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Blurring the Boundaries

Domestic and International Ozone Politics and Lessons for Climate Change

MICHELE M. BETSILL AND
ROGER A. PIELKE, JR.

Introduction

Over the past decade, the threat of global climate change has stimulated numerous international responses. In 1988, the United Nations established the Intergovernmental Panel on Climate Change (IPCC), an international scientific body devoted to the study of the problem, and more than 150 countries signed the Framework Convention on Climate Change (FCCC) in 1992. The FCCC was amended by the Kyoto Protocol in December 1997. These policy responses have been based in large part on the precedent of stratospheric ozone depletion. Scholars and practitioners alike widely cite the ozone case as one of the few true success stories in the realm of international environmental politics: an example of how sovereign states can effectively work together to address a global environmental problem.[1] Many observers have used the ozone case as an analogy from which to draw lessons that can be applied to other international environmental concerns, including global climate change.

Conventional wisdom of the ozone case can be summarized in terms of four lessons. The first lesson is that there must be a scientific consensus on the nature of the problem, its causes, and its impacts. The second lesson concerns the importance of a strong lead actor in the international policy process. The third

Michele M. Betsill: Department of Political Science, University of Colorado.
Roger A. Pielke, Jr.: Environmental and Societal Impacts Group, National Center for Atmospheric Research, Boulder.

lesson is that industry groups should play a major role in forging international policy responses. The fourth lesson suggests that a "crisis," such as the discovery of the ozone hole, is necessary to catalyze international action. Most of these lessons have been drawn by international relations scholars who tend to focus on actors operating at the level of the international system.

In this article, we re-examine the conventional wisdom of the ozone case by focusing on the process of national and international decision making. In particular, we examine the policy process in the United States and its relation to the international policy process.[2] In so doing, we call into question the four lessons traditionally drawn from the ozone case and challenge their application to the case of global climate change. We also find that a focus on decision process blurs the boundary between domestic and international politics, which is often used as an analytical stopping point in the study of international relations. Based on our analysis, we suggest several revised lessons of the ozone case that appear more appropriate for the case of global climate change.

Lessons from the Ozone Depletion Issue

Four lessons are typically drawn from the ozone experience and applied to the case of climate change. The first lesson is that a scientific consensus on the nature of the problem is a prerequisite for action. Several scholars have noted that by the mid-1980s, scientists generally agreed on the nature of the problem of ozone depletion, its causes, and its potential impacts.[3] An example of this consensus is a 1986 report entitled *Atmospheric Ozone 1985* (the "NASA report"), in which a team of 150 scientists from around the industrialized world concluded that continued release of chlorofluorocarbons (CFCs) at 1980 levels could reduce stratospheric ozone concentrations between 4 and 9 percent by the year 2050.[4]

Several analysts identify the NASA report as having a significant impact in shaping the content of the Montreal Protocol on Substances that Deplete the Ozone Layer, which was signed by twenty-eight countries in 1987. Peter Morrisette argues that the report prompted a new sense of urgency in the need to address the depletion of the ozone layer. Sharon Roan observes that this report was the first to present specific evidence of the negative impacts of CFCs on the ozone layer, the first to predict future destruction, and the first to link the issue of ozone protection to the larger issue of global warming. The NASA report clearly called for a global response to the ozone issue. In addition, Richard Benedick, head of the U.S. delegation in the Montreal Protocol negotiations, suggests that the NASA report represented emerging scientific consensus on the nature and severity of ozone depletion.[5]

In addition to forging a consensus, Peter Haas has argued that scientists were instrumental in bringing the problem of ozone depletion to the attention of national decision makers.[6] He contends that ozone scientists formed an

"epistemic community"—a "specific community of experts sharing a belief in a common set of cause-and-effect relationships as well as common values to which policies governing these relationships will be applied."[7] In the case of ozone depletion, he argues that members of this community were in a position to interpret information for policy makers, thus guiding policy decisions.[8]

The resultant lesson is that scientific consensus motivated the international community to join together to enact strong measures to protect the ozone layer. This lesson has prompted calls for the IPCC to forge a scientific consensus on the issue of climate change. Scientists have also played an important role in support of the negotiations of the FCCC and the Kyoto Protocol.

A second lesson is the necessity for leadership from a strong actor; in the ozone case it was the United States. Haas argues that the "rapid adoption of the Montreal Protocol was the consequence of extensive pressure applied by the U.S. at international negotiations."[9] Likewise, Richard Benedick credits skillful diplomatic negotiations led by the U.S. An inherent assumption is that the U.S. served as a hegemon and was able to facilitate international cooperation by providing incentives for states to cooperate, controlling how the costs and benefits of cooperation were distributed, and preventing states from cheating. This lesson has led to calls that the U.S. be the lead actor in the climate change arena.[10] Without U.S. leadership, international cooperation on global climate change is assumed to be less likely.

A third lesson of the ozone story focuses on cooperation from the industrial CFC production and consumption community. In 1986, DuPont, the world's leading producer of CFCs, announced that it would begin to phase out CFC production and begin to develop alternatives.[11] Around that same time, the Alliance for Responsible CFC Policy, an industry group representing five hundred CFC users and producers, announced its support for global limits on the growth of CFC production.[12] Some analysts suggest that the Montreal Protocol could not have been agreed upon in the first place without such support.[13] This support and the promise of alternatives reduced uncertainty about the political and economic feasibility of reducing CFC emissions and thus diminished the risk of international cooperation. The resultant lesson for climate change is that industry representatives, especially coal and petroleum producers, should be brought into international negotiations to limit greenhouse gases.

The fourth common lesson drawn from the success of international cooperation on ozone depletion is related to the discovery of a "hole" in the stratospheric ozone layer, first mentioned in 1985.[14] Peter Morrisette contends that the ozone hole and the public concern it generated served to establish the political will for states to act. Likewise, Sheldon Ungar argues that the discourse of the ozone hole created a social scare and a sense of public urgency in the need to address the problem of ozone depletion. William Lambright suggests that the ozone hole served to re-engage the U.S. as an actor in the international policy process.[15] When applied to the climate change case, this lesson suggests

that effective international action is unlikely until the point at which a similar "crisis" appears in the public eye.

International Relations Theory and International Cooperation on Ozone Depletion

These four lessons have been drawn primarily by international relations scholars, who tend to examine actors operating at the systemic level and to relate their behavior to international outcomes. Theories such as neorealism and regime theory explain international cooperation in terms of actions that take place only at the system level, while often ignoring the importance of factors at other levels of analysis, such as the level of the nation-state.[16] As we argue below, neorealism and regime theory fail to adequately explain international cooperation on ozone depletion precisely because they neglect the process by which international policy is shaped and the role of domestic politics in that process.[17]

One strand of neorealism focuses on the role of a hegemon (in the ozone case, the U.S.) and its ability to shape the nature of international cooperation.[18] A hegemon is believed to be necessary to overcome states' concerns about the distribution of the costs and benefits of cooperation and concerns that some states will cheat. Uneven distribution of costs and benefits could upset the established balance of power in the international system (which neorealists assume is necessary to maintain peace) and threaten individual states concerned with their power relative to their neighbors.[19] A neorealist explanation of international cooperation on the problem of ozone depletion pinpoints U.S. leadership as the primary factor leading to cooperation. This explanation assumes that the U.S. was able to coerce states into cooperating by making and enforcing rules and to structure the situation so as to achieve more favorable gains for itself.

