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Before Climategate: Visual strategies to integrate ethos across the "is/ought" divide in the IPCC's Climate Change 2007: Summary for Policy Makers

Lynda Walsh *University of Nevada, Reno*

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Studies in the Rhetoric of Science

Before Climategate

Visual strategies for establishing ethos across the "is/ought" divide in the IPCC's Report Climate Change 2007: Summary for Policy Makers

Lynda Walsh

Dept. of English, University of Nevada-Reno, Reno, NV, USA

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Introduction: Climategate and the ethical dilemma of climate policy scientists

In the last decade the most salient scientific issue for the American public has arguably been global warming. From the Kyoto protocol in 1997 to the release of *An Inconvenient Truth* in 2006 to the 2007 Nobel Peace Prize for that movie and for the United Nations Intergovernmental Panel on Climate Change's [IPCC] *Fourth Assessment Report* [AR4] support seems to have growing for both the fact of anthropogenic warming and the political will to do something about it. The AR4 was authored with the participation of over 200 climate scientists. Consequently, it was touted as the *coup de grace* for skeptics who had been insisting that there was no scientific consensus on evidence of anthropogenic warming.i But just two months ago, in November 2009, almost precisely two years after the IPCC had won the Nobel Prize, a hacked stream of emails, data, code, and images from the Climate Research Unit servers at East Anglia university damaged the appearance of consensus achieved in the AR4. Many of that document's authors were implicated in the hack, christened "Climategate" by skeptical media outlets, which contained emails dishing on internal squabbles, ridiculing opposition to the AR4 findings, and weighing "tricks" for presenting climate change data persuasively (Revkin, 2009, November 20, para 3).

Reactions to Climategate by both the impugned scientists and climate change skeptics were immediate and predictable. Skeptics hailed the emails as evidence of suspected infighting and political biases in the IPCC. They devoted particular attention to hacked emails that discussed the famous "hockey stick" graph, which formed the centerpiece of the argument for anthropogenic global warming in the *Third Assessment Report* [TAR] released in 2001 (Figure 1). The graph, which first appeared in Mann, Bradley, and

Hughes (1998), showed a rapid increase in temperature in the 20th century compared to the otherwise regularly oscillating Northern Hemispheric average temperature series. The graph's appearance and the statistical methods used to produce it were the source of bitter contention for several years following the AR3's publication. McIntyre and McKitrick's (2003) charge that Mann et. al. had

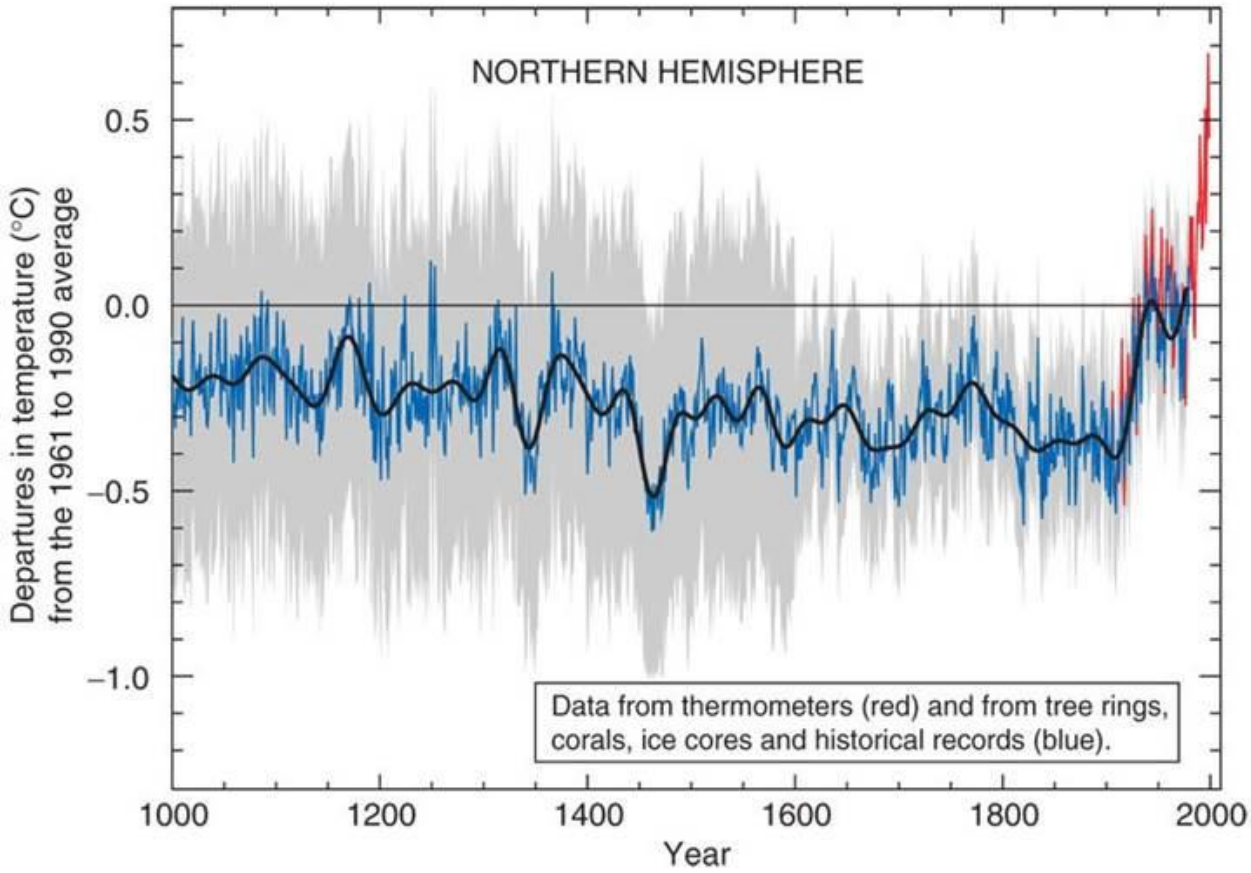

Figure 1: The infamous "hockey stick" graph published first in Mann, Bradley and Hughes (1998) and then in the IPCC's AR3 in 2001. The debate concerned the statistical methods used to generate the sharp upward spike in departures from average temperature in the Northern Hemisphere beginning roughly in 1900. Source: http://upload.wikimedia.org/wikipedia/en/e/ed/Hockey_stick_chart_ipcc_large.jpg

mishandled the data input to the graph ultimately sparked a series of Congressional hearings. Although these hearings failed to force a retraction of the graph, its notoriety was sealed.

The hacked East Anglia cache contained emails purportedly written by members of the TAR authoring team in which they expressed private doubts about the statistical methods behind the "hockey stick" graph, methods that they would later defend vehemently and publicly. This apparent hypocrisy set off avid debates on Climate Skeptic and other skeptical blogs about the

validity of the TAR and AR4 and their authors' reputations (Meyer, 2009, November 23).

In response, the authors largely avoided reentering the "hockey stick" and other old debates. Instead, they strove to insulate their professional reputation—or ethos—in various ways, primarily by bracketing off their scientific ethos from their ethos as citizens or private persons: "Newton may have been an ass, but the theory of gravity still works," argued Gavin Schmidt, a NASA climate scientist who admitted to writing some of the hacked emails (Revkin, 2009, November 20, para 20).

Climategate raises many interesting questions for rhetoricians of science, although answering them will prove complicated—first because of the privacy of the source material and secondly because of the questionable authenticity of the fragmentary remnants of the necessary data base circulating through skeptical media outlets. However, documented reaction to the scandal so far makes at least two things clear. The IPCC scientists are having real problems with their ethos as "policy scientists"—scientists who advise policymakers on science-related civic issues. Moreover, they are acutely aware of this ethical instability and of its capacity to hamper their ability to persuade publics and policymakers in the court of public opinion.

