

AN INCONVENIENT BURDEN OF PROOF? CO₂ NUISANCE PLAINTIFFS WILL FACE CHALLENGES IN MEETING THE *DAUBERT* STANDARD

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Synopsis: Litigation regarding “climate change” allegedly caused by emissions of “greenhouse gases” – primarily CO₂ – has been winding its way through the federal court system for more than half a decade. The Supreme Court has now issued two opinions in climate change cases. The first opinion, in *Massachusetts v. EPA*, upheld a challenge to EPA’s decision not to regulate CO₂ emissions and has led the EPA to begin rulemaking on greenhouse gases. The second, *Connecticut v. AEP*, shut the courthouse doors on cases seeking to enjoin CO₂ emissions under federal common law nuisance claims but left the door open to state law claims and possibly damages claims.

With the doors to the federal courthouses still open at least a crack, and a spate of recent state complaints, climate litigation seems to be a new fact of life. As the initial challenges to justiciability are overcome, the next line in the sand may be challenges to the admissibility of plaintiff’s scientific evidence. This article focuses on the admissibility of scientific testimony on causation in common law nuisance damages cases under the *Daubert* standard, which is followed in all federal courts and about half of the states’ courts. The authors have collaborated to blend an analysis of scientific theories and legal principals. They conclude that based on the current state of climate science and the principles of *Daubert*, climate change theories are not yet well enough established to hold CO₂ emitters liable for damages in a court of law.

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I. INTRODUCTION

“What gets us into trouble is not what we don’t know. It’s what we know for sure that just ain’t so.” - Al Gore, quoting Mark Twain.¹

As the debate over anthropogenic² global warming (AGW) moves from the chambers of legislative bodies to the courthouse, trial judges will be called upon to decide what we know for sure and what we don’t know. The initial decision will be made on *Daubert*³ challenges.

A handful of cases have been filed in recent years against emitters of carbon dioxide alleging various types of injuries and damages. Plaintiffs have sought both injunctive relief and recovery of damages under federal and state common law nuisance theories. To date, the battle has focused solely on threshold motions related to whether such claims are justiciable, including defenses of political question, standing, and failure to state a claim for nuisance. This spring, the U.S. Supreme Court jumped into the fray, reversing in part and remanding *Connecticut v. American Electric Power Co.*, which was the first Circuit Court case to find plaintiffs had standing to bring a nuisance suit.⁴ The Court held that claims for abatement under federal common law nuisance are preempted⁵ by the Clean Air Act (CAA).⁶ But while the Supreme Court effectively barred suits based on federal common law, it left the door open to suits based on state common law, remanding the state claims for further proceedings.⁷

It may be 2012 before the Second Circuit decides whether to allow CO₂ nuisance claims based solely on state common law, and another appeal to the Supreme Court is likely, leaving the viability of such claims up in the air for several more years. Pending Supreme Court review of a case based on state law, which could come again in *American Electric Power Co. v. Connecticut (AEP)*⁸ or possibly in *Native Village of Kivalina v. ExxonMobil Corp. (Kivalina)*,⁹ it seems likely that CO₂ claims will proliferate unless and until Congress steps in or defendants develop an unassailable line of defense. And assuming state law claims are not preempted,¹⁰ the next line in the sand will be challenges to admissibility of plaintiffs’ scientific evidence under the *Daubert* standard that is

1. Davis Guggenheim, *An Inconvenient Truth*, IMDB.COM (Aug. 31, 2006), <http://www.imdb.com/title/tt0497116/quotes> (Al Gore quoting Mark Twain).

2. “[O]f, relating to, or resulting from the influence of human beings on nature.” Definition of *Anthropogenic*, MERRIAM-WEBSTER.COM, available at <http://meriam-webster.com/dictionary/anthropogenic>.

3. *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579 (1993). See *infra* Section III. E. (*Daubert* applies in all federal courts and has been adopted by about half the states).

4. *Connecticut v. American Elec. Power Co.*, 582 F.3d 309 (2d Cir. 2009), *rev’d* American Elec. Power Co. v. Connecticut, 131 S. Ct. 2527 (2011).

5. *American Elec. Power Co.*, 131 S. Ct. at 2537.

6. 42 U.S.C. §§ 7401-49 (2006).

7. *American Elec. Power Co.*, 131 S. Ct. at 2540 (The court left “the matter open for consideration” because state law claims had not been reached by the Second Circuit and had not been briefed by any of the parties).

