



Policy history of the US Global Change Research Program: Part I. Administrative development

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1. Introduction

On a hot day in June, 1988 NASA scientist James Hansen testified before a US Senate Committee that he was “99% certain” that global warming was underway (Hansen, 1988).² In the record hot summer of 1988, Hansen’s testimony elevated the subject of global warming and the specter of associated impacts such as more hurricanes, floods, and heat waves, to unprecedented levels of attention from the public, media, and policy makers. In the years that followed Hansen’s testimony, the US government committed itself to one of the most expensive and ambitious programs of research ever conducted and then signed an international treaty with the goal of limiting global warming. Table 1 shows federal funding for the US Global Change Research Program from 1989 to 2000.

This paper and its sequel tells the story through 1991 of the development of the Global Change Research Program, the centerpiece of the US response to global warming. Important elements of the story include personalities, bureaucracies, presidents, members of congress, advocacy groups, and experts. At its core, it is a story of how science was enlisted in support of policy development through the institutions of US govern-

ment.³ The US response is based on the notion that of science can motivate a political consensus on the causes and impacts of global warming. Yet in the more than 12 years since Hansen’s call to action, a political consensus in support of the US response seems as distant as ever, and attention to the issue of global warming has diminished (cf. Ungar, 1995).

The central thesis of the two papers is that how policy makers, administrators, and scientists define the role of science in the policy process is critical to success or failure of policies that depend on scientific input. Policy makers established the Global Change Program to support policy development, and its administrators subsequently structured the Program to develop predictive knowledge of the earth’s climate. However, rather than motivating a political consensus, scientific research has been selectively used (and misused) by opposing camps in the global warming debate to support previously held positions. As a result the Program has achieved notable bureaucratic and scientific successes while falling short of its ultimate goal to support policy development (Pielke, 1995). The lessons of the program’s early years are important to understand, not only for future implementation of the program, but also for the more general connection of research and societal needs (cf. Boehmer-Christiansen, 1994a, b).

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² Hansen testified to three main points: (1) that 1988 was the warmest year on record (of the past 100 years), (2) there was a high degree of confidence that warming was caused by human activities, and (3) that computer models indicated that the greenhouse effect was already large enough to result in extreme events like summer heat waves.

³ The story of the program told in this paper and its sequel is a synthesis based on materials found in the public record (notably Congressional and administrative documents), published analyses and interviews with numerous outside observers, as well as individuals closely involved with the program, from their perspectives on science, administration, and policy. Interviews were conducted over the period 1993–1997, some on record and some off record. I have chosen not to identify by name many interview sources cited in the text out of consideration for their candor and in recognition that the US Global Change Research program is an ongoing effort with many interviewees having continued involvement in the Program. In the text the interviews are cited simply as ([I]interview with [A]uthor [year]), e.g. (IA, 1994). See Pielke (1995) for an appraisal of USGCRP implementation through 1994.

Table 1
USGCRP Funding 1989–1997 in millions of current dollars^a

Fiscal year	Appropriation (millions of current year \$)		
	Focused	Contributing	Annual increase (% of focused)
1989	134	1475	—
1990	659	1412	491
1991	1034	918	45
1992	1110	1186	16
1993	1326	1391	19
1994	1763	Unavailable	33
1995	1769	Unavailable	0
1996	1810	Unavailable	2
1995	1769	Unavailable	
1996	1810	Unavailable	2
1997	1810	Unavailable	0
1998	1677	Unavailable	−7
1999	1682	Unavailable	0
2000 ^b	1787	Unavailable	+6
Totals	16 561	6382	

^aCommittee on Earth Sciences (1989, 1990), Committee on Earth and Environmental Sciences (1991–1993), Committee on Environment and Natural Resources (1995–2000), Marshall (1994), Wakefield (1995).

^bFrom FY00 President's Budget Request.

The Global Change Program is in many respects a tremendous success story. It represents years of hard work, political maneuvering, and scientific progress by individuals and institutions who feel strongly that global warming is an important matter of societal concern. At the same time, through at least 1995 the program had yet to meet its mandate; it did not meet the needs of policy makers (Pielke, 1995). As one Congressman asked in 1992,

How much longer do you think it will take before [the USGCRP is] able to hone [its] conclusions down to some very simple recommendations, on tangible, specific action programs that are rational and sensible and cost effective for us to take... justified by what we already know? (HCSST, 1989, p. 244)

The answer could have been “never” because the program was structured to develop a predictive understanding of the earth's climate, and not to provide recommendations on “action programs”. It has not systematically provided information useful to policy makers. This represents a performance shortfall in program implementation that persisted because of breakdowns in the policy process (Pielke, 1995).

The story of the program can be understood from two distinct, but related, points of reference. The first point of reference is the story of the Committee on Earth and Environmental Sciences, an interagency body established in law in 1990 with instructions to develop and implement a Global Change Research Program. The Committee was terminated and replaced in 1994 by the Clinton

Administration. The second point of reference is the unfolding story of the program, which existed before the Committee had responsibility for its implementation, and continues following the Committee's termination under a different institutional structure. The story of the Committee is the story of the program from late 1990 to early 1994, a period of about three and a half years. The story of the program is part of the broader policy process in which the Committee existed. It is possible to draw definitive conclusions about and assess responsibility for the Committee's successes and shortfalls with respect to its legal mandate. However, definitive conclusions about program's performance and responsibility are not possible as the program continues to evolve and change. The Committee is a fixed target, amenable to policy appraisal. The program has continued to evolve, and thus allows for only tentative conclusions subject to reinterpretation as events unfold.

1.1. *Why history matters*

Under the Committee, the program did not meet its legal mandate and a “growing number of critics warn[ed] that the program appears headed toward failure unless fundamental changes are made” (Monastersky, 1993, p. 158). This paper and its sequel explain how congress gave the program a broad mandate to produce “usable information”. However, the program was structured to “reduce uncertainty” rather than “expand policy alternatives”, and as a consequence the program produced little in the way of usable information. The policy shortfall was noted in a 1993 congressional oversight hearing in which several witnesses testified that the program was falling short of its legal mandate to provide information usable by decision makers.⁴ One witness argued that in spite of high-quality science conducted in the program, “these studies have had only a tenuous connection to the present needs of public and private decision makers” (HCSST, 1994, p. 64). Other witnesses argued that “the program's agenda has not focused on addressing policy relevant questions” (HCSST, 1994, p. 86).

In the broader context of US science policy, policy makers have in recent years been struggling with the task of evaluating the performance of federal programs and agencies. The evaluation task has been motivated by the passage of the Government Performance and Results Act (GRPA) of 1993 (P.L. 103-62). Congress enacted the GRPA because it felt that

all too frequently individual agencies have lacked clear missions and goals, and related agencies efforts have

⁴ That there was a performance shortfall is generally not controversial. See Pielke (1995) and the sources cited therein.

not been complementary. Moreover, legislative mandates may be unclear and Congress, the executive branch, and other stakeholders may not agree on the goals an agency and its programs should be trying to achieve, the strategies for achieving those goals, and the ways to measure their success. Thus, many agencies cannot confidently answer the basic questions in defining a mission — what is our purpose, whom do we serve, and how do we meet our mission? (GAO, 1996, p. 4)

Science programs, in particular, have been identified as difficult to evaluate due to poor understanding of the connections between research efforts and related societal benefits (GAO, 1996). The history of the Global Change Program has potential to shed light on the challenging task of evaluating science programs in the context of demands by the public and their representatives for greater accountability and efficiency in federal programs.

2. Background

2.1. *The executive branch and climate change in the early 1980s*

The Reagan and Bush administrations' climate change policies were controlled by the president along with the help of a close circle of advisors, in spite of the creation of various climate change advisory and decision-making bodies in the agencies. By the end of the 1980s on the issue of climate change, the executive branch relied on ad hoc decision making rather than a central policy coordinating body (GAO, 1990). Throughout the late 1980s, executive branch organization frustrated those members of Congress who wanted to organize the agencies to respond to climate change. These pressures intersected in the formation of a White House Committee on Earth Sciences in the late 1980s.