A fundamental flaw with this explanation is that the U.S. did not assume a leadership position on the issue of ozone depletion until 1986 (the year after the first international ozone agreement—the Vienna Convention on Protection of the Ozone Layer—was signed).[20] In addition, during negotiations of the 1987 Montreal Protocol, the U.S. was forced to accept fewer benefits compared to members of the European Community (which were allowed to implement the proposed cuts in CFC production as a regional block, thereby enabling some countries to maintain higher levels of production) and the Soviet Union (which was permitted to complete construction of additional CFC-producing facilities before establishing its baseline production levels).[21] The Protocol gave U.S. companies much less flexibility in reducing CFC use and production than their European and Soviet competitors. In other words, the hegemon was forced to accept a distribution of the costs and benefits of

international cooperation on ozone depletion that left it with a relative disadvantage. This is inconsistent with neorealist expectations.

Regime theorists explain that international cooperation occurs within a framework of "principles, norms, rules, and decision-making procedures around which actor expectations converge in a given issue area."[22] Regimes constrain behavior and generate opportunities for action by defining expectations of acceptable behavior for pursuing state interests. Regime theorists differ from neorealists in that they assume that states may in some instances be more concerned with the absolute gains derived from international cooperation. Regimes facilitate this cooperation by reducing transaction costs (the costs incurred over and above the provision of the collective good) and by providing information, especially that which ensures that cheaters will be detected.[23] A regime theorist's explanation of international cooperation on ozone depletion would claim that a regime exists in this issue area and that it has facilitated cooperation by reducing transaction costs and providing information for members of the regime.

The principles, norms, rules, and decision-making procedures of the ozone regime are embedded in the Montreal Protocol and its subsequent amendments. The regime has reduced many of the transaction costs associated with international ozone regulations by setting up a system whereby states can meet on a regular basis to discuss the problem and by spreading the cost of developing alternatives to CFCs across the international community. However, the regime has not been as successful in providing states with information on cheaters. The international community has not rigorously enforced provisions that states must submit reports on measures taken to address the problem of ozone depletion. In 1994, only 46 of 114 countries required to submit 1993 data had done so and 40 countries had failed to submit baseline emissions data.[24] This makes it extremely difficult to gauge the effectiveness of the regime and to identify cheaters. The regime theory explanation is thus indeterminate. It is not clear that the mere presence of the ozone regime has enabled states to cooperate on the problem of ozone depletion.

Why do traditional international relations theories, such as neorealism and regime theory, fail to fully account for the success of international ozone cooperation? They exclude important factors, such as the role of domestic politics. They also rarely question the process by which actors forge agreements on international policy issues. In sum, they tend to overlook the multiple levels at which decision making takes place. Ozone depletion began as a national-level issue, with several countries (including the U.S.) taking unilateral action to regulate the use of ozone-depleting substances in the late 1970s. By the early 1980s, the issue of ozone depletion had expanded into the international arena. Decision making did not "move" from national fora to the international stage as some have suggested.[25] Rather, several decision-making processes were ongoing in parallel. Table 1 shows very simply these parallel processes in the United States, internationally, and within the scientific community.

Table 1. Parallel Decision Processes in the U.S. and the International Arena, 1974 to 1987

Year	U.S. Ozone Policy	International Ozone Policy	Science
1974	Congressional hearings		Molina and Rowland article in *Nature*
1975	Congressional hearings		
1977	Clean Air Act Amendments	World Plan of Action for the Ozone Layer	
1980	EPA issues Advanced Notice of Proposed Rulemaking (ANPR) re: CFC regulation		
1981		UNEP convenes a working group to draft a Global Framework Convention for the Protection of the Ozone Layer	
1984	NRDC files a lawsuit against EPA re: 1980 ANPR		
1985	EPA and NRDC settle lawsuit	Vienna Convention on the Protection of the Ozone Layer	Farman et al. publish first report of ozone hole over Antarctica
1986	U.S. drafts Stratospheric Protection Plan and convenes several workshops on problem of ozone depletion		NASA report published; Solomon et al. and McElroy publish findings on the existence and cause of the ozone hole over Antarctica
1987		Montreal Protocol on Substances that Deplete the Ozone Layer	

There is, of course, growing interest in domestic politics among international relations scholars. Robert Putnam's work on two-level games has been particularly influential. According to Putnam, state actions are best understood in terms of a decision maker trying to balance domestic and international interests.[26] Putnam's work assumes these are two separate processes. Another promising line of research focuses on "transnational relations," or "regular interaction across national boundaries when at least one actor is a non-state agent or does not operate on behalf of a national government or an intergovernmental organization."[27] Here, domestic and international politics are assumed to be more closely linked, but the focus remains on the actor rather than on the overall policy process. We next examine the interrelation of domestic and international policy processes on the issue of ozone depletion. In so doing, we find the four lessons of the ozone story are not as straightforward as previously believed and that the boundary between domestic and international politics is often blurred.

Ozone Politics in the United States

Shortly after Mario Molina and F. Sherwood Rowland published their seminal work on ozone depletion in *Nature*, the U.S. Congress acted on the issue, holding several hearings between December 1974 and September 1975.[28] The executive branch acted quickly as well: In January 1975, the Council on Environmental Quality and the Federal Council on Science and Technology—two White House committees—created an interagency task force on Inadvertent Modification of the Stratosphere (IMOS) to report on the "fluorocarbon-ozone question." In its report, produced six months later and distributed to each member of Congress, the IMOS task force concluded that "fluorocarbon releases to the environment are a legitimate cause for concern . . . If the National Academy of Sciences confirms the current task force assessment, it is recommended that the Federal regulatory agencies initiate the rulemaking procedures for implementing regulations to restrict fluorocarbon use."[29]

At the time, a significant obstacle existed to the promulgation of any regulation in that "in early 1975 no one was certain what agencies could regulate fluorocarbons under which legislation; the authorities appeared to be both overlapping and incomplete."[30] In overcoming this obstacle, a "vehicle" for linking science and policy was created. A domestic ozone policy was formulated and applied in three overlapping phases: clarification of the roles and responsibilities, legislation of authority and control, and invocation of the policy.

Clarification

At the request of the IMOS task force, the Justice Department sought to clarify legal authority for chlorofluorocarbon regulation based on existing legislation.

In a June 1975 letter to IMOS from Wallace H. Johnson, assistant attorney general, the Justice Department reported that the Environmental Protection Agency (EPA) could regulate aerosol-related pesticide products; the Food and Drug Administration (FDA) could regulate aerosol-related foods, drugs, and cosmetics; and the Consumer Product Safety Commission could regulate all other aerosol-related consumer products as well as home and school refrigeration and air conditioning.[31] However, the Justice Department determined that no agency had jurisdiction over aerosol-related commercial and industrial uses or aerosols used by the automotive industry. This report was key in identifying what decisions could and could not be made based on existing legislation, and thus clarified what actions were needed to establish a process that would allow future decisions about chlorofluorocarbons.

Legislation

Congress introduced several bills in 1975 in response to the ozone issue. The Upper Atmosphere Research and Monitoring Act of 1975 gave the National Aeronautics and Space Administration (NASA) authority to conduct research, technology development, and monitoring of the upper atmosphere. The bill became law (P.L. 94-39) on 19 June 1975 as an amendment to NASA's organic act whereby it added upper atmospheric research to the NASA mission. The law provided for "a long-term R&D effort . . . [with] research [to be] relatively basic, generally performed by academic scientists."[32]

Congress proposed two bills in 1975 to establish a process for research to contribute to decision making.[33] These bills would later be adopted into law as the Clean Air Act Amendments of 1977. Congress not only expressed a desire for answers in the Clean Air Act Amendments but established a process to get those answers and translate them into policy action. In the Act, Congress established a criteria for assessing whether action would be necessary. Specifically, the bill states that the Administrator of the EPA must regulate

> for the control of any substance, practice, process, or activity (or any combination thereof) which in his judgment may reasonably be anticipated to affect the stratosphere, especially ozone in the stratosphere, if such effect in the stratosphere may reasonably be anticipated to endanger public health or welfare.[34]

The legislation also provided for the possibility of Congressional disapproval of any promulgated regulations.