8. *Id.*

9. See generally *Native Vill. of Kivalina v. ExxonMobil Corp.*, 663 F. Supp. 2d 863 (N.D. Cal. 2009); See discussion *infra* Section II.B.

10. This question is a topic of its own that is well beyond the scope of this article. But it is quite possible that state claims may be allowed, as is discussed briefly below in Section II.C.

currently applicable in federal courts and many state courts as well. Plaintiffs seeking damages will face two hurdles under *Daubert*, to show: 1) that the emission of CO₂ has materially changed the earth's climate; and 2) if so, that such a change caused the specific harms and localized effects the plaintiffs claim to have suffered.

Most non-scientists – including most lawyers, judges, and jurors – have a very limited and rudimentary understanding of the climate science underpinning the AGW theory. The public's understanding of AGW comes largely from Al Gore's movie, "An Inconvenient Truth,"¹¹ and the media; television, radio, newspapers, magazines, and the internet. The former was intended as a call to action by a strong advocate for regulating CO₂ output and the latter is nearly always hopelessly superficial.¹² Only scientists and a small minority of lay students of the topic even begin to understand how complex earth's climate is and consequently how difficult it is to prove AGW or any theory of what causes long term changes in our climate, let alone that climate change is the cause of a specific weather event or series of events.

This article will provide a concise high-level explanation of the science behind the AGW theory written in mostly non-scientific terms that lawyers, judges, and policy makers can readily understand and apply, particularly in tort cases. It will also show how the legal standards of admissibility may be applied in the context of a tort case seeking to draw a causal connection between defendants' CO₂ emissions and alleged specific harms to plaintiffs. We conclude, based on review of the current state of science and applicable federal law, that despite the scientific "consensus" on AGW, plaintiffs cannot satisfy the level of proof required by the scientific method and therefore cannot meet the *Daubert* standard for admissibility of evidence on causation in tort cases seeking damages.¹³

II. BACKGROUND AND HISTORY OF GLOBAL WARMING THEORY AND LITIGATION

To understand the difficulties in "proving" both AGW theory in general and that defendants caused or contributed materially to plaintiffs' alleged damages, it is helpful to understand how new climate science is and how little time – in climate terms – the scientific measurements required to develop and test the AGW theory have been available. Climatology is a study of weather averages over the long term: decades, centuries, and millennia. Just because the earth is colder or warmer from one year to the next does not prove or disprove a climate trend, just as the fact the daily high temperature goes up five days in a row in early December in Chicago does not mean that summer is coming soon. Such year to year variations have always been accepted as being natural in origin. The

11. AN INCONVENIENT TRUTH (Paramount Vantage 2006).

12. And in the case of the Internet, much of what is available on both sides of the argument is unreliable as it is written and compiled by partisans. This is not to say that other forms of popular media are necessarily un-biased.

13. Cases seeking only injunctive relief and cases in state courts that do not follow *Daubert* may fare somewhat better. While such cases are beyond the scope of this article, the analysis herein may nevertheless be applicable so far as it goes, and state case considerations are discussed briefly below.

explanation for longer term variations, though, has increasingly been blamed upon human activities.

A. Brief History of Human CO₂ Emissions and Advent of AGW Theories

Humans have had a general understanding of weather and climate since prehistoric times. The earliest humans would have readily grasped that some days were colder than others, sun was associated with warmth, and clouds could lead to precipitation and generally cooler temperatures. The commencement and widespread adoption of agriculture depended on a rudimentary understanding of climate. No ancient civilization would have invested the time and effort to prepare soil and sow seeds in the spring without the knowledge that spring and then summer would nourish the seed and crops with rain, warmth, and sunshine, leading to a harvest in the fall.

Only relatively recently did humans develop technology to study weather and climate. The graduated liquid-filled tube we think of as a “thermometer” was not invented until the 1600s.¹⁴ Regular and reliable observation and recordation of local temperatures began only about 100 years ago.¹⁵ It was not until 1979 that mankind was able to take the temperature of the entire globe using satellites.¹⁶ Regular direct measurement and monitoring of CO₂ concentrations in the atmosphere did not begin until 1958.¹⁷ Later, scientists developed proxies for measuring CO₂ concentration and prepared “reconstructions” of both CO₂ and temperatures going back hundreds, thousands, and even hundreds of thousands of years.¹⁸

Almost as soon as CO₂ began to be measured, an upward trend was observed.¹⁹ This trend had been measured at many stations around the world and is not disputed.²⁰ Nor is it disputed that the main cause is human consumption of fossil fuels.²¹ It is believed that CO₂ concentrations began to slowly increase by the 19th Century at the dawn of the industrial revolution and to increase rapidly in the mid-20th Century after World War II.²² Because CO₂ is a known “greenhouse gas,” scientists began to consider whether CO₂ increases might

14. Hervé Le Treut et al., 2007: *Historical Overview of Climate Change*, in CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS; CONTRIBUTION OF WORKING GROUP I TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE § 1.3.2 (S. Solomon et al. eds., 2007), available at <http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-chapter1.pdf> [hereinafter *Historical Overview of Climate Change*].

