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Reliable Science: Overcoming Public Doubts in the Climate Change Debate

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RELIABLE SCIENCE: OVERCOMING PUBLIC DOUBTS IN THE CLIMATE CHANGE DEBATE

MICHELLE S. SIMON* & WILLIAM PENTLAND**

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INTRODUCTION

Every day, the U.S. government spends millions of dollars protecting airports, train stations and other locations from terrorist threats based

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on a small percentage chance that a terrorist might strike at that location and on that day.¹ The public seldom seriously questions the wisdom of these investments. By contrast, despite mounting evidence of the risks posed by climate change, the public has remained reluctant to support even modest policies to prevent the potential risks posed by climate change. What makes climate change different? At least part of the explanation is that non-trivial portions of the public lack confidence in the credibility and legitimacy of climate change science.² Several recent surveys and opinion polls suggest that the public's perception of the legitimacy and credibility of climate science has deteriorated dramatically over the past three years.³ A significant reason why the debate has become so intractable⁴ is the tendency to view through a scientific lens the complicated political, social and economic issues involved in climate change policy.⁵ This dynamic confuses

¹ See John Mueller & Mark G. Stewart, *Terror, Security, and Money: Balancing the Risks, Benefits, and Costs of Homeland Security* 2, 13, 15 (Mar. 20, 2011) (unpublished paper prepared for presentation at the panel *Terror and the Economy: Which Institutions Help Mitigate the Damage?* at the Annual Convention of the Midwest Political Science Association, April 1, 2011), available at <http://polisci.osu.edu/faculty/jmueller/MID11TSM.PDF>.

² See, e.g., ANTHONY LEISEROWITZ ET AL., *GLOBAL WARMING'S SIX AMERICAS 2009: AN AUDIENCE SEGMENTATION ANALYSIS* 3 (2009) [hereinafter LEISEROWITZ ET AL., *GLOBAL WARMING'S SIX AMERICAS 2009*] (segmenting the public views on climate change as "Alarmed" (18 percent), "Concerned" (33 percent), "Cautious" (19 percent), "Disengaged" (12 percent), "Doubtful" (11 percent), and "Dismissive" (7 percent)); CRAIG IDSO & S. FRED SINGER, *CLIMATE CHANGE RECONSIDERED: REPORT OF THE NONGOVERNMENTAL INTERNATIONAL PANEL ON CLIMATE CHANGE (NIPCC)* (2009); *GLOBAL WARMING PETITION PROJECT*, <http://www.petitionproject.org> (last visited Oct. 30, 2012).

³ See, e.g., *69% Say It's Likely Scientists Have Falsified Global Warming Research*, RASMUSSEN REPORTS (Aug. 3, 2011) http://www.rasmussenreports.com/public_content/politics/current_events/environment_energy/69_say_it_s_likely_scientists_have_falsified_global_warming_research; Anita Pugliese & Julie Ray, *Fewer Americans, Europeans View Global Warming as a Threat*, GALLUP (Apr 20, 2011), <http://www.gallup.com/poll/147203/Fewer-Americans-Europeans-View-Global-Warming-Threat.aspx> (noting ten percent declines in public concern about climate change in Western Europe and United States from 2007 to 2008 and 2010).

⁴ See, e.g., Andrew Hoffman, *The Growing Climate Divide*, 1 *NATURE CLIMATE CHANGE* 195, 195 (July 2011); Aaron M. McCright & Riley E. Dunlap, *The Politicization of Climate Change and Polarization in the American Public's Views of Global Warming, 2001–2010*, 52 *SOCIOL. QUART.* 155, 155 (2011); MIKE HULME, *WHY WE DISAGREE ABOUT CLIMATE CHANGE: UNDERSTANDING CONTROVERSY, INACTION AND OPPORTUNITY* xxiii (Cambridge 2009).

⁵ See, e.g., Andrew J. Hoffman, *Talking Past Each Other? Cultural Framing of Skeptical and Convinced Logics in the Climate Change Debate*, 24 *ORG. ENV'T* 3, 4 (2011); Jeroen van der Sluijs et al., *Beyond Consensus: Reflections from a Democratic Perspective on the Interaction Between Climate Politics and Science*, 2 *CURRENT OPINION IN ENV'T SUSTAINABILITY* 409, 409 (2010) (exploring the complex interactions between science and policy in the context of climate change); Daniel Sarewitz, *How Science Makes Environmental Controversies*

the issues, exacerbates misunderstandings, and makes them more difficult for the public to understand.⁶ Something must be done to restore the public's confidence in the credibility of climate change science. The public discourse surrounding climate change needs to separate the science from the rest of the debate so that the public can understand the political and social issues better.

Climate policy is unlikely to escape its present state of paralysis unless the credibility and legitimacy of climate science is restored.⁷ In addition to diminishing support for new climate policies, the crisis of confidence in climate science is interfering with the efforts of federal agencies trying to implement existing environmental regulations. For example, the U.S. Environmental Protection Agency ("EPA") was heavily criticized—and legally challenged—for supporting an Endangerment Finding for Greenhouse Gases under Section 202(a) of the Clean Air Act.⁸ The public's concerns about the credibility of climate change science are usually associated with the scientific findings of the Intergovernmental Panel on Climate Change ("IPCC").⁹

In 1988, the United Nations General Assembly established the IPCC to provide the governments of the world with a comprehensive assessment of the state of scientific knowledge regarding climate change.¹⁰

Worse, 7 ENVTL. SCI. & POL'Y 385, 385 (2004) (claiming that science exacerbates political controversies associated with environmental issues).

⁶ See sources cited *supra* note 4.

⁷ Jerry Ravetz, *The Post-Normal Science of Precaution*, 36 FUTURES 347, 347 (2004).

⁸ See, e.g., U.S. EPA, OFFICE OF INSPECTOR GENERAL, REPORT NO. 11-P-0702, PROCEDURAL REVIEW OF EPA'S GREENHOUSE GASES ENDANGERMENT FINDING DATA QUALITY PROCESSES (2011); U.S. EPA, RESPONSE TO THE PETITIONS TO RECONSIDER THE ENDANGERMENT AND CAUSE OR CONTRIBUTE FINDINGS FOR GREENHOUSE GASES UNDER SECTION 202(A) OF THE CLEAN AIR ACT, VOL. I, II, III (2010).

⁹ Judith Curry, *On the Credibility of Climate Research, Part II: Towards Rebuilding Trust*, CLIMATE CHANGE BLOG (Feb. 24, 2010) http://curry.eas.gatech.edu/climate/towards_rebuilding_trust.html.

¹⁰ See, e.g., INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, ORGANIZATION, <http://www.ipcc.ch/organization/organization.shtml> (last visited Oct. 30, 2012).

The Intergovernmental Panel on Climate Change (IPCC) is the leading international body for the assessment of climate change. It was established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) in 1988 to provide the world with a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio-economic impacts. In the same year, the UN General Assembly endorsed the action by WMO and UNEP in jointly establishing the IPCC.

Id.

The credibility and legitimacy of the IPCC's assessments have suffered huge losses among members of the public after several errors were discovered in the most recent IPCC report, the Fourth Assessment Report ("AR4"), errors which resulted primarily from the IPCC's mistreatment of non-peer-reviewed research.¹¹ Perhaps the most widely publicized of these errors involved a prediction in the AR4 that the world's glaciers were melting so fast that those in the Himalayas could disappear by 2035.¹² In 2009, a journalist discovered that this claim was based on a news story he had written seven years before the Assessment Report, and that the news story was based on a short telephone interview with a little-known Indian scientist.¹³ That scientist subsequently admitted that the claim was not supported by any formal research,¹⁴ and in 2010, the IPCC retracted the claim.¹⁵ As a result, the IPCC instituted a review of its assessment procedures, and concluded that it had to change its practices for handling non-peer-reviewed literature to ensure these kinds of mistakes do not happen in the future.¹⁶

The issues surrounding the credibility and legitimacy of IPCC assessments mirror many of the reliability issues regarding the admissibility of scientific evidence at trial. From 1923 to 1993, the "general acceptance test" articulated in *Frye v. United States*¹⁷ was the standard for determining the admissibility of novel scientific evidence. Under this test, the scientific community was charged with determining the validity of scientific evidence.¹⁸ In 1993, in *Daubert v. Merrell Dow Pharmaceuticals*, the Supreme Court held that the *Frye* standard was superseded by Rule 702 of the Federal Rules of Evidence.¹⁹ Instead, the Court created a flexible

¹¹ See INTERACADEMY COUNCIL COMMITTEE TO REVIEW THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE ASSESSMENTS: REVIEW OF THE PROCESSES AND PROCEDURES OF THE IPCC xiii–xiv (2010).

¹² See MARTIN PERRY ET AL. EDS., CONTRIBUTION OF WORKING GROUP II TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 493 (2007).

¹³ See Fred Pearce, *Claims Himalayan Glaciers Could Melt by 2035 Were False, Says UN Scientist*, GUARDIAN (Jan. 20, 2010), <http://www.guardian.co.uk/environment/2010/jan/20/himalayan-glaciers-melt-claims-false-ipcc>.

¹⁴ *Id.*

¹⁵ See Press Release, Intergovernmental Panel on Climate Change, IPCC Statement on the Melting of Himalayan Glaciers (Jan. 20, 2011).

¹⁶ See INTERACADEMY COUNCIL COMMITTEE TO REVIEW THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 11.

¹⁷ See *Frye v. United States*, 293 F. 1013, 1014 (D.C. Cir. 1923).

¹⁸ *Id.*

¹⁹ *Daubert v. Merrell Dow Pharm.*, 509 U.S. 579, 587 (1993).

inquiry based on principles and methodology.²⁰ Unlike the standard in *Frye*, which essentially outsourced admissibility determinations to the scientific community, the standard in *Daubert* and its progeny tasks judges with separating good science from bad science by using those inquiries.²¹

The approach in *Daubert* and its progeny should be used as a framework to vet research in climate change assessments, because it is flexible, gives the responsibility to the non-scientific community, and rejects a “one size fits all” model. The best way to achieve this objective is to establish a domestic institution that is devoted to evaluating the scientific evidence included in an IPCC assessment by conducting a more expansive and flexible review within the *Daubert* guidelines. By moving away from the “*Frye*-like” narrow, scientifically based analysis into a broader public based analysis, we will be able to restore the legitimacy of climate science. Having more credible and legitimate assessments will yield other benefits, such as making it more likely that the scientific results will be able to inform public policy, and it will reduce the complexity and confusion of the public debate by shifting the debate away from the science to the political and social issues, where it belongs.²²

This article will consider the case for instituting a domestic agency that would evaluate the findings from IPCC assessments to improve the credibility and legitimacy of those claims and conclusions for multiple purposes. The proposed agency would consider the robustness of an assessment’s conclusions by construing the evidence through the lens of *Daubert* rather than *Frye*. Part I will outline the public debate about climate science—what the debate is about and why it exists. Part II will examine the current role of the IPCC—what it is and why it has not been successful in legitimating U.S. policies responding to the potential risks posed by climate change. Part III will review the Court’s approaches to the understanding of science in the context of the admissibility of scientific evidence. Part IV will suggest a new framework for reviewing the IPCC’s assessments based on those standards, and will analyze how that new framework has the potential to change the public’s view about climate science.

²⁰ *Id.* at 594–95.

²¹ *Id.*; see *United States v. Saelee*, 162 F. Supp. 1097, 1100 (D. Alaska 2001) (explaining that “*Daubert* assigned a gatekeeping function to trial judges to exclude unreliable scientific expert testimony. *Kumho* extended this gatekeeping function not only to scientific testimony but also to all expert testimony”).

²² See Sarewitz, *supra* note 5, at 389.

I. THE DEBATE ABOUT CLIMATE SCIENCE: WHAT IT IS AND WHY IT EXISTS

The controversy surrounding climate change science in the United States has been attributed to the prevalence of scientific illiteracy,²³ lack of familiarity with technical problems,²⁴ industry propaganda²⁵ and political luddites.²⁶ Yet, the dispute is not about the basic principles of climate change science. For example, the scientific basis for the greenhouse effect, which maintains that greenhouse gases (“GHG”) in the atmosphere trap and reradiate thermal energy from the sun in all directions, was widely accepted by scientists long before anyone had heard of anthropogenic climate change.²⁷ Instead, the main disagreements about climate change science “are over how certain the research must be to reach various conclusions and findings, not so much in the substance of the science itself.”²⁸ While the mere fact of climate change is not controversial, the consequences of climate change are extraordinarily so.²⁹ Rather, the climate change debate is about whether climate science can support specific conclusions about the consequences of climate change with objective scientific facts.³⁰

The climate system is a complicated composite of several subsystems, including the hydrosphere, the biosphere, the atmosphere, the geosphere, and human systems.³¹ In turn, each of these subsystems

²³ See Susanne C. Moser & Julia A. Ekstrom, *A Framework to Diagnose Barriers to Climate Change Adaptation*, 107 NAT'L ACAD. OF SCI. 22026, 22028 (2010) (arguing that climate change is hard for non-specialists to understand, because it is inherently difficult and media has not sent clear signals for the need to respond for the common good).

²⁴ See Daniel Read et al., *What Do People Know About Global Climate Change?*, 14 RISK ANALYSIS: AN INT'L JOURNAL 971, 971 (1994) (arguing that ingrained cognitive and affective responses to risk may cause people to misinterpret the risks of climate change).

²⁵ See, e.g., Naomi Oreskes & Erik M. Conway, *MERCHANTS OF DOUBT* (2010); David Michaels, *Doubt Is Their Product*, 292 SCI. AM. 96, 96 (2005); Memorandum from Frank Luntz: A Cleaner, Healthier, and Safer Am. to GOP Cong. Candidates 137 (2002).

²⁶ See JAMES LAWRENCE POWELL, *THE INQUISITION OF CLIMATE SCIENCE* 1 (2011).