This sequence of events suggests one of the most important lessons in our understanding of the connection between ozone science and policy in the U.S. The production of information usable by policy makers depends more on the establishment of a healthy process than on the support of any particular body of research.[35] In other words, U.S. policy makers decided early on that action on the problem of ozone depletion could not wait until scientists reached

consensus about the nature of the problem, its causes, and its impacts. Rather, they identified a threshold at which they would be willing to take precautionary measures and created a mechanism to ensure that they would be adequately informed when that threshold was reached.

In October 1976, as the Clean Air Act Amendments were slowly moving into law, Congress passed the Toxic Substances Control Act (TSCA, P.L. 94-469), the beginning of regulatory action in the U.S. on CFCs. A working group established by the TSCA divided the regulations into two phases: phase one would consider the regulation of "nonessential uses" of CFCs (that is, uses for which there were substitutes), and phase two would consider what was expected to be the more difficult challenge of the regulation of essential uses.[36] The TSCA covered only nonessential uses, for which regulations were developed and implemented in December 1978 (the "aerosol ban").[37] Regulation of essential uses was covered by the broader authority provided by the Clean Air Act Amendments.

Invocation

The ozone policy established through the Clean Air Act Amendments of 1977 and the TSCA provided the legal mechanism to ensure that the U.S. would promulgate domestic regulations, and ultimately led to participation in the international ozone negotiations. That the ozone policy was necessary to enjoin the U.S. to participate in the international policy process can be clearly seen by examining a 1984 lawsuit brought by the National Resources Defense Council (NRDC) against the EPA and the subsequent settlement.

In October 1980, the EPA released an Advanced Notice of Proposed Rulemaking (ANPR) in which the administrator acknowledged the danger of CFCs to the stratosphere and human health and called for an immediate freeze on production.[38] The ANPR, issued in the last days of the Carter administration, was one of a suite of actions called the "midnight regulations" because of their proximity to the November elections.[39] Less than a month later, Ronald Reagan was elected to office. He installed Anne Gorsuch, who was cool to further regulations of CFCs, as director of the EPA. During this period, the science of ozone depletion was in many ways still uncertain, yet it was certain enough that the previous EPA administrator had seen fit to propose in the ANPR further regulations of essential uses of CFCs.

Scientific uncertainty led some to reconsider the ozone policy. In Congress, Representative Thomas H. Luken (D-OH) and Senator Lloyd Bentsen (D-TX) sought to amend the Clean Air Act again with respect to ozone depletion and in the process remove the criterion for action ("The EPA administrator shall regulate if . . ."). They wanted the EPA to focus solely on research without any criteria for action in the law.[40] In short, they wanted to remove the legal basis for CFC regulation. Those who wished to modify the 1977 law received a "giant gift-wrapped present" in the form of a 1982 National

Academy of Sciences study that suggested that the ozone depletion threat was somewhat less than was previously thought.[41] However, efforts within Congress led by Senator Robert Stafford (D-VT) stopped the attempts to amend the Clean Air Act, meaning that the U.S. ozone policy remained intact.[42]

Although the Clean Air Act Amendments remained on the books, the EPA under Gorsuch still wished to avoid promulgating any new regulations because of the Reagan administration's reticence toward regulatory action. This strategy worked for about three years. In March 1983, the EPA directorship changed hands from Anne Gorsuch to William Ruckelshaus, but the agency's position with respect to the 1980 ANPR remained the same. A process of change in the EPA position began in May 1983 when the NRDC filed a letter with the EPA providing a sixty-day notice of its intention to sue the agency because "we believe that the Agency is legally obligated to take some regulatory action on the basis of the scientific conclusions stated in the ANPR. . . . The EPA is obligated by Section 157 of the Clean Air Act."[43] Both the NRDC and the EPA had experience with such "citizen lawsuits," which were included as a provision in the original Clean Air Act of 1970.[44]

By invoking the ozone policy, the NRDC took a chance that the EPA would try to remove the basis for the lawsuit (that is, rescind the 1980 ANPR). Such an effort did begin in the wake of the threatened lawsuit, but a number of scientists within the EPA were opposed to making an argument that CFCs would *not* endanger public health or welfare and thus resisted the effort to overturn the ANPR.[45] Furthermore, had the EPA actually rescinded the ANPR, that decision would have been judicially reviewable, requiring scientific evidence that CFCs would *not* endanger public health or welfare.[46] This meant that the EPA would have to face the provisions of the 1977 law regardless of whether they followed the 1980 ANPR. In this instance, it was scientific uncertainty (rather than scientific consensus) that ensured that the 1977 law could not be overturned easily and that rulemaking would proceed. In September 1983, amid internal reorganization of the EPA offices responsible for the ozone issue, the agency reconsidered reversing the ANPR. The NRDC was encouraged by this action, but remained concerned about possible EPA or Congressional efforts to rescind the basis for the lawsuit and did not pursue further action at that time.

By August 1984, the EPA had taken little action with respect to CFC regulation. The NRDC again notified the EPA of its intention to file suit, which it eventually did in November of that year.[47] William Ruckelshaus resigned in January 1985 and was replaced by Lee Thomas. After reviewing the issue immediately upon assuming office, Thomas agreed to the possibility of an out-of-court settlement with the NRDC. Negotiations between the EPA and the NRDC resulted in a settlement in December 1985. As part of the settlement, the EPA agreed to conduct further research on regulatory aspects of ozone depletion, reestablish interagency coordination, hold a series of assessment workshops, participate in international workshops, and importantly, pro-

vide support for the Vienna Convention on the Protection of the Ozone Layer, which had been signed by twenty countries in March of that year.[48] The provisions of the settlement later proved important in moving the international policy process forward.[49]

The threat of and actual filing of the NRDC lawsuit were an invocation of the U.S. ozone policy established in 1975–1977 (the Toxic Substance Control Act and the Clean Air Act Amendments) and were important in re-engaging the EPA in the ozone issue and in mobilizing the U.S. to take a leadership role in international negotiations. Some scholars incorrectly attribute the reappearance of the EPA as an actor in the ozone issue to the discovery of the "ozone hole." In May 1985, Joe Farman, a British researcher, and his colleagues published an article in *Nature* in which they reported a 40 percent decrease in stratospheric ozone over Antarctica the previous October.[50] This article prompted a great deal of research as well as a sense of public urgency on the problem of ozone depletion. However, the NRDC lawsuit was filed in November 1984 and Thomas agreed to negotiate an out-of-court settlement in early 1985, *before* Farman's paper was published or his results were widely known.[51]

It is uncertain what would have happened in the absence of the legal mandate that required the EPA to regulate if CFCs were determined to be harmful to human life. However, it is plausible that the Reagan Administration would have continued to thwart efforts to ensure U.S. participation in international negotiations under the claim that the science was incomplete and uncertain. The 1977 Clean Air Act Amendments provided a standard or level of certainty for action that was met in 1980. By 1984, additional research had not shown that CFCs were safe and the EPA was consequently forced by the citizen lawsuit to take action at both the national and international levels. Politicians, not scientists, determined the threshold for action. In this case, the definition of "scientific consensus" was political rather than scientific.

Bifurcation

Between 1977 and 1985, the problem of ozone depletion expanded into the international arena, so that by 1985 there were national and international decision processes in place designed to address the issue. These parallel processes often interacted in such a way that decisions made at one level shaped future decisions at another level. In addition, boundaries between these levels often became blurred, with the same actors informing policy decisions both in the U.S. and in the international arena.