15. *Id.* This is actually a point of great debate. While a few measuring stations have been operating longer, the measurements of just a few stations make a poor proxy for global temperatures. Additionally, observed temperatures at earth stations must be adjusted for the recognized “urban heat island” effect and, thus, are not direct measurements. *Id.* See also sources cited *infra* note 17.

16. *Historical Overview of Climate Change*, *supra* note 14, § 1.3.2.

17. *Id.* § 1.3.1.

18. See, e.g., *id.* §§ 1.3.2, 1.4.2.

19. *Id.* § 1.3.1.

20. Piers Forster et. al., 2007: *Changes in Atmospheric Constituents and in Radiative Forcing*, in CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS; CONTRIBUTION OF WORKING GROUP I TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE § 2.3.1 (S. Solomon et al. eds., 2007), available at <http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-chapter2.pdf> [hereinafter *Changes in Atmospheric Constituents and in Radiative Forcing*].

21. *Id.* “Fossil fuels” refers to coal, oil, and natural gas.

22. *Id.*

cause global warming.²³ In 1988, the UN formed the Intergovernmental Panel on Climate Change (IPCC).²⁴ The IPCC issued four reports from 1990 to 2007, each sounding an increased alarm and calling for policy makers world-wide to act to curb global CO₂ emissions.²⁵ A fifth report is now in preparation.

B. Brief History of CO₂ Litigation

Litigation related to CO₂ emissions can be traced back about a decade.²⁶ The first case to work its way through the legal system did not seek damages but rather was aimed at changing government policy, specifically seeking action to curb emissions of CO₂.²⁷ Environmentalists were frustrated that the U.S. government had taken little action to reduce CO₂. Neither Democrats nor Republicans seemed interested in passing climate legislation with any teeth. Thus, “[t]he first President Bush . . . signed the United Nations Framework Convention on Climate Change (UNFCCC), a nonbinding agreement,” and the Senate ratified it unanimously.²⁸ But when it came to the Kyoto Protocol, the Senate unanimously rejected it.²⁹ The stated reason was that the Kyoto targets for greenhouse gas emissions did not apply to developing and heavily polluting nations such as China and India, but the other key difference is that the targets were mandatory. The second Bush administration was seemingly resistant to CO₂ controls, which helped set up the landmark case of *Massachusetts v. EPA*,³⁰ which was the first suit to gain traction in the courts. The case took a long, slow path to the Supreme Court.

Massachusetts v. EPA began in 1999 with 19 environmental and other private organizations filing a rulemaking petition with the EPA asking it to regulate “greenhouse gas emissions from new motor vehicles under §202 of the Clean Air Act.”³¹ Although two of the EPA’s General Counsels under the Clinton Administration had given opinions that the EPA had authority to regulate CO₂ emissions, in 2003 the EPA reached the opposite conclusion.³² The EPA decided that “the Clean Air Act does not authorize [it] to issue mandatory regulations to address global climate change, and . . . that even if the Agency had the authority to set greenhouse gas emission standards, it would be unwise to do so.”³³

23. *Historical Overview of Climate Change*, *supra* note 14, § 1.4.1.

24. *Id.* § 1.6.

25. *See, e.g., id.* *See generally, Reports*, IPCC, http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml (last visited Sept. 10, 2011) (First through Fourth reports linked there).

26. *See, e.g., Massachusetts v. EPA*, 549 U.S.497, 510 (2007) (starting as a rulemaking petition to the EPA in 1999).

27. *Id.*

28. *Id.* at 509.

29. *Id.* By Senate resolution expressing its sense that the United States should not enter into the Kyoto Protocol. S. Res. 98, 105th Cong. (1997) (enacted). So strong was the opposition that “President Clinton did not submit the Protocol to the Senate for ratification.” *Massachusetts*, 549 U.S. at 509.