Climate change joined the White House agenda through an administrative structure that was developed by the Reagan Administration during the 1980s. Shortly after his inauguration on 20 January 1981, President Ronald Reagan established five Cabinet councils: economic affairs, commerce and trade, human resources, natural resources and environment, and food and agriculture (Brownstein and Kirschtien, 1986).⁵ These councils were the brainchild of advisor Edwin Meese who believed that policy issues would “bubble up” through the councils to the full Cabinet for Presidential decisions (Brownstein and Kirschtien, 1986). In practice, however, policy rarely “bubbled up” through the councils, but

rather was controlled by Chief of Staff James Baker III, his deputy Richard Darman, and OMB director David Stockman.⁶ According to one anonymous White House official, the Councils were often irrelevant to what was really going on: “There were many instances where the Cabinet councils were sitting around discussing things and Stockman couldn't make the meeting because he was on the Hill negotiating a settlement of the exact same issue they were discussing” (Brownstein and Kirschtien, 1986, p. 1583). In an April 1985 reorganization Chief of Staff Donald Regan replaced the cabinet councils with a Domestic Policy Council and an Economic Policy Council, both Cabinet-level bodies (Brownstein and Kirschtien, 1986).

The Economic Policy Council was to advise the President on economic policy and trade issues, while the Domestic Policy Council was to be concerned with domestic issues that did not deal with economics or trade (CCSTG, 1991).⁷ Under each Council, working groups staffed by sub-cabinet officials were created to deal with specific issues. The primary function of such working groups was to reduce the range of policy alternatives in a particular issue area to a number that could be handled at the cabinet level.

Climate change first appeared on the White House agenda in the Domestic Policy Council working group on the Energy, Natural Resources, and Environment during President Reagan's second term (Nitze, 1991; Kennedy, 1992a). Climate change became a matter of White House concern because of public attention to Congressional hearings called in response to warnings from the scientific community of the consequences of increasing carbon dioxide in the atmosphere.

2.2. *Congress and the National Climate Program*

Legislation calling for a National Climate Program was introduced in Congress in 1975. Congressional concern “arose over a series of severe climatic anomalies and climate-related events that occurred in many parts of the world in the brief interval from 1971 to 1978” (Justus and Morrison, 1988, p. 11). Events included the failed Peruvian anchovy harvests in 1971 and 1973, the 1972–1974

⁶ Brownstein and Kirschtien (1986) point also to Baker's White House Legislative Strategy Group as a key player in policy development.

⁷ The members of the DPC were the President (Chair), Vice President, Secretaries of Treasury (Chair, pro tem), State, Agriculture, Commerce, Labor, Transportation, OMB Director, US Trade Representative, Council of Economic Advisors Chair, President's Chief of Staff, and OSTP director. The members of the DPC were the President (Chair), Vice President, Attorney General (Chair, pro tem), Secretaries of Education, Interior, Health and Human Services, HUD, Energy, OMB Director, OSTP director, and EPA Administrator (CCSTG, 1991).

⁵ In 1987 Reagan added additional Cabinet councils on legal affairs and government management (Brownstein and Kirschtien, 1986).

drought in the African Sahel, a severe 1972 winter freeze in the Soviet Union, and in 1974 floods, drought, and early frost in the US Midwest. In 1977, the eastern US suffered its coldest winter ever recorded, and summer was one of the three hottest in a century (Justus and Morrison, 1988).

The Climate Program was established by Public Law 95-367 in September 1978.⁸ The law was passed by Congress to “assist the Nation and the world to understand and respond to natural and human-induced climate processes and their implications” (P.L. 95-367, Sec., 3). The law called for “assessments of the effect of climate” on various aspects of society, basic and applied research to improve scientific understanding, forecasts and data collection of climate processes, and international and intergovernmental cooperation in climate research. The law also called for “studies on policy options for reducing the impact of man’s activity on global climate change. The studies will be made available to Federal Agencies, the Congress, and the public” (sec. 5.d.9). In short, the Climate Program was to generate climate information, conduct climate research, and explore the policy implications of climate. The interagency program was to be coordinated by a National Climate Program Office (NCPO) within the National Oceanic and Atmospheric Administration (NOAA) under the Department of Commerce.

The Climate Program delegated to various agencies responsibility for implementation of different aspects of the program. For example, the State Department was responsible for coordination of US participation in international programs, National Aeronautics and Space Administration (NASA) was responsible for remote sensing, and National Science Foundation (NSF) was to conduct basic research. Table 2 shows the various agencies and their responsibilities in the Climate Program. These responsibilities served to strengthen traditional agency efforts in the area of climate change and would later form the core of agency responsibilities in the Global Change Program.

In a 1986 report, the National Academy of Sciences (NAS) found that the Climate Program had many “significant achievements” and faced a “promising future” (NAS, 1986, p. viii). The report found also that the program could be improved with better communication and integration of research findings with public policy. The report notes that “climate and public policy are inextricably intertwined. Coordination of the climate-related activities and interests of the various federal agencies involved is fundamental for program success” (NAS, 1986, p. 1-2). The report noted also that policy develop-

Table 2

National Climate Program Agency Responsibilities (Justus and Morrison, 1988, p. 32)

Energy:	Lead agency for the study of carbon dioxide and climate
State:	Coordination and policy setting for US participation in international programs.
EPA:	Assessing impacts of climate change on environmental quality and developing a coordinated national policy on global climate change.
NASA:	Developing remote sensing techniques to study the Earth as an integrated system; lead agency for coordination of the ozone program.
NOAA:	Lead agency for coordination of the NCP; monitoring, archiving, and dissemination of atmospheric and ocean data; lead agency for climate prediction.
NSF:	Support of basic research in all aspects of NCP; lead agency for coordinating the Arctic Research and Policy Act of 1984; conduct of US Antarctic Program.
USDA:	Evaluation of the role of climate change and variability on agriculture (food and fiber) systems.
USGS:	Lead agency for study of the interaction between climate and hydrology and for study of paleoclimates.

ment in response to climate-related problems would be difficult as “management strategies to deal with socioeconomic consequences of climate variation... are virtually unknown as yet, except as concepts, and their development will involve participation from several disciplines” (NAS, 1986, p. 2). The NAS report implied that research into the scientific aspects of climate was advancing faster than knowledge of the policy implications of climate science.

By the mid-1980s some members of Congress sought to improve upon the Climate Program. For instance Congressman George Brown (D-CA), who had introduced the Climate Program legislation in the 1970s, observed in a 1987 hearing that

Our inability to forecast the implications of human-induced climate change stems from our vast ignorance of how in fact we are disturbing our surroundings. The National Climate Program Act of 1978 was a step in the right direction, towards helping us grasp the nature of climate change on planet Earth. However, that program has represented only a first effort in what will be required to address this enormous problem (HCSST, 1987, p. 3).

A number of scientists and other experts testified before Congress to the effect that “to have a problem-oriented approach toward the future, we have to integrate more disciplines than those in the traditional atmospheric sciences or climate-related disciplines” (HCSST, 1987, p. 5). In other words, the Climate Program was judged to be producing good science, but to be incomplete from the perspective of clarifying policy responses to the threat of climate change.

⁸ Public Law 95-367 was amended by P. L. 97-375 (December 1982) and P.L. 99-272 (April 1986).

The Climate Program became subordinated to the larger and more ambitious Global Change Program by the late 1980s for a number of reasons: First, congressional concerns about human impacts on the global environment increased, and the Climate Program was a relatively narrow program. And secondly, the science and agency communities wanted to expand the research agendas of a new area — global change studies. The legacy of the Climate Program was to help to define agency roles in earth sciences research that would continue throughout the 1980s and into the 1990s.