By the late 1970s, Canada, Norway, Sweden, Denmark, Germany, and the U.S. had taken unilateral action to address the problem of ozone depletion.[52] In addition, a number of international organizations, including the United Nations Environment Programme (UNEP), the World Meteorological Organization, the Organization for Economic Cooperation and Development, and the European Economic Commission had begun to take seriously the

issue of CFCs.[53] Supported by national regulatory and research activities, these organizations began to formulate an international response. In 1977, UNEP held a meeting that resulted in the creation of a World Plan of Action for the Ozone Layer to coordinate research. In 1981, UNEP formed a working group to draft a global framework convention for the protection of the ozone layer. Four years later, this would become the Vienna Convention for the Protection of the Ozone Layer. Two years later, in 1987, the vague commitments of the Vienna Convention were translated into stringent regulations of CFCs in the Montreal Protocol on Substances that Deplete the Ozone Layer.

How did the U.S. go from regulation of only nonessential uses of CFCs to participation in a global regulatory accord? According to William Lambright, U.S. participation in the international process was encouraged by "user pull" from the international community. Lambright is somewhat unclear and very brief on this point. We interpret Lambright's use of the term "user pull" to mean that the international community's interest in negotiations was a primary cause of the eventual U.S. commitment to action.

It is certainly likely that the concern of the international community added support to those encouraging U.S. participation in the international negotiations. However, the pull of the international community is not sufficient to explain U.S. participation—the international community pulled for several years before the U.S. became an active participant. There is also the issue of how hard the international community was actually pulling in the years leading up to the 1985 Vienna Convention. According to Peter Usher, chief of UNEP's Atmospheric Unit, the period leading up to the Vienna Convention was not permeated with the same sense of urgency that characterized the period leading to the Montreal Protocol two years later. Thus, some other factor must be responsible for the re-emergence of U.S interest in international action with respect to the ozone layer.[54]

We contend that it was the presence of a criterion for action set in law that enjoined the U.S. to move from limited domestic regulation to active participation and acceptance of a global agreement to cut CFC production and consumption. In the early 1980s, the domestic ozone policy ensured that research findings would lead to policy action. If more political support had existed for Senator Bentsen's and Congressman Luken's proposals, Congress could have overturned the 1977 Clean Air Act Amendments or the EPA could have pursued its efforts to rescind the 1980 ANPR. However, in the absence of such political will, the 1977 law set a standard that proved difficult to change in light of continuing scientific uncertainty.

Challenges to Conventional Wisdom

The story of ozone politics in the U.S. and its relation to international politics calls into question the validity of much of the conventional wisdom about the international response.

Scientific consensus

Contrary to the traditional belief in the necessity of scientific consensus, we note that the earliest domestic actions were taken and a process was established to link research with policy action almost immediately after initial suggestions that CFCs were linked to ozone depletion, arguably when the science was in its infancy. Likewise, international negotiations for the Vienna Convention in the early 1980s were surrounded by uncertainty about the causes and effects of ozone depletion.

The scientific consensus argument suggests that science precedes policy and that once scientists reach a consensus about a problem, its causes, and its impacts, policy automatically follows. The ozone case indicates a more accurate picture is one of two streams, a policy stream and a problem stream, running parallel to one another, each occasionally feeding the other and moving it along.[55] Scientific information about ozone depletion was important in shaping the issue and perceptions of its seriousness and causes. Scientific information did not lead directly to international cooperation but combined with other factors to influence how the problem was framed by the various actors. In the case of ozone depletion, there was a shared understanding of the nature of the problem. It was seen as a global problem caused by anthropogenic emissions of CFCs and other ozone-depleting substances, having consequences for human health as well as economic development, for which there were available alternatives. Thus the problem appeared tractable, which reduced the risk involved in taking action.[56]

A scientific consensus on the problem of climate change may not be sufficient to lead to strengthened cooperation and may in fact reduce the chances for cooperation. Even assuming a universal consensus on the causes, effects, and impacts of climate change, there would still be winners (for example, those whose climates become more amenable to agriculture) and losers (those who become more vulnerable to extreme weather events), unlike the ozone case, where there were essentially only losers.[57] In the ozone case, everyone faced a tradeoff between short-term costs and long-term benefits. These factors, in addition to scientific uncertainty, enter into the calculation of state interest on climate change. Even with greater scientific understanding, the presence of winners and losers may make it difficult to move beyond current positions, and a better understanding of who wins and who loses may solidify these positions.[58]

Global climate change is as much a political problem as a scientific problem. For example, Dale Jamieson asserts that the problem of climate change is shrouded by competing values. Even if scientists can tell us exactly how the climate is likely to change and the implications of such change, questions about how humans ought to live and who is responsible for the problem are sure to remain. Sheila Jasanoff contends that increased technical knowledge alone cannot improve environmental management. Such knowledge must be accompanied by mechanisms for deciding what problems are most important and for

resolving normative issues related to how we would like the world to be.[59] Thus a process for linking science and policy must be put into place before science is considered in decision making as it was in the ozone case.

It is also important to note that scientific consensus has different meanings with respect to different decision processes. In the international arena, the level of consensus at each decision point in the ozone case (Vienna Convention, Montreal Protocol, subsequent amendments to the Montreal Protocol) was seen as sufficient to warrant further action. In the U.S., once the initial process for linking science to action was agreed upon in 1974, it was actually scientific uncertainty rather than consensus that made policy action possible. The ozone language in the Clean Air Act Amendments set a standard for determining when further regulation of ozone-depleting substances should occur (when substances were found to have deleterious effects on the stratospheric ozone layer and when that effect was believed to be potentially harmful to human health). Domestic action did not require scientific consensus on the exact nature of ozone depletion and the contribution of ozone-depleting substances. Rather, when reasonable evidence (but not necessarily consensus) suggested possible harm to the ozone layer and human health, the ozone policy urged precautionary measures. The only way to have avoided further regulation in the early 1980s would have been to forge scientific consensus that CFCs were not harmful to the stratospheric ozone layer and human health.

Within different policy processes, the concept of "scientific consensus" takes on different meanings that are a function of how the process relates science with policy action. In other words, scientific consensus (as well as scientific uncertainty) is always a relative term. It is not enough to say that a consensus exists in the scientific community (however defined); one must still ask, With respect to what is there consensus? For example, on the issue of climate change, the FCCC has a goal of avoiding "dangerous interference" with the climate system but does not define what this might be or how decision makers would know when such interference is taking place. This stands in stark contrast to the 1977 Clean Air Act Amendments, which clearly defined a threshold for action as well as a process for determining if that threshold had been met.

U.S. leadership

Our view of the ozone story also calls into question those explanations that focus on the leadership role of the U.S. The U.S. did not assume a leadership position on the issue of ozone depletion until 1986. As early as 1982, a group of Nordic countries proposed strong international regulations on ozone-depleting substances. Other actors, such as UNEP, were also active in organizing international workshops in which countries could meet to discuss the problem of ozone depletion. The Vienna Convention was signed in 1985, before the U.S. became an active leader on the issue.

One could still argue, however, that the vague principles of the Vienna

Convention would never have been translated into concrete regulations without U.S. leadership. In the months preceding the signing of the Montreal Protocol, the U.S. sponsored several international meetings for both scientists and policy makers and engaged in an aggressive diplomatic campaign designed to gain international support for an ozone agreement.[60] But why did the U.S. assume a leadership role in 1986? Why not in 1982 or in 1990?