While some of the ethical attacks on the IPCC in the course of Climategate have been launched from predictable, quantitative grounds—such as the accuracy of models or the completeness of records—the most prevalent and vehement attacks have used the climate scientists' involvement in politics *in the first place* as grounds for discrediting their scientific findings. This line of argument is too pervasive to document comprehensively, but here are two illustrative examples. In the first, the blogger at *Finem Respice* accuses IPCC scientists of acting for political gain:

As a group one rarely sees scientists (or, indeed, any vocational group other than politicians) so deeply in love with the by-hook-or-by-crook of politics, the grand import of jetting off to Nice for the next climate meeting and the limelight that accompanies all these world-saving goings on as those few, those lucky few exposed in the CRU emails… It is all but impossible not to come away with a sense of what is plainly a naked lust for naked ambition simply oozing out of those texts. I am utterly devoid of sympathy for any such that later claim to have been forced to compromise their composure, their decorum or their data because of the unfortunate realities of politics. ("Their charms proved irresistible," 2009, November 28, para 26)

Similarly, on his *Climate Skeptic* blog, Meyer (2009, November 23) implies that bias is the only reasonable explanation for one AR3 author's failure to publish his private concerns (expressed in a hacked email) about the "hockey stick" graph: "When we understand the incentives that are driving him to suppress his own scientific views, and to publicly ridicule those who share his private concerns, we will understand better what is broken in the climate science process" (para 2). What's wrong with climate science, in other words, is politics. If we refract this warrant through an ethical lens, we get the argument that it's somehow inappropriate for a scientist to be involved in politics at all. And yet policy scientists regularly feature in the political landscape. In fact, they are accreted to it under the auspices of government agencies such as the NSF, NIH, and USDA.

The ethical paradox faced by the American policy scientist is well-documented. Steven Shapin (2008) and Roger Pielke, Jr. (2007), have recently explored the issue in historical monographs. Both tell versions of the same tale. Until the end of the 19th century, scientists were expected to moralize the results of their inquiries *pro bono publico*. Starting after the Second World War, however, American scientists fell under a philosophical stricture referred to as the "is/ought" problem or the "naturalistic fallacy." This rule, stated first by David Hume and elaborated since then by philosophers such as A.J. Ayer and scientists such as Albert Einstein, holds that democracies cannot make social or moral policy based on observations of the natural order. Facts are one thing. Values and the choices they undergird are another (Ayer, 1952; Einstein, 1950; Weber, 2002).

Shapin and Pielke point to ample historical motivations for the "is/ought" stricture in the arguments of the post-WWII writers who invoked it, not least the terrifying results of the atomic bomb and the nazification of the life sciences. In addition, the post-war industrialization of science in America complicated the heroic ethos of its practicioners, whose pre-war portrait Sinclair Lewis had drawn so lovingly (and, it appeared in retrospect, naively) in *Arrowsmith*.

However, and in fact *because* of these motivations for invoking it, the "is/ought" rule is impossible to enforce. In practice scientists are citizens with their own biases and opinions. These inevitably color their policy recommendations. Indeed, governments and publics routinely ask scientists to cross the "is/ought" divide in order to give advice about how to navigate civic questions related to their expertise, such as global warming. The IPCC itself was convened by the United Nations under the auspices of its Environment Programme; and the Nobel Prize it received for its

work in 2007 is evidence of its perception, at some times and in some lights, as an activist body.

These public investitures and the "is/ought" divide combine to create the paradoxical ethos policy scientists experience in 21st-century America. When scientists make policy recommendations at the behest of government agencies, the factions whose politics align with these recommendations laud the trustworthiness of the source; those whose politics are out of phase accuse the scientists of "junk science," bias, and corruption (cf. (Goklany, 2008; McKitrick, 2007; McLean, 2008).[ii] Policy itself founders in the resulting impasse over the trustworthiness of the very experts policymakers called upon for advice in the first place.

As we've already seen in the scientist-authors' reactions to Climategate, climate policy scientists are keenly aware of their fraught ethical stance in the court of public opinion. But in contrast to their passive, defensive responses to Climategate to date (which may be partially chalked up to the intervention of the Copenhagen talks in December 2009), the IPCC had already enacted preemptive rhetorical strategies in the AR4 to integrate their fractured ethos. In this paper I will focus on one of these strategies—visualizations of climate models. In short, I will argue that the visualizations in the AR4 SPM integrate the IPCC's ethos by performing its continuity from "is" to "ought" while shifting the burden of proof from ethos to logos—the objectified results of the models. These visualizations deploy strong emotional or pathos appeals that ease the persuasive load on the IPCC's ethos. While determining the effectiveness of these strategies is difficult, I will point to some reception evidence that indicates the IPCC's visual strategies may have helped integrate their ethos, at least with some audiences.

In order to understand how the visualizations could accomplish these rhetorical effects on the IPCC's ethos, it is necessary first to do a bit more work with the "is/ought" stricture. While both Shapin and Pielke define and make recommendations for amending the observed ethical paradox of the policy scientist, neither satisfactorily explains how late-modern civic debate *generates* the ethical paradox that Climategate has dramatized so vividly. Casting the "is/ought" divide in the light of stasis theory helps explain the ethical paradox. Once we see that scientists' statements at the stasis of cause/effect are inevitably interpreted as value judgments and policy suggestions, we can explain the ethical paradox and be in a better position to evaluate the IPCC's visual strategies to cope with it.

The paradoxical ethos of the American policy scientist: the "is/ought" stricture

Shapin's and Pielke's accounts have already been sketched, but prior to these very recent contributions, the ethos of the American scientist had already been amply graphed by philosophers, historians, and rhetoricians. Max Weber was one of the earliest and most prolific and influential writers on the subject. His *The Protestant Ethic and the Spirit of Capitalism* (1958) instituted a portrait of scientific ethos molded by Puritan ethics—scientific discovery as a reward for faithfulness and a sign of election to redemption. This portrait has since been filled out by Shapin (1994), Schaffer (1987), Lessl (1989) and others, who reconstructed the early ethos of the scientist as a "priest of nature." We can infer from this vocational portrait that scientists were not only allowed but expected to draw conclusions, based on their unprecedented access to God's will and "maker's knowledge," about how society could be shaped to fit divine order and perhaps even recapture some pre-lapsarian comfort (Briggs, 1996, pp 181-183, 195).

This ethical structure dominated until the influence of Charles Darwin's works and the resulting school of Scientific Naturalism exiled metaphysical questions from the purview of scientific inquiry (Shapin, 2008). But the Puritan influence was still particularly strong in America, which led to a unique ethical configuration for the American naturalist (Brown, 1997). While questions of "ought" were officially off the table, nonetheless the persistence of the inductive model of Early Modern science suggested that correct science should lead to correct policy. Pielke calls this uniquely American system for integrating science with society the "linear model" (2007, p. 12). Scientists were to discover how nature worked, and then this information would be "handed off" to the civic arena across the "is/ought" divide, where citizens would then go on to decide how to apply the scientists' discoveries to technology and policy development.

The linear model ostensibly preserved the vestiges of Puritan teleology in the face of "is/ought" naturalism, but at the cost of an integrated ethos for American scientist-citizens. When making policy decisions as voters, they somehow had to remove their "scientist hat," and vice versa—a patently ridiculous proposition, which Weber sharply criticized in the conclusion to *The Protestant Ethic and the Spirit of Capitalism* (1958). No longer able to justify their vocation, their "calling," by divine warrant, American scientists had to justify themselves via "mundane passions" such a sense of civic responsibility or sheer mercenary interests, both of which were supported by large corporations and federal grants for Big Science (p. 182). Foucault commented around this time in "Truth and Power" on the ethical plight of the resulting "specific intellectual," whose individual aspirations and social utility were

now entirely circumscribed by public or private commission (1980, pp 126-129).

