two Pershing II missiles for use in these displays.

Prior to retiring as Chairman of the Joint Chiefs of Staff, Admiral William J. Crowe, Jr. formally discussed such an exchange with his counterpart, General Mikhail A. Moiseyev. The proposal has also been discussed with Ambassador Yuriy Dobinin, with Marshal Sergei Akhromeyev and Defense Minister Dmitri Yazov, on the occasions of their separate visits to the Air and Space Museum. All have indicated their support for the idea, but as yet there has been no official response from the Soviet Union.

I suspect that all of the Soviet representatives involved are waiting for some formal approval from Mr. Gorbachev. If you agree with me that this proposed exchange is one that would be in the interests of both

our countries, I suspect that a word from you to Mr. Gorbachev during your forthcoming meeting could very well make it happen.

Recommendation

That you mention this to President Gorbachev if the occasion arises.

Finally, I expect to receive shortly the first two copies of the inaugural American edition of the Soviet high school science and mathematics magazine, Quantum, which will shortly be distributed to over 200,000 U.S. students, with NSF support. I will provide you these two copies (which will bear appropriate designation as copy 1 and copy 2), one for yourself and one to present to Mr. Gorbachev.

Zaellick Draft

Press Backgrounder

President Bush to Host Environmental Negotiations

- President Bush discussed global climate change with General Secretary Gorbachev, telling him that the US intends to offer to host negotiations for a framework convention on global climate change to begin after the IPCC completes its work next fall.
- The President raised the environmental issue because of its importance globally and because the US and the Soviet Union are working closely together in the IPCC process.
- The IPCC (the Intergovernmental Panel on Climate Change) is an offshoot of the UN Environmental Programme (UNEP) and the World Meteorological Organization (WMO). It was set up in 1988 to provide a central forum to discuss global climate change.
- IPCC has three working groups: the Soviet Union chairs the Working Group assessing the impacts of climate change and the US chairs the Working Group tasked with identifying strategies to respond to climate change; the Working Group on science is chaired by the UK.
- Both the US and the Soviet Union believe the IPCC process is working well; the leaders reaffirmed their support for the IPCC's work and look forward to the next IPCC meeting to be held in Washington, D.C., in February.
- Scientific uncertainties about global climate change remain: we understand that increased emissions of certain gases, called greenhouse gases (carbon dioxide, CFCs, methane, etc), can cause global warming but existing scientific models cannot predict precisely how the global climate system will respond because of variables, such as cloud cover, ocean temperature and rainfall.
- Given these uncertainties, our approach must be flexible enough to allow changes to be made as our understanding increases: we believe a framework convention with associated protocols is the best approach. This format was used successfully in the Vienna Convention and its Montreal Protocol to Protect the Ozone Layer.
- More scientific research is needed to address these uncertainties. The United States proposes to invest \$500 million in global climate change research during the coming year; we hope others will join our efforts.
- Even with the scientific uncertainties, President Bush believes we should take actions that are also important for other environmental reasons. Such actions include ending the use of CFCs by 2000, controlling CO2 emissions, undertaking aggressive reforestation programs and promoting energy conservation and energy efficiency. A number of these and other important initiatives are included in the President's ambitious Clean Air Act proposal.