Here it is useful to consider the importance of the U.S. ozone policy as articulated in the Toxic Substances Control Act and the Clean Air Act Amendments as well as the lawsuit filed against the EPA by the NRDC in November 1984. The ozone policy set up the vehicle for linking science and policy on the ozone issue and established a clear criterion for action. In 1980, that criterion (the potential harm to human health) had been determined, but for political reasons (that is, the election of an anti-regulation president), no regulations were forthcoming. The 1984 lawsuit held the EPA accountable for its earlier findings and set in motion a process that had been established in the Clean Air Act Amendments. As part of the settlement, the EPA developed its Stratospheric Protection Plan. It also sponsored a series of international workshops for policy makers and scientists on ozone depletion, which then fed into the international policy-making process.[61] The U.S. might not have taken on a leading role internationally without this pre-established ozone policy and its subsequent invocation by the NRDC.

The key lesson from our interpretation of the ozone story is the importance of a framework for domestic debate about the issue and the establishment of a vehicle for linking science and policy in a meaningful way, including the promulgation of criteria for action. There must also be a provision for the responsible parties within the government (including, in the U.S., Congress, the executive, and the bureaucracy) to be held accountable. United States leadership, if it were to occur, would enhance the prospects for effective international action on climate change. The lesson of the ozone case is that such leadership is more likely to be the result of a domestic policy process rather than of international pressure.

The U.S. does have a climate policy. The U.S. response is centered on domestic and international actions as defined in legislation passed in 1990 by the 101st Congress and signed by President George Bush. Briefly, the law (P.L. 101-606) creates the procedures through which scientific research is to support domestic policy making and the U.S. role in international protocols and other agreements related to global climate change.[62] It established a White House Committee to oversee research that would "provide usable information on which to base policy decisions related to global change." The law also directed the U.S. State Department (in cooperation with other relevant agencies such as the Departments of Energy and Commerce as well as the U.S. Trade Representative) to lead U.S. participation in any international negotiations.

The law mandates in very broad terms that research should be conducted to measure, document, and understand global changes as a means to produc-

ing information "readily usable by policy makers attempting to formulate effective strategies for preventing, mitigating, and adapting to the effects of global change." The law defines "usable information" as a process, mandating that the Global Change Research Program, established by the 1990 legislation, "consult with actual and potential users of the results of the Program to ensure that such results are useful in developing national and international policy responses to global change." The law does not, however, contain any standard or criterion for further action, nor does it establish a process to provide usable information to policy makers.

Industry cooperation

Peter Morrisette points to industry cooperation as another important part of the explanation for the success of the ozone story.[63] We have already described the actions of DuPont and the Alliance for Responsible CFC Policy in the 1980s.

In the case of climate change, this lesson has been translated to mean that industrial producers and users of greenhouse gas–emitting fossil fuels should be given a seat at the negotiating table. In involving these actors in the process, supporters of fossil fuel regulations hope to convince industry that the problem of climate change is real and that they must alter their business practices. The majority of petroleum and coal producers have been fierce foes of international efforts to mitigate the potential impacts of climate change by reducing greenhouse gas emissions. They work closely with oil-producing states such as Saudi Arabia and Kuwait and attempt to block any initiative to reduce global greenhouse gas emissions.[64] In the weeks preceding the 1997 meeting of the Parties to the FCCC in Kyoto, Japan, a coalition of industrial actors engaged in a multi-million dollar million ad campaign in the U.S. to try to turn the tide of public opinion against any possible limits on the use of fossil fuels. These efforts suggest that the inclusion of industry groups in the international policy-making process has not been sufficient to bring about their support for the regulation of fossil fuels.

An important, and often overlooked, aspect of the ozone case is why DuPont and other CFC producers decided to support international regulations in 1986. Early on, the CFC production industry tried to discredit the theory that CFCs were causing ozone depletion. In the early 1980s, DuPont halted its research on CFC alternatives, believing further regulation would not be forthcoming.[65] In 1986, however, U.S. regulation of CFCs was on the horizon as a result of the NRDC lawsuit and subsequent settlement. Rather than be subjected to strict regulations and lose its market share, DuPont might have chosen to support international regulations in order to ensure that its global competitors would face similar restrictions. This would also have allowed the company to get a head start on the development of alternatives to CFCs and gain a competitive advantage in this new market.

By considering the U.S. domestic context of international ozone policy, we are able to gain a better perspective on the importance of industry in interna-

tional environmental cooperation. It was not necessarily that DuPont and other CFC producers suddenly bought into the ozone depletion theory or participated as a result of their enlightened self-interest. In fact, they had spent a good deal of time and resources trying to discredit the theory. However, in the mid-1980s, industry groups saw that regulations were likely to be promulgated, and thus chose the strategy of seeking to ensure the regulations worked to their advantage.

In this light, efforts to convince the petroleum and coal industries that the science on climate change is robust may be futile. Environmental groups might argue that their involvement in international negotiations is more of a hindrance than a necessary part of international agreement. Rather, it may take compelling evidence that certain actions are inevitable to bring a cooperative industry to the table. In fact, there is evidence of such a turn related to the recent negotiations on the Kyoto Protocol to the FCCC. There now exists a "green" industry lobby that supports international regulations to reduce greenhouse gas emissions. Some oil companies, such as British Petroleum (BP), have come out in support of regulation, as have industries involved in the use of alternative energy sources such as wind, solar, and water. While the support of the latter group is not surprising, the change in position by a major oil producer may portend future changes in perspective, much as DuPont's position on CFCs was soon followed industry-wide. Of course, the relative simplicity of the CFC industry as compared to the fossil fuel industry makes change in the latter more difficult. The recent changes in position by some members of the fossil fuel industry warrant further investigation.

The ozone hole

One final lesson from the ozone story concerns the discovery of a "hole" in the stratospheric ozone layer over Antarctica. This discovery received a great deal of media attention and some have suggested the hole served as a "social scare," which then created the political will within the international community to take strong action to protect the ozone layer. Sheldon Ungar suggests that such a scare is necessary to move beyond the current climate impasse.[66] While the potential impacts of climate change include changing weather patterns and increased incidence of certain infectious diseases, it is difficult, if not impossible, to link particular weather and disease-related events with climate change. It is also unclear what a climate "crisis" would be. For example, some scientists suggest that malaria would spread beyond the tropics, reaching as far north as the southern United States. A recent article in *Science*, however, argues that humans will be able to adapt to these changes through lifestyle changes and public health measures, thereby minimizing the negative effects of the "crisis."[67]

The role of the ozone hole in bringing about international cooperation to protect the ozone layer continues to be debated. Part of the problem is confusion over exactly when the hole was discovered. Farman and his col-

leagues published their observations in 1985. Susan Solomon and her team published the results of their expedition to Antarctica to confirm the British researchers' observations in June 1986, but the contribution of CFCs to observed losses remained uncertain.[68] Thus, during much of the negotiations of the Vienna Convention and the Montreal Protocol, the ozone story was "out there" but had yet to be confirmed. The Vienna Convention would likely have been concluded without the discovery of the hole. It may be that the discovery of the ozone hole created the sense of public urgency that characterized the negotiations on the Montreal Protocol.[69]

It is worth noting, however, that the U.S. declared that the hole was not instrumental (at least officially) in motivating its involvement in the Montreal Protocol negotiations. In its December 1987 proposed rule to meet the requirements of the Montreal Protocol, the EPA referred to continuing scientific uncertainty about the cause of the ozone hole and asserted that "the Agency has de facto assumed that the ozone hole is not related to CFCs and halons."[70]

We are not suggesting that the ozone hole had no role in facilitating international cooperation on the problem of ozone depletion. However, we would like to challenge those, like Ungar, who claim the ozone hole was both necessary and sufficient to bring about international cooperation on ozone depletion. This lesson might suggest to policy makers interested in achieving international cooperation on climate change that they adopt a "wait-and-see" attitude or try to elevate or create public concern by pointing to climate and weather extremes as evidence of climate change.