How did this new problematic scientific ethos manifest itself in social products, including scientific writing? In the 1970s Robert K. Merton identified the following normative traits of the new scientific culture in the texts they produced—communism (not in the political, but in the cooperative sense), disinterestedness, organized skepticism, universality, originality, and humility. These norms all resonated with the new naturalist view of the scope of science. Significantly, they also applied at the community level. Big Science had swallowed the scientific individual as an ethical unit. Twenty years later, however, Prelli (1997) found textual evidence of "counter-norms" that balanced the Mertonian norms: solitariness for communism, interestedness for disinterestedness, organized dogmatism for organized skepticism, and particularism for universalism. Prelli's findings suggested either that the social structure of science had changed substantially in the last twenty years, or that the Mertonian ethos had always been a rhetorical reflection of the prescriptive (rather than descriptive) nature of the linear model. Shapin and Pielke's recent analyses suggest the latter was the case.

Pielke and Shapin both refer to uncertainty in explaining the breakdown of the linear model in practice—but in slightly different ways. Pielke qualifies first that the linear model does actually function at times—but only in cases of what he terms Tornado Politics, in which values are uniform ("Tornados are bad and to be avoided") and uncertainty is limited to nonexistent ("The best thing to do in case of a tornado is hide in a basement.") In these cases, scientists' observations and statements about what is (i.e., "That dark funnel is indeed classified as a tornado and it is indeed headed directly for this building") translate unambiguously into policy decisions about what *ought* to be done ("OK, then, the basement it is!"). However, Pielke argues, most policy issues are actually instances of what he terms Abortion Politics, where decision-makers' values differ significantly, and uncertainty is high—i.e., there are a myriad policy options. In these political situations, scientific observations, classifications, and identification of causal factors are next to useless except as red-herring arguments deflecting public attention from the true stasis of argument (2007, pp 40-47).

Shapin also focuses on uncertainty as being the downfall of the linear model, but in this case, it is the sheer *multiplication* of uncertainties that Shapin says drives the problematic ethos of the late modern policy scientist (2008, p. xv). Shapin does not state but implies that the immediate post-War era was somehow less certain;

indeed, this is the same era in which scientists' ethos went relatively unchallenged, as they rode a wave of popular good will occasioned by technological advances in medicine, commercial agriculture, defense, and space exploration. But the proliferation of these technologies and of the dilemmas they have brought within our ken have generated increasing uncertainty about "the way we live now" (Latour, 1993; Shapin, 2008). This increasing uncertainty in turn generates more calls to scientists for help making policy decisions in an increasingly technical political landscape.

While both theorists have accurately identified the rift in the ethos of the modern American scientist—Mertonian ethos vs. policy ethos—neither has satisfactorily explained the paradoxical public reaction to scientists in policy debates: critics use scientists' policy statements to attack Mertonian ethos—the very ethos that presumably led to their public commission in the first place. However, viewing the "is/ought" divide in conjunction with stasis theory can illuminate both this reaction and a subtle rhetorical strategy for coping with it that the IPCC scientists used in the AR4 and that Shapin, Pielke, and other scholars have not yet noted.

The paradoxical ethos of the policy scientist: explanation via stasis theory

At about the same time that scholars of scientific ethos were beginning to recognize complications of the linear model of scientific and civic integration, rhetoricians were reviving the stases as a tool for analyzing civic engagement (Fahnestock and Secor, 1998; Fleck, 1981). Roman rhetoricians developed the stases to describe a sequence (stasis/stases translates as "sticking point/s ,"" "step/s," or "level/s") of questions and answering arguments used by democratic institutions such as the courts or the Senate in arriving at policy decisions. The stases move from simpler to more complex, and each stasis builds on the answer to the question at the previous stasis. For example:

Fact: What is the condition of the lungs of children exposed to cigarette smoke?

Definition: Would we classify the condition (tarry residue) as damage?

Cause/effect: What is the mechanism of this damage? And/or what health effects does the damage produce?

Value: Are nicotine, tar, and the other causes of lung damage worth banning or regulating? Are the health effects life-threatening?

Action: What policies will we adopt to reverse or prevent the damage caused to children's lungs by the chemicals in secondhand smoke?

Although Fahnestock and Secor (1998) does not deal much with it, the stasis of jurisdiction is a meta-stasis at which procedural questions are addressed: is this the right venue for considering this case? This stasis figures in some models derived from Cicero's (Prelli, 1990, December, p. 317). Since the IPCC is an advisory body without a formal jurisdiction, we will not deal much with procedural questions, although we can see that in titling their summary document *Summary for Policy Makers* [SPM], the IPCC acknowledges that many members of its primary audience have jurisdiction in the ruling bodies of their home countries and institutions. Further, questions of jurisdiction tend to obscure the true paradox inhering in the policy scientist's ethos, an effect we will turn to in a moment.

Note that the lower stasis questions (fact, definition, cause) are ones we commonly turn to scientists to help us answer today. Note also, however, that as the questions move up the stases, answering them requires engaging the values of communities outside the scientific community (parents, lawmakers, etc.) in order to establish criteria for evaluation and motivation for action (Fleck, 1981).

The "is/ought" schism occurs between the stases of cause/effect and value. When scientists restrict their activities—and their public announcements—to the lower stases of fact, definition, and cause, they are operating within the guidelines of all modern models of scientific ethos from the Puritan to the Mertonian. When scientists evaluate their findings in terms of "good," "bad" or any other value scale, or when they proceed to suggest actions that would bring civic society more in line with practices they consider "good," they are still operating within pre-modern and early modern scientific ethos; however, according to the post-war linear model, they have transgressed the "is/ought" divide between Mertonian and policy ethos. That transgression on first glance looks like a simple judgment at the translative stasis, in which the public and policymakers tell scientists that they have no jurisdiction in the civic arena. But the special character of the rhetorical attacks noted in the introduction tells us that more is going on here than a simple procedural wrist-slapping. In these attacks, scientists' statements on policy issues are treated not just as out-of-bounds but *as evidence that the speakers are not real scientists*. The attacks use the illegitimacy of scientists' policy ethos to vitiate their Mertonian ethos as well. This is the true ethical paradox of the policy scientist.

Why would intelligent scientists and policymakers continue to perform this futile ritual in debates not just over global warming but about stem cell research, nuclear power, and genetic engineering? It seems inexplicable until we look more closely at the problematic stasis of cause/effect.

The stases exert an irresistible upward pull on the discourse surrounding a particular issue because the answer to a question at one stasis generates a question at the one above it (see the secondhand smoke example above). So, to revisit Pielke's example of Abortion Politics, we can see that statements about scientific facts, well within the province of Mertonian ethos, in fact *do* generate policy-level statements via the power of implication. For instance, if we state at the stasis of fact that "Human fetuses have a heartbeat at N weeks," we can immediately feel the policy-level implications of such a statement—for example, "I believe nothing alive should be killed; therefore, abortion is against my values," and "I should vote against abortion rights." Values so permeate civic inquiry that they determine even the collection and selection of elements to observe at the stasis of fact, a dynamic that sociologists of science have repeatedly demonstrated for the funding and direction of Big Science (Fleck, 1981).

The upward pull of the stases intensifies at the stasis of cause/effect. This stasis is the bridge between forensic questions on the one hand ("is" questions) and epideictic and deliberative questions on the other ("ought" questions). Therefore, when scientists are asked to determine the causes and effects of phenomena, even though these activities are *within the purview of Mertonian ethos, nevertheless, their statements are perceived as arguments at the stases of value and action* by rhetorical implicature.[iii] Nowhere is this effect more apparent than in debates over global warming. If scientists state that humans are in fact causing climate change, the upward pull of the stases insures that policymakers "hear" scientists saying that this enormous impact on the earth is so obviously bad (value) that it should be avoided (action), even if the scientists are careful not to use value or action language.

Contrary to Pielke's argument, then, the issue of global warming *is* settled at the stasis of cause/effect because the conclusions we draw from it are functionally inevitable given our democracy's long history and practice with the stases of argumentation. It is against this revised understanding of the paradoxical ethos of policy scientists that I wish to interpret the rhetorical strategies in the IPCC's AR4 SPM, particularly the visual strategies. First, however, a brief ethical history of the IPCC is in order.