²⁷ See Svante Arrhenius, *On the Influence of Carbonic Acid in the Air Upon the Temperature of the Ground*, 41 PHIL. MAG. & J. OF SCI. 237, 263 (1896), available at http://www.rsc.org/images/Arrhenius1896_tcm18-173546.pdf.

²⁸ See Letter From Michael MacCracken to Margo Schaub, *Comments on Draft Guidelines for Peer Review and Information Quality* 2 (Oct. 6 2003).

²⁹ *Id.*

³⁰ *Id.*

³¹ The major components of the climate system bearing on climate change and its consequences over the next century are: the atmosphere, oceans, terrestrial biosphere, glaciers and ice sheets, and land surface. See IPCC, *TECHNICAL PAPER II, AN INTRODUCTION TO*

encompasses separate components, which include distinct elements and so on and so forth.³² For example, human systems encompass various economic, political and cultural subsystems.³³ The climate's behavior reflects the collective interactions of these systems and subsystems, but not always in a linear manner. The so-called "butterfly effect" is a popular metaphor for explaining the chaotic behavior of complex systems like the Earth's climate.³⁴ A butterfly flapping its wings in Asia creates a tropical storm in the Atlantic Ocean a few weeks later.³⁵ In complex systems, the slightest variation in initial conditions can create large deviations in future system conditions over time, and not necessarily in predictable ways.³⁶

The controversy about whether the science can support conclusions about the impact of climate change is a result of the uncertainty that is intrinsic to this kind of complex system. In particular, there are three dynamics driving the deadlock over climate change. First, "[s]ignificant [scientific] uncertainties plague projections of climate change and its consequences."³⁷ Second, the projected consequences of climate change are loaded with value judgments, which may be perfectly legitimate but are often hidden.³⁸ Third, the problem posed by climate change can be framed to accommodate a plurality of fundamentally different but equally legitimate perspectives.³⁹

SIMPLE CLIMATE MODELS USED IN THE IPCC SECOND ASSESSMENT REPORT 1997 [hereinafter IPCC TECHNICAL PAPER II].

³² *Id.*

³³ See NAT'L RESEARCH COUNCIL, GLOBAL ENVIRONMENTAL CHANGE 26 (Paul C. Stern et al. eds., 1992).

³⁴ Edward Lorenz, the mathematician who discovered "sensitive dependence on initial conditions" and pioneered chaos theory, coined this metaphor in a speech, "Does the Flap of a Butterfly's Wings in Brazil Set off a Tornado in Texas," he delivered in 1973. See Edward N. Lorenz, Predictability: Does the Flap of a Butterfly's Wings in Brazil Set Off a Tornado in Texas? at the 139th Meeting of the Am. Ass'n for the Advancement of Sci. (Dec. 29, 1972), in EDWARD N. LORENZ, THE ESSENCE OF CHAOS 181 (1993).

³⁵ See John Quiggin, *Complexity, Climate Change and the Precautionary Principle* 6 (Univ. of Queensland Risk & Sustainable Mgmt. Grp, Working Paper No. C07#3), available at http://www.uq.edu.au/rsmg/WP/WPC07_3.pdf (noting that nonlinearities in the system may enhance stability or generate instability).

³⁶ *Id.*

³⁷ Stephen H. Schneider & Kristin Kuntz-Duriseti, *Uncertainty and Climate Change Policy*, in CLIMATE CHANGE POLICY: A SURVEY 54 (Stephen H. Schneider et al. eds., 2002).

³⁸ See Daniel A. Farber, *Uncertainty*, 99 GEO. L.J. 901 (2011).

³⁹ In the context of climate change, problem framing, value-loading and uncertainty have allowed questions of social value to be transformed into questions of scientific fact. Each of these three dynamics are intrinsic to the production of climate science. See, e.g., Schneider & Kuntz-Duriseti, *supra* note 37.

A. *Uncertainties of the Science*

While today's best estimates predict that average global temperatures will rise between 2° to 4°C by the year 2100 as a result of anthropogenic climate change, the variability of these estimates is relatively large.⁴⁰ Moreover, decades of research suggest that it may not be possible to obtain a definitive reduction in this uncertainty within the time frame needed to avoid the worst effects of climate change.⁴¹ As a result, uncertainty associated with climate change and its impacts has become the greatest problem for policy makers.

The term "uncertainty" encompasses a spectrum of meanings ranging from a lack of absolute precision to such vagueness as to preclude anything other than speculation. The sources of uncertainty are equally diverse, including linguistic imprecision, measurement errors, approximation and many others. Science is no stranger to uncertainty. It is an intrinsic aspect of the scientific enterprise.⁴² So why has uncertainty become so salient in climate change science, especially in the context of the projected consequences of climate change?⁴³ To begin, in the context of climate change, the conventional sources of scientific uncertainty are compounded by their scale, long time horizons and, "the impossibility of before-the-fact experimental controls."⁴⁴

Climate change takes place at many scales, from the atmosphere as a whole, to local micro-climates and the ecosystems they support.⁴⁵

⁴⁰ See GEORGE BACKUS ET AL., SANDIA REPORT ASSESSING THE NEAR-TERM RISK OF CLIMATE UNCERTAINTY: INTERDEPENDENCIES AMONG THE U.S. STATES 9 (2010).

⁴¹ *Id.*

⁴² See *Climate Change Research and Scientific Integrity: Hearing on S. 1060 Before the S. Comm. on Commerce, Sci. & Transp.*, 110th Cong. 73, 76 (2007) (statement of Peter Gleick, President of Pacific Inst.). "Absolute certainty in science, or even in politics, is a rare luxury, and never guaranteed. Insisting that scientists provide certainty before setting vital public policy is a recipe for inaction and delay . . ." *Id.*

⁴³ See Martijntje Smits, *Taming Monsters: The Cultural Domestication of New Technology*, 28 TECH. SOC'Y 489 (2004).

⁴⁴ Richard H. Moss & Stephen H. Schneider, *Uncertainties in the IPCC TAR: Recommendations to Lead Authors for More Consistent Assessment and Reporting*, GUIDANCE PAPERS ON THE CROSS CUTTING ISSUES OF THE THIRD ASSESSMENT REPORT OF THE IPCC 33, 35 (R. Pachauri et al. eds., 2000), available at <http://www.ipcc.ch/pdf/supporting-material/guidance-papers-3rd-assessment.pdf>.

⁴⁵ See, e.g., Quiggin, *supra* note 35, at 7 (noting that complex systems may encompass "emergent" effects, which arise when "behaviour at some scale of aggregation, such as a national economy or a global climate system cannot be derived by modelling behaviour at a more disaggregated scale, such as that of individual industries or components of the climate system"). See also JOSEPH Y. HALPERN, REASONING ABOUT UNCERTAINTY (2003).

Climate change projections are also affected by structural sources of uncertainty arising from the complex interactions between socioeconomic, biological, and atmospheric systems.⁴⁶ These interactions within the climate system, such as changes in the dynamics of cloud formation and in the development of tropical cyclones, are frequently non-linear. For instance, rising temperatures may result in more frequent and more intense bushfires, which in turn produce massive emissions of CO₂ and lead to further warming.⁴⁷ The future interactions of human activities and these natural processes is likely the greatest source of uncertainty in climate models.⁴⁸

B. Judgments and Assumptions in the Analysis

Within the scientific community, there are normative judgments that are made about the choice of model used, the parameters selected, and where system boundaries are drawn for purposes of describing the problem.⁴⁹ This is known as value loading.⁵⁰ In varying degrees, all statistical analysis is affected by value loading. As one contemporary philosopher of science explained: “[a]ll statistical tests are value-loaded, necessarily designed to avoid one or another sort of error . . . any test might be overly selective, rejecting correlations that are probably real; or it might be overly sensitive, accepting correlations that are probably accidental It is impossible to design a statistical test which avoids both types of error; there must be a choice, made by someone, somewhere.”⁵¹

⁴⁶ See Moss & Schneider, *supra* note 44, at 39.

The process whereby uncertainty accumulates throughout the process of climate change prediction and impact assessment has been variously described as a “cascade of uncertainty” or the “uncertainty explosion.” When an assessment progresses from the biogeochemical cycle to radiative forcing and climate sensitivity calculations through to economic and social outcomes, including valuations of climate damages, considerable uncertainty can be accumulated.

Id.

⁴⁷ See Quiggin, *supra* note 35, at 7.

⁴⁸ See FACILITATING CLIMATE CHANGE RESPONSES: A REPORT OF TWO WORKSHOPS ON KNOWLEDGE FROM THE SOCIAL AND BEHAVIORAL SCIENCES (Paul C. Stern & Roger E. Kasperson eds., 2010).

⁴⁹ See *passim* U.S. CLIMATE CHANGE SCI. PROGRAM, CLIMATE MODELS: AN ASSESSMENT OF STRENGTHS AND LIMITATIONS (2009).

⁵⁰ See Jeroen P. van der Sluijs et al., *Exploring the Quality of Evidence for Complex and Contested Policy Decisions*, 3 ENVTL. RES. LETTERS 1 (2008) [hereinafter *Policy Decisions*].

⁵¹ See Ravetz, *supra* note 7, at 5 (internal citations omitted).

In many circumstances, these choices have enormous impacts on the outcomes of the analysis.⁵² For example, this inevitable discretion has created considerable difficulties in the context of computer simulations of the Earth's climate used to project the consequences of climate change.⁵³ Computer models project future conditions of the climate system by simulating the interactions of the system's primary components—clouds, oceans, atmosphere and so forth.⁵⁴ Some of the processes, variables, and parameters that create uncertainty are treated exogenously as assumptions, especially as the number of linkages among different subject areas and scenarios expands.⁵⁵

A less appreciated but equally significant “assumption” made in climate change analyses is the choice of discount rates used to assess the economic consequences of climate change.⁵⁶ Given that climate change takes place over centuries, the impact of compound interest on climate change economics is critical. “It is not an exaggeration to say that the biggest uncertainty of all in the economics of climate change is the uncertainty about which interest rate to use for discounting.”⁵⁷ The validity of these kinds of projections is a flashpoint in the climate change controversy.⁵⁸ When scientists use different assumptions, they lead to different results. Those judgments and assumptions lead to distrust in the result.

⁵² See Stephen Schneider, *Integrated Assessment Modeling of Global Climate Change: Transparent Rational Tool for Policy Making or Opaque Screen Hiding Value-Laden Assumptions?*, 2 ENVTL. MODELING & ASSESSMENT 229, 239 (1997).

⁵³ See Jens C. Refsgaard et al., *Uncertainty in the Environmental Modelling Process*, 22 ENVTL. MODELING & SOFTWARE 1543, 1547 (2007).

⁵⁴ See, e.g., U.S. CLIMATE CHANGE SCIENCE PROGRAM, CLIMATE MODELS: AN ASSESSMENT OF STRENGTHS AND LIMITATIONS (2008); IPCC, AN INTRODUCTION TO SIMPLE CLIMATE MODELS USED IN THE IPCC SECOND ASSESSMENT REPORT (1997).

⁵⁵ THE ROYAL SOCIETY, CLIMATE CHANGE CONTROVERSIES: A SIMPLE GUIDE 7 (Dec. 2008) (“[C]omputer models cannot exactly predict the future, since there are so many unknowns concerning what might happen. Scientists model a range of future possible climates using different scenarios of what the world will ‘look like’. Each scenario makes different assumptions about important factors such as how the world’s population may increase, what policies might be introduced to deal with climate change and how much carbon dioxide and other greenhouse gases humans will pump into the atmosphere.”).

⁵⁶ See Martin Weitzman, *A Review of The Stern Review on the Economics of Climate Change*, 45 J. OF ECON. LITERATURE 705 (2007).

⁵⁷ *Id.*

⁵⁸ IPCC TECHNICAL PAPER II, *supra* note 31, at 5.

There is considerable uncertainty about the changes that might occur in some climate system processes, such as those involving clouds, in an altered climate. The effect of aerosols on the radiation balance of the climate is also not well known. Difficult-to-predict changes in the ocean circulation could have a significant effect on both regional and global

C. *The Framing of the Issue*

People's understanding of climate change is shaped by "frames," or underlying structures of perception, knowledge, and behavior.⁵⁹ Public response to climate change is not a linear response to scientific information. Rather, people are already predisposed either to accept or reject what scientists say about it, and similarly, to support or oppose proposed policies.⁶⁰ As an example, one scholar has identified "six Americas," each characterized by a unique set of understandings of and responses to climate change.⁶¹ These six distinct groups, or segments, vary in terms of how much they believe global warming is a reality, how concerned they are, and how motivated they are to take action.⁶²

A series of recent surveys and polls have suggested that a person's political orientation is by far the strongest statistical indicator of his or her views about the legitimacy and credibility of climate change science.⁶³ Republicans and ideological conservatives are more likely to doubt the science behind climate change than Democrats and liberals.⁶⁴ The converse—liberals are more likely to trust the science behind climate change than conservatives—is also true.⁶⁵ In perhaps the most compelling analysis to date, Aaron McCright and Riley Dunlap evaluated data from ten Gallup polls between 2001 and 2010 to show that the gulf of understanding between liberals/Democrats and conservatives/Republicans on the subject of climate change science has grown over the past decade.⁶⁶ McCright and Dunlap also found that rather than reconciling political and social differences, science seems to be deepening them.⁶⁷

climatic changes. Unexpected changes in the flow of carbon between the atmosphere and terrestrial biosphere and/or the oceans could occur.

Id.; see also Naomie Oreskes et al., *Verification, Validation, and Conformation of Numerical Models in the Earth Sciences*, 263 *SCI.* 641 (1994).

⁵⁹ See DONALD A. SCHÖN & MARTIN REIN, *FRAME REFLECTION: TOWARD THE RESOLUTION OF INTRACTABLE POLICY CONTROVERSIES* 23 (1995).