30. *Massachusetts*, 549 U.S. 497.

31. *Id.* at 510.

32. *Id.* at 510-11.

33. *Id.* at 511 (citation omitted).

The private “[p]etitioners, now joined by a number of intervenor states and local governments,” appealed the EPA’s decision to the D.C. Circuit.³⁴ “Each of the three judges on the [Circuit Court’s] panel wrote a separate opinion,” but two of three agreed that the EPA had properly exercised its discretion.³⁵ The D.C. Circuit denied review of EPA’s refusal to commence a rulemaking to regulate greenhouse gases.³⁶ The Supreme Court accepted certiorari and reversed, holding that the petitioners had standing, that Congress had given the EPA the authority to regulate greenhouse gases, and that EPA acted arbitrarily and capriciously in “refus[ing] to decide whether greenhouse gases cause or contribute to climate change.”³⁷

Shortly after *Massachusetts v. EPA* debuted in court, a few plaintiffs warmed to the idea of suing CO₂ emitters under the theory of federal common law nuisance, despite the obviously daunting prospects.³⁸ The leading case is *Connecticut v. American Electric Power Co.*, which was filed “[i]n 2004, separately by two groups of [p]laintiffs, one consisting of eight States and New York City, and the other of three land trusts.”³⁹ Each group sued the same power companies which generate electricity with fossil fueled power plants.⁴⁰ According to plaintiffs, defendants contribute to the public nuisance of global warming “as the ‘five largest emitters of carbon dioxide in the United States and . . . among the largest in the world.’”⁴¹ The plaintiffs in *Connecticut v. American Electric Power Co.* “sought ‘abatement of defendants’ ongoing contributions to a public nuisance.’”⁴² The suits were pled under federal common law and, alternatively, under state law.⁴³ The Second Circuit reversed the District Court’s dismissal, holding that the plaintiffs had standing to sue.⁴⁴ As noted above and discussed in detail below, the Supreme Court reversed the Second Circuit in part.⁴⁵

In more recent suits plaintiffs have focused on recovery of damages. In *Comer v. Murphy Oil USA*, the plaintiffs filed a class action, after Hurricane Katrina, on behalf of themselves and other “residents and owners of lands and property along the Mississippi Gulf coast.”⁴⁶ They alleged that the defendants’ emissions of greenhouse gases had contributed to global warming, which raised “sea levels and added to the ferocity of Hurricane Katrina,” destroying the plaintiffs’ property.⁴⁷ The complaint asserted that defendants’ emissions

34. *Id.* at 514.

35. *Id.*

36. *Id.*

37. *Id.* at 526, 534.

38. Such actions were suggested many years ago in an extensive and perhaps prescient law review article. David A. Grossman, *Warming Up to a Not-So-Radical Idea: Tort-Based Climate Change Litigation*, 28 COLUM. J. ENVTL. L. 1 (2003).

39. *Connecticut v. American Elec. Power Co.*, 582 F.3d 309, 314 (2d Cir. 2009).

40. *Id.*

41. *Id.* (quoting *Connecticut v. American Elec. Power Co.*, 406 F. Supp. 2d 265, 268 (S.D.N.Y. 2005)).

42. *Id.* at 316.

43. *Id.*

44. *Id.* at 392.

45. *American Elec. Power Co. v. Connecticut*, 131 S. Ct. 2527, 2540 (2011).

46. *Comer v. Murphy Oil USA*, 585 F.3d 855, 859 (5th Cir. 2009).

47. *Id.*

constituted public and private nuisances.⁴⁸ In an oral ruling, the District Court granted the defendants' motion to dismiss "on the grounds that the plaintiffs lack standing . . . and that their claims present nonjusticiable political questions."⁴⁹ The Fifth Circuit initially reversed, holding that "[t]he plaintiffs have pleaded sufficient facts to demonstrate standing for their public and private nuisance, trespass, and negligence claims."⁵⁰ The Fifth Circuit later dismissed the appeal when, after granting rehearing en banc, the Circuit lost a quorum after recusal by 8 of its 16 judges.⁵¹