IPCC history and ethos

The IPCC was authorized in 1988 by World Meteorological Organization and United Nations Environment Programme. It is a consortium of hundreds of scientists representing member nations of the United Nations, and to date it has produced four assessment reports on climate change since its founding. The IPCC constructs its organizational ethos as follows (emphasis mine):

> The IPCC was established to provide the decision-makers and others interested in climate change with an objective source of information about climate change. The IPCC does not conduct any research nor does it monitor climate related data or parameters. Its role is to assess *on a comprehensive, objective, open and transparent basis* the latest scientific, technical and socio-economic literature produced worldwide relevant to the understanding of *the risk of human-induced climate change, its observed and projected impacts* **and** *options for adaptation and mitigation*. IPCC reports should be *neutral with respect to policy*, **although they need to** *deal objectively with policy relevant scientific, technical and socio economic factors*. They should be of *high scientific and technical standards, and aim to reflect a range of views, expertise and wide geographical coverage*. (IPCC, 2009, para 1)

The performance of Mertonian ethos is clear in the following italicized phrases:

- "comprehensive, objective, open, and transparent basis"
- "observed and projected impacts"
- "neutral with respect to policy"
- "deal objectively"
- "high scientific and technical standards"
- "aim to reflect a range of views, expertise and wide geographical coverage"

The upward pull of the stases exerted on the IPCC as a civic body is apparent in the following phrases:

- "options for adaptation and mitigation"
- "policy relevant scientific, technical, and socio economic factors"

The acknowledgment of the "is/ought" schism in the linear model is evidenced by the bolded "although they need to" interpolated between the phrases signaling the Mertonian ethos on the one hand and the policy ethos on the other. However, the IPCC also

acknowledges their policy ethos when they connect it to their Mertonian ethos with the simple "and" conjunction (bolded), indicating that all of the stases may be within their purview.

The IPCC has handled division of labor within its sizeable ranks by organizing three working groups, one on the physical science of climate change, one on its socio-economic and natural impacts, and one on the monitoring and mitigation of greenhouse gases. Working Group I issued its SPM in advance of the AR4 in February 2007. The full AR4 was released in November of that year, and in December, the IPCC won the Nobel Peace Prize in conjunction with Al Gore for work on the socio-economic effects of global warming.

With this ethical background, we can turn to considering rhetorical strategies in the SPM related to the "is/ought" division and the stases. First, I will examine language in the SPM as it relates to Mertonian v. policy ethos, as I did for the IPCC's ethical mandate above. The language selected by the authors demonstrates their sensitivity to the strictures of Mertonian ethos. I will also discuss some of the reaction to the SPM language to support my argument that the IPCC was perceived as arguing at the stases of value and action although the language of the document was restricted to cause/effect.

Primarily, however, I wish to examine a unique rhetorical strategy of ethical integration utilized by the IPCC authors in the SPM: visualizations of climate models. The authors presented these visualizations in the SPM as well as in follow-up presentations across the country. The visualizations perform the continuity of the IPCC's Mertonian and policy ethos and shift the burden of proof from that ethos via pathos appeals and objectification of the model results.

Language in the AR4 SPM: Graphing a problematic ethos

Although my focus in this case study is the visual rhetoric of the Working Group I SPM, a brief examination of the language of the document establishes that its authors were sensitive to the "is/ ought" divide and were careful to restrict their claims to the "is" side, the traditional territory of Mertonian ethos, comprising the stases of fact, definition, and cause. The introductory paragraph of the SPM demonstrates this scope perspicuously [emphasis added]:

The *Working Group I contribution* to the IPCC Fourth Assessment Report describes progress in understanding of the human and natural *drivers* of climate change, *observed* climate change, climate *processes and attribution*, and *estimates of projected future climate change*. It *builds upon past IPCC assessments and incorporates new findings* from the past six years

of research. Scientific progress since the Third Assessment Report (TAR) is based upon *large amounts of new and more comprehensive data*, more sophisticated analyses of data, improvements in understanding of processes and their simulation in models and more *extensive exploration of uncertainty ranges*. (IPCC, 2007a, p.1)

Table 1 presents the highlighted language in terms of its relation to the stases and to Mertonian norms:

	Fact	Definition	Cause	Value	Action
Communism		"Working Group 1 contribution"		?	?
Disinterestedness	"observed"			?	?
Organized Skepticism		"extensive exploration of uncertainty ranges"		?	?
Universalism		"builds upon past IPCC assessments"		?	?
Originality	"incorporates new findings" "large amounts of new and more comprehensive data"	"processes"	"drivers" "attribution"	?	?
Humility			"estimates" "projected future climate change"	?	?
N/A		"processes"	"drivers" "attribution"	?	?

Table 1: Language in the introduction to the SPM charted in terms of its relation to the stases of argument (across) and Mertonian norms of scientific ethos (down). Bold column divider symbolizes "is/ought" divide inhering in the linear model of the social role of science

Mertonian ethos is developed via hedges demonstrating humility ("estimates," "projected") as well as the arguments for the objectivity and rigor of the findings in the SPM. **Note that language indexing value judgments or activism is absent.**

This trend continues throughout the SPM. A particularly interesting strategy for communicating universalism (impersonal objectivity) and communism (cooperation) is the IPCC authors' adoption of qualitative shorthand for percent likelihood of various outcomes, ranging from "virtually certain" to "likely" to "unlikely." In this framework, the likelihood of outcomes such as "a human contribution to observed trend" is determined via "expert judgment" on the results of statistical analysis, including model results (IPCC, 2007b, p. 27).

In a few places in the SPM, the authors' language strays close to value judgment through the use of quantifiers that scale up predicted effects. For example, the authors write that current levels of greenhouse gases "far exceed" pre-industrial norms as judged from ice cores (2007a, p. 2) and describe as "very likely" an increase in "hot extremes, heat waves, and heavy precipitation" (p. 15). While these word choices may seem inflammatory, that rhetorical implicature is due to the upward pull of the stases; there are no value judgments *stated* in a term such as "hot extremes"; we as readers, rather, immediately link such a phrase to our value structures by the equation "hot extremes = bad." In fact, these phrases appear to be an attempt on the authors' part to use more scientific, descriptive language rather than the value-laden terms "drought" and "flood."

Did this strategy work? Perhaps with some audiences, but many readers perceived the Working Group I SPM's authors to be arguing at the policy stases of value and action, even though they had taken linguistic pains to avoid this ethical stance. A survey of the critical responses yields many of the same types of ethical attacks launched in Climategate. A particularly tart example—the right-leaning *Washington Pest* blogger commented, "Anyone who doubts that the new IPCC Summary for Policy Makers is an advocacy document is ineligible for duty on the jury of reason" (2007, para 1). Other critics responded similarly. A blogger running a page entitled "IPCC Criticism of the Week" focused on "distorted, misleading, biased" statements in the SPM (2008, para 1). Goklany (2008), writing on the Cato Institute's blog in September 2008, took a related IPCC document, Working Group II's SPM, to task for predicting effects such as "Hundreds of millions of people exposed to increasing water stress." He argued that the authors selectively focused on drought areas rather than areas that would receive more water as a result of global warming and termed this omission equivalent to "perpetrating a fraud on the readers" (para 14). McLean (2008) compiled on the *Science and Public Policy Institute* blog what he claimed was a list of "50 articles that seriously question the credibility and integrity of the IPCC's activities and claims," one of which was his own article claiming the SPM authors were biased because many of them had previously published scientific papers together. Another was a critique of the SPM from the blog *spiked* by Woudhuysen and Kaplinsky (2007). These authors argued that by digesting and summarizing the AR4, the SPM was unwittingly participating in the fomenting of a "New Scientism" where "doubt, a key ingredient of the scientific method, is now out" (para 4). These critics performed readings of the IPCC's claims at the stases of value and action and then used them to attack the authors'

Mertonian ethos. But the IPCC writing team had other rhetorical "tricks" up their sleeves. It was their visual strategies in the AR4 SPM that enjoyed more success in stabilizing the IPCC's fractured ethos with some audiences.