⁶⁰ See Andrew J. Hoffman, *Climate Science as Culture War*, *STANFORD SOCIAL INNOVATION REVIEW*, available at http://www.ssireview.org/articles/entry/climate_science_as_culture_war (last visited Oct. 30, 2012).

⁶¹ See LEISEROWITZ ET AL., *GLOBAL WARMING'S SIX AMERICAS 2009*, *supra* note 2, at 3.

⁶² *Id.* at 20–21.

⁶³ *Id.* at 24.

⁶⁴ *Id.*

⁶⁵ See ANTHONY LEISEROWITZ ET AL., *POLITICS & GLOBAL WARMING: DEMOCRATS, REPUBLICANS, INDEPENDENTS, AND THE TEA PARTY* 21–23, 4 (2011), available at <http://environment.yale.edu/climate/item/PoliticsGlobalWarming2011> [hereinafter LEISEROWITZ ET AL., *POLITICS & GLOBAL WARMING*].

⁶⁶ See McCright & Dunlap, *supra* note 4.

⁶⁷ *Id.* at 161.

Several other recent studies have similarly challenged the prevailing wisdom by showing that the more people claim to know about climate change science, the more likely they are to express politically partisan views.⁶⁸ For example, Tea Party members are more likely than members of any other political party to describe themselves as “very well informed” about climate change and express doubts about whether climate change is happening.⁶⁹ In one very large survey, two scholars concluded that individuals who are “predisposed by their values to dismiss climate change evidence” are likely to become more dismissive as their scientific literacy increases.⁷⁰

Climate change can accommodate a plurality of perspectives.⁷¹ Climate change can be described as different “problems” depending on how one organizes the various elements, which encompass biodiversity, energy, demographic patterns, and several other fields of knowledge.⁷²

Each of these ways of looking at the problem of climate change involves a variety of interests and values, and each may call on a body of relevant knowledge to help understand and respond to the problem. Not only may the interests, values, and knowledge relevant to one way of understanding the problem be, in small part or large, different from those associated with another way, but they may also be contradictory.⁷³

For example, members of an island community may evaluate evidence suggesting that climate change would significantly increase sea levels differently than those residing in locations far away from the ocean.⁷⁴ Similarly, agricultural communities may evaluate evidence suggesting that climate change would worsen seasonal droughts differently than non-agricultural communities.⁷⁵ These perspectives would likely shape

⁶⁸ *Id.* at 171–72.

⁶⁹ See LEISEROWITZ ET AL., *POLITICS & GLOBAL WARMING*, *supra* note 65, at 4.

⁷⁰ See Dan M. Kahan et al., *The Tragedy of the Risk-Perception Commons: Culture Conflict, Rationality Conflict, and Climate Change* (Yale L. Sch. Cultural Cognition Project, Working Paper No. 89, 2011) (finding that survey respondents were “predisposed by their values to dismiss climate change evidence became more dismissive, and those predisposed by their values to credit such evidence more concerned, as science literacy and numeracy increased”).

⁷¹ See Hans Von Storch, *Presentation at the InterAcademy Council IPCC Review Meeting* (June 15, 2010).

⁷² See Sarewitz, *supra* note 5, at 389.

⁷³ *Id.*

⁷⁴ See *id.*

⁷⁵ See *id.*

resulting preferences on policy options for managing the risks posed by climate change.⁷⁶ In addition, as previously discussed, the institutional and legal parameters framing climate change have facilitated competing interpretations of climate change science.⁷⁷

These “divergent frames” can become a potential source of intractable conflicts.⁷⁸ People with incompatible perspectives can only communicate meaningfully if their frames share some modicum of similarity.⁷⁹ As a result, how we frame the climate change problem provides the parameters not only for how society should respond, but also whether society should respond.⁸⁰ Along with the scientific uncertainties of climate change science and the accumulating evidence linking the public’s perception of climate change with other social and political preference, climate science has become a proxy for deeper disputes about social, economic and political values.⁸¹ The question of whether society and policy makers should respond at all to the climate change problem, and if so, how, has been stymied by the lack of an effective institutional mechanism to manage these dynamics.

⁷⁶ See Sheila Jasanoff, *Comment on Office of Management and Budget (OMB) Proposed Bulletin on Peer Review and Information Quality* (2003), available at <http://www.whitehouse.gov/sites/default/files/omb/inforeg/2003iq/159.pdf> [hereinafter OMB Peer Review].

⁷⁷ See Robert W. Kates, Thomas M. Parris & Anthony A. Leiserowitz, *What Is Sustainable Development? Goals, Indicators, Values, and Practice*, 47 ENV’T: SCI. & POL’Y SUSTAINABLE DEV. 8 (2005).

There was ready agreement in the literature that sustainable development implies linking what is to be sustained with what is to be developed, but here, too, the emphasis has often differed from extremes of “sustain only” to “develop mostly” to various forms of “and/or.” Similarly, the time period of concern, ambiguously described in the standard definition as “now and in the future,” has differed widely. It has been defined from as little as a generation—when almost everything is sustainable—to forever—when surely nothing is sustainable.

Id. at 12.

⁷⁸ See SCHÖN & REIN, *supra* note 59, at xix.

⁷⁹ See Joop De Boer, *Frames and Tools for Public Participation*, CLIMATE RESEARCH NETHERLANDS—RESEARCH HIGHLIGHTS 54 (2009).

⁸⁰ In the context of ecosystem management, Donald N. Michael argued that: “More information provides an ever-larger pool out of which interest parties can fish differing positions on the history of what has led to current circumstances, on what is now happening, on what needs to be done, and on what the consequences will be.” Donald N. Michael, *Barriers and Bridges to Learning in a Turbulent Human Ecology*, in BARRIERS AND BRIDGES TO THE RENEWAL OF ECOSYSTEMS AND INSTITUTIONS 461, 473 (Lance H. Gunderson et al. eds., 1995).

⁸¹ See Jeroen P. van der Sluijs, *Post Normal Science: Working Deliberatively Within Imperfections*, Lecture at Studium Generale of Wageningen University (Mar 21, 2007).

II. THE IPCC—WHAT IT IS AND WHY IT HAS NOT BEEN SUCCESSFUL

The United Nations General Assembly established the IPCC in 1988 to prepare “a comprehensive review and recommendations with respect to the state of knowledge of the science of climate and climate change.”⁸² Nearly a quarter century later, the IPCC has completed four climate change assessment reports and in the process has become “the largest and most complex orchestration of sustained international scientific co-operation the world has ever seen.”⁸³ Despite this impressive track record, the IPCC’s impact on policy has been hampered by a lack of public legitimacy and credibility.⁸⁴ These problems stem from the quality-control procedures the IPCC has relied on to produce its assessments, which were designed for managing the challenges associated with “research science” but have proven to be inadequate for managing the credibility and legitimacy issues encountered in the context of “regulatory science.”

A. *What IPCC Is*

The IPCC is responsible for determining whether climate change science is sufficiently certain to support the implementation of climate policies.⁸⁵ The IPCC was assigned this responsibility in Article 2 of the

⁸² G.A. Res. 43/53, ¶ 10, U.N. Doc. A/RES/43/53 (Dec. 6, 1988). The IPCC was asked to prepare “a comprehensive review and recommendations with respect to the state of knowledge of the science of climate and climate change,” with special emphasis on global warming. *Id.* The IPCC’s assessments have vast implications for the world’s multitrillion-dollar energy economy and the 194 U.N. member nations that rely on it. See Shardul Agrawala, *Structural and Process History of the Intergovernmental Panel on Climate Change*, 39 CLIMATIC CHANGE 621 (1998).

⁸³ See THE ROYAL SOCIETY, KNOWLEDGE, NETWORKS AND NATIONS: GLOBAL SCIENTIFIC COLLABORATION IN THE 21ST CENTURY 79–80 (2011), available at http://royalsociety.org/uploadedfiles/royal_society_content/influencing_policy/reports/2011-03-28-knowledge-networks-nations.pdf. The 2007 Fourth Assessment Report (AR4) involved 130 countries, 450 lead authors, 800 contributing authors and 2,500 scientific expert reviewers. The AR4 cited 18,000 peer-reviewed publications and included 90,000 comments from experts and Governments. See Rajendra Pachauri, *Climate Change Assessments: Review of the Processes and Procedures of the IPCC*, Statement at the Cancun Climate Change Conference (Nov. 29, 2010) (transcript available at <http://reviewipcc.interacademycouncil.net/PachauriStatement.html>).

⁸⁴ See Lyle Scruggs, Professor of Political Sci. Univ. of Conn., *Declining Public Concern About Climate Change: Can We Blame the Great Recession?*, Presented at 2010 World Congress of Sociology Meeting in Gothenburg, Sweden (July 2010), at 6, available at <http://www.sp.uconn.edu/~scruggs/gecsub.pdf>.

⁸⁵ See FIRST ASSESSMENT REPORT OF THE IPCC (1990).

U.N. Framework Convention on Climate Change,⁸⁶ which provides that “[t]he ultimate objective of this Convention and any related legal instruments . . . is to achieve . . . stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.”⁸⁷ So the basic question that the IPCC is charged with is determining what constitutes “dangerous anthropogenic interference with the climate system” under Article 2.⁸⁸

The IPCC’s principal task is “to provide a sound scientific basis that would enable policymakers to better interpret dangerous anthropogenic interference with the climate system.”⁸⁹ The IPCC’s assessments also provide guidance on what policy options are available for achieving the Article 2 objectives.⁹⁰ The IPCC explained its role in addressing the twin challenges posed by Article 2:

The challenges presented to the policymaker by Article 2 are the determination of what concentrations of greenhouse gases might be regarded as “dangerous anthropogenic interference with the climate system” and the charting of a future which allows for economic development which is sustainable. The purpose of this synthesis report is to provide scientific, technical and socioeconomic information that can be used, *inter alia*, in addressing these challenges.⁹¹

By establishing what constitutes “dangerous anthropogenic interference with the climate system,” the IPCC has unrivaled influence on the

⁸⁶ U.N. Framework Convention on Climate Change art. 2, May 9, 1992, 1771 U.N.T.S. 107 [hereinafter UNFCCC].

⁸⁷ *Id.* The UNFCCC does not indicate the level of total GHG concentrations beyond which “dangerous anthropogenic interference with the climate system” would occur. Nor does it state a limit for total anthropogenic GHG emissions required to achieve its objective. *Id.*

⁸⁸ *Id.*

⁸⁹ INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, IPCC SECOND ASSESSMENT: A REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 3 (1995), <http://www.ipcc.ch/pdf/climate-changes-1995/ipcc-2nd-assessment/2nd-assessment-en.pdf> [hereinafter SECOND ASSESSMENT REPORT OF THE IPCC].

⁹⁰ *See id.* at iii, 36–42. While the IPCC and the Convention are legally distinct and separate entities, the Kyoto Protocol, in its Articles 3 and 5, requires the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol to take into account, among other things, the methodological work of IPCC when it makes relevant decisions pertaining to those Articles. In this context, the work of IPCC is institutionally recognized by the Framework Convention in Climate Change and its Kyoto Protocol. *See Kyoto Protocol to the United Nations Framework Convention on Climate Change*, 33, 35, Dec. 10, 1997, 37 I.L.M. 22.

⁹¹ *See* SECOND ASSESSMENT REPORT OF THE IPCC, *supra* note 89, at 3.

question of whether climate change science is sufficiently certain to support implementation of various climate change policies.⁹² The quality of the IPCC's assessments is therefore at the center of the climate debate.

B. Why the IPCC's Assessments Have Not Been Effective Within the United States

Over the past decade, Congress has enacted a constellation of new administrative laws and procedures for policing the reliability of scientific information used to promulgate federal regulations. For example, the Data Access Act ("DAA") replicates *Daubert's* falsifiability prong in the form of the so-called "reproducibility" requirement to ensure "the quality, objectivity, utility, and integrity of information (including statistical information) disseminated by Federal agencies."⁹³ Similarly, the Information Quality Act ("IQA") requires federal agencies to subject all "influential" information used in the rulemaking process to minimum peer-review standards.⁹⁴ These minimum standards are specified in guidelines that are non-binding norms.⁹⁵ Rules are developed under the Administrative Procedure Act, and require an agency to provide notice and invite public comment.⁹⁶ Ordinarily, rules are binding on both the agency and the public.

These legal requirements will shape how (and whether) federal agencies incorporate IPCC assessments into the rulemaking process. For example, an analysis by the U.S. EPA's Inspector General concluded that the agency had not fulfilled its obligations under the IQA when it relied on the IPCC's assessments to support its GHG endangerment finding without submitting the assessment to additional peer review.⁹⁷ Under the IQA, if

⁹² *Id.* (citing the UNFCCC).

⁹³ Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by Federal Agents, 66 Fed. Reg. 49,718, 49,722 (Sept. 28, 2001). Statutorily designated steering documents for policymaking that qualify as "influential scientific or statistical information" must meet a "reproducibility" standard, setting forth transparency regarding data and methods of analysis, "as a quality standard above and beyond some peer review quality standards." *Id.*

⁹⁴ *Id.* The Information Quality Act (IQA) was an obscure rider to the Treasury and General Government Appropriations Act for Fiscal Year 2001. Treasury and General Government Appropriations Act for Fiscal Year 2001, Pub. L. No. 106-554, App. C §515(a), 114 Stat. 2763, 2763A-153 (2001) [hereinafter Information Quality Act].

⁹⁵ Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by Federal Agents, 66 Fed. Reg. 49,718, 49,719 (Sept. 28, 2001) (describing the guidelines as a "performance goal").

⁹⁶ Administrative Procedures Act, Pub. L. No. 79-404, 60 Stat. 237, 239 (1946).