2.3. *The development of agency roles and responsibilities*

Agencies participating in the Climate Program developed expertise and responsibility for different aspects of the climate change issue. Of these agencies, NOAA, NASA, and NSF became the three major players in climate change science in the 1980s and 1990s (Bloch et al., 1987). Because of the energy crisis, the Department of Energy (DOE) was the most active agency in the climate change area in the late 1970s and early 1980s. However, the energy crisis abated, and with the election of Ronald Reagan DOE fell out of political favor, e.g., Reagan formally proposed DOE termination.

NOAA, NASA, and NSF entered the 1980s with intense political and budgetary pressures. NOAA was a favorite target of the Reagan Administration, which had proposed eliminating the agency on at least several different occasions. NASA had successfully launched the Space Shuttle in 1981, and hoped to increase a flat budget in order to return to its glory days of the Apollo era. NSF, while a favorite of the Reagan Administration, remembered Congressional challenges of the late 1960s and 1970s to its mandate, and sought to protect itself from future assaults upon basic research. These conditions were favorable for the rise of a unified global change community across the federal agencies.

2.4. *National Oceanic and Atmospheric Administration*

In 1970 President Richard Nixon created by executive order the National Oceanic and Atmospheric Administration within the Department of Commerce to consolidate the Environmental Sciences Services Administration (ESSA), the Bureau of Commercial Fisheries, and the Lake Survey of the Corps of Engineers (Fleagle, 1986).⁹ At the same time the Environmental Protection Agency (EPA) was created. NOAA's missions were to serve pub-

lic safety and welfare and to support commercial development.

From 1971–1981, a period typically characterized by observers of science policy as one of bad fortunes for science, NOAA funding rose from \$280 million to \$840 million. During this period NOAA's budget rose by an average of 11% annually, or 3% greater than the average annual rate of inflation (Fleagle, 1986). In 1981 NOAA, like DOE, came under attack by the Reagan Administration. In his first five budget submissions to Congress, Reagan requested an average 14% cut in the NOAA budget. However, as was typical of the period, in every fiscal year Congress appropriated more to NOAA than it had the previous year, but less than had been projected in prior years.¹⁰ Because of these budgetary pressures and uncertainty during the mid-1980s, NOAA sought stability and focus that would lower the level of political tension brought on by the Reagan Administration (Fleagle, 1986).

2.5. *National Aeronautics and Space Administration*

NASA began the 1970s with the rejection by the Nixon administration of its vision of a human mission to Mars. With the assembly lines of the Apollo program shut down in the early 1970s, the agency decided not to abandon its technological vision of a space shuttle, space station, and mission to Mars. Instead, NASA decided to pursue its vision as a series of logical steps, which logic dictated that a space shuttle must be step one. The space shuttle was approved by President Nixon in 1972 and became NASA's primary development program of the 1970s.

During the decade of the 1970s the agency produced a series of science spectaculars beginning with the Pioneer missions to the inner and outer planets. In 1976 the Viking probes landed on Mars, and the decade ended with the Voyager probes at the outer boundaries of the solar system (Edelson, 1988). However, despite such science successes NASA budgets continued to fall (in constant dollars) from their 1965 Apollo peak. In the late 1970s when the Shuttle began experiencing technical problems and significant cost overruns, the agency sacrificed many science programs to pay for the Shuttle and preserve its vision of human spaceflight. Van Allen (1986, p. 37), a prominent space scientist, later called this “the slaughter of the innocent”.

Congress came to the rescue of human spaceflight and appropriated supplemental funds to support the Shuttle program. Therefore, NASA was able to afford many of the science programs cut previously. The Space Shuttle

⁹In 1965 the Weather Bureau, the Coast and Geodetic Survey, and the Central Radio Propagation Laboratory were combined to form the Environmental Sciences Services Administration (ESSA) (Fleagle, 1986). The ESSA was a response to growing policymaker concern about environmental problems.

¹⁰Schick (1990) characterizes the Reagan years as a period when Congress could honestly claim to be “cutting back and [actually] spending more”. Congress could at the same time cut from projected spending, and increase agencies over the baseline of the previous year. NOAA is an example of these dynamics.

lifted off on its maiden voyage in 1981. For NASA visionaries the main lesson of the 1970s was based upon the Shuttle and Apollo precedents: The goal of colonization of space had to be achieved through a series of logical steps secured at the presidential level (Pielke, 1993). These lessons were invoked when James Beggs, administrator, and Hans Mark, associate administrator, President Reagan's appointees to NASA's two highest posts, announced plans to pursue political approval of an orbiting, permanently occupied space station (Mark, 1990).

In short, NASA entered the decade of the 1980s with a sense of optimism about its chances to return to the golden age of spaceflight through a new space station proposal. For space scientists, a lesson of the 1970s was that no matter how successful their programs were, within the agency they would be secondary to the human spaceflight program. Hence, many space scientists viewed warily the proposed space station.

2.6. *National Science Foundation*

NSF entered the 1980s recovering from challenges to its mandate in the 1960s and 1970s. In the 1970s NSF had an essentially level budget, accounting for inflation. NSF has never had a large budget compared to other science agencies. For example, in 1981 the agency's budget was about \$1 billion out of a total of about \$34 billion spent by the government on research and development. Thus, when President Reagan expressed strong support for the agency it helped "turn around" concerns stemming from the 1970s (Smith, 1990, pp. 122–158). Morin (1992, p. 71) compares the NSF to a "proud and purposeful mouse foraging in a limited territory among a herd of lumbering federal elephants". To extend the metaphor, in the 1980s NSF began to take steps to ensure that it would not be stepped on by the giants of the federal bureaucracy.

In short, the 1980s saw the spinning of a complex web of agencies, perspectives, events, developments, and ideologies which set the stage for the emergence of a large-scale program focused on global change. The sciences of global change had made remarkable advances due to improved technologies and a long record of decentralized support from the federal government. Thus, the scientific disciplines of global change were ripe for interdisciplinary inquiry (Edelson, 1988). During the 1970s many science agencies had seen their proposals for increased funding defeated or deferred due to austere budgets, creating an atmosphere of institutional crisis, especially in NOAA and NSF.¹¹ Anthony Calio,

a NOAA Administrator in the 1980s observed that "there's a natural climate for us to coexist these days ... [The budget pressure] forces us to work closer and closer together" (Cowen, 1987, p. 18).

3. **The selling of global change: "a nonsinister conspiracy"**

The global change movement arose from a group of scientists and administrators from various countries, agencies, and disciplines who sought a coordinated, large-scale, and interdisciplinary research program. What seems to be an incoherent hodgepodge of acronyms — NASA, NOAA, NSF, ICSU, NAS, System Z, EOS, MTPE, NRC, IGBP — was in reality the institutional affiliations, often overlapping, of a well-defined community interested in creation of a global change program in the United States. The "nonsinister conspiracy" refers to the efforts by members of the global change community to initiate a research program. Global change was first presented as a scientific initiative by NASA in 1982 and by the late 1980s had matured into a large-scale program of research.

NASA first publicly presented its proposal for a global change program in July 1982 when it sponsored a conference on what it called "global habitability". The concept of "global habitability" originated in a February 1982 meeting between NASA associate administrator Hans Mark and Harvard professors Richard Goody and Michael McElroy (Waldrop, 1984). The purpose of the NASA conference, according to its summary report, was to design a space-based scientific program to examine environmental "changes that may affect the habitability of the earth". The report asked "Why should NASA be responsible for this program?" and answered "The short answer is that NASA can do it and no other Federal Agency can" (Goody, 1982). One month later, NASA presented its global habitability concept at the UNISPACE '82 conference, sponsored by the United Nations in Vienna, Austria.