Our interpretation of the ozone story demonstrates that a process for achieving international cooperation was already underway by the time the hole was discovered. Certainly, the discovery of the ozone hole mobilized public opinion in several countries in ways favorable to international regulation. It may also have enabled negotiators to arrive at a resolution more quickly than otherwise might have been the case. However, it is possible that the process may have resulted in international cooperation in the absence of the ozone hole. It is questionable whether the ozone hole discovery would have led to cooperation in the absence of the existing policy process. Rather than waiting for or trying to create a "crisis" related to global warming, policy makers should instead focus on developing a solid climate-change policy process.

Revised Lessons

Richard Rose urges caution in using analogies to draw policy lessons, noting at least three analytic weaknesses of analogies.[71] First, there is the risk that an analogy is not perfectly related to the new situation. This leaves the door open for analogies incorrectly applied. Second, once a seemingly appropriate analogue has been found, decision makers may be unable (or unwilling) to discern the contextual similarities and differences between the two situations. There

may be unique characteristics of either the problem at hand or the analogy that make lesson-drawing problematic. Finally, one must consider whether the passage of time makes it less likely that the current problem will respond to the same type of solution. The fundamental lesson is that in order for analogies to be useful, they must be understood correctly.

We have argued that the case of ozone depletion as an analogue for climate change has been misunderstood. The lessons drawn from the ozone case have been incomplete and thus in important respects inappropriate for application to the problem of global climate change. Drawing heavily on ozone politics in the U.S., we have argued that international ozone policy is best understood as multiple parallel processes involving actors at multiple levels of analysis. A process-focused approach to the study of the ozone case suggests that the lessons drawn from that experience are not as straightforward as is often believed. Based on our analysis and on recent events in international climate change politics, we offer some revised lessons from the ozone case.

SCIENTIFIC CONSENSUS. Scientific consensus is not the missing link needed to produce meaningful international cooperation on the problem of climate change. The IPCC (or any other scientific body) does not have the ability in and of itself to provide answers regarding how states should go about reducing risks associated with increased emissions of greenhouse gases. Science alone cannot solve political questions. In the case of ozone depletion, a great deal of interaction took place between science and policy. This was especially true in the U.S., where policy makers framed the ozone issue early on and established mechanisms for obtaining answers to what they viewed as the important questions. In the case of climate change, the IPCC has carried out its work in the absence of any such policy mandate. The IPCC's mandate is to present its findings to the policy community. In other words, the IPCC is charged with "science for policy." What is missing, however, is a "policy for science," which could inform scientists about the types of questions policy makers wish to have addressed by the science as well as criteria for identifying when scientific understanding is sufficient for policy action.[72] In order for scientific information to be useful in the formulation of an international response to climate change, a recursive process for linking science and policy must be established. Criteria for action are an important part of that process.

In some instances, scientific uncertainty, rather than consensus, may actually move policy along. Again looking at the U.S., the 1977 Clean Air Act Amendments called for regulation of ozone-depleting substances if their "effect in the stratosphere may reasonably be anticipated to endanger public health or welfare." Once the EPA administrator determined CFCs could reasonably be anticipated to have such an effect, the only way to overturn the ruling would have been to establish scientific consensus that CFCs were not harmful. As long as some level of uncertainty remained about the potential effects of CFCs, policy makers advocated precautionary measures to protect the ozone layer.

In the case of climate change, policy action might be facilitated by a lack of knowledge. As long as the scientific community remains uncertain about the potential impacts of climate change, the issue of winners and losers will be less likely to stall international negotiations. Uncertainty about potential impacts warrants a precautionary approach because no state can be certain that it will be spared the negative effects of climate change. If scientists are better able to predict regional and local impacts, winners may decide that their long-term interests are better served by allowing climate change to proceed. This could block any future efforts to develop a truly international response.

U.S. LEADERSHIP. It is entirely plausible that U.S. leadership was essential in moving from the vague principles of the Vienna Convention to the specific regulations contained in the Montreal Protocol. However, the ozone case suggests that such leadership came not from an external pull from the international community but rather from an internal push by domestic actors such as the NRDC. When it came time to discuss concrete global reductions in CFC use and production, a domestic debate had already taken place in the U.S., and a foundation had been established for directing U.S. participation in international negotiations. The ability of the U.S. to act as a strong leader in the case of global climate change requires a commitment on the part of domestic decision makers to the establishment of criteria for action, which to date have not been discussed, much less enacted in law.

INDUSTRY COOPERATION. As conventional wisdom notes, industry cooperation was a key piece of the puzzle in understanding international cooperation on ozone depletion. The availability of alternatives to CFCs reduced the risks and costs of international cooperation. However, it is important to recognize that industries required incentives to support international ozone regulations. The CFC industry was not always a willing participant in international ozone negotiations. It was only once regulations appeared inevitable that they were drawn to the bargaining table as partners. In the absence of such incentives, industry representatives can greatly hinder the process of establishing international cooperation, as has been clear in the case of climate change.

THE OZONE HOLE. Finally, the significance of the ozone hole discovery should not be overestimated. Its importance in moving states toward international cooperation remains unclear. As is evident in Table 1, a great deal of momentum had already developed in the domestic and international arena by the time the hole was first mentioned in 1985. If the discovery of the hole did serve to raise the level of public awareness and political will, it may well have served only to increase momentum that had already been established. Climate change policy makers should not conclude from the ozone case that international policy action will be possible only once some similar "crisis" appears. Efforts to relate weather phenomena and natural disasters to climate change may backfire because of the difficulty in linking the two. Policy makers should instead focus on creating a healthy policy process.

Implications for International Relations Theory

Interest is growing within the field of international relations in examining the processes by which states develop their positions on international issues. Scholars recognize the importance of domestic politics in interest formation and frequently analyze this process as a two-level game where domestic and international policy processes proceed simultaneously and a decision maker must determine how to balance his or her interests (which sometimes conflict) at these two levels.[73] This, of course, assumes that two distinct levels can be analyzed separately.

Our understanding of the relationship between domestic and international politics on the issue of stratospheric ozone depletion suggest that these spheres are not always distinguishable. At least in the U.S., many of the actors involved in developing the domestic ozone policy were also involved in international policy making. Results of meetings sponsored by the EPA fed into both the domestic and international processes. Similarly, when an international group of scientists generated information on some aspect of the problem, response sometimes appeared first at the national level, for example, when most industrialized countries unilaterally decided to phase out CFCs by 1996, prior to this date being adopted as an amendment to the Montreal Protocol.

Rather than viewing domestic politics as an external influence on international politics, international relations scholars should consider domestic politics as an integral part of international politics. Of course, in some instances distinct processes do take place at the international and national levels, which affect one another. More frequently, these processes seamlessly interact, the boundary between them often being blurred to the point where it is impossible to separate domestic from international politics. International political outcomes may often be understood only in terms of system level interactions between actors (states) as well as domestic political processes within those states. The state boundary has long been a convenient stopping point for international relations scholars. We suggest that scholars view this boundary as arbitrary, malleable, and context-dependent in order to arrive at more satisfactory understandings of international phenomena and to develop better lessons to apply to new cases. A focus on the process by which decisions are made and cooperation is achieved, as compared to a focus on the actors who cooperate, may help us overcome some of the limitations we face in drawing appropriate lessons for future action.

Conclusion

The case of ozone depletion conventionally has been used as an analogy for the problem of global climate change. We argue that the lessons drawn from

the ozone case have been incomplete or misinterpreted and thus in important respects are inappropriate for the case of climate change. Analysts have typically emphasized the importance of certain actors operating at the international level while largely ignoring the overall process by which international ozone policy was developed. This process was simultaneously influenced by both domestic and international politics. In adopting a focus on process, we find that the boundary between domestic and international politics is frequently blurred, much more so than is acknowledged in most studies of the ozone issue.