⁹⁷ U.S. ENVIRONMENTAL PROTECTION AGENCY OFFICE OF INSPECTOR GENERAL, PROCEDURAL REVIEW OF EPA'S GREENHOUSE GASES ENDANGERMENT FINDING DATA QUALITY PROCESSES,

a regulation “is supported by influential scientific information or a highly influential scientific assessment, the underlying” information typically requires peer review prior to the agency proposing regulation.⁹⁸ The IQA requires information to be subject to more stringent peer-review procedures than those followed by the IPCC.⁹⁹

The purpose of the IPCC’s assessments is to provide support for regulatory change.¹⁰⁰ In assessing scientific information, however, the IPCC has institutionalized procedures and standards commonly used in the context of research science.¹⁰¹ The procedures used to support research science are more stringent than procedures and standards used in the context of regulatory science.¹⁰² Research science serves different goals, produces different forms of scientific knowledge, relies on different mechanisms of accountability, and follows distinct procedures and standards for quality control purposes.¹⁰³

By relying on procedures designed for “research science,” specifically peer-reviewed published articles, the IPCC has not effectively managed the credibility and legitimacy challenges that commonly affect scientific research conducted primarily for promulgating public policy.¹⁰⁴ The disconnect between the IPCC’s procedures for preparing climate change assessments and the distinct challenges scientific assessors commonly encounter when producing knowledge for policy is illustrated by recent IPCC incidents related to possible conflicts of interest and failure to follow official procedures for the use of non-peer-reviewed scientific research.¹⁰⁵

REPORT NO. 11-P-0702 (Sept. 26, 2011), available at <http://www.epa.gov/oig/reports/2011/20110926-11-P-0702.pdf>.

⁹⁸ U.S. ENV’T PROT. AGENCY, PEER REVIEW HANDBOOK 15 (3d ed. 2006). “[S]oliciting comments from stakeholders and the general public after a rule is proposed does not constitute peer review.” *Id.*

⁹⁹ *See id.* at 12. “Typically, peer involvement takes two general forms: peer input (ongoing discussions during the development of the work product) and peer review (an evaluation of a work plan, preliminary draft or the like, or the final objective expert evaluation of the work product).” *Id.* (underlining omitted).

¹⁰⁰ *See* SECOND ASSESSMENT REPORT OF THE IPCC 3; UNFCCC.

¹⁰¹ *See* SECOND ASSESSMENT REPORT OF THE IPCC Foreword.

¹⁰² *See* OMB Peer Review, *supra* note 76, at 8.

¹⁰³ *See id.* at 3 (“[t]hese differences include: Goals of scientists and scientific assessors; Institutions in which science is done; Products of scientific activity; Incentives and rewards for producing science; Time-frame within which science must be done; Options for action available to decision-makers; and, Accountability for results.”).

¹⁰⁴ Jeroen van der Sluijs et al., *Beyond Consensus: Reflections From a Democratic Perspective on the Interaction Between Climate Politics and Science*, 2 CURRENT OPINION IN ENVIRONMENTAL SUSTAINABILITY 409 (2010).

¹⁰⁵ *See* INTERACADEMY COUNCIL COMMITTEE TO REVIEW THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 11, at vii, 60, 61, 63.

The IPCC's lack of a conflict of interest policy or an alternative mechanism for avoiding actual or perceived conflicts of interest is illustrative of its reliance on procedures designed for "research science."¹⁰⁶ As a result, despite the value-laden nature of climate change projections, the IPCC has treated assessment authors, reviewers, contributors and commenters as objective, disinterested sources of scientific information rather than stakeholders.¹⁰⁷ For example, the chairman of the IPCC, R.A. Pachauri has been criticized for conflicts of interest resulting from financial interests he holds in various energy and carbon-trading businesses.¹⁰⁸ This has eroded the IPCC's credibility among many members of the public.¹⁰⁹

The procedures being used by the IPCC to evaluate climate change science need to be reconsidered. The purpose of the IPCC's assessment is to provide support for regulatory change.¹¹⁰ Therefore, it is not appropriate to use methods that are meant to provide support for research science, where the search is for certainty and statistical significance. There needs to be a more flexible approach that supports the goals of policy and regulatory change. Without that support, the IPCC's assessments will not lead to climate change policy in the United States.

¹⁰⁶ See Roger A. Pielke, Jr., *Major Change Is Needed if the IPCC Hopes to Survive*, YALE ENV'T 360 (Feb. 25, 2010), <http://e360.yale.edu/content/feature.msp?id=2244>. "The parent bodies of the IPCC—the United Nations and World Meteorological Organization—do have conflict of interest policies, but they do not apply to the IPCC." *Id.*

¹⁰⁷ See Weitzman, *supra* note 56, at 705.

Overall, I believe it is fair to say that the *Stern Review* consistently leans toward (and consistently phrases issues in terms of) assumptions and formulations that emphasize optimistically low expected costs of mitigation and pessimistically high expected damages from greenhouse warming—relative to most other studies of the economics of climate change. But far more crucially, the key assumption that drives its strong conclusions is the mundane fact that a very low interest rate is postulated, with which distant-future benefits and costs are then discounted.

Id.

¹⁰⁸ *Pachauri Accused of Making 'Fortune' from Carbon Trading Firms*, MSN NEWS (Dec. 21, 2009), <http://news.in.msn.com/international/article.aspx?cp-documentid=3490272>.

¹⁰⁹ See *id.* Several other recent similar incidents have created credibility problems for the IPCC. "Because the IPCC has no requirement for disclosure of potential conflicts, it is likely that the organization itself is unaware of what other potential conflicts may [impact its legitimacy and credibility]." Pielke, *supra* note 106. Other institutions have stringent conflict policies. *Id.*

¹¹⁰ See UNFCCC; United Nations Environmental Programme, *Intergovernmental Panel on Climate Change: Outline of an Assessment*, 4, 7, U.N. Doc. UNEP/IPBES/3/INF/13 (Jun. 7, 2010).

III. *DAUBERT* AND ITS PROGENY: A MODEL FOR EXAMINING SCIENCE

The controversy over climate change science is a disagreement over whether the evidence of climate change is sufficiently certain or reliable to justify or require policy action.¹¹¹ The IPCC's procedures are not scientifically flawed, but rather lack the flexibility needed to raise or lower the thresholds needed to establish reliability and relevance as the circumstances require.¹¹² This issue is the same one that has confronted the courts as they have had to determine the correct standard for the admissibility of scientific evidence.¹¹³ An examination of the courts' treatment of scientific evidence and its current approach under *Daubert v. Merrill Dow Pharmaceuticals*¹¹⁴ and its progeny provides guidance for the treatment of science within the IPCC.

A. *History of the Legal Standard for the Admissibility of Evidence*

The courts have always had to struggle with the intersection of law, policy, and science through the admissibility of scientific evidence.¹¹⁵ Before 1923, judges generally based admissibility upon an assessment of the expert rather than the testimony; experts had to be qualified, and qualification was often based on the expert's popularity in the "commercial marketplace."¹¹⁶ As might be expected, this test frequently failed to distinguish valid science from entertainment, and excluded certain fields of science entirely.¹¹⁷ Perhaps even more importantly, courts never questioned

¹¹¹ See *id.* at 3.

¹¹² See Principles Governing IPCC Work, App. A, *Procedures for the Preparation, Review, Acceptance, Adoption, Approval and Publication of IPCC Reports*, Annex 2 (adopted at the Fifteenth Session, San Jose April 15–18, 1999), available at <http://www.ipcc.ch/pdf/ipcc-principles/ipcc-principles-appendix-a.pdf> [hereinafter Appendix A].

¹¹³ See Bert Black, *The Supreme Court's View of Science: Has Daubert Exorcised the Certainty Demon?*, 15 CARDOZO L. REV. 2129 (1994).

¹¹⁴ 509 U.S. 579 (1993).

¹¹⁵ See SHEILA JASANOFF, *THE FIFTH BRANCH: SCIENCE ADVISERS AS POLICY MAKERS* xi, xii, 39, 40 (1990).

¹¹⁶ Before the sixteenth century, experts were usually part of the jury. See John Baston, *The Court Expert in Civil Trials—A Comparative Appraisal*, 40 MOD. L. REV. 174, 175 (1977); John B. Chapin, *Experts and Expert Testimony*, 22 ALB. L.J. 365 (1880). The term "commercial marketplace" is used by the authors in David L. Faigman et al., *Check Your Crystal Ball at the Courtroom Door, Please: Exploring the Past, Understanding the Present, and Worrying About the Future of Scientific Evidence*, 15 CARDOZO L. REV. 1799, 1803, 1804 (1994).

¹¹⁷ See Faigman et al., *supra* note 116, at 1805.

whether a body of knowledge existed separately from the expert who possessed it.¹¹⁸

In *Frye v. United States*,¹¹⁹ the Defendant offered the results from an early form of polygraph testing, called the “systolic blood pressure deception test,” to support his plea of not guilty to a murder charge.¹²⁰ This presented a novel scientific question as it was a new technique where there was no commercial marketplace and in fact, might never be one.¹²¹ In analyzing whether the evidence should be admitted, the court created what has become known as the “general acceptance”¹²² test, drawing the line for admissibility on whether the scientific principle underlying the evidence is accepted by a sufficient portion of the relevant scientific community.¹²³ This “general acceptance test” became the dominant standard for determining the admissibility of novel scientific evidence.¹²⁴ This new standard separated the expertise from the expert, thereby creating the idea that the body of knowledge had to be evaluated apart from the notoriety of the expert. It also allowed new kinds of science to be assessed, even if they might never find a place in the “commercial marketplace.”¹²⁵

Despite these improvements, the test merely shifted the expertise from the purchasers of the science to the sellers of the science.¹²⁶ The evaluation of the science still belonged to the scientists.¹²⁷ In fact, the standard was so similar that the analysis in *Frye* went unnoticed for years. No articles were written about it, courts did not cite it, and commentators

¹¹⁸ *Id.*

¹¹⁹ 293 F. 1013 (1923).

¹²⁰ *Id.*

¹²¹ *Id.* at 1014.

¹²² *Id.*

¹²³ In a brief, citation free opinion, the Second Circuit stated:

Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this twilight zone the evidential force of the principle must be recognized, and while courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, *the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs.*

Daubert v. Merrell Dow Pharm., 509 U.S. 579, 585–86 (1993) (quoting *Frye*, 293 F. at 1014).

¹²⁴ *Daubert*, 509 U.S. at 585.

¹²⁵ Faigman et al., *supra* note 116, at 1806.

¹²⁶ Michael Saks et al., *Admissibility of Scientific Evidence*, SJ081 ALI-ABA 1 (Am. Law Inst. 2004).

¹²⁷ Paul Giannelli, *The Admissibility of Novel Scientific Evidence: Frye v. United States, A Half-Century Later*, 80 COLUM. L. REV. 1197, 1207 (1980).

ignored it.¹²⁸ But, as the distinction between experts and expertise became more apparent to the courts, as new fields and specializations began to arise, and as old fields began to offer new knowledge, the *Frye* test became the standard for the admissibility of scientific evidence.¹²⁹ Judges had to look towards the scientific community as a whole to assess the validity of scientific evidence.¹³⁰ If the science was not the subject of general acceptance among scientists, it was not appropriate for the jury.¹³¹

By the 1970s, courts and commentators began to attack the *Frye* test in earnest.¹³² Some critics said that the test was too conservative because it excluded scientific evidence that was too new to be accepted in the scientific community, thus forcing the courts to prefer older information.¹³³ Others found the test difficult to apply and determined that it generated anomalous results.¹³⁴ Courts had to determine what field of science it was, what part of the evidence needed general acceptance the theory behind the science or the technique itself, and what kind of evidence demonstrated general acceptance scientific literature: judicial opinions, expert testimony, or some combination of the two.¹³⁵

In 1975, the Federal Rules of Evidence offered another standard for the admissibility of scientific information.¹³⁶ Under the Federal Rules, in order to be admissible, scientific evidence, like any other evidence, had to be relevant.¹³⁷ In addition, it had to satisfy Rule 702, which stated that “[i]f scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a

¹²⁸ *Daubert*, at 585 (citing ERIC D. GREEN & CHARLES R. NESSON, PROBLEMS, CASES, AND MATERIALS ON EVIDENCE 649 (1983)) (“In the 70 years since its formulation in the *Frye* case, the ‘general acceptance’ test has been the dominant standard for determining the admissibility of novel scientific evidence at trial.”); *see id.* (“The *Frye* test has its origin in a short and citation-free 1923 decision concerning the admissibility of evidence derived from a systolic blood pressure deception test, a crude precursor to the polygraph machine”).

¹²⁹ *Daubert*, 509 U.S. at 585.

¹³⁰ Giannelli, *supra* note 127, at 1204–05.

¹³¹ *Daubert*, 509 U.S. at 586.

¹³² *Daubert*, 509 U.S. at 585 (citing PAUL GIANNELLI & EDWARD IMWINKELRIED, SCIENTIFIC EVIDENCE §§ 1–5, 10–14 (2d ed., 1991)) (“Although under increasing attack of late, the rule continues to be followed by a majority of courts, including the Ninth Circuit.”).

¹³³ *See, e.g.*, GIANNELLI & IMWINKELRIED, *supra* note 132, at 27.

¹³⁴ *See id.* at 16.

¹³⁵ *See* Daniel Klein, Annotation, *Reliability of Scientific Technique and Its Acceptance Within Scientific Community as Affecting Admissibility, at Federal Trial, of Expert Testimony as to Result of Test or Study Based on Such Technique-Modern Cases*, 105 A.L.R. FED. 299, at 303–05.

¹³⁶ *See* FED. R. EVID. 402.