NASA administrator James Beggs and associate administrator Hans Mark used the UNISPACE '82 conference to push a broad new agenda for NASA (Dickson, 1982). The new agenda revolved around "selling" a manned space station program to President Ronald Reagan and Congress in order to help reverse what Beggs and Mark saw as NASA's institutional decline in the 1970s (Mark, 1990). Mark recognized the expediency of advancing the agency's agenda on a broad front. According to one scientist involved with the "global habitability" study,

One of the things that [Mark] was concerned about was a rationale for NASA's earth presence. What is NASA going to do on the earth that is not in competition with NOAA or some other agency? The planets he

¹¹ The apparent paradox of support and austere budgets disappears when it is recognized that federal science agencies continued to receive a significant federal funding in the 1970s, hence the "long record of support"; however such funding was often less than the agencies expected or desired, hence "austere budgets".

saw as interesting, but that's not going to keep the agency afloat (Quoted in Kennedy, 1992a, p. 4).

In order to gain support for the space station program from those scientists who were hesitant about supporting any large-scale spaceflight effort based on their previous experience with the Shuttle, the agency offered earth scientists a remote sensing program, called "System Z," to be funded out of the station budget (Taubes, 1993). President Reagan's Commerce Secretary Malcolm Baldrige explained why System Z was necessary:

The science and applications community bears many scars from the Apollo and space shuttle programs. The perception, no matter what the reality may be, is that the user community's interests were always subordinated to the more glamorous manned activities. To prevent a large outcry from that community, the space station program must have a parallel effort, separately budgeted, to support the uses of the station and its companion man-tended platforms (Lowndes, 1984, p. 151).

System Z became the Earth Observing System in 1983 and then part of NASA's Mission to Planet Earth in 1987. It was to become the centerpiece of the US Global Change Research Program in the 1990s.

System Z, referred to as a "gift" by one prominent earth scientist, appealed to many scientists for at least two reasons.¹² First, it offered scientists an opportunity to conduct simultaneous measurements of many environmental variables which, many scientists believed, would help investigators assess the complex interactions of the Earth system (Taubes, 1993). Second, some scientists believed that linkage to the space station budget would increase the chances for congressional funding of such an ambitious project. According to NASA scientist Dixon Butler, "the space station gave us optimism for the first time to think of a mission that addresses the comprehensive earth science need" (Taubes, 1993, p. 912). And Burt Edelson, former head of NASA's space science office, recalled:

We sort of cut a deal. In the face of the agency trying to start up the space station program, I could never have come up with a brand new multi-billion dollar program. It was certainly a good deal for the [space station office] because they were gaining the support of a very large and vociferous element of the national scientific community (Stevens, 1990).

Thus, many scientists lent support to the space station concept in exchange for the promise of System Z.¹³

Predictably, there was resistance in the scientific community to the trade-off. John McElroy, then NOAA assistant administrator for satellite programs, was criticized by some scientists for *not* being openly against the station. He stated that "some of my science friends have called me a traitor for even being this positive about the space station" (Lowndes 1984, p. 151). James Van Allen expressed why some scientists might consider McElroy a traitor: "The [System Z] polar platforms should not be tied to the station effort in any way — it's political fraud to fund them like that" (Covault, 1988, p. 46). However, in spite of such protests, the promise of System Z was enough to garner a critical mass of scientific support for the space station. When System Z was renamed the Earth Observing System (EOS) in 1983, NASA officials and scientists alike hoped that — likes its namesake — EOS represented the dawn of a new era for the space program (Broome, 1985).¹⁴

NASA received a positive response to its space station at UNISPACE '82; however, its "global habitability" proposal was not well received (Waldrop, 1984; Edelson, 1988). One participant at the conference said that the proposal "came across like NASA trying to take over the world."¹⁵ A NASA official later agreed that the proposal was not advanced tactfully, "NASA moved out on global habitability prematurely, without having developed a collegial understanding across the government and internationally to back it."¹⁶ The negative reaction foreshadowed conflicts to come over the structure of global change research. In spite of the negative reaction to the form of NASA's proposal, its content persisted.

In 1983 NASA reintroduced "global habitability" to the scientific community as "Earth System Science" in the form of a committee headed by Francis Bretherton, director of the National Center for Atmospheric Research in Boulder, Colorado (Edelson, 1988).¹⁷ The Earth System Science Committee was committed to

¹³ The degree to which some scientists accepted the space station in exchange for EOS is evident in a 1988 statement by a NASA project scientist for EOS. He linked NASA's "Mission to Planet Earth" with human spaceflight to Mars. "[Mission to Planet Earth] can be a stepping-stone to a joint manned Mars project. If we are going to form an international Mars mission we must start on common ground, and Mission to Earth (sic) provides that common ground" (Jerry Stoffen quoted in Covault, 1988, p. 16).

¹⁴ Eos is the name of the Greek goddess of the dawn.

¹⁵ As quoted in Edelson (1988, p. 7). A similar recounting is found in Kennedy (1992).

¹⁶ Dixon Butler quoted in Edelson (1988, p. 7).

¹⁷ According to Edelson (1988), the initiative to form the Earth System Science Committee began with Shelby Tilford, director of NASA's Earth Science and Applications division.

¹² Thomas Donohue, former chair of the NRC Space Science Board, quoted in Taubes (1993, p. 912).

avoid previous NASA mistakes in the promotion of the global habitability initiative. According to Bretherton,

From the outset, we realized that we had to look at NASA's role in a broader context than just NASA programs. NASA wasn't the only, or even the largest, agency looking at the earth. So we set up a liaison program with people from NSF and NOAA.¹⁸

NOAA had been developing a program called Climate and Global Change and NSF had a program called Global Geosciences. Each was looking at the new area of global change. Through collaboration stemming from these parallel initiatives, the three agencies — NASA, NSF, and NOAA — became the core of federal global change research in the 1980s (Bloch et al., 1987).

During the same period that the Bretherton Committee was being formed by NASA, Herbert Friedman, chair of the National Research Council Commission on Physical Sciences, Mathematics, and Resources, proposed an "international geosphere-biosphere program" to commemorate the twenty-fifth anniversary of the International Geophysical Year (Waldrop, 1984; Perry, 1991).¹⁹ Perhaps recalling the political reaction to NASA's "global habitability" proposal, John Perry of the National Academy of Sciences later suggested that "the genius of Friedman's initiative lay in its inscrutability" (Perry, 1991, p. 40). The proposed geosphere-biosphere program was defined in greater detail at another Woods Hole conference during the summer of 1983 (Perry, 1991). At this conference, participants debated whether a geosphere-biosphere program should be explicitly focused on research to advance scientific understanding, or related to policy development. Perry (1991) recalls that those favoring research supporting policy development prevailed in the debate and observes that the final report of the workshop failed to document the "spirited" debates over the two alternatives. These debates were a precursor to debate over the role of global change science in public policy making that arose with concerns over global warming later in the decade.²⁰

An outcome of the 1983 NAS workshop was the formation of a US Committee for an International Geosphere-Biosphere Program of the National Research Council (NRC, 1986). The Committee held several meetings and produced a report in 1986 which proposed the

scientific basis and orientation of an international geosphere-biosphere program. The work of the NRC committee and the Bretherton Committee (1986) laid the foundation for a series of national and international global change efforts in the international science community.²¹

The International Geosphere-Biosphere Program (IGBP) of the International Council of Scientific Unions was proposed in 1986 by an ad hoc planning group to begin in 1992 and last for 10 years (ICSU, 1986; Malone, 1986).²² The IGBP proposal was significant because it represented a consensus among scientists of many disciplines around the world on the need for a large-scale and long-term research program focused on global change. The goals and objectives of the ICSU proposal resemble very closely those of the NRC and Bretherton reports. This is understandable because several individuals served more than one committee.²³ Perry observes that "the structure of overlapping memberships in the concurrent development of scientific concepts and government program has kept this nonsinister conspiracy together very well" (Edelson, 1988, p. 10). The "nonsinister conspiracy" acted to advance the interests of scientists and the agencies. Global change science first arose more from a "push" from the bottom (i.e., scientists and administrators), than from a "pull" from the top (i.e., elected officials) of the decision-making structure.