Visualizations in the AR4 SPM: Integrating ethos across the "is/ought" divide

The most dramatic rhetorical devices in the SPM, the ones that have been copied and posted on blogs throughout the cybersphere, are the report's graphics, most of which represent the results of climate models. Computer models are the primary technology of prophecy for scientists. Even so, they are methodologically problematic because they operate at the ethically fraught stasis of cause/effect. Scientists input perceived causal factors and vectors to models and retrieve predicted effects. One of the *IPCC Synthesis Report* authors admitted, "All we have is theoretical evidence and modeling evidence now. The way we test our models is we run them on historic cases, and when they give us some semblance of reality in historic cases then we at least have modest confidence in them to project the future" (Schneider, 2005, para 8). Martin Parry, an SPM author, went to greater length to justify climate models in a BBC radio interview after the release of the AR4:

> Orthodox science has difficulty predicting the future, especially if we have experienced nothing like it in the past. Computer models are essential to these predictions. But to many non-scientists, they are an unknown quantity. However, a new development in the Fourth Assessment is that it concludes, from an examination of 29,000 data sets, that the impacts of climate change occurring now can be observed everywhere on our planet…This is traditional science-based observation and measurement, not 'arm-waving' with computer models. (Parry, 2007, November 13, para 25-28)

This discussion—with its hedges and justification, its performance of classical inductive argumentation—reveals that the IPCC authors are aware that basing their conclusions on computer models may open them up to further criticisms of their Mertonian mandate in public policy debates. The cause/effect stasis of the models is not their only difficulty. Since models take assumptions as input in addition to observations, their output is conditioned by scientists' best judgments about the nature of the relationship between the past, present, and future. In addition, modeling exercises primarily arise in response to public calls for scientific advice, such as the IPCC's mandate, quoted above, which includes "projected impacts" in the body's commission. So, models are

invoked in response to the very questions of value and action that are supposed to remain outside traditional scientific work.

The limited scholarship on the rhetoric of computer modeling in policy situations acknowledges these dynamics but handles them differently depending on the orientation of the particular scholars in question. In his study of forestry simulations, Luymes stresses that the inherent biases of models (in input and parameter selection) should be made apparent to its viewers (Luymes, 2001, p. 201). Meanwhile, Tavakoli and Thorngate just assume that policy models will be biased toward desired outcomes, and thus they recommend eliding or hiding the methodology of the model to increase its power to persuade the client's audience (Thorngate and Tavakoli, 2009, February 6, p. 13).

The inherent biases of models do not help stabilize the shaky ethical ground scientists find themselves standing on when addressing policy-leading issues, such as global warming. Advice such as Luymes's has little chance of working when the scientists' audience is not able to understand the technicalities of model construction. But the fact remains, as Schneider and Parry both argued above, that there is no way around modeling when scientists are asked questions about the future.

Aimee Kendall, in her analysis of the evidentiary status of computer simulations, argues that the virtual evidence that models can support traditional scientific evidence, rather than undermining it:

> Traditionally, scientific evidence falls under the category of epistemic or veridical evidence. First-hand observations strengthen the validity of the claims that scientists can make about lab experiment findings. Simulations, however, qualify as virtual evidence, because they rely on virtual observation rather than actual. Virtual observation yields important data about a problem. The data needn't be conclusive or absolute to lend meaning. That [they contain] the virtue of a thing—the worth and workings of it—gives [them] the capacity to explain the thing itself. (Kendall, 2005, p. 45)

In other words, climate simulations can add important meaning to policy situations without having to be matters of forensic fact. It's how these models are presented and interpreted that can bolster or damage scientists' right to speak on policy issues.

Of the ten graphics in the SPM, seven are visualizations of the results of computer models, and all operate primarily at the problematic stasis of cause/effect. More specifically, all graphics in the document exhibit one of both of the following characteristics:

- time series proceeding from past to future (left to right) showing increasing trends
- color-coding using red to indicate warming effects directly or indirectly (as in the concentration of greenhouse gases)

Perhaps the most famous graphic in the SPM is Figure SPM 5, versions of which appeared on over a dozen websites and blogs during 2007-2008:

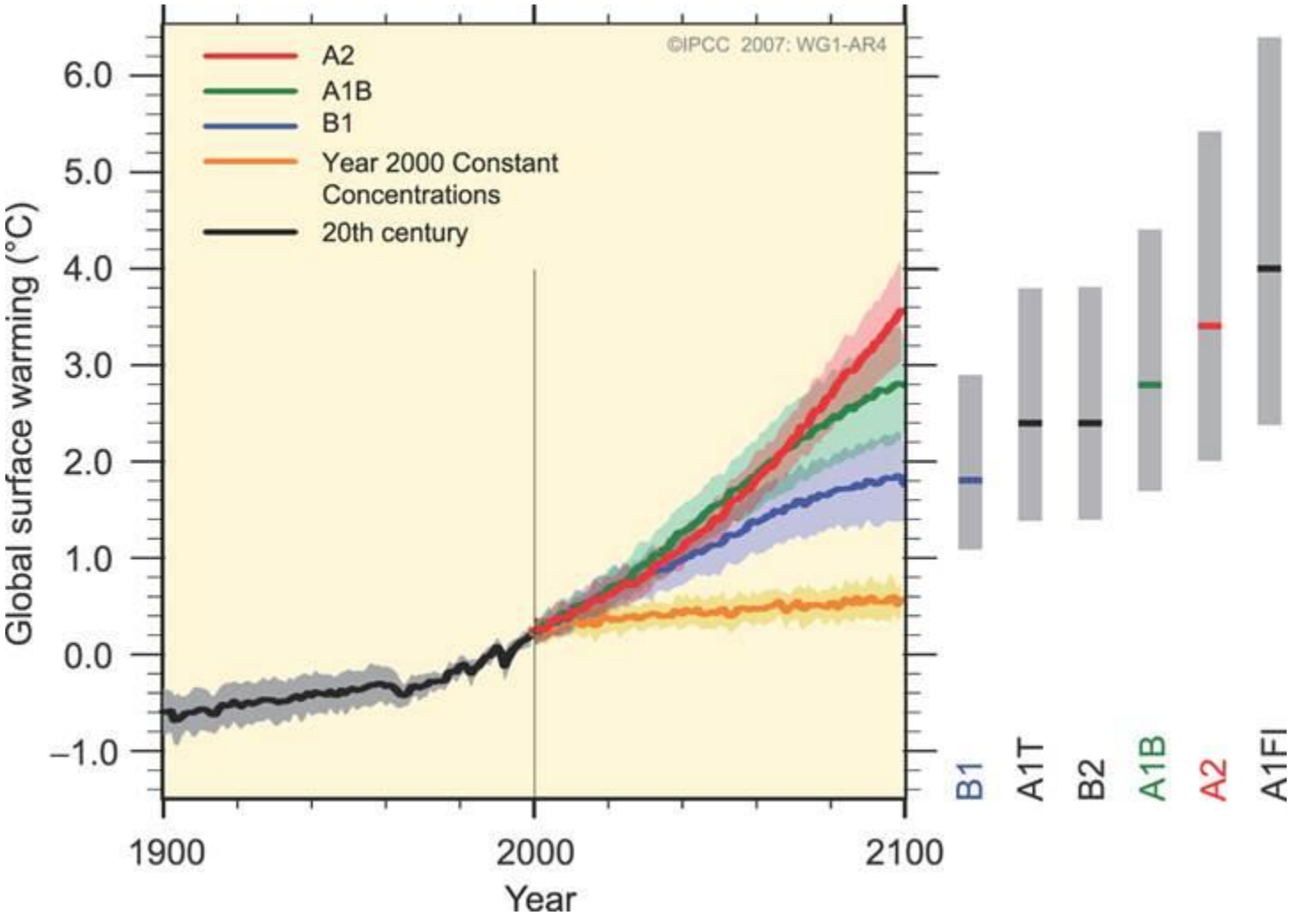

Figure 2: Figure SPM 5 showing model output for surface warming 1900-2100. Source: http://www.ipcc.ch/graphics/ar4-wg1/jpg/spm5.jpg

In terms of the theoretical discussion so far, the vertical line at the year 2000 locates both the present and the "is/ought" split: the observations to the left fall within the purview of Mertonian ethos (past, present) and are colored in somber, definitive black; the colored lines to the right represent possible future outcomes depending on model parameters, which were defined elsewhere in the document. Of these, the most extreme is colored red and dominates the visual impression of the graph; the red is alarming and implies a value judgment of "bad" that would underwrite policies crafted to avoid such a possible future.