Then, in 2008 an Eskimo village and city sued a number of energy and utility companies under both federal and state common law of nuisance, alleging that defendants' emissions of greenhouse gases had contributed to global warming and thereby caused erosion of Arctic sea ice.⁵² The complaint asserted that the reduction in sea ice due to global warming led to increased erosion of the coastline, rendering the Village of Kivalina – situated on the Arctic Ocean – uninhabitable.⁵³ Plaintiffs sought damages to cover the cost of relocating the village, estimated at \$95 to \$400 million.⁵⁴ The district court again granted the defendants' motion to dismiss, concluding "that Plaintiffs' federal claim for nuisance [was] barred by the political question doctrine and for lack of standing under Article III" of the U.S. Constitution.⁵⁵ The case is currently on appeal to the Ninth Circuit, with oral argument scheduled for November 28, 2011.⁵⁶

None of the cases to date has yet addressed the question of whether the plaintiffs' can establish causation, although at least one court has alluded to the potential difficulty facing the plaintiffs.⁵⁷ To date, the defendants have successfully invoked standing and justiciability defenses to avoid going to trial on the merits. As discussed in the next section, the Supreme Court, by an equally divided court affirmed the Second Circuit's holding of standing in *AEP*,⁵⁸ and the only remaining hurdle for cases to proceed on the merits is determination of whether state nuisance law is preempted by the CAA. When and if the cases start dealing with the merits, the plaintiffs will face the next big hurdle to overcome to actually get to trial⁵⁹ in the form of *Daubert* challenges.

48. *Id.*

49. *Id.* at 860.

50. *Id.* at 879.

51. *Comer v. Murphy Oil USA*, 607 F.3d 1049, 1053-54 (5th Cir. 2010).

52. *Native Vill. of Kivalina v. ExxonMobil Corp.*, 663 F. Supp. 2d 863, 869 (N.D. Cal. 2009).

53. *Id.*

54. *Id.*

55. *Id.* at 883.

56. Another case, *California v. General Motors Corp.*, might have been considered by the Ninth Circuit but for the intervening bankruptcy of GM and the EPA's decision to regulate greenhouse gases from motor vehicles. *California v. General Motors Corp.*, No. C06-05755, 2007 WL 2726871 (N.D. Cal. 2007); Unopposed Motion to Dismiss Appeal at 3, *California v. Gen. Motors Corp.*, No. 07-16908 (9th Cir. June 19, 2009), available at <http://www.globalclimateaw.com/uploads/file/California%20v%20GM%20dismissal.pdf>.

57. "We do not hazard, at this early procedural stage, an *Erie* guess into whether these claims actually state all the elements of a claim under Mississippi tort law, e.g., whether the alleged chain of causation satisfies the proximate cause requirement under Mississippi state common law . . ." *Comer v. Murphy Oil USA*, 585 F.3d 855, 880 (5th Cir. 2009); see also *id.* at 877 n.18 (discussing proximate causation).

58. *American Elec. Power Co. v. Connecticut*, 131 S. Ct. 2527 (2011).

59. *Daubert* challenges are usually considered pre-trial on motions for summary judgment.

C. The Current State of the Law of Climate Litigation – Evolving and Unsettled

The Supreme Court dealt a significant blow to nuisance claimants in *AEP*. The Court's holding is simple: "We hold that the Clean Air Act and the EPA actions it authorizes displace any federal common law right to seek abatement of carbon-dioxide emissions from fossil-fuel fired power plants."⁶⁰ Importantly, however, plaintiffs' standing was affirmed by an equally divided court,⁶¹ potentially allowing the case to proceed on remand.⁶²

The reason the law remains unsettled is that the Court expressly did not rule on whether state common law is preempted by the CAA.⁶³ Because "[n]one of the parties have briefed preemption or otherwise addressed the availability of a claim under state nuisance law. . . . the matter [is left] . . . for consideration on remand."⁶⁴ It would not be surprising if the majority on the Second Circuit panel allowed the state claims to proceed since state common law of nuisance is quite similar to federal law, both drawing on and forming the basis for the Restatement.⁶⁵

Defendants will likely argue that the state law claims are preempted by the CAA. However, the threshold for preemption is higher than for the doctrine of displacement, which was the basis of the Court's decision in *AEP*.⁶⁶ So long as damages suits do not interfere with the Congressional purpose of the CAA, claims may be permitted.⁶⁷ And the CAA contains a savings clause for private actions: "Nothing in this section shall restrict any right which any person (or class of persons) may have under any statute or common law to seek enforcement of any emission standard or limitation or to seek any other relief (including relief against the Administrator or a State agency)."⁶⁸

There is precedent for allowing state based nuisance cases for damages, notwithstanding federal regulation of the discharged pollutants. In *International Paper Co. v. Ouellette*, the Supreme Court permitted plaintiffs to maintain a damages action for water pollution under state common law nuisance theory, notwithstanding that the Clean Water Act prescribed regulations governing discharge of pollution into waterways.⁶⁹ The *AEP* Court may actually have left a loophole for claimants seeking damages as opposed to injunctive relief. If

60. *American Elec. Power Co.*, 131 S. Ct. at 2537.