4. Climate change becomes political

In the fall of 1985, the Senate held several hearings on the topic of global warming and climate change in response to the report of an international scientific conference held in Villach, Austria. These were the first hearings on climate change in the Senate since 1979. The House had held hearings on rising levels of atmospheric carbon dioxide under the guidance of Representative Albert Gore in 1981, 1982, and 1984. Senator David Durenberger observed presciently, in his opening statement to the December 1985 hearings on global warming, that "grappling with this problem [of climate change] is going to be

¹⁸ Bretherton quoted in Edelson (1988, p. 7).

¹⁹ The International Geophysical Year (IGY) was a scientific effort sponsored by the International Council of Scientific Unions in 1957 (Fleagle, 1992, McDougall, 1986). Several notable accomplishments of the IGY were the discovery of the Van Allen radiation belts around the Earth, efforts to launch the first western satellite, and the initiation of sustained efforts to monitor the concentrations of carbon dioxide in the Earth's atmosphere.

²⁰ The debate at the Woods Hole workshop is documented also in Kennedy (1992).

²¹ NRC (1990a) documents many of these efforts, including those of the National Academy of Engineering, Social Science Research Council, International Federation of Institutes for Advanced Study, United Nations University, United Nations Educational, Scientific, and Cultural Organization, European Science Foundation, and the International Institute for Applied Systems Analysis.

²² Another important international scientific effort that contributed to climate change research was the World Climate Research Program.

²³ For example, John Eddy, chair of the NRC US Committee for an IGBP, was also a member the ICSU Ad Hoc Planning Group on Global Change, and was the National Center for Atmospheric Research's liaison to the Bretherton Committee. Other influential players had similar concurrent relationships. Compare participants listed in NRC (1986), NASA (1986), and ICSU (1986).

just about as easy as nailing jello to the wall” (SCEPW, 1986a, p. 1).

More members of Congress became interested in climate change following Senate hearings of June 1986. In these hearings a NASA scientist, Robert Watson, testified that “I believe global warming is inevitable. It is only a question of the magnitude and the timing” (SCEPW, 1986b, p. 22). The statement was picked up by major papers such as the *New York Times* and *Washington Post* briefly elevating what had been a relatively obscure scientific topic to national prominence. Administration officials testified before the Senate committee the next day. In general, the officials from EPA, Commerce, NASA, State, and Energy tried to downplay the significance of Watson’s comments, which only served to bring them into sharper relief. Following the testimony of the administration officials Senator John Chafee summarized the hearings as follows: “It was the scientists yesterday who sounded the alarm, and it was the politicians, or the government witnesses, who put the damper on it” (SCEPW, 1986b, pp. 183–184). Chafee’s comments were an accurate characterization of the developing relationship between many in Congress who sought to heed the scientists’ alarm and those in the executive branch who tried to dampen it.

Although press attention to climate change in 1986 was characteristically short-lived, the hearings had piqued the interest of a number of policymakers. For example, Senator Patrick Leahy (D-VT) wrote NASA Administrator James Fletcher several weeks after Watson’s testimony, expressing his interest that NASA work closely with NOAA and NSF to coordinate research on climate change (Leahy, 1986). An effect of Watson’s comments was to shore up congressional support for the research proposed by NASA’s Earth System Science Committee, presented by NASA before Senator Leahy and the rest of NASA’s Senate Appropriating Committee less than two weeks after Watson’s testimony.²⁴

5. Creation of the committee on earth sciences

In the months following Watson’s testimony a White House Domestic Policy Council working group on

climate change was formed, headed by NOAA Administrator Anthony Calio (Kennedy, 1992a). A former Calio aide recalled that “this is not the way Reagan asked the question, but the question [posed to the DPC group] was basically ‘Is there anything to this climate change issue, and if there is, what am I, as President of the United States, supposed to do about it?’” (IA, 1994). Participation in the working group presented Calio with an opportunity to reverse NOAA’s fortunes with the Reagan Administration (Kennedy, 1992a). The success of NASA’s Earth System Science proposals caught the attention of NOAA leadership. According to one participant

[Earth System Science], to a lot of us, was typical NASA. Damned if they hadn’t figured out what was going to be hot, and there it was. And [NOAA’s] Mike [Hall] knew that it was time to build a [new] climate program at NOAA, that if we didn’t get on board as a visible, high-profile player, NASA and NSF would run off with the program (Kennedy, 1992a, p. 9).

The DPC working group, which existed for less than six months, brought Calio into close contact with White House science advisor William Graham, giving him an opportunity to sell NOAA as a home for climate change research.

The warnings of potential global warming by the national and international scientific communities had not gone unnoticed by the Office of Management and Budget. OMB was not concerned with climate change per se, but that policy responses that might be enacted in response to the scientists’ warnings of climate change could negatively affect the economy (Kennedy, 1992a). Norm Hartness, an OMB economist, recalled that “The general tenor was ‘the sky is falling.’ People abroad and in our domestic scene had some crazy ideas about how serious this was and how quickly we should do something about it” (Kennedy, 1992a, p. 11). Jack Fellows, who focused on science budgets for OMB, used the Bretherton Report framework to classify agency funding for global change in order to get a rough approximation of funds going to global change science in the total budget. He discovered that the disparate science programs totaled over \$1 billion (Kennedy, 1992a). Fellows later recalled his surprise at the large total, “I was floored, actually. But, I talked to some higher ups at OMB and said, ‘You know, this could probably be spent in a better fashion than it’s currently being spent’” (Kennedy, 1992a, p. 11). Thus, OMB lent its support to the idea of a global change program in order to better coordinate and better focus the decentralized research.

Consequently, when NOAA’s Calio presented a proposal to coordinate global change research to Science Advisor Graham, the political atmosphere in the

²⁴ Evidence for such support is found in Leahy’s (1986) letter to Fletcher when Leahy linked Watson’s testimony with the Earth System Science Committee and his desire to see NASA pursue and “aggressive research program to ensure that our decision makers have the information that they need to develop timely policies to protect the planet”. Because Watson’s written comments differed significantly from his spoken comments, the long lead time between scheduling of hearing and the lack of communication between Congressional committees it is unlikely that Watson’s comments were intended to influence the appropriations hearings two weeks following. Nevertheless, NASA did benefit from the series of events beginning with Watson’s testimony.

administration fostered its acceptance.²⁵ According to Fellows, “All of a sudden, Graham decided that there would be a committee. It just came together” (Kennedy, 1992a, p. 12). Graham proposed that the Federal Coordinating Council on Science, Engineering, and Technology (FCCSET, pronounced “fix-it”) mechanism of the Office of Science and Technology Policy coordinate global change research. FCCSET had been largely neglected in favor of other coordinating in the executive branch mechanisms, such as the cabinet-level Domestic Policy Council (Sun, 1984, Knezo, 1989). It is understandable, then, that there was little, if any, Congressional interest when in March, 1987 Graham formed the Committee on Earth Sciences within the FCCSET structure with NOAA’s Calio as chair. The Committee’s Charter described its purpose

to increase the overall effectiveness and productivity of Federal R & D efforts directed toward an understanding of the Earth as a global system. In fulfilling this purpose, the Committee addresses significant national policy matters which cut across agency boundaries (CES, 1987).

The mandate emphasized coordination of research and development in the earth sciences over clarification or consideration of policy issues related to global change.

Meanwhile, some members of Congress had been trying to organize the agencies to develop alternative policies to deal with climate change. The Global Climate Protection Act of 1987 (P.L. 100-204) was enacted in December 1987 after numerous congressional hearings during the year (GAO, 1990). The Act gave authority for development of climate change policy to the Environmental Protection Agency and the State Department. The Reagan Administration opposed (but signed) the legislation, arguing that the White House Office of Science and Technology Policy was responsible for interagency coordination of science issues and that the law would interfere with existing policy mechanisms (GAO, 1990). The Reagan Administration (and later Bush) used such tactics (i.e., formal acceptance but actual opposition) to effectively thwart the intent of the Global Climate Protection Act by retaining control over climate change policy at the highest levels (GAO, 1990). As congressional efforts to organize the agencies to help the legislative branch to develop policies in response to climate change were being frustrated by the Reagan Administration, the Committee on Earth Sciences

began to organize climate change research in the federal agencies.