In addition to these somewhat obvious arguments at the stases of value and action—performing the policy ethos of the IPCC authors—the visualization makes two less obvious rhetorical appeals. The first constructs the *continuity* of the IPCC scientists' ethos from the Mertonian ethos through the stasis of cause (the grounds for predicting the future based on the past) to the policy ethos; the implicit argument is, if we have the expertise to construct these models, you should trust our predictions and our policy advice. That argument underwrites the second appeal, which transfers the ethos of the expert scientist to the model itself, reifying it as a rhetorical object, an occasion for debate and analysis. Its rhetorical status is confirmed by its Internet replication after the release of the SPM, which sparked online discussions about questions such as, which scenario in the graph was really most probable? Were the parameters that generated the scenarios reasonable and reliable?

More importantly, however, the visualization of the model results reified a rhetorical object that could be critiqued separately; i.e., the model might be bad, but the good scientists who made it could correct its assumptions and predictions; this was the gist of several online discussions, such as a protracted debate between Gavin Schmidt of NASA and Roger Pielke, Jr., on Pielke's science policy blog, *Prometheus* (2008).

Most of the remaining visualizations in the SPM ran along the lines of Figure 2, but some added the dimension of space to create a heightened pathos appeal, such as Figure 3 (next page):

This figure provided a map so readers could locate their homes, partially obscured by the red blur of anthropogenic forcing of surface temperature (separated by both profile and color from natural forcing for effect). The invitation to compare/contrast the profiles, coupled with the invocation of "home" for the viewers, is designed to invoke pathos responses of identification and alarm. The pathos appeals of "hot" and "home" are both intensified in the following visualization, Figure 3:

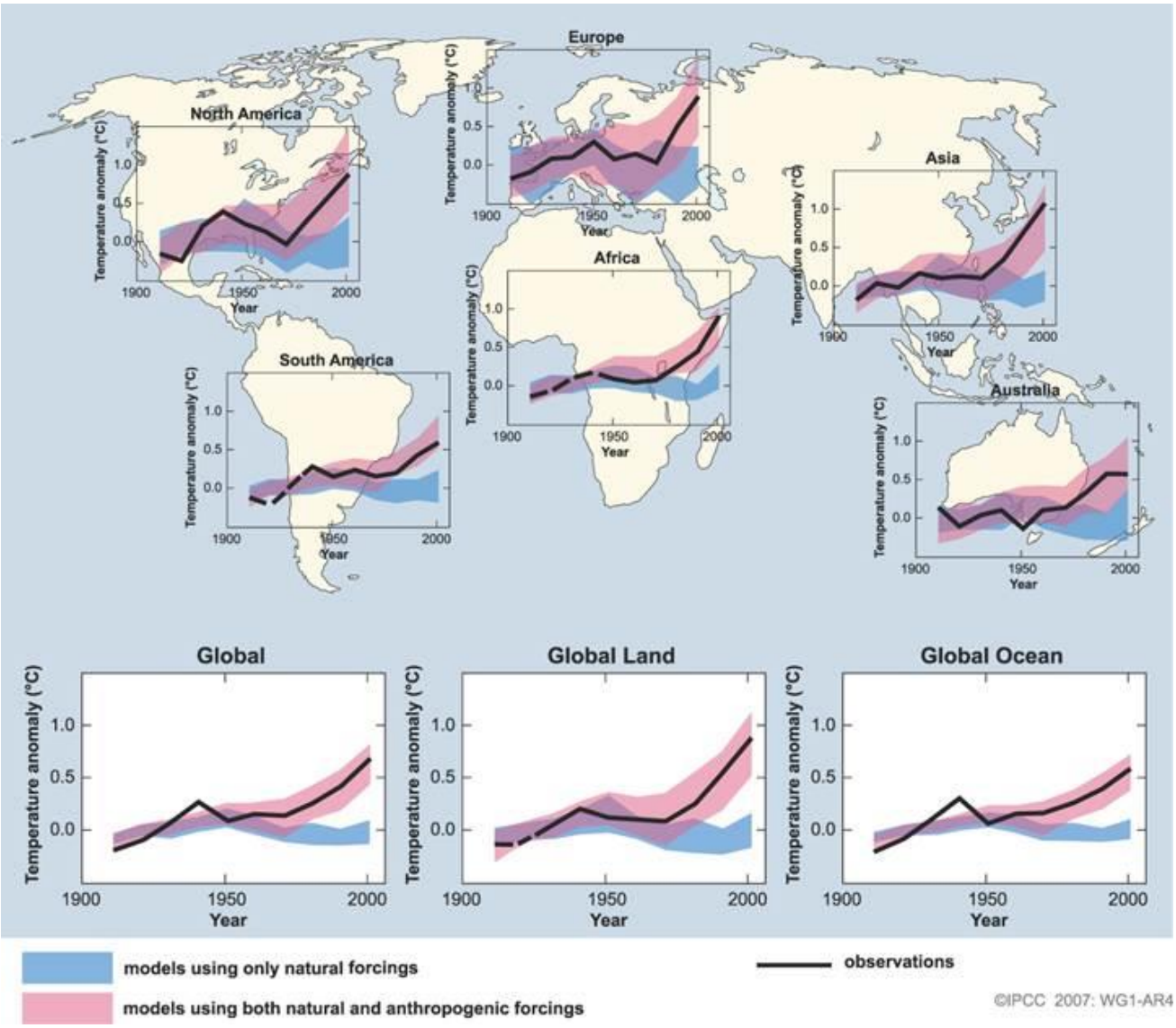

Figure 3: Figure SPM 4 with anthropogenic forcing of surface temperature in red. Source: http://www.ipcc.ch/graphics/ar4-wg1/jpg/spm4.jpg

The projected globes on the right appear to be boiling, no matter the extremity of the particular model in question. No one is safe.

To summarize the analysis of the rhetoric of the visualizations in the SPM as they relate to the authors' ethos: Linear trends perform the continuity of the authors' Mertonian ethos with their policy ethos. This is so even in two of the *tables*, which due to the parameters the researchers selected are organized left-to-right with time increasing. At the same time, pressure on the authors' personal ethos is eased by the strategies of intensifying pathos appeals ("hot" and "home") and of serving up the output of the models as *logoi* or rhetorical objects for debate. The complex and

vivid nature of the models also grab readers' attention, shifting the locus of persuasion away from the ethos of the IPCC authors.