We contend that a process-focused approach to the study of the ozone case improves our ability to use this experience as an analogy for the problem of global climate change. For example, our analysis suggests that scientific consensus alone is insufficient to bring about international cooperation. We must also address political questions such as agreement on criteria for action, and establish a mechanism for linking science and policy.

More broadly, this particular case leads us to call upon scholars of international relations to increase attention to domestic politics and to view them as an integral part of the international policy process. The state boundary should not be a stopping point for international relations inquiry. It is often only by blurring that boundary that one can adequately understand and explain international political outcomes.

Notes

An earlier version of this paper was presented at the annual meeting of the International Studies Association-Western Region, Eugene, Oregon, October 1996.

1. For example, see Richard Benedick, *Ozone Diplomacy: New Directions in Safeguarding the Planet* (Cambridge: Harvard University Press, 1991); Peter M. Haas, Robert O. Keohane, and Mark A. Levy, eds., *Institutions for the Earth: Sources of Effective International Environmental Protection* (Cambridge: MIT, 1993); Peter M. Morrisette, "The Montreal Protocol: Lessons for Formulating Policies for Global Warming," *Policy Studies Journal* 19, no. 2 (1991): 152–61; Edward A. Parson, "Protecting the Ozone Layer," in *Institutions for the Earth*, pp. 27–74; and Edward A. Parson and Owen Greene, "The Complex Chemistry of the International Ozone Agreements," *Environment* (March 1995): 16–20; 35–43.
2. We do not mean to suggest that the U.S. was the most important national actor in the ozone issue. The U.S. case is meant to be illustrative of the way in which national and international policy processes are interrelated.
3. For example, see Benedick, *Ozone Diplomacy*; David Leonard Downie, "Road Map or False Trail: Evaluating the 'Precedence' of the Ozone Regime as a Model and Strategy for Global Climate Change," *International Environmental Affairs* 7, no. 4 (1995): 321–45; Peter M. Haas, "Policy Responses to Stratospheric Ozone Depletion," *Global Environmental Change* (June 1991): 223–34; Peter M. Morrisette, "The Evolution of Policy Responses to Stratospheric Ozone Depletion," *Natural Resources Journal* 29 (1989): 793–820; and Sharon Roan, *Ozone Crisis: The 15-Year Evolution of a Sudden Global Emergency* (New York: John Wiley & Sons, 1989).
4. National Aeronautics and Space Administration (NASA), *Atmospheric Ozone 1985*,

WMO Global Ozone Research and Monitoring Project, Report No. 16, 1986. CFCs are human-made substances used as refrigerants, solvents, and aerosol propellants. They are the most well-known and commonly used ozone-depleting substance. Others include halons, methyl bromide, and HCFCs.

5. Morrisette, "The Evolution of Policy Responses to Stratospheric Ozone Depletion"; Roan, *Ozone Crisis*; Benedick, *Ozone Diplomacy.*
6. Haas, "Policy Responses to Stratospheric Ozone Depletion."
7. Peter Haas, "Do Regimes Matter? Epistemic Communities and Mediterranean Pollution Control," *International Organization* 43 (Summer 1989): 377–403.
8. See also Downie, "Road Map or False Trail?"; and Karen Litfin, *Ozone Discourses: Science and Politics in Global Environmental Cooperation* (New York: Columbia University Press, 1994).
9. Haas, "Policy Responses to Stratospheric Ozone Depletion," p. 228.
10. Benedick, *Ozone Diplomacy.* Benedick was the lead negotiator for the United States. Environmental nongovernmental organizations regularly call upon the U.S. to take a leadership role on the issue of climate change. For example, see *ECO*, the newsletter of the Climate Action Network. See also Matthew Paterson, "The Politics of Climate Change after UNCED," *Environmental Politics* 2 (1993): 174–90.
11. "DuPont Leads Industry Shift on CFCs," *Chemicals Business News Base*, 16 December 1986.
12. "U.S. Urged to Follow Global Limits in Policy on Chlorofluorocarbon Production Capacity," *International Trade Reporter* 3 (1986): 1171.
13. For example, see Haas, "Policy Responses to Stratospheric Ozone Depletion"; and Morrisette, "The Montreal Protocol."
14. J. C. Farman, B. G. Gardiner, and J. D. Shanklin, "Large Losses of Total Ozone in Antarctica Reveal Seasonal ClO_x/NO_x Interaction," *Nature* 315 (16 May 1985): 207–210. Not everyone agrees on the importance of the discovery of the ozone hole. For example, Richard Benedick argues that the ozone hole had no impact on the negotiation of the Montreal Protocol. See Benedick, *Ozone Diplomacy.* We address this debate below.
15. Morrisette, "The Montreal Protocol"; Sheldon Ungar, "Social Scares and Global Warming: Beyond the Rio Convention," *Society and Natural Resources* 8 (1995): 443–56; William H. Lambright, "NASA, Ozone and Policy-relevant Science," *Research Policy* 42, no. 4 (Sept. 1995): 747–60.
16. On the levels of analysis problem in international relations, see Kenneth Waltz, *Man, the State and War: A Theoretical Analysis* (New York: Columbia University Press, 1959).
17. Michele M. Betsill, "Explaining Environmental Cooperation: The Contribution of International Relations Theory," paper presented at the annual meeting of the International Studies Association, San Diego, California (16–20 April 1996). On the importance of domestic politics in international relations, see Emanuel Adler, "Cognitive Evolution," in *Progress in Postwar International Relations*, ed. Emanuel Adler and Beverly Crawford (New York: Columbia University Press, 1991), pp. 1–42; Emanuel Adler and Peter M. Haas, "Conclusion: Epistemic Communities, World Order, and the Creation of a Reflective Research Program," *International Organization* 46 (Winter 1992): 367–90; Robert Cooper, *The Post-Modern State and the World Order* (London: Demos, 1996); Robert O. Keohane, "International Institutions: Two Approaches," in *International Institutions and State Power: Essays in International Relations Theory* (Boulder, Col.: Westview Press, 1989); Robert D. Putnam, "Diplomacy and Domestic Politics: The Logic of Two-Level Games," *International Organization* 42 (Summer 1988): 427–60; and Thomas Risse-Kappen, ed., *Bringing Transnational Relations Back In: Non-state Actors, Domestic*

Structures, and International Institutions (Cambridge: Cambridge University Press, 1995).