6. Development of the Global Change Research Program

6.1. *The Committee on Earth Sciences and Budgetary Coordination*

In spite of the Committee’s stated purpose, different participants had different expectations about its role in the policy making process. Within OSTP, Science Advisor Graham saw the Committee as a mechanism which could reinvigorate the FCCSET process, which since its creation in 1976 had played little role in science policy. Federal agencies saw the Committee as a lead towards securing increased federal funding for earth sciences, while the OMB viewed it as a source of intelligence on the distribution and amount of federal funding for the earth sciences, which were diffused through many different federal agencies. Some agency representatives to the Committee, including its chair, saw it as the Reagan Administration’s central science and policy coordinating body on issues of climate change. These different perspectives clashed at the Committee’s first meeting in April 1987.

The first meeting of the Committee on Earth Sciences was a “disaster”.²⁶ At the meeting Calio presented his view that the Committee would coordinate federal global change science and policy responses. A new organizational entity to staff the Committee, such as a secretariat, was required in order to fulfil Calio’s vision. One participant recalled that Calio’s

proposal seemed to build an empire, then figure out something for it to do. The group just didn’t see a program large enough to justify that, particularly since the agencies knew they’d have to come up with the money [to support the proposed staff secretariat].²⁷

The NSF representative to the committee interpreted Calio’s proposal to encroach somewhat on the Foundation’s “turf”, which traditionally had been to plan and prioritize a large portfolio of research. The OMB representative rendered the argument moot when he declared

²⁵ According to Kennedy (1992a) several science administrators, including Robert Corell of NSF and Shelby Tilford of NASA, had been engaged in discussions with Fellows at OMB and OSTP staff about the coordination of global change science. Hence, Calio’s proposal represented a convergence of opinion. In other words, the “nonsinister conspiracy” had gone political.

²⁶ Quoted in Kennedy (1992a, p. 12). The events of the first meeting were related to the author in interviews with several participants. The most comprehensive published recounting of the first CES meeting is found in Kennedy (1992a, b). Other evidence in the public record is found, for example, in references to a “rocky start”, Perry quoted in Edelson (1988, p. 11), and Corell (1990) dates the Committee’s beginning to its second meeting. The CEES secretariat informed the author that the minutes of the first meeting are “unavailable”; all other meeting minutes are available.

²⁷ Anonymous participant at first CES meeting quoted in Kennedy (1992a, p. 12).

that the Budget Office would not allow the Committee to develop a program simply to increase earth sciences funding. One participant described the meeting as follows.

The combination of three things made the meeting very tense and emotional: The antagonism between some of the players, the anger that anything in FCCSET would have anything to do with policy, and then being told [by OMB] that there's no reason to be here anyway because we're not going to give you any money. [In response] Calio basically said, "Okay, it's over. We tried. It's over" (Kennedy, 1992b, p. 2).

Another participant recalled the meeting in more graphic terms: "It was a feeding frenzy in a shark tank with Calio as the chum" (IA, 1994).

Calio resigned from government before the Committee regrouped for a second try. Science Advisor Graham recalled that despite the tone of the first meeting "I didn't have any sense of failure. I didn't have enormous aspirations for the group, particularly, either, but [the first meeting] started the process. People were still talking to each other" (Kennedy, 1992b, p. 2). The people still talking together included the representatives from NASA, NOAA, and NSF who had a continuing interest in organizing a global change effort. The continuing interests of the three agencies following the first meeting are documented in a letter from the directors of the three agencies to the director of OMB (Bloch et al., 1987). According to one participant this letter was instrumental in keeping the Committee together following the lack of progress in its first meeting (IA, 1994). It was during this period that NASA, NSF, and NOAA developed parallel global change initiatives: NASA developed the Earth System Science Program, NSF developed the Global Geosciences Program, and NOAA developed the Climate and Global Change Program. Moreover, for budgetary reasons, OMB was still interested in organizing earth sciences research in the federal agencies.

Graham appointed Dallas Peck, director of the US Geological Survey within the Department of Interior, to replace Calio as the Committee's chair, before it met for a second time in December 1987. This time, the meeting was "smooth as could be".²⁸ Prior to the meeting Peck had met individually with most agency representatives to the Committee to determine what roles for the Committee each thought acceptable and unacceptable.²⁹ One attendee recalled that participants had been "greased" ahead of time by Peck so that the second meeting was a "love-in" (IA, 1994). At the second meeting the Com-

mittee established a staff working group to do the bulk of its work, and various agencies and the OMB voiced their different views of the role that the Committee would play. Not surprisingly, the views of agency officials were consistent with the missions of their home institutions: OMB stressed the need for data on current and projected earth sciences funding, NOAA emphasized environmental policy planning, and the State Department stated that policy issues and decisions should be the concern of the president's Domestic Policy Council (where it had more influence). Such concerns limited the role of the Committee to coordination of science budgets, constrained by existing agency turf. The Committee delegated to its Staff Working Group the task of proposing how to describe and achieve a federal global change program by the next meeting.

The global change program began as a multi-agency budget summary, or crosscut. A budget crosscut is a funding table organized in two dimensions: by agency and by discipline (or program). Typically, agencies kept budget numbers and projections to themselves because control of such information is a valuable resource in budget negotiations with Congress and the OMB. OMB participation in the crosscut held the promise of budget increases, and this ensured that each agency's budget figures would be released to the budget office. According to a former executive secretary of the Committee, OMB coerced cooperation by promising funding in return for the budget crosscut:

[OMB said] the administration is so eager to come out with some kind of statement as to what we're doing nationally in response to global change, we'll get [the statement] released at the same time as the president's budget. Well, you know, such visibility. We have to meet this challenge.³⁰

The Committee developed budget crosscuts for FY 1989 and FY 1990.³¹

The Staff Working Group spent much of 1988 developing the first budget crosscut. The task was difficult because many agencies were unsure about how a global change program would be politically received, because under the Reagan Administration the "environment" was not a favored policy issue. Hence, some in the agencies worried about a negative political reaction to a global change program. A participant recalled that

The agencies were hesitant. They wanted to show that they were players, so they had to show something, but

²⁸ Ray Watts, of the USGS, quoted in Kennedy (1992b, p. 3).

²⁹ The material on the second meeting is drawn from interviews by the author with participants, CES (1988) meeting minutes, and Kennedy (1992b).

³⁰ Paul Dresler quoted in Kennedy (1992b, p. 6)

³¹ CEES and its successor have continued to produce budget crosscuts. They are published annually as the *Our Changing Planet Series* ((CEES, 1989–1993, CENR, 1995–1997). See them on the Web at <http://www.usgcrp.gov/usgcrp/RECDOCS.html>

Table 3
Fiscal year 1989 USGCRP budget crosscut by agency

Agency	USGCRP FY 1989 Budget (\$ in millions)			
	Focused	Contributing	Total	Focused/total
DOC	9.0	442.1	451.1	0.02
DOD	0.0	45.7	45.7	0.00
DOE	20.2	46.5	66.7	0.30
DOI	5.3	210.9	216.2	0.02
EPA	27.4	70.0	97.4	0.28
NASA	14.5	399.2	413.7	0.04
NSF	39.2	112.4	151.6	0.26
USDA	18.3	149.4	167.7	0.11
Total	133.9	1476.2	1610.9	0.08

they certainly didn't want to show it all, because that's where you're vulnerable. You're putting your budget on the line, and nobody knows where this is going. This is brand new. So most agencies thought, we can risk a certain level; then we'll still survive if for some reason the dagger comes out after it's out on the table.³²

In a creative move that would allow agencies to show support for the initiative, yet minimize their budgetary risk, the Committee created two budget categories: The *focused* global change budget consisted of programs explicitly addressing global change. The *contributing* global change budget consisted of programs that were in some way relevant to global change. Each agency was allowed to define what was focused and what was contributing.