Performance and reception of the AR4 SPM visualizations in the court of public opinion: Establishing ethical distance and intensifying pathos appeals

The publication of the AR4 was followed up by a series of lectures at universities across the country, during which authors presented key graphics from the SPM and gave overviews tailored to particular audiences—fellow scientists, voters, policymakers. I attended one of these talks at a small technical university, attended by both university faculty and members of the public, and found the rhetorical strategies listed above reinforced as follows. First, the IPCC speaker stood apart from the model results and pointed to them with a laser pointer rather than inserting his hand in the image to point out aspects of it. This stance performed the reification of the predictions and their separation from his personal ethos. Second, he performed the continuity of Mertonian and policy ethos with repeated left-to-right motions of the laser pointer following past-to-future trends on the projected graphics. Finally, the speaker added a slide that replicated the "hot spot" strategy used in Figure 4 at a regional level; at that scale, those of us in the

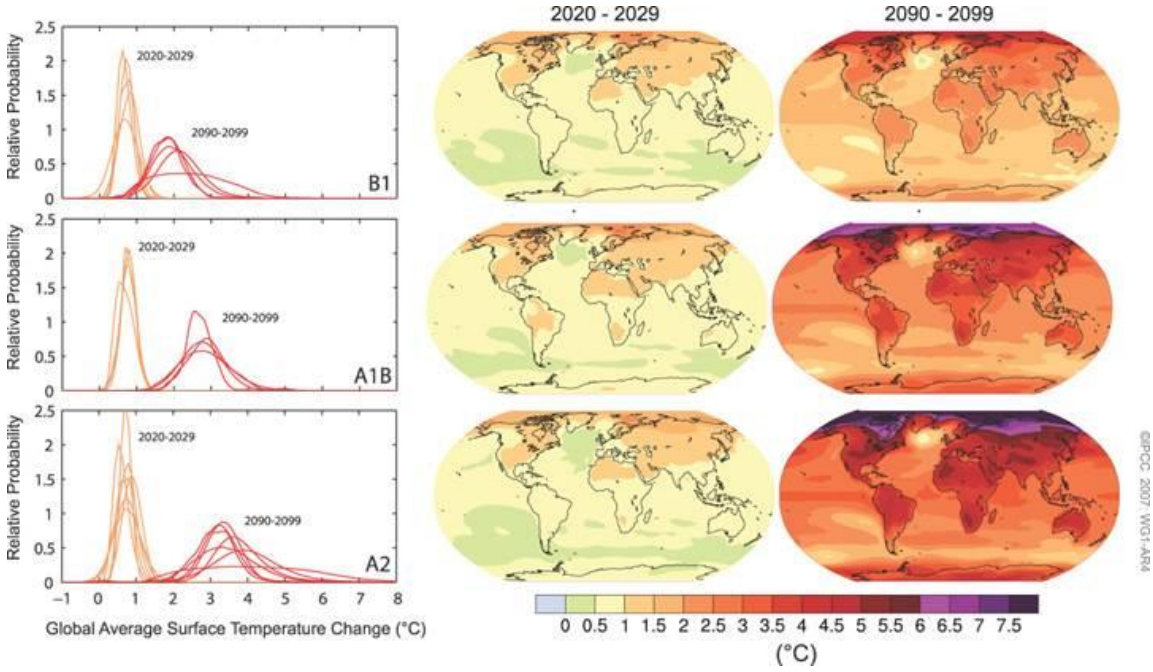

Figure 4: Figure SPM 6 with surface temperature projections mapped in hot colors. Source: http://www.ipcc.ch/graphics/ar4-wg1/jpg/spm6.jpg

audience could pick out the city or mountain range in which we lived and observe how much hotter it was predicted to be by 2050.

Were these strategies recognized by members of the AR4 SPM's audience? I can tell you that the presentation of the "hot" regional map at the SPM talk was greeted with an audible gasp from some members of the audience. Naturally, this response only indicates that the pathos appeals of "hot" and "home" hit their marks with some viewers, but there is at least some evidence that the color appeals also registered with skeptical scientists. The Fraser Institute, a conservative think-tank, issued the "Independent Summary for Policy Makers" (McKitrick, 2007) in response to the AR4 SPM. This document also makes use of copious model visualizations, some of which are explicit revisions of AR4 graphics under differing assumptions (Figures 5 and 6). The Fraser authors use the same time series and the same overall color scheme throughout the document, but overall they employ the "cool" colors of blue and black to underwrite their argument against anthropogenic forcing of climate change.

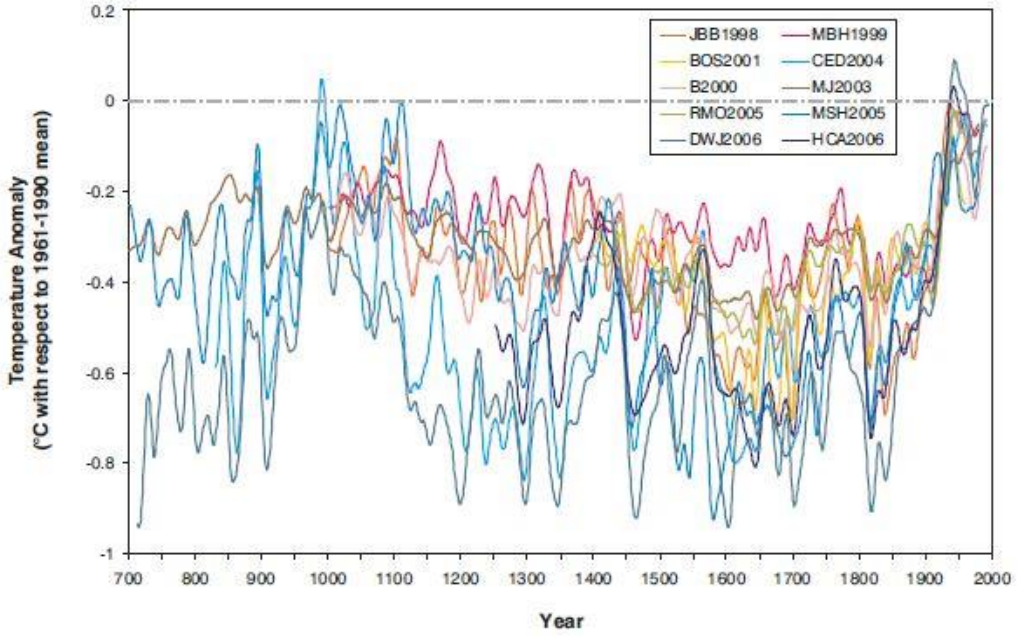

Figure 5: Figure ISPM 9, revision of AR4 6-10b with the color series altered to foreground cool tones. Compare with Figure 6.

Source: http://www.fraserinstitute.org/Commerce.Web/product_files/IndependentSummary5.pdf

While the specific arguments implied by the models in the ISPM and the SPM are diametrically opposed, the Fraser report replicates the SPM's overall rhetorical strategies: visualizations, performances of continuity, and pathos appeals. Therefore, while contesting the IPCC's conclusions, it appears that the Fraser authors nonetheless share the IPCC's opinion of the effectiveness of these strategies for

an audience of policymakers. Furthermore, the Fraser's replication and discussion of so many of the IPCC's graphics is an indirect indicator that the IPCC authors succeeded at least partially in shifting the locus of criticism away from their fractured ethos and toward the objectified model results.

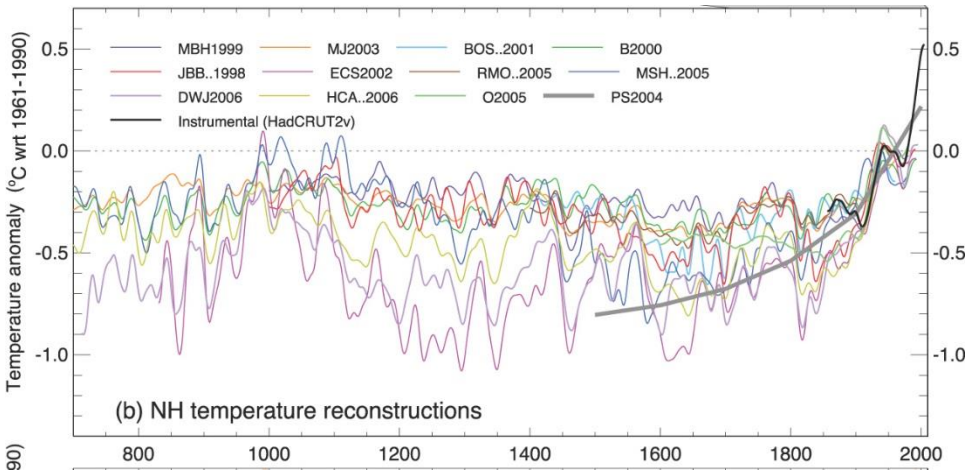

Figure 6: AR4 6-10b. Source: http://www.ipcc.ch/graphics/ar4-wg1/jpg/fig-6-10.jpg