¹³⁷ *See id.*

witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise.”¹³⁸ Although the Federal Rules and the accompanying Advisory Notes did not mention the *Frye* criteria, a majority of the federal circuits and most states imported the *Frye* analysis into the Federal Rules test.¹³⁹ While the Rules were widely regarded as having been intended to allow greater access to scientific experts, a majority of jurisdictions continued to hold that the general acceptance standard was still required.¹⁴⁰

In 1993, the Supreme Court decided *Daubert v. Merrell Dow Pharmaceuticals*,¹⁴¹ holding that the *Frye* “general acceptance test” was superseded by Rule 702.¹⁴² The Court set out a two-part analysis based on the requirements of the Rule.¹⁴³

Faced with a proffer of expert scientific testimony, then, the trial judge must determine at the outset . . . whether the expert is proposing to testify to (1) scientific knowledge that (2) will assist the trier of fact to understand or determine a fact in issue. This entails a preliminary assessment of whether the reasoning or methodology underlying the testimony is scientifically valid and of whether that reasoning or methodology properly can be applied to the facts in issue.¹⁴⁴

To assist with the analysis, the Court suggested that the judges consider four factors: (1) whether the evidence can be and has been tested; (2) whether the evidence has been subjected to peer review and publication; (3) the known or potential rate of error for the technique or evidence seeking to be admitted; and (4) the general acceptance of the technique or evidence in the scientific community.¹⁴⁵ The *Frye* standard appeared as an appropriate, although not exclusive, inquiry.¹⁴⁶ Instead, the Court created a flexible inquiry based on principles and methodology rather than the specific conclusions that may be generated by the specific evidence.¹⁴⁷ As

¹³⁸ FED. R. EVID. 702.

¹³⁹ See Saks et al., *supra* note 126. See also Alice Lustre, Annotation, *Post-Daubert Standards for Admissibility of Scientific and Other Expert Evidence in State Courts*, 90 A.L.R. 5th 453 (2001).

¹⁴⁰ See Saks et al., *supra* note 126.

¹⁴¹ *Daubert v. Merrell Dow Pharm.*, 509 U.S. 579 (1993).

¹⁴² *Id.* at 589.

¹⁴³ *Id.* at 592.

¹⁴⁴ *Id.*

¹⁴⁵ *Id.* at 593–94.

¹⁴⁶ *Id.* at 594.

¹⁴⁷ *Daubert*, 509 U.S. at 594–95.

a result of *Daubert*, the evaluation of accuracy and usefulness of science knowledge shifted from the scientists, whether they are part of the commercial or intellectual marketplace, to the judges.¹⁴⁸

Following *Daubert*, the Supreme Court decided *General Electric Co. v. Joiner*¹⁴⁹ in 1997 and *Kumho Tire Co. v. Carmichael*¹⁵⁰ in 1999. In *Joiner*, the Court held that the standard of review for *Daubert* admissibility decisions should be the deferential abuse of discretion standard, and found that the district court did not abuse its discretion when it refused to allow expert testimony that supported the plaintiff's theory of cancer exposure.¹⁵¹ In *Kumho*, the Court held that the *Daubert* guidelines apply not only to scientific knowledge, but also to technical or specialized knowledge and wherever the methods, data, principles, or application of expert testimony is an issue, the *Daubert* analysis should be applied.¹⁵² Taken together, the three cases generated a new standard for the admissibility of scientific evidence by making the judges the gatekeepers, outlining four criteria for the judges to consider, confirming that the judge may use whichever of those criteria is helpful under the circumstances, and giving the judges complete deference in their decision making.¹⁵³

B. Parallels Between the Issues Presented by the Frye Test and the IPCC's Approach

There are parallels between the criticisms surrounding *Frye*'s "general acceptance" standard and the criticisms resulting from the IPCC's assessment process. The "general acceptance" standard, originally developed for research science, was being used to regulate the quality of science

¹⁴⁸ *Id.* at 595–97.

¹⁴⁹ *General Electric Co. v. Joiner*, 522 U.S. 136 (1997).

¹⁵⁰ *Kumho Tire Co. v. Carmichael*, 526 U.S. 137 (1999).

¹⁵¹ *See Joiner*, 522 U.S. at 136–37.

¹⁵² *Kumho*, 526 U.S. at 137.

¹⁵³ The *Daubert* trilogy holdings were incorporated into Rule 702 of the Federal Rules of Evidence in 2000.

A witness who is qualified as an expert by knowledge, skill, experience, training, or education may testify in the form of an opinion or otherwise if: (a) the expert's scientific, technical, or other specialized knowledge will help the trier of fact to understand the evidence or to determine a fact in issue, (b) the testimony is based upon sufficient facts or data, (c) the testimony is the product of reliable principles and method; and (d) the expert has reliably applied the principles and methods reliably to the facts of the case.

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in the regulatory area of litigation.¹⁵⁴ This was unsuccessful because research science and litigation have different objectives.¹⁵⁵ Research science seeks to demonstrate “certainty,” while litigation aims to resolve differences in areas where facts are uncertain and values are in dispute.¹⁵⁶ In addition, the burden of proof for research science is much higher than the legal burden of proof.¹⁵⁷ As a result, the Court in *Daubert* changed the approach, shifting the focus of the analysis for admissibility from scientific certainty to the validity of the process underlying testimony.¹⁵⁸

Similarly, the IPCC’s rules of procedures limit information included in climate change assessments to research published in peer-reviewed journals.¹⁵⁹ The IPCC allows a limited exception for non-peer-reviewed literature—which is also referred to as “grey literature.”¹⁶⁰ Aside from this limited exception, the IPCC imposes a uniform peer-review process on all three Working Groups involved in the production of climate change assessments.¹⁶¹ This rigidity is problematic because it risks excluding valid research in some scenarios and admitting illegitimate research in other scenarios.¹⁶² Using this standard to regulate the quality of science in a regulatory area has been unsuccessful, for the same reasons the “general acceptance” standard was unsuccessful in the litigation context.¹⁶³ The IPCC needs to adopt an approach more similar to the test enunciated by the Court in *Daubert*, where it can shift the basis for the evaluation of scientific evidence away from peer review and certainty and towards the underlying validity of the scientific process.

Under the *Frye* test, federal courts assessed the admissibility of testimony from scientific experts by deferring to the opinions of scientists in the particular field.¹⁶⁴ If most scientists in the expert’s field “generally accepted” the validity of the expert’s methodology, the testimony was

¹⁵⁴ See OMB Peer Review, *supra* note 76.

¹⁵⁵ See Black, *supra* note 113, at 2130.

¹⁵⁶ See *Policy Decisions*, *supra* note 50.

¹⁵⁷ See, e.g., Thomas McGarity, *Our Science Is Sound Science and Their Science Is June Science*, 52 U. KAN. L. REV. 897, 898–900 (2004); Sheila Jasanoff, *Science, Politics, and the Renegotiation of Expertise at EPA*, OSIRIS 1992 [hereinafter Jasanoff, *Science, Politics*].

¹⁵⁸ *Daubert*, 509 U.S. at 594–95.

¹⁵⁹ See Appendix A, *supra* note 112.

¹⁶⁰ The procedures for evaluating the use of unpublished or non-peer-reviewed scientific research in IPCC Reports are outlined in Annex 2 of Appendix A to the Principles Governing IPCC Work. See *id.*

¹⁶¹ *Id.*

¹⁶² See OMB Peer Review, *supra* note 76, at app. A, par 4(2)(3).

¹⁶³ See *id.*

¹⁶⁴ See *Daubert v. Merrell Dow Pharm.*, 509 U.S. 579, 579 (1993).

deemed admissible.¹⁶⁵ By contrast, if the expert testimony was based on methods not “generally accepted” in the relevant scientific community, the courts excluded the testimony.¹⁶⁶ In *People v. Williams*,¹⁶⁷ the court concluded that selection of the relevant scientific community appears to influence the result.¹⁶⁸ There is no standard defining “relevant field.” Courts have construed this parameter broadly and narrowly.¹⁶⁹ The more narrowly a court defined the pertinent field, the more agreement it was likely to find.¹⁷⁰ As a result, the “general acceptance” analysis often degenerated into a process of deciding whose noses to count,¹⁷¹ especially in circumstances extending across more than one discipline.¹⁷² A similar issue arose when courts considered how many scientists were needed to establish or destroy a “consensus.”¹⁷³ As a result, the *Frye* inquiry merely forced the courts to accept whatever scientists believe.

¹⁶⁵ See *United States v. Jakobetz*, 955 F.2d 786, 793–94 (2d Cir. 1992) (stating that “[t]he *Frye* court assumed that general acceptance indicated reliability and that only reliable evidence should be admissible. The majority of jurisdictions that have faced similar issues have adopted the *Frye* test, and to this day, it remains the majority rule.”).

¹⁶⁶ See *id.* at 794.

¹⁶⁷ *People v. Williams*, 331 P.2d 251, 253–54 (Cal. Ct. App. 1958).

¹⁶⁸ See *id.* at 253–54. The Court admitted a technique that was “generally accepted by those who would be expected to be familiar with its use” even though “it cannot truthfully be said that the . . . test has met with general acceptance by the medical profession as a whole.” *Id.*

¹⁶⁹ See, e.g., *Commonwealth v. Lykus*, 327 N.E.2d 671, 677 (Mass. 1975) (*Frye* test is met when the technique is “generally accepted by those who would be expected to be familiar with its use.”). See Giannelli, *supra* note 127.

¹⁷⁰ See *United States v. Williams*, 583 F.2d 1194, 1198 (2d Cir. 1978) (noting that “[s]election of the ‘relevant scientific community,’ appears to influence the result”).

¹⁷¹ See *United States v. Downing*, 753 F.2d 1224 (3d Cir. 1985) (rejecting a version of the *Frye* test that hinged on “nose-counting.”).

The reliability inquiry that we envision is flexible and may turn on a number of considerations, in contrast to the process of scientific “nose-counting” that would appear to be compelled by a careful reading of *Frye*. Unlike the *Frye* standard, the reliability assessment does not require, although it does permit, explicit identification of a relevant scientific community and an express determination of a particular degree of acceptance within that community. The district court in assessing reliability may examine a variety of factors in addition to scientific acceptance.

Id. at 1238.

¹⁷² See *State v. Williams*, 446 N.E.2d 444, 448 (Ohio 1983) (rejecting *Frye* because there is no wisdom “in scientific nose-counting for the purpose of deciding whether evidence based on newly ascertained or applied scientific principles is admissible.”).

¹⁷³ See *Reed v. State*, 391 A.2d 364, 377 (Md. 1978) (stating that “[t]he purpose of the *Frye* test is defeated by an approach which allows a court to ignore the informed opinions of a substantial segment of the scientific community which stands in opposition to the process in question”).

Like *Frye's* "general acceptance" standard, the IPCC's assessment process relies on peer review for assessing the reliability of experimental methodologies and empirical observations.¹⁷⁴ Again, the purpose of the process is to regulate the quality of science to be used in the regulatory area. As values are in dispute, stakes are high, and decisions are urgent, the use of scientific consensus-based standards for evaluating the reliability of the science in the regulatory area has created the same conundrum for the IPCC that was faced by the Supreme Court in *Daubert*.

Peer review is a well-established concept widely practiced within the scientific community. However, it takes different forms and uses different procedures because the circumstances and the functions to be performed are different.¹⁷⁵ For instance, the peer-review practices at scientific journals vary between journals.¹⁷⁶ Similarly, funding agencies follow different peer-review methods to review grant applications.¹⁷⁷ Recognizing the need for flexibility in conducting peer review, the American Bar Association's official policy regarding the use of peer review in the context of risk assessments by federal agencies provides: "[t]he nature, significance, and complexity of the risk assessment should dictate when peer review is used and the scope and nature of any peer review."¹⁷⁸

The IPCC's assessments purport to represent the "consensus" of the scientific community.¹⁷⁹ Critics of the IPCC have challenged this claim.¹⁸⁰ The existence of a "consensus" depends on how the relevant scientific community is defined, which can be construed broadly or narrowly. In the latter instance, William Anderegg defined "consensus" narrowly by limiting the relevant community of scientists to those actively publishing in the field.¹⁸¹ By contrast, critics of the IPCC have construed the community

¹⁷⁴ See Appendix A, *supra* note 112, at Annex 2.

¹⁷⁵ See BRUCE ALBERTS, OMB PEER REVIEW COMMENTS FROM NATIONAL ACADEMY OF SCIENCES (2003), available at <http://whitehouse.gov/sites/default/files/omb/inforeg/2003iq/115.pdf>.

¹⁷⁶ See *id.*

¹⁷⁷ See, e.g., U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-99-99, PEER REVIEW PRACTICES AT FEDERAL SCIENCE AGENCIES VARY (1999).

¹⁷⁸ Ronald A. Cass, *Resolution on Risk Assessment*, A.B.A. SEC. ADMIN. & REG. PRAC. (1999).

¹⁷⁹ See Appendix A, *supra* note 112.

¹⁸⁰ Idso & Singer, *supra* note 2.

¹⁸¹ See William R. L. Anderegg et al., *Expert Credibility in Climate Change*, PROCEEDINGS OF THE NAT'L ACAD. OF SCI. (2010), available at <http://www.pnas.org/cgi/doi/10.1073/pnas.1003187107>. Anderegg identified 908 climate scientists who had published at least twenty papers on climate. *Id.* at 1. These scientists then classified those researchers as convinced or unconvinced by the evidence for human-induced climate change. *Id.* at 2.

broadly, which tends to suggest that no such consensus exists.¹⁸² For example, in 2007, Frederick Seitz, the former head of the National Academy of Sciences, re-launched the Petition Project “to demonstrate that the claim of ‘settled science’ and an overwhelming ‘consensus’ in favor of the hypothesis of human-caused global warming and consequent climatological damage is wrong. No such consensus or settled science exists.”¹⁸³ The Petition has been endorsed by 31,487 Americans with university degrees in science—including 9,029 PhDs.¹⁸⁴ The vast majority of those who endorsed the Petition Project would not qualify as part of the relevant community as defined by Anderegg.¹⁸⁵

In *Daubert*, the district court held that the expert testimony was inadmissible under the “general acceptance test” because it had not established a link between Benedictine and birth defects with a ninety-five percent level of statistical significance, which is the threshold that epidemiologists typically required to establish scientific proof of causation.¹⁸⁶ The district court rejected the plaintiff’s expert testimony because it did not satisfy a scientific standard of certainty, which was far more demanding than the law’s “preponderance of the evidence” requirement.¹⁸⁷ On appeal, the Ninth Circuit affirmed the district court’s decision but primarily on the rationale that the expert’s testimony had not been the subject of a peer-reviewed publication.¹⁸⁸ The court held that under *Frye* only peer-reviewed publications were “generally accepted” by the scientific community—non-peer-reviewed expert testimony was thus categorically inadmissible.¹⁸⁹

¹⁸² *Id.*

¹⁸³ See GLOBAL WARMING PETITION PROJECT, *supra* note 2.