Table 3 shows the first budget crosscut. Of the crosscut total, about 70% was money for existing programs (OTA, 1993a, p. 18). Thus, when an agency contributed funds to the crosscut process they were risking "base" (i.e., "money in the bank") funding in addition to proposed new funding. About \$134 million, 8% of the crosscut total, was classified as focused. The large ratio of contributing to focused budget elements indicates agency concerns about how the program would be received: If the program was politically unsuccessful, then each agency could argue that the bulk of its earth sciences research was for a purpose other than global change and thereby mitigate any long-term political damage. For instance, in the first cross-cut NASA refused to classify its proposed Earth Observing System program budget as focused, although the program was to be the centerpiece

of a Global Change Program. The crosscut was released in January 1989 with the President's Fiscal Year 1990 budget in a report entitled *Our Changing Planet: A Strategy for US global change research*.

The Committee was able to conduct its first crosscut in relative obscurity. In the spring of 1988 global warming had yet to fully emerge on the public stage, and in the political arena it was still overshadowed by other environmental concerns such as acid rain and ozone depletion. However, change occurred rapidly following the congressional testimony by NASA scientist James Hansen who testified before a Senate Committee that global warming was under way (SCENR, 1988). While Hansen's statement was very similar in substance to Robert Watson's two years earlier, the political and physical context that framed the statement had changed significantly. Congress had slowly become more aware of the global warming issue through hearings, legislation, and dealings with the President over the previous two years. In addition, the summer of 1988 was extremely hot in the United States and the Midwest was experiencing a severe drought. Later that summer Yellowstone experienced its largest forest fires on record, and in September, one of the most powerful hurricanes of the century, Hurricane Gilbert, heavily damaged Cancun and the northeastern coast of Mexico. These weather events were linked to global warming in the press, and thus certainly added momentum to Hansen's warning (Ungar, 1999). In contrast, Watson's statement of two years before had little staying power.

OMB was the primary beneficiary of the first crosscut because it provided heretofore unavailable comprehensive budget data on the earth sciences community in the federal agencies. However, in order to better make difficult budget choices, OMB needed to prioritize the crosscut data. The agencies had yet to see any benefits because it was still unclear whether the visibility that came along with the report would result in budget cuts or increases. Early in 1989 the Committee had no formal role in the budget process: budgets were determined through each agency's individual negotiations with OMB. For the agencies, the true test of the value of the proposed program would come with the second crosscut for fiscal year 1990.

As the 1990 budget process gathered steam in 1989 OMB asked the Committee to prioritize its crosscut by discipline (or program) in return for a promise of new funding for the earth sciences. A former executive secretary of the Committee recalled how OMB exchanged classification of the program as the first "Presidential Initiative" in return for the list of priorities within the earth sciences, "OMB came back to us and said, 'Well, gee, you guys did a great job. This is fine. Nice work. But we need more'... The agencies were saying 'Presidential Initiative. New money. They're serious; we're going to

³² Dresler in Kennedy (1992b, p. 6).

put some extra effort into this.”³³ As a result, the Committee, in collaboration with the National Academy of Sciences Committee on Global Change, produced what came to be known as the “tombstone” chart, so called because of the shape of the tables and because the lower priority items on the chart would be the first to be cut or “killed” in tight budgets. Hence, each box of priorities is a potential tombstone. Research elements are further prioritized within each of the seven science priorities.

The OMB, armed with comprehensive budget data on and a list of priorities in the earth sciences developed through agency collaboration, next gave the Committee an opportunity to participate formally in the budget process. OMB requested that the agencies submit their global change research budget requests directly to the Committee so that it could prepare five alternative program compositions to meet five different levels of funding provided by the Administration. OMB would then use the Committee’s recommendations as a template for earth sciences funding. The Staff Working Group decided that it made political sense to leave existing projects alone, so as not to antagonize the agencies, and thus decided to adjust the budget within each of the five alternatives by approving or rejecting proposed new projects. In this manner, the Committee had taken on the role of a “virtual” budget examiner, and was, in effect, doing some of OMB’s work for them.³⁴ In exchange, a Global Change Research Program was taking shape.

The addition of NASA’s Earth Observing System to the focused part of the Global Change Research Program was the most important change from the first to the second budget crosscut. Table 4 shows the second crosscut as it was presented in July 1989 and in October 1990. NASA’s focused element of the program changed from \$21.5 million in July 1989 to \$488.6 million in October 1990. Meanwhile, NASA’s contributing element of the program decreased from \$412.6 million to \$24.7 million. The symmetrical changes in budget categories indicate that NASA redefined the EOS program as directly supportive of the goals of the Program. NASA was on board, yet the substance of neither EOS nor the global change program had changed.³⁵

Table 4
Fiscal year 1989 USGCRP budget crosscut by agency

Agency	USGCRP FY 1989 Budget (\$ in millions)					
	Focused		Contributing		Total	
	(7/89)	(10/90)	(7/89)	(10/90)	(7/89)	(10/90)
DOC	20.0	18.0	382.8	265.7	402.8	283.7
DOD	0.0	0.0	32.3	31.2	32.3	31.2
DOE	27.2	50.0	46.5	39.3	73.7	89.3
DOI	11.3	13.3	204.5	225.1	215.8	238.4
EPA	35.3	13.2	58.9	83.3	94.2	96.5
NASA	21.5	488.6	412.6	24.7	434.1	509.3
NSF	53.5	55.0	120.0	124.2	173.5	179.2
USDA	22.7	21.2	154.2	25.4	176.9	46.6
Total	191.5	659.3	1412	818.9	1603	1478.2

6.2. Climate change policy in the Bush White House ...

President George Bush came into the White House in 1989 after raising expectations during his campaign for action on climate change, claiming that he would counter the greenhouse effect with the “White House effect”. Upon entering office in January, 1989 President Bush initially attempted to deal with the increasingly visible issue of climate change through his own Domestic Policy Council working group on energy, environment, and natural resources. According to Nitze (1991, p. 13), that group failed to develop policy alternatives, in part, because of a struggle “between national security and domestic policy elements of the White House staff”.

Political missteps by the Bush Administration during 1989 and 1990 helped to keep climate change in the headlines. For example, in May, 1989 NASA scientist James Hansen once again made headlines when he accused the OMB of altering testimony which he was to give before the House Science Committee (Shabecoff, 1989b, c).³⁶ Two days later, in an effort to quell criticism, President Bush announced that he would convene an international meeting on global warming in the fall of 1989, which ensured that global warming would remain a high-level issue for at least another six months (Shabecoff, 1989d). Other events which served to keep the media and Congress focused on climate change include the Paris Economic Summit of June, 1989 and a rift in the Bush Cabinet over climate change that became public prior to the fall conference which, ironically, Bush had called to reduce controversy (SCFR, 1989; Gold, 1989). In addition, the Exxon Valdez oil spill in Prince William Sound in March, 1989, while unrelated to climate change,

³³ Dresler in Kennedy (1992b, pp. 7–8).

³⁴ A budget examiner works for OMB and is responsible for accounting for federal spending within a particular part of the budget, called a budget function. The examiner is responsible for compiling agency requests and needs. Thus, from OMB’s perspective the CES was created, in effect, to fulfill the role of a budget examiner.

³⁵ It is unclear whether the increase in the NASA total is related in any way. In addition, the contributing element of the Commerce Department and the focused USDA element changed significantly between the two versions of the second cross-cut. It is unclear why these changes occurred.

³⁶ Response of climate change scientists to Hansen is found in Kerr (1989).

helped keep attention on the environment. Such events and missteps seemed to haunt the Bush Administration and served to keep the media and Congress focused on climate change.