Another intriguing piece of circumstantial evidence for the effectiveness of the visual and other strategies of ethical integration in the AR4 SPM is a sharp spike in the use of the phrase "global warming denier" in Internet news sources coinciding with the report's publication. Google Timeline, which graphs the occurrence of search terms on Web news sites and blogs over time, shows that instances of the term nearly doubled between January 2007 (98 uses) and February 2007 (182 uses), the month the Working Group I SPM was pre-released. Since that month, the term has remained in higher currency in Internet news than it has during any previous epoch in Web history. What is the significance of this trend? "Denier" is a much stronger term than "skeptic," implying willful disbelief. It has been applied to those who deny the existence of the Holocaust and other human atrocities. Using this epithet, therefore, means taking a serious ethical risk for news writers, who are in general are enjoined to eschew *ad hominem* attacks, even in op/ed pieces. If twice as many news sites were willing to take this risk after the publication of the SPM, it suggests that they felt licensed by the consensus findings of the report—which in turn suggests that the IPCC succeeded in projecting an integrated ethos, thus

establishing their findings as scientific fact rather than as the mere opinions of a fractious and biased advocacy think-tank.

Conclusion: Ethos, Pathos, and Logos in the IPCC Report

An analysis of the rhetoric of model visualizations in the AR4 SPM reveals the SPM authors attempted to re-integrate their ethos before policymakers and members of the public via a performance of ethical continuity. That they acknowledged an "is/ought" divide in their ethos is clear from their linguistic choices in the document, as they were careful to use verbs and nouns consistent with Mertonian ethos. To re-integrate their ethos, the IPCC authors visualized its continuity across the "is/ought" divide, substituted models for people as critical objects, and used color strategically to create fear-based pathos appeals. The strategies' ultimate persuasive success is indeterminate; however, their replication in a major rival policy publication as well as the increase in *ad hominem* attacks against skeptics by Internet news sources following the SPM's publication indirectly support their effectiveness. That the AR4 SPM *in toto* stabilized rather than destabilized the IPCC's ethos is evident in the Nobel Prize it received in December 2007.

While the visualizations may represent a locally effective strategy for performing ethical re-integration, bodies such as the IPCC can continue to expect statements about cause and effect, and models at that stasis, to be interpreted as value judgments and policy recommendations due to the upward pull of the stases—no matter how much they protest that these arguments are "neutral with respect to policy" (IPCC, 2009, para 1). Are there comprehensive solutions to the ethical paradox faced by policy scientists advising the United States government?

Pielke, Jr.'s (2007) suggests a solution that would ironically intensify the "is/ought" stricture by more sharply delineating the Mertonian ethos of the scientist from his/her "policy" ethos. The scientist accomplishes this ethical feat in Pielke's scheme by eliding the "I" or "we" from policy recommendations, instead presenting a range of policy options to decision-makers without endorsing particular outcomes. Pielke calls this model the "honest broker" model and contrasts it with the "stealth issue advocacy" that results during Abortion Politics-type debates when scientists—in at attempt to re-integrate their Mertonian ethos with their citizen or policy ethos—present policy ("ought") as scientific fact ("is"); Pielke points to remote sensing of weapons of mass destruction in advance of the Iraq War as a particularly notorious example of a few technical experts pushing policy with the engine of "fact" (2007, p. 99).

The litmus test, Pielke explains, for distinguishing the "stealth issue advocate" from the "honest broker of policy alternatives" is "the latter seeks to reduce the scope of available choice, while the former seeks to expand (or at least clarify) the scope of choice" (2007, p. 18), a definition which raises an interesting problem for his proposal to re-integrate the fractured ethos of the policy scientist. His solution assumes two points: 1. that the multiplication of policy alternatives will appear to enforce the "objectivity" norm of the scientists' Mertonian ethos, and 2. that the scientist can somehow anticipate all relevant policy alternatives. The first assumption may hold, but as for the second, Pielke himself states elsewhere real policy situations often feature "fundamental, irreducible uncertainty about the problem and policy options" (p. 52). In these situations, Pielke's "honest broker" by definition must limit policy options using his/her best judgment. Thus, by Pielke's own criteria, the "honest broker" becomes vulnerable to the criticisms leveled at "stealth issue advocates."

Shapin (2008) primarily examines science policy decisions made in the private sector and the world of venture capitalists, but the implication of concluding his history of the American scientist with a venture-capital case study is not lost on the reader: The private sector may become the primary technoscience policy arena in the United States. In the overwhelmingly technical and breakneck world Shapin describes, venture capitalists resort to pre-modern rhetorical grounds for deciding which projects to fund: it's largely about trust, personal familiarity, and whether a scientist comes across to his/her potential investors as "good people" (2008, 282-303). Thus, Shapin argues that the drive to simplify a fundamentally uncertain policy landscape may lead us to bypass the "is/ought" stricture and place our future in the hands of trusted individuals.

Perhaps policy scientists can re-integrate their ethos by using "tricks" such as the visualizations in the AR4 SPM. Perhaps Pielke, Jr. (2007) is right, and clearly delineating the scientific facts from the policy alternatives will alleviate the pressure on policy scientists' ethos. However, even if these integrative strategies succeed, it is likely given the long history of the "is/ought" stricture that ethical criticism of policy scientists will merely shift up-stasis in response. Critiques of policy scientists will then target their "withholding" or selecting of certain policy alternatives as biased political decisions. These strategies were nascent in some responses to the SPM (Goklany, 2008; Woudhuysen and Kaplinsky, 2007)

and have already been realized in some critics' interpretation of comments in the Climategate emails as evidence that IPCC authors were subverting peer review and suppressing antithetical views (Knappenberger, 2009, December 2; Tracinski, 2009, November 24; Watson, 2009, November 23). Unless and until the social position of the policy scientist is radically restructured in America—perhaps through privatization, as obliquely predicted by Shapin's absorbing study of American venture-capitalism—public debate of scientific issues in the United States will continue to turn on the ethos of the citizens we have engaged to advise us.

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Notes

[i] Blogs such as climateark.org, climateprogress.org, realclimate.org, and greenfacts.org contain multiple references to the significance of the AR4, especially with respect to whether the scientific consensus on anthropogenic warming should be judged skeptically. For a more centrist example of the same rhetoric, see Oppenheimer et. al.’s “Climate Change: The Limits of Consensus,” Science 14 September 2007: 1505-1506. This article’s title belies its actual argument. It warns that the unprecedented consensus reflected in the AR4 may mislead policymakers into downplaying or ignoring some of the more dire possible outcomes of anthropogenic warming that had been excluded from the IPCC consensus.

[ii] Lest I give the impression that these ethical attacks are lobbed only at the scientists who recommend (or whose work grounds recommendations of) activism against anthropogenic warming, there are myriad examples of exactly the same types of arguments leveled against skeptical scientists. Just a few quick examples to illustrate: Michael Mann refers to McKitrick and McIntyre’s (2003) criticisms of the methods behind Mann’s famous “hockey stick” graph as “refuted claims…by two Canadians (an economist and an oil industry consultant),” obviously implying the researchers’ industry connections cast aspersions on their scientific findings: quoted in (Schmidt, 2006, July 14). And Crooked Timber (Quiggin, 2006, January 4) lumps McKitrick with “’sceptics’ [who] are not, as they claim, fearless seekers after scientific truth, but ideological partisans and paid advocates, presenting dishonest arguments for a predetermined party-line conclusion” (para. 6).

[iii] Implicature is the logical process by which an unstated but understood proposition is generated by a different utterance within a habitual system of communication; e.g., irony is an example of implicature at work. See Grice (1975).