¹⁸⁴ Idso & Singer, *supra* note 2.

¹⁸⁵ Anderegg et al., *supra* note 181.

¹⁸⁶ *Daubert v. Merrell Dow Pharm., Inc.*, 727 F.Supp. 570, 575–76 (S.D. Cal. 1989). See also Brief of Professor Alvan R. Feinstein as Amicus Curiae Supporting Respondent, *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579 (1993) (No. 92-102), 1993 WL 13006384, at *3–4.

¹⁸⁷ *Daubert*, 727 F.Supp. at 575–76.

¹⁸⁸ *Daubert v. Merrell Dow Pharm., Inc.*, 951 F.2d 1128 (9th Cir. 1991).

¹⁸⁹ In *Daubert*, the Ninth Circuit held that certain expert testimony from scientists of unchallenged qualifications was wholly inadmissible because the methods of research and analysis employed by those scientists were not “generally accepted” by the “scientific community.” *Id.* at 1130–31. In *Metabolife v. Wornick*, the Ninth Circuit explained that “peer review is the chief way of satisfying th[e] requirement” that expert testimony be based on scientifically valid principles. 264 F.3d 832, 841 (9th Cir. 2001). In other words, the *Frye* standard indulged a strong assumption that “when a study has been peer-reviewed, it has presumptively been conducted in accordance with the dictates of scientific methodology.” Brief of the Carnegie Comm’n on Sci., Tech., & Gov’t as Amicus Curiae Supporting Neither Party, *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579 (1993) (No. 92-102), 1992 WL 12006521, at *26.

The application of the *Frye* standard to the facts in *Daubert* created a specific problem that had to be solved. Legal standards of proof are significantly less stringent than scientific standards of proof.¹⁹⁰ By deferring to the standards of the scientific community for assessing the admissibility of expert testimony, *Frye*'s "general acceptance" standard risked excluding probative expert testimony that met legal standards of proof.¹⁹¹ By rejecting both of the lower courts' rationales for excluding the expert testimony, the Supreme Court created the following conundrum: how can a screening mechanism be created for science that holds scientists to the standards of the scientific community but still achieves the objectives of litigation?¹⁹²

The Supreme Court resolved this dilemma with a two-pronged solution.¹⁹³ First, the *Daubert* Court unequivocally rejected the idea that

¹⁹⁰ See JASANOFF, *supra* note 115, at 80 (noting that legal tests of sufficiency typically require lower degrees of certainty than scientific standards of proof).

¹⁹¹ The disparity between judicial and scientific standards of proof created what one commentator has called the "certainty trap," which refers to the constraints on using science in the courtroom. See Black, *supra* note 113 (proposing that *Daubert* rejected *Frye*'s treatment of peer review but avoided the "certainty trap" by focusing the admissibility question on the validity of the methodology used to produce the expert testimony and unequivocally rejecting the idea that science was about certainty and absolute truth).

¹⁹² As amicus briefs for *Daubert* put it:

[The Ninth Circuit] concluded that unless an expert scientific study reflects the "consensus" of the pertinent field and has been published in a peer-reviewed journal, then it is not "good science" and is per se inadmissible in a federal court The Ninth Circuit relies on notions of "general acceptance" and "consensus," but these unelaborated formulations beg more questions than they answer.

Brief for Physicians, Scientists, and Historians of Science as Amici Curiae Supporting Petitioners, *Daubert*, 509 U.S. 579 (No. 92-102). The brief also stated:

Amici challenge the Ninth Circuit's premise that the only "good science" is that which is "generally accepted" and published in peer-reviewed journals, and reject the notion that scientific analysis and conclusions that might diverge from what a court deems the published "consensus" are so unreliable as to be wholly unworthy of consideration.

See also Oral Argument, *Daubert*, 509 U.S. 579 (No. 92-102), available at http://www.oyez.org/cases/1990-1999/1992/1992_92_102.

¹⁹³ In *Daubert*, Justice Blackmun explained that the judge's task under Rule 702 was screening out testimony that did not deserve to be called "scientific knowledge." *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 589-90 (1993) (No. 92-102). Justice Blackmun defined "scientific knowledge" in terms of the process used to produce it. *Id.* at 594. *Daubert* abandoned the notion that research requires an absolute threshold level of certainty that must be surmounted for an idea to become scientific. Quoting an amicus brief, Justice Blackmun also recognized that the scientific process did not yield theories that are "immutable true." *Id.* at 590 (quoting Brief Amici Curiae of Nicolaas Bloembergen et al. in Support of Respondents, *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579 (1993) (No. 92-102), 1993 WL 13006386, at *9).

science is solely about certainty or truth.¹⁹⁴ By doing so, the Court redefined what it legally meant for courts to hold scientific experts to the standards of the scientific community.¹⁹⁵ There was no longer an absolute level of certainty that had to be surmounted for an idea to be scientifically acceptable. Instead, the Court found that different kinds of decisions required different levels of certainty.¹⁹⁶

Second, the Court instructed trial courts to consider specific criteria to evaluate the admissibility of expert evidence.¹⁹⁷ It brought the criteria of science into the courtroom and asked judges to evaluate whether expert testimony met those criteria, and therefore satisfied the standards of the scientific community.¹⁹⁸ The question to be analyzed became whether the scientists could validly reach conclusions at the level of certainty the law requires, not the level of certainty the scientific community requires.¹⁹⁹ As a result, science in the courtroom serves the objectives of the judicial process but has the same level of reliability and certainty in the courtroom as it does anywhere else.

The IPCC's procedures are not scientifically flawed, but rather lack the flexibility needed to raise or lower the thresholds needed to establish reliability and relevance as the circumstances require. The IPCC needs a more robust and diverse portfolio of strategies to ensure that the science is credible. By using the standard for "research science," to assess the quality of science to be used in the regulatory area, the IPCC is using a standard that is too stringent and rigid for its purposes. The objective should

¹⁹⁴ See Oral Argument, *supra* note 192, at 18:23 (statement of Michael Gottesman, Esq.) ("The issue here is not whether the plaintiffs can prove this scientific proposition to the degree of certainty that would make it like the law of gravity [but] whether the plaintiffs can demonstrate that it is likelier or not that this is causing that.").

¹⁹⁵ *Daubert*, 509 U.S. at 593–94. *Daubert* resoundingly rejected this view of peer review as a presumptive proxy for reliability. *Id.* *Daubert's* discussion of "peer review and publication" takes pains to emphasize that publication in a peer-reviewed journal is no assurance of soundness of a finding, and the lack of publication is no assurance that a study and its findings are not sound. *Id.* The primary benefit of peer review and publication is the likelihood that the scrutiny involved will identify substantive flaws in methodology. *Id.* at 593. The *Daubert* Court thus concluded that publication in a peer-reviewed journal "is not a *sine qua non* of admissibility" and "does not necessarily correlate with reliability." *Id.* Instead, the Court concluded that the "fact of publication (or lack thereof) in a peer reviewed journal thus will be a relevant, though not dispositive, consideration in assessing the scientific validity of a particular technique or methodology on which an opinion is premised." *Id.* at 594.

¹⁹⁶ *Id.* at 597.

¹⁹⁷ *Id.* at 592.

¹⁹⁸ *Id.* at 592–93.

¹⁹⁹ *Id.* at 597.

not be “certainty,” but should depend on the context on which the science is being used. For the same reasons that the *Frye* standard was replaced by the *Daubert* guidelines, the IPCC would bolster the strength of its findings by adopting more flexible standards and shifting its analysis from scientific certainty to the validity of the process underlying the scientific findings.

IV. A NEW FRAMEWORK FOR REVIEWING IPCC ASSESSMENTS

In order for the IPCC assessments to be useful, U.S. agencies must be comfortable enough with the conclusions to incorporate them into the rulemaking process.²⁰⁰ Under the IQA,²⁰¹ federal agencies may only use information supplied by a third party as the basis for factual determinations if the information satisfies the requirements of the U.S. Office of Management and Budget’s “Final Information Quality Bulletin for Peer Review” (“the Bulletin”).²⁰² Because the Bulletin applies to information supplied by a third party and used by agencies as the basis for factual determinations, it includes the IPCC assessments.²⁰³ The Bulletin requires agencies to conduct a review of “influential”²⁰⁴ scientific information to ensure the information meets certain minimum reliability and quality standards.²⁰⁵ While the Bulletin provides basic guidelines about what review mechanisms and procedures agencies should consider in different circumstances, it gives agencies considerable discretion over how they review influential information provided by third parties.²⁰⁶

Although the IPCC could adjust its assessment procedures to conform with the requirements of U.S. administrative law, this does not fully

²⁰⁰ Jasanoff, *Science, Politics*, *supra* note 157, at 195.

²⁰¹ See Information Quality Act, *supra* note 94.

²⁰² Final Information Quality Bulletin for Peer Review, 70 Fed. Reg. 2664 (Jan. 14, 2005) [hereinafter OMB Bulletin].

²⁰³ The OMB Bulletin defines “scientific assessment [as an] evaluation of a body of scientific or technical knowledge[, which] typically synthesizes multiple factual inputs, data, models, assumptions, and/or applies best professional judgment to bridge uncertainties in the available information.” *Id.* at 2665.

²⁰⁴ *Id.* at 2667 (“[I]nfluential scientific information means scientific information the agency reasonably can determine will have or does have a clear and substantial impact on important public policies or private sector decisions”).

²⁰⁵ *Id.* at 2675 (defining highly influential scientific information that “(i) [c]ould have a potential impact of more than \$500 million in any year, or (ii) is novel, controversial, or precedent-setting or has significant interagency interest”).

²⁰⁶ Agencies may tailor the review process to the substance of the information product as necessary to ensure both the “scientific integrity” and “process integrity” of the review. *Id.* at 2668.

address the problem, as Congress could expand, narrow or otherwise modify the requirements for using IPCC assessments in the domestic rulemaking process. For this reason, this Article proposes instituting a domestic agency that would bear primary responsibility for reconciling IPCC assessments with the requirements of U.S. administrative law.

The *Daubert* screening process used to deconstruct the IPCC assessment will allow agencies to assess whether information is “influential” or exempt under the Bulletin.²⁰⁷ In addition, by “grading” the substance of IPCC assessments, the proposed agency would facilitate compliance with the IQA by allowing agencies to assess “individual versus panel review; timing; scope of the review; selection of reviewers; disclosure and attribution; public participation; disposition of reviewer comments; and adequacy of prior peer review.”²⁰⁸ Other factors likely to bear on the review procedures include “the novelty and complexity of the science to be reviewed, the relevance of the information to decision making, the extent of prior peer reviews, and the expected benefits and costs of additional review.”²⁰⁹

A. *The Agency Structure and Role*

In 1972, Congress created the Office of Technology Assessment (“OTA”) to provide Congressional members and committees with assessments of the complex scientific and technical issues of the late 20th century.²¹⁰ The OTA was governed by a twelve-member board, which consisted of six members of Congress from each party divided equally between the Senate and the House of Representatives.²¹¹ All told, the OTA produced about 750 studies on a wide range of topics, including acid rain, climate change and polygraphs.²¹² During the Reagan administration, the OTA attracted criticism as an “unnecessary agency” that duplicated the work of other government agencies.²¹³ These criticisms culminated in the decisions to defund the OTA in 1995.²¹⁴ Although the OTA was defunded, it

²⁰⁷ OMB Bulletin, *supra* note 203.

²⁰⁸ *Id.* at 2668.

²⁰⁹ *Id.* at 2671.

²¹⁰ See Office of Tech. Assessment Act, Pub. L. No. 92-484, 86 Stat. 797 (1972).

²¹¹ See *id.*

²¹² Jon Peha, *Science and Technology Advice for Congress: Past, Present, and Future* (Dep’t of Engineering and Pub. Pol’y, Paper No. 55, 2006), available at <http://repository.cmu.edu/epp/55/>.

²¹³ See Laura H. Kahn, *Bring Back the Office of Technology Assessment*, BULLETIN OF ATOMIC SCIENTISTS (May 20, 2007), <http://www.thebulletin.org/web-edition/columnists/laura-h-kahn/bring-back-the-office-of-technology-assessment>.

²¹⁴ Peha, *supra* note 212, at 3–4.

was never de-authorized.²¹⁵ This paper proposes re-instituting the OTA for the purpose of enhancing the domestic legitimacy and credibility of the IPCC's climate change assessments.²¹⁶

The proposed agency would be responsible for evaluating the validity of the methodologies underlying IPCC assessments. This would be a two-part process analogous to the way trial judges review the admissibility of expert testimony under *Daubert*. The process would establish a record containing sufficient scientific information and analysis to support these recommendations, which could be used by agencies to support policy, and could ultimately be reviewed by the courts under the “substantial evidence” or “arbitrary and capricious” tests for judicial review of administrative action.²¹⁷

The threshold step involves the agency's determination of what the claims are within the IPCC assessment that need to be validated. Each assessment contains about 100 findings.²¹⁸ Each of those findings involves differing levels of complexity, dimensionality and spatial resolution.²¹⁹ Depending on the complexity of the finding, the agency would make an initial determination of whether to apply the *Daubert* criteria according to an “atomized” or “corpuscular”²²⁰ standard, or a “weight-of-the-evidence” standard.²²¹ In the litigation context, under the “corpuscular standard,” the party offering expert testimony must demonstrate that each individual

²¹⁵ See *Hearing on 2011 Appropriations Before the Subcomm. on Legislative Branch of the H. Comm. on Appropriations*, 111th Cong. (2010) (statement of Francesca T. Grifo, Senior Scientist, Union of Concerned Scientists Scientific Integrity Program).