To coordinate climate change policy development, President Bush created, in early 1989, a National Security Council Policy Coordinating Committee on Oceans, Environment and Science chaired by Frederick Bernthal, an assistant secretary of state (Nitze, 1991; SCFR, 1989). The line of authority ran from Bernthal through the Secretary of State, James Baker, and the National Security Advisor, Brent Skowcroft, to the President. The relatively low position of the Bernthal Committee limited its ability to shape policy, leaving effective control of climate change policy to high-ranking administration officials. The Bernthal committee, with putative authority for policy development related to climate change, had no formal connection to the Committee on Earth Sciences (GAO, 1990). Consequently, the science and policy of climate change were poorly linked at this time.

6.3. ... and congressional frustrations

For those members of Congress who dealt with climate change, the convoluted organization of the climate change policy making structure in the executive branch was often baffling. A line of questioning pursued by Senator Paul Sarbanes (D-MD) of William Reilly, EPA administrator, and Frederick Bernthal during a hearing before the Committee on Foreign Relations following the Paris Economic Summit, where climate change played an important role, is representative of Congressional frustrations in attempts to understand executive branch organization (SCFR, 1989, pp. 29–30).

Sen. Sarbanes: Is there going to be an environmental action task force to try to implement the [Paris economic] communiqué's provisions on the environment?

Mr. Reilly: Secretary [James] Baker, Governor [John] Sununu, and I had a conversation with the President on Air Force One...in which we were agreed upon the need to give this a very high and urgent priority in the coming weeks. There was no decision to have a task force to address it, however. We have tended to operate on this either through the Domestic Policy Council or through conversations with various of the agencies affected on a specific part of the problem.

Sen Sarbanes: Who is the responsible person [for international environmental policy] within our Government?

Mr. Reilly: Well, the President.

Senator Sarbanes had no more luck with Frederick Bernthal, the next witness (SCFR, 1989, p. 45).

Sen. Sarbanes: Who do you consider the responsible person Government-wide to be for following through on the environmental portion of the summit agenda — other than the President of the United States who I understand is the responsible person for everything?

Mr. Bernthal: I do not think I can point to a single responsible person.

Senator Sarbanes may not have realized it at the time, but with the advantage of hindsight it is clear that EPA Administrator William Reilly answered his question in his first sentence: policy development with respect to climate change was controlled by the President and a close circle of advisors, and not through a formal organizational mechanism.³⁷ According to Nitze (1991, p. 31), the Bernthal Committee had little impact on policy development and coordination because it had to send its proposals through National Security Advisor Brent Skowcroft, who had “little interest”, and Chief of Staff John Sununu and OMB Director Richard Darman, who were opposed to any policies in response to threats of climate change.

Even the committee that funds the White House Office of Policy Development (OPD) showed signs of befuddlement when it came to the development of policy in the Bush Administration. In hearings on the 1991 budget, the Chair of the House Subcommittee on Treasury, Postal Service, and Government Appropriations asked a White House representative “Do you [the OPD] recommend policy?... Do you coordinate it?... Does debate take place?... what I am trying to get this for is a picture of what takes place” (HCA, 1990, pp. 99–100). In general, Congress had little idea how the Bush administration operated, and in the case of climate change was growing increasingly frustrated.

Bernthal, in addition to being chair of the State Department committee, was also chairman of the policy response working group of the Intergovernmental Panel on Climate Change (IPCC) (Houghton et al., 1990). While the IPCC is an international group, the lines of authority from Bernthal's perspective were identical to those he faced from his position as chair of the coordinating committee within the State Department. Hence, in both national and international contexts the formal climate change policy structure of the executive branch was effectively controlled by a small group of close presidential advisors.³⁸

³⁷ See also the exchange between Senator John Kerry (D-MA) and Fredrick Bernthal in SCCST (1989a, b, pp. 61–63).

³⁸ See also Gabriel (1989) and Roberts (1989).

Congressional frustration over the Administration's apparent lack of coordination and inaction on the climate change issue resulted in a request to General Accounting Office to determine what, exactly, the federal government was doing to organize and respond to the threats of climate change. The GAO confirmed in a January 1990 report that the Administration was, in fact, taking very little action on climate change (GAO, 1990). In the dry prose of the General Accounting Office, "Administration approach cautious pending validation of threat". Interestingly, the GAO itself appears to have had difficulty wading through the byzantine executive branch structure, as it presented an incomplete overview of the Administration's climate change policy organization in that it failed to explicitly consider the policy role of the Bernthal Committee within the State Department. As is typical under the division of labor in Congress, fragmentation created significant obstacles to Congress' ability to compel and coordinate the various agencies involved with global change to assist in the development of policy alternatives. According to one observer, was "like putting Humpty Dumpty together again".³⁹

Congressional frustration intensified as the Bush Administration emphasized research over other action as the center-piece of its "no regrets" strategy (Vig, 1994; Shabecoff, 1989a, b; GAO, 1990; Roberts, 1989; Gabriel, 1989).⁴⁰ Interestingly, the phrase "no regrets" was initially used by Bush during his 1988 campaign as a phrase to justify certain types of policy action in response to climate change, but by 1990 "no regrets" was used to justify inaction (Shabecoff, 1989a). The most complete presentation of "no regrets" from the Bush Administration's perspective is an article by EPA Administrator Reilly (1990). As a result of Congressional frustration and inability to compel the Bush Administration to respond to climate change, in the late 1980s Congress looked for new ways to increase pressures on the Administration to coordinate policy development with respect to climate change.

7. Conclusion to Part I

Thanks to the efforts of the Committee on Earth Sciences, Congress had available a complete budgetary picture of global change research and access to a coordinating body which could, in principle, be used to aid Congress in the development of policy responses to climate change. However, the Committee was heretofore

used within the executive branch only to coordinate the budgets of agencies that conducted global change science, and had little (if any) responsibility for consideration of policy issues. Congress would have to change the Committee's mandate — to adapt it to its own purposes — if the Committee was to go beyond coordination of agency budgets. That is exactly what happened over the next two years with the passage of the bill leading to the Global Change Research Act of 1990 (Public Law 101-606).

Part II of this paper will appear in the next issue of *Global Environmental Change*.

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³⁹ Irwin Goodwin, of *Physics Today*, in an interview with Bush Science Advisor D. Allan Bromley quoted in Anon (1993, p. 54).

⁴⁰ See also the discussion between Michael Boskin, chairman of the president's Council of Economic Advisors and Representative James H. Scheuer (D-NY) in JEC (1990).

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The U.S. Global Change Research Program (USGCRP) was established in law in 1990 (P.L. 101â€“606) with a mandate to provide policymakers with usable information. The law gave a White House Committee on Earth and Environmental Sciences (CEES) responsibility to implement the program with respect to its policy mandate. In 1994 CEES was replaced, in part, because it failed to provide usable information.Â In particular, we examine the policy process in the United States and its relation to the international policy process.Â Finally, we draw on our personal experiences to highlight some of the key individual characteristics and values that are needed to operate more effectively at the interface of science, policy and practice. The U.S. Global Change Research Program (USGCRP) is a Federal program mandated by Congress to coordinate Federal research and investments in understanding the forces shaping the global environment, both human and natural, and their impacts on society. USGCRP facilitates collaboration and cooperation across its 13 Federal member agencies to advance understanding of the changing Earth system and maximize efficiencies in Federal global change research.Â USGCRP conducts state-of-the-art research to understand the interactive processes that influence the total Earth system and how they impact society. Policy history of the US Global Change Research Program: Part I. Administrative development. *Global Environmental Change* 10(1):9â€“25. Page 43 Share Cite. Suggested Citation: "References." National Academies of Sciences, Engineering, and Medicine. 2017. Accomplishments of the U.S. Global Change Research Program. Washington, DC: The National Academies Press. doi: 10.17226/24670. —.Â USGCRP (U.S. Global Change Research Program). 2001a. High-End Climate Science: Development of Modeling and Related Computing Capabilities. Washington, DC: USGCRP. USGCRP.