18. For example, see Robert O. Keohane, *After Hegemony: Cooperation and Discord in the World Political Economy* (Princeton: Princeton University Press, 1984); and Helen Milner, "International Theories of Cooperation Among Nations: Strengths and Weaknesses," *World Politics* 44 (April 1992): 466–96.
19. For example, see Joseph Grieco, "Anarchy and the Limits of Cooperation: A Neorealist Critique of the Newest Liberal Institutionalism," in *Controversies in International Relations Theory: Neorealism and the Neoliberal Challenge*, ed. C. W. Kegley (New York: St. Martin's Press, 1995); and Kenneth Waltz, *Theory of International Politics* (New York: Random House, 1971).
20. Parson, "Protecting the Ozone Layer."
21. See Betsill, "Explaining Environmental Cooperation."
22. Stephen D. Krasner, "Structural Causes and Regime Consequences: Regimes as Intervening Variables," in *International Regimes*, ed. Stephen D. Krasner (Ithaca, N.Y.: Cornell University Press, 1983), p. 1.
23. See Keohane, *After Hegemony.*
24. UNEP, *OzoneAction* (Paris: United Nations Environment Programme, Industry and Environment Programme Activity, July 1994).
25. For example, see Morrisette, "The Evolution of Policy Responses to Stratospheric Ozone Depletion."
26. Putnam, "Diplomacy and Domestic Politics."
27. Risse-Kappen, *Bringing Transnational Relations Back In*, p. 3.
28. Mario J. Molina and F. Sherwood Rowland, "Stratospheric Sink for Chlorofluorocarbons: Chlorine Atomic-atalysed Destruction of Ozone," *Nature* 249 (1974): 810. The House Interstate and Foreign Commerce Committee held hearings in December 1974 and March 1975; the Senate Committee on Aeronautical and Space Sciences held hearings in January and September 1975; and the House Science and Technology Committee held hearings in May and July 1975.
29. Inadvertent Modification of the Stratosphere (IMOS) Task Force, *Fluorocarbons and the Environment*, Report of the Federal Task Force on IMOS, Council on Environmental Quality, Federal Council for Science and Technology, June 1975: p. 5.
30. C. L. Bastian, "The Formulation of Federal Policy," in *Stratospheric Ozone and Man*, vol. II, ed. Frank A. Bower and Richard B. Ward (Boca Raton, Fla.: CRC Press, 1982), p. 173.
31. IMOS, *Fluorocarbons and the Environment*, pp. 101–109.
32. National Aeronautics and Space Administration (NASA), *National Aeronautics and Space Act of 1958*, as amended and related legislation; Committee on Commerce, Science, and Transportation, U.S. Senate, Ninety-fifth Congress, Second Session, 1978, p. 750.
33. HR 3118, "Stratospheric Research and Protection Act of 1975," in the House and a similar bill in the Senate, S 3219.
34. P.L. 95-95, Section 157(b).
35. For example, see Roger A. Pielke, Jr., "Scientific Information and Global Change Policymaking," *Climatic Change* 28 (1994): 315–19.
36. George F. Wirth, Perry W. Brunner, and Ferial S. Bishop, "Regulatory Actions," in *Stratospheric Ozone and Man*, vol. II.
37. See Morrisette, "The Evolution of Policy Responses to Stratospheric Ozone Depletion." In addition, certain aspects of the phase one regulations were covered by the Food, Drug and Cosmetic Act. The regulatory process is described in detail in Wirth et al., "Regulatory Actions."

38. 45 FR 66726, 7 October 1980. For a well-documented history of this period, see Seth Cagin and Philip Dray, *Between Earth and Sky* (New York: Pantheon Books, 1993).
39. Cagin and Dray, *Between Earth and Sky.*
40. David Dickson, "Congress Faces Decision on CFC: New Ozone Data from NASA," *Nature* 293 (Sept. 1981): 3–4; and Roan, *Ozone Crisis.*
41. Cagin and Dray, *Between Earth and Sky*, p. 249. Recall the 1975 IMOS report recommended federal regulations to restrict CFC use *if* the National Academy of Sciences confirmed the IMOS assessment that CFC emissions are a cause for concern.
42. Roan, *Ozone Crisis.* The Clean Air Act was not amended during the Reagan administration.
43. Quote from letter from Alan Miller, NRDC, to William Ruckelshaus, EPA, 31 May 1983, excerpted in Cagin and Dray, *Between Earth and Sky*, pp. 254–55.
44. Henry A. Waxman, "An Overview of the Clean Air Act Amendments of 1990," *Environmental Law* 21 (1991): 1721–1816.
45. See Cagin and Dray, *Between Earth and Sky.*
46. Our thanks to David Doninger for this observation.
47. NRDC v. EPA, DC DC, No. 84-3587. See also Cagin and Dray, *Between Earth and Sky*, pp. 280–81.
48. M. S. Lobo, "Thinning Air, Better Beware: Chlorofluorocarbons and the Ozone Layer," *Dickinson Journal of International Law* 6 (1987): 87–117.
49. David D. Doninger, "Politics of the Ozone Layer," *Issues in Science and Technology* (Spring 1988): 86–92.
50. For example, see Lambright, "NASA, Ozone, and Policy-relevant Science"; Farman et al., "Large Losses of Total Ozone."
51. For more information on the factors that mobilized the EPA and the U.S. on the issue of ozone depletion, see Roger A. Pielke, Jr. and Michele M. Betsill, "Policy for Science for Policy: A Commentary on Lambright on Ozone Depletion and Acid Rain," *Research Policy* 26, no. 2 (May 1997): 157–68.
52. Bastian, "The Formulation of Federal Policy." Great Britain and France were more cautious about the issue. See Morrisette, "The Evolution of Policy Responses to Stratospheric Ozone Depletion."
53. Morrisette, "The Evolution of Policy Responses to Stratospheric Ozone Depletion."
54. Lambright, "NASA, Ozone, and Policy-relevant Science"; see also Parson, "Protecting the Ozone Layer."
55. John W. Kingdon, *Agendas, Alternatives, and Public Policies*, 2nd. ed. (Boston: Harper Collins, 1995).
56. Haas, "International Responses to Stratospheric Ozone Depletion."
57. See Michael H. Glantz, "Assessing the Impact of Climate: The Issue of Winners and Losers in a Global Climate Change Context," in *Climate Change Research: Evaluation and Policy Implications*, ed. S. Zwerver, R. S. A. R. van Rompaey, M. T. J. Kok and M. M. Berk (Amsterdam: Elsevier, 1995).
58. David Downie adds that economic and political interests will make scientific consensus less powerful on the issue of climate change. See Downie, "Road Map or False Trail?" p. 333.
59. Dale Jamieson, "Ethics, Public Policy and Global Warming," *Science, Technology and Human Values* 17 (Spring 1992): 139–53; Sheila Jasanoff, "The Dilemma of Environmental Democracy," *Issues in Science and Technology* (Fall 1996): 63–70.
60. See Benedick, *Ozone Diplomacy*; and Parson, "Protecting the Ozone Layer."
61. Bureau of National Affairs (BNA), "U.S. Ratification of Montreal Protocol Likely

to Occur Early in Congressional Year," *International Environmental Reporter, Current Report* 11 (1988): 105.

62. For a detailed overview of this legislation, see Roger A. Pielke, Jr., "Usable Information for Policy: An Appraisal of the U.S. Global Change Research Program," *Policy Sciences* 28 (1995): 39.
63. Morrisette, "The Montreal Protocol."
64. Karan Capoor and Annie Petsonk, "The Climate Summit: From Rio to Berlin and Beyond," *Hotline* 2 (1995).
65. Litfin, *Ozone Discourses.*
66. Ungar, "Social Scares and Global Warming."
67. Gary Taubes, "Apocalypse Not," *Science* 278 (7 November 1997): 1004–1006.
68. Susan Solomon, Rolando R. Garcia, F. Sherwood Rowland, and Donald J. Wuebbles, "On the Depletion of Antarctic Ozone," *Nature* 321 (19 June 1986): 755–58; Michael B. McElroy, Ross J. Salawitch, Steven C. Wofsy, and Jennifer A. Logan, "Reductions of Antarctic Ozone Due to Synergistic Interactions of Chlorine and Bromine," *Nature* 321 (19 June 1986): 759–62.
69. Peter Usher, United Nations Environment Programme, interview, 1 May 1996.
70. U.S. Environmental Protection Agency proposed rule on the protection of the stratospheric ozone, 40 FR 82—52 FR 47489, 14 December 1987. Reprinted in *BNA International Environmental Reporter, Current Report* 11 (1988): 62.
71. Richard Rose, *Lesson-Drawing in Public Policy: A Guide to Learning Across Time and Space* (Chatham, N.J.: Chatham House Publishers, 1993).
72. See Pielke and Betsill, "Policy for Science for Policy."
73. See Putnam, "Diplomacy and Domestic Politics."