²¹⁶ Many others have similarly suggested re-funding the OTA. In April 2010, the Woodrow Wilson International Center for Scholars published *Reinventing Technology Assessment*, which called for establishing a nationwide network of non-partisan policy research organizations for performing the functions of the OTA that emphasized citizen engagement—the Expert & Citizen Assessment of Science & Technology (ECAST) network. RICHARD SCLOVE, WOODROW WILSON INT'L CENTER FOR SCHOLARS, REINVENTING TECHNOLOGY ASSESSMENT ix (2010).

²¹⁷ See CARL F. CRANOR, REGULATING TOXIC SUBSTANCES: A PHILOSOPHY OF SCIENCE AND THE LAW 147 (1993).

²¹⁸ See generally INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, FOURTH ASSESSMENT REPORT: CLIMATE CHANGE 2007 (2007).

²¹⁹ See INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS 943 (Susan Solomon et al. eds. 2007).

²²⁰ See COMMITTEE ON THE DEVELOPMENT OF THE THIRD EDITION OF THE REFERENCE MANUAL ON SCIENTIFIC EVIDENCE, REFERENCE MANUAL ON SCIENTIFIC EVIDENCE 19, 21 (3d ed. 2011) [hereinafter REFERENCE MANUAL ON SCIENTIFIC EVIDENCE].

²²¹ See, e.g., *Milward v. Acuity Specialty Products Grp., Inc.*, 639 F.3d 11, 18–20, 23 (1st Cir. 2011) (finding that the “weight of the evidence” as a whole could properly support an expert's opinion).

study upon which the expert relies as well as the expert's overall conclusions satisfy the *Daubert* criteria.²²² The plaintiff must meet the burden of “‘validating’ each of the studies relied upon by the plaintiff’s experts as well as [the burden of establishing] the scientific reliability of their overall conclusions.”²²³ By contrast, “[t]he weight-of-the-evidence approach focuses upon the totality of the scientific information” and whether a specific conclusion seems warranted.²²⁴ In the same way that the court must decide which of these approaches to take, the agency would have to make that determination as well depending on the complexity of the climate system model.

Once the various claims have been identified and organized, the proposed agency would apply the *Daubert* criteria to those claims by evaluating whether each of the IPCC’s conclusions was supported by the underlying texts and scientific references.²²⁵ The analysis would focus on assessing statements by identifying errors and inaccuracies—both in claims and corroboration. The evaluation would assess whether statements that attribute impacts to climate change are well founded in scientific research, including systematic observations, modeling and statistics. Any expert judgments that are incorporated in summaries would be made transparent and plausible by explaining the line of reasoning behind them in the main text. The agency would ensure observations and interpretations had been captured conscientiously, statements had been substantiated and the influence of any expert judgments had been made transparent.

This process has many advantages. First, it allows agencies to use the IPCC assessments in a more tailored and efficient manner. Second, it provides user-friendly materials that are salient and understandable not only to the agencies, but also to the public. Since it is impossible for most readers of IPCC reports to understand and check every reference, all data, models, calculations and measurements, they must be able to rely on the quality control and quality assurances given by the assessment process.

²²² See Erica Beecher-Monas, *Blinded by Science: How Judges Avoid the Science in Scientific Evidence*, 71 TEMP. L. REV. 55, 57, 69 (1998) (noting that the courts have frequently read *Daubert* to require them to evaluate each study underlying an expert’s conclusion sequentially to determine admissibility).

²²³ *Id.*

²²⁴ *Id.* at 23.

²²⁵ See NETH. ENVTL. ASSESSMENT AGENCY, ASSESSING AN IPCC ASSESSMENT 5 (2010) (The Netherlands Environmental Assessment Agency is “an independent governmental body that by statute provides the Dutch Government and Parliament—and the European Commission, European Parliament and U.N. organizations—with scientific advice on problems regarding the environment, sustainability and spatial planning.”).

B. Applying the Framework to a Climate Change Model

A key IPCC finding that would benefit from this new framework is the claim that average global surface temperatures have risen over the past half century.²²⁶ In the AR4, the IPCC claims that “[w]arming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level.”²²⁷ More specifically, the IPCC concludes that the mean global-surface temperature (both land and oceans) increased by about 0.64°C annually from 1956 to 2005.²²⁸

The historical changes in average global surface temperatures, which we will refer to simply as “global temperature trends,” have been described as the “most important indicator of global warming, by far.”²²⁹ The basis for the IPCC’s finding can be traced to three institutional efforts to reconstruct average global surface temperature histories for the purposes of studying climate change.²³⁰ These analyses were produced by three institutions: the U.S. National Aeronautics and Space Administration Goddard Institute for Space Studies (“NASA”), the U.S. National Oceanic and Atmospheric Administration (“NOAA”), and a collaboration of the Hadley Centre of the U.K. Meteorological Office with the Climate Research Unit of East Anglia (“CRU”).²³¹ These groups have developed separate frameworks for reconstructing global temperature trends based on similar

²²⁶ INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: SYNTHESIS REPORT (2007).

²²⁷ *Id.* at 30.

²²⁸ Kevin Trenberth et al., *Observations: Surface and Atmospheric Climate Change*, in INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS 249 (Susan Solomon et al. eds. 2007). The annual average increase in global surface temperatures has a margin of error of about 0.13°C. *Id.*

²²⁹ *A New Assessment of Global Warming*, BERKELEY EARTH SURFACE TEMPERATURE, <http://berkeleyearth.org/study/> (last visited Oct. 30, 2012). See also ROBERT ROHDE ET AL., BERKELEY EARTH TEMPERATURE AVERAGING PROCESS 1 (2011), available at <http://berkeleyearth.org/pdf/berkeley-earth-averaging-process.pdf> (“While there are many indicators of climate change, the long-term evolution of global surface temperatures is perhaps the metric that is both the easiest to understand and most closely linked to the quantitative predictions of climate models. It is also backed by the largest collection of raw data.”); Richard A. Muller, *The Case Against Global-Warming Skepticism*, WALL STREET JOURNAL (Oct. 21, 2011), <http://online.wsj.com/article/SB10001424052970204422404576594872796327348.html>.

²³⁰ See ROHDE ET AL., *supra* note 229, at 3.

²³¹ *Id.* These groups have developed their respective analysis frameworks, which share many features, over the past twenty-five years. *Id.*

but not identical weather records.²³² In all three cases, the reconstruction frameworks follow a basic three-part process, which includes: (1) the compilation of a basic dataset, (2) the application of a processing framework for adjusting or correcting erroneous, biased, and questionable data, and (3) a process by which the resulting data is mapped and averaged to produce useful climate indices.²³³

With respect to the compilation of data, all three groups reconstruct global temperature trends based on measurements gathered from land-based weather stations and ocean-borne weather monitors on ships and buoys and cover roughly 1850 to present.²³⁴

CRU, NASA, and NOAA cull through these measurements in a process commonly called “homogenization” designed to “correct” distortions resulting from changes in instrumentation, station location, measurement procedures, local vegetation or other factors that can introduce artificial biases in a temperature record.²³⁵ The “homogenized” data are stored in the Global Historical Climatology Network’s (“GHCN”) archive,²³⁶ which includes separate databases for daily and monthly temperature measurements that draw on different data sources and involve different quality control and bias correction procedures.²³⁷ In the case of land-based temperatures,²³⁸ all three global averages rely at least partially on the GHCN to reconstruct global-average temperatures in the past and estimate how they may change in the future.²³⁹

²³² *Id.* at 4. The three groups use heavily overlapping data sets consisting of temperature records from between 4400 and 7500 monitoring stations. The selection of stations is influenced by algorithms that require long, nearly continuous records. *Id.*

²³³ *Id.*

²³⁴ ROHDE ET AL., *supra* note 229, at 3.

²³⁵ See NOAA, SUMMARY OF RECENT CHANGES IN THE GHCN-M TEMPERATURE DATASET AND MERGED LAND-OCEAN SURFACE TEMPERATURE ANALYSIS 2 (2011).

²³⁶ The GHCN website is available at <http://www.ncdc.noaa.gov/ghcnm/>.

²³⁷ See *Global Historical Climatology Network—Daily*, NOAA SATELLITE AND INFORMATION SERVICE, <http://www.ncdc.noaa.gov/oa/climate/ghcn-daily/index.php> (last visited Oct. 30, 2012).

²³⁸ The land-based and ocean-surface time series are essentially independent. See ROHDE ET AL., *supra* note 229, at 3 (“Two of the three groups [NASA and CRU] treat the land-based and ocean problems as essentially independent reconstructions with global results only formed after constructing separate land and ocean time series.”).

²³⁹ See Ross McKittrick, *A Critical Review of Global Surface Temperature Data Products 4* (Social Science Research Network, Working Paper 1653928, 2010) (“CRU and [NASA] supplement it with a small amount of additional data. . . . CRU has stated that about 98 percent of its input data are from GHCN. [NASA] also relies on GHCN with some additional US data from the USHCN network, and some additional Antarctic data sources. NOAA relies entirely on the GHCN network.”).

Given the common reliance on GHCN, critics have claimed that any flaws in the GHCN's data would potentially flow through to all three global temperature histories.²⁴⁰ In particular, critics have expressed concerns that the quality assurance mechanisms, bias corrections, and other processing steps used to adjust the raw data are ineffective.²⁴¹ The three groups address temporal and spatial gaps in the data in different ways.²⁴² Thus, critics have challenged the reliability of land and sea-surface data used to create long-term warming trends as a result of various potential processing errors and sampling biases.²⁴³

1. Step One—Construing the Claim

To assess the reliability of the IPCC's claim that temperatures have risen by an estimated annual average of 0.64°C from 1956 to 2005, the proposed agency would first construe the claim that needs to be validated. This claim construction would determine the degree to which the agency "atomized" the evidence supporting the IPCC's claim for purposes of vetting the claim's reliability in the following step. The atomization analysis would reflect the complexity of the claim and novelty of the evidence supporting it, and would serve as a platform for performing the Daubert-like screening in the second step of the process.

The evidence supporting the IPCC's finding—the three major global temperature trend reconstructions—is more complex than one would likely suspect.²⁴⁴ The complexity results from the sheer scale of data involved²⁴⁵ and, perhaps more importantly, the pervasive reliability problems possibly affecting a very large portion of that data.²⁴⁶ The key word is "possibly."

Ross McKittrick has explained these reliability problems in the GHCN archives by contrasting actual temperature records with the ideal

²⁴⁰ *Id.* ("Because of this [common] reliance on GHCN, its quality deficiencies will constrain the quality of all derived products.").

²⁴¹ *See id.* at 17, 28, 33–34, 44–45.

²⁴² Juliet Lapidus, *How Important Is the East Anglia Climate Data Set?*, SLATE (Dec. 2, 2009), http://www.slate.com/articles/news_and_politics/explainer/2009/12/how_important_is_the_east_anglia_climate_data_set.html (noting that in order to address the lack of permanent weather stations in the Arctic Ocean, "NASA's approach is to extrapolate temperatures from the nearest land-based stations," while the "CRU doesn't 'fill in' the [missing measurements from the] Arctic Ocean . . . which makes it seem as though the Arctic is warming at the same rate as the global mean.").

²⁴³ *See Muller, supra* note 229.

²⁴⁴ *See ROHDE ET AL., supra* note 229, at 3; NETH. ENVTL. ASSESSMENT AGENCY, *supra* note 225, at 5.

²⁴⁵ *See* NETH. ENVTL. ASSESSMENT AGENCY, *supra* note 225, at 5.

²⁴⁶ *See* discussion *supra* Part IV.B.

record of surface temperatures.²⁴⁷ The ideal record for land-based temperatures would be collected continuously at consistent intervals at a monitoring site unaffected by changes in the surrounding environment (e.g., urbanization) using the same, perfectly maintained equipment.²⁴⁸ Temperature measurements gathered at such an ideal monitoring site over a given time period would yield an unambiguously reliable history of temperature trends during that time period. Of course, the real world is anything but ideal and the GHCN archive is by no means an exception. Temperatures at land-based observational sites can be affected by local land-use changes in the area surrounding the monitoring site—deforestation, road-building and urbanization.²⁴⁹ Imagine a hypothetical weather station where minimum, maximum, and mean temperatures were recorded every day for fifty years using the same equipment and measurement procedures. If the weather station was surrounded by raw forests for the first half of that time period and industrial-scale manufacturing facilities for the second half of that time period, it would be reasonable to expect temperature records to overestimate temperature increases during the latter half of the time period.

But land-use changes are not the only sources of bad thermometer readings possibly distorting the GHCN archive. The sources of possible distortion abound. A few of the better known examples include equipment and procedural discontinuities, changes in local air pollution, temporal gaps and so forth.²⁵⁰

Ross McKittrick has documented the deficiencies in the GHCN data and suggested that these deficiencies diminish the reliability of the three climatic histories used by the IPCC to support various policy recommendations.²⁵¹ In particular, McKittrick concludes that “there are serious quality problems in [the GHCN] that call into question whether the global temperature history, especially over land, can be considered both continuous and precise.”²⁵²

Recent research has called into question the reliability of the temperature data.²⁵³ In particular, Anthony Watts classified 82.5 percent

²⁴⁷ See McKittrick, *supra* note 239, at 34.

²⁴⁸ *Id.*

²⁴⁹ *Id.*

²⁵⁰ *Id.*

²⁵¹ *Id.* at 18.

²⁵² See McKittrick, *supra* note 239, at 4.

²⁵³ See, e.g., Anthony Watts, *Is the U.S. Surface Temperature Record Reliable*, THE HEARTLAND INSTITUTE (2009); Roger Pielke et al., *Unresolved Issues with the Assessment of Multi-Decadal Global Land Surface Temperature Trends*, 112 J. GEOPHYS. RES. D24S08 (2007), available at <http://www.agu.org/journals/jd/jd0724/2006JD008229/2006JD008229.pdf>.

of the 1218 weather stations included in the U.S. Historical Climatology Network (“USHCN”) according to a reliability grading schematic²⁵⁴ adopted by the NOAA in 2002.²⁵⁵ The schematic assigns individual stations a reliability grade ranging from the most reliable (Class 1) to the least reliable (Class 5).²⁵⁶ The survey shows that seventy percent of the USHCN temperature stations are ranked in the least reliable categories of four or five, which have a margin of error of 2°C to 5°C, respectively.²⁵⁷ The scale of this potential inaccuracy is significantly larger compared to the IPCC estimates of annual warming trends, which estimate that global average temperatures have risen by 0.64°C ± 0.13°C every year from 1956 to 2005.²⁵⁸ The analysis found that temperature biases are largest for stations with the worst siting characteristics.²⁵⁹ As a result, the study concluded that poor siting suggested that global-average temperature reconstruction had overestimated warming trends.²⁶⁰

This research suggests that the potential rate of error in the unadjusted GHCN data is very high. To address these reliability concerns, the global-temperature histories that support the IPCC’s finding²⁶¹ on recent global warming trends rely on various statistical techniques to adjust the temperature records for problems.²⁶² The reliability of the

²⁵⁴ The reliability schematic was developed in 1999. See M. Leroy, *Classification d’un Site, Note Technique no. 35*, Direction des Systèmes d’Observation, MÉTÉO-FRANCE, 12pp. (1999).

²⁵⁵ See NOAA, *SITE INFORMATION HANDBOOK 6–7* (2002). The classification system evaluates accuracy in four categories: temperature/humidity, precipitation, solar radiation, and wind. *Id.*

²⁵⁶ See Souleymane Fall et al., *Analysis of the Impacts of the Station Exposure on the U.S. Historical Climatology Network Temperatures and Temperature Trends*, 116. J. GEOPHYS. D141120 (2011).

²⁵⁷ *Id.*

²⁵⁸ RHODE ET AL., *supra* note 229, at 3 (citing Trenberth et al., *supra* note 228 (2007)).

²⁵⁹ Souleymane Fall et al. *supra* note 256, at 2.

²⁶⁰ *Id.* at 13.

²⁶¹ The IPCC has addressed the problem of surface-data contamination and adjustment mechanisms in all of its Assessment Reports. In AR4, the IPCC takes up the issue in Chapter 3 of Working Group I’s report, which states:

Systematic instrumental errors, such as changes in measurement practices or urbanization, could be more important, especially earlier in the record, although these errors are calculated to be relatively small at large spatial scales. Urbani[z]ation effects appear to have negligible effects on continental and hemispheric average temperatures

Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change 243 (S. Solomon et al. eds., 2007) (citing P. Brohan et al., *Uncertainty Estimates in Regional and Global Observed Temperature Changes: A New Data Set from 1850*, 111 J. GEOPHYS. RES. D12106 (2006)).

²⁶² See *Overview*, NOAA, available at <http://www.ncdc.noaa.gov/ghcnm/v3.php>.

global-average temperature reconstructions depends on the validity of these adjustments applied to the temperature records in the GHCN archive.²⁶³ As a result, the “quality control” measures used to correct or adjust the temperature measurements are critical for the accuracy of global average temperature reconstructions.

Under the framework for evaluating the IPCC’s assessment reports described above, the evidence of high potential rates of error in the unadjusted data would likely persuade the proposed agency to adopt a corpuscular or atomized approach to evaluating the reliability of the IPCC’s finding that global average temperatures have increased annually by about 0.63°C from 1956 to 2005. The existing groups construct a global average surface temperature record based on the “adjusted” time series.²⁶⁴ More specifically, the agency would likely construe all three adjustment frameworks used to reconstruct global average temperature trends as separate claims—or “methodologies”—to be validated independently. The argument for atomizing these adjustment frameworks would likely be enhanced given that a critical rationale for endorsing these reconstructions regardless of concerns raised about the reliability of their adjustments²⁶⁵ is that they arrive at the same results. Because each reconstruction framework applies different adjustment mechanisms to the GHCN data, the fact that they arrive at nearly identical conclusions suggests that their adjustments are reliable.²⁶⁶

2. Step Two—Applying *Daubert*

In the second part of the proposed framework, the agency would assess the reliability of the quality-control adjustments applied to the GHCN data based on factors similar to those described in *Daubert*.²⁶⁷ This section of the paper focuses on the extent to which the methods used to adjust the GHCN data had been “tested.”²⁶⁸ This is not to suggest that

²⁶³ McKittrick, *supra* note 239, at 4.

²⁶⁴ RHODE ET. AL., *supra* note 229, at 3.

²⁶⁵ McKittrick, *supra* note 239, at 30.

²⁶⁶ The EPA emphasized this rationale when it cited the IPCC in support of its Endangerment Finding. See, e.g., PEABODY ENERGY, PETITION FOR CORRECTION OF EPA’S ENDANGERMENT FINDING IX-6–IX-18 (Dec. 2009) (noting “[T]here are significant data problems with GHCN, and these problems are of sufficient magnitude as to invalidate claims to have identified trends in the three temperature records with . . . precision.”).

²⁶⁷ See *Daubert v. Merrell Dow Pharm.*, 509 U.S. 579, 593–95 (1993).

²⁶⁸ The paper does not consider the peer-review prong of the *Daubert* test or whether the technique is generally accepted in the scientific community. See Daniel Farber, *Modeling Climate Change and Its Impacts: Law, Policy, and Science*, 86 TEX. L. REV. 1655, 1658

this is the only, or even the most important criterion to consider, but rather to take advantage of recent research validating the adjustment frameworks underlying the three reconstruction efforts supporting the IPCC's claim that the world has warmed over the past fifty years.²⁶⁹

The Berkeley Earth Surface Temperature ("BEST") project,²⁷⁰ which began in 2010 under the leadership of Dr. Richard Muller and Dr. Robert Rohde, merged existing land-surface temperature records from over 36,000 weather stations into a comprehensive raw data set.²⁷¹ The BEST project reviewed "existing temperature processing algorithms for averaging, homogenization, and error analysis to understand both their advantages and their limitations."²⁷² Based on the limitations of extant adjustment methodologies, the BEST project created a new global surface temperature record based on "alternative statistical methods."²⁷³

In all three global average land-surface temperature reconstructions, every temperature measurement used to determine the global average land-surface temperature record is assumed to be equally reliable.²⁷⁴ As a result, heavily adjusted temperature measurements are deemed to be as reliable as temperature measurements where no bias adjustments were found to be necessary.²⁷⁵ This uniform treatment of adjusted and unadjusted data has diminished the accuracy of the resulting global average land-surface temperature reconstructions.

To evaluate the claim that flawed quality-control measures were producing erroneous reconstructions of global-average temperatures, the BEST project weighted temperature records from 1800 to present in the GHCN land-temperature dataset for reliability.²⁷⁶ This weighted data was used to reconstruct global average land-surface temperatures using only the non-homogenized, non-adjusted GHCN data.²⁷⁷ The weighting

(arguing that climate scientists have created "a unique institutional system for assessing and improving models, going well beyond the usual system of peer review . . . [and so] their conclusions should be entitled to considerable credence by courts and agencies").

²⁶⁹ See, e.g., KARL POPPER, CONJECTURES AND REFUTATIONS: THE GROWTH OF SCIENTIFIC KNOWLEDGE 37 (5th ed. 1989) ("[T]he criterion of the scientific status of a theory is its falsifiability, or refutability, or testability") (emphasis omitted).

²⁷⁰ See ROHDE ET AL., *supra* note 229; *Frequently Asked Questions*, BERKELEY EARTH SURFACE TEMPERATURE, <http://berkeleyearth.org/faq/> (last visited Oct. 30, 2012).

²⁷¹ *Frequently Asked Questions*, *supra* note 270.

²⁷² DAVID BRILLINGER ET AL., BERKELEY EARTH SURFACE TEMPERATURE ANALYSIS 1 (2011), available at <http://berkeleyearth.org/pdf/berkeley-earth-summary.pdf>.

²⁷³ *Id.*

²⁷⁴ See ROHDE ET AL., *supra* note 229, at 6.

²⁷⁵ *Id.* at 2.

²⁷⁶ *Id.*

²⁷⁷ *Id.* at 6.

framework was designed to ensure that temperature records considered more likely to be biased or distorted as a result of changing land-use patterns or other well-recognized distortions had less influence on the reconstructed climatic history.²⁷⁸ In other words, the BEST methodology allowed data with varying levels of quality to be used without compromising the accuracy of the resulting reconstructions.

The resulting reconstruction showed that the global land mean temperature had increased by $0.911^{\circ}\text{C} \pm 0.042^{\circ}\text{C}$ since the 1950s, which is significantly higher than the rate of warming claimed by the IPCC in AR4 but with a smaller margin of error.²⁷⁹

What about poor station quality? Again, our statistical methods allowed us to analyze the U.S. temperature record separately for stations with good or acceptable rankings, and those with poor rankings (the U.S. is the only place in the world that ranks its temperature stations). Remarkably, the poorly ranked stations showed no greater temperature increases than the better ones. The mostly likely explanation is that while low-quality stations may give incorrect absolute temperatures, they still accurately track temperature changes Our results turned out to be close to those published by prior groups. We think that means that those groups had truly been very careful in their work, despite their inability to convince some skeptics of that. They managed to avoid bias in their data selection, homogenization and other corrections.²⁸⁰

By developing an alternative methodology for reconstructing global average temperatures that relied directly on the unadjusted data, the BEST project validated the effectiveness of the averaging process and quality-assurance controls²⁸¹ applied by previous global average temperature reconstructions.²⁸²

²⁷⁸ *Id.*

²⁷⁹ See ROHDE ET AL., *supra* note 229, at 6.

²⁸⁰ Muller, *The Case Against Global Warming Skepticism*, *supra* note 229.

²⁸¹ See Richard Muller et al., *Earth Atmospheric Land Surface Temperature and Station Quality in the United States* at 9 (2011) (“Although our analysis was done using only US land stations, it indicates that the poor station quality documented by Fall et al. . . . should not significantly bias estimates of global warming”). For additional discussion of the Fall research, see *supra* note 256 and accompanying text.

²⁸² *Daubert v. Merrell Dow Pharm.*, 509 U.S. 579, 593 (1993) (“Ordinarily, a key question to be answered in determining whether a theory or technique is scientific knowledge that

Science recognizes that it is impossible to prove the absolute truth of any hypothesis or model. The most well-established physical laws are “conditional.” Rather, the doctrine of falsifiability developed by the philosopher of science, Sir Karl Popper, and adopted by the Supreme Court in *Daubert*, stands for the proposition that the more independent challenges that a theory or model passes successfully, the more confidence one can have in it.²⁸³

CONCLUSION

The debate about climate change science is unlike any other scientific controversy in recent memory. Not only does the public disagree, but highly esteemed scientists (and political leaders who largely parrot those scientists) champion conflicting certainties about climate change with enormous levels of confidence. On one hand, many scientists claim that the evidence of global warming is virtually “incontrovertible.” On the other hand, a non-negligible number of scientists claim the same evidence is wildly inconclusive.

Still more stunning is that decades of intense research have at most, modestly narrowed the gulf of understanding between those who say the science is settled and those who say it is anything but settled. Indeed, a series of recent surveys and studies have strongly suggested that the disagreement over climate change science has hardened over the past decade and especially in the past two or three years. The lack of convergence around a prevailing interpretation of the scientific evidence of climate change has prompted many scientists to consider whether changes in the structure of scientific activity over the past half century are driving the climate change science controversy. Leading scientists from both sides of the climate change controversy have concluded that the answer is resoundingly “yes.”

In a forthcoming paper, one of the most highly regarded scientific critics of climate change science concludes that “progress in climate science and the actual solution of scientific problems in this field have moved at a much slower rate than would normally be possible” as the result of changes in the underlying structure of scientific activity over the past

will assist the trier of fact will be whether it can be (and has been) tested.”). *See also* POPPER, *supra* note 269, at 37 (“[T]he criterion of the scientific status of a theory is its falsifiability, or refutability, or testability”).

²⁸³ POPPER, *supra* note 269, at 35 (“[O]ur belief in any particular natural law cannot have a safer basis than our unsuccessful critical attempts to refute it.”).

half century.²⁸⁴ A growing number of climate scientists who have supported the IPCC assessments in various forms have similarly recognized that concerns about the validity of the methodologies used by climate change science has exacerbated the controversy over climate change science. In other words, climate change skeptics are posing “a challenge to the process of climate change science, or to the values they believe to be implicit in the science, rather than as a direct challenge to scientific knowledge.”²⁸⁵

This paper has argued that the U.S. Supreme Court’s decision in *Daubert v. Merrell Dow Pharmaceutical* was driven by the same “changes in the structure of scientific activity over the past half century.” In particular, the issues implicated by litigation-driven science are sufficiently similar to those implicated by policy-driven science. The *Daubert* experience provides a potential model for enhancing the credibility and legitimacy of climate change science.

²⁸⁴ See Richard Lindzen, *Climate Science: Is It Currently Designed to Answer Questions?*, EURISIS, 161, 180–181 (2012).

²⁸⁵ Mike Hulme, *The Appliance of Science*, THE GUARDIAN, Mar. 13, <http://www.guardian.co.uk/society/2007/mar/14/scienceofclimatechange.climatechange>.