61. *Id.* at 2535. Justice Sotomayor did not participate in the decision because she was on the Second Circuit panel that decided the case. Some commenters presume she would have voted for standing, creating a 5-4 majority on that issue, but that is speculative and likely a moot point for now.

62. And potentially influencing state courts to find in favor of standing.

63. *American Elec. Power Co.*, 131 S. Ct. at 2540.

64. *Id.*

65. See, e.g., RESTATEMENT (SECOND) OF TORTS, § 821A-F (1979).

66. See, e.g., *American Elec. Power Co.*, 131 S. Ct. at 2537 ("Legislative displacement of federal common law does not require the 'same sort of evidence of a clear and manifest [congressional] purpose' demanded for preemption of state law.") (quoting *City of Milwaukee v. Illinois*, 451 U.S. 304, 317 (1981)).

67. See, e.g., *North Carolina v. Tennessee Valley Auth.*, 615 F.3d 291 (4th Cir. 2010).

68. 42 USC § 7604(e) (2006).

69. *Int'l Paper Co. v. Ouellette*, 479 U.S. 481, 497-500 (1987). However, the district court was required to apply the law of the state where the discharge occurred, not the law of the state where the harm occurred, which will force climate plaintiffs to adapt their case to multiple states' laws if they sue multi-state defendants.

defendant's emissions are consistent with regulations, that is a defense.⁷⁰ But to date, the EPA has no standards for CO₂ emissions by power plants. Thus, while injunctive relief may not be available, since the EPA is considering standards, damages actions based on past emissions allegedly contributing to current and recent harms may be cognizable.

III. THE SUPREME COURT ADOPTED THE *DAUBERT* TEST TO ENSURE THAT JURIES ONLY HEAR SCIENTIFIC EXPERT TESTIMONY THAT IS BASED ON REPUTABLE AND RECOGNIZED SCIENTIFIC THEORIES.

A. *Daubert Interpreted Evidence Rule 702 to Depart from the Longstanding "Generally Accepted" Standard of Frye.*

For many decades prior to the Supreme Court's decision in *Daubert*, federal district courts generally applied the *Frye v. United States (Frye)* standard to proffered scientific opinion testimony.⁷¹ Even eight decades ago courts struggled to determine what constitutes scientific "knowledge" as opposed to unproven theory:

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.⁷²

Thus, under *Frye*, the touchstone was "general acceptance."⁷³ In 1975, the Federal Rules of Evidence became effective.⁷⁴ Rule 702 addressed expert testimony, establishing a fairly low bar: "If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise."⁷⁵

The expert testimony only needed to be relevant evidence that would "assist the trier of fact."⁷⁶ The test for relevance under Rule 401 is also low, requiring only that evidence have "any tendency to make the existence of any fact that is of consequence to the determination of the action more probable or less probable than it would be without the evidence."⁷⁷

70. See, e.g., *North Carolina*, 615 F.3d at 310.

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

72. *Id.* at 1014.

73. *Id.*

74. Act of Jan. 2, 1975, Pub. L. No. 93-595, 88 Stat. 1926.

75. FED. R. EVID. 702 (1975).

76. *Id.*

77. FED. R. EVID. 401. The standard of "any tendency" likely means that any scientific testimony that can meet Rule 702 and *Daubert* would certainly be ruled relevant.

Arguably Rule 702, which contained no “generally accepted” requirement, effectively superseded the *Frye* standard.⁷⁸ However, most federal courts continued to apply *Frye* until the *Daubert* standard was announced.⁷⁹ In 2000, Rule 702 was amended in response to *Daubert*, adding the following qualification after the language of the original rule quoted above: “if (1) the testimony is based upon sufficient facts or data, (2) the testimony is the product of reliable principles and methods, and (3) the witness has applied the principles and methods reliably to the facts of the case.”⁸⁰

Because the 2000 Amendments to Rule 702 were adopted in response to *Daubert*, the case is still considered good law and is routinely cited by federal courts.⁸¹ And while both *Daubert* and the Advisory Committee Notes to the 2000 Amendments note that *Daubert* does not constitute a definitive or exclusive checklist,⁸² the case remains a good starting point in any evaluation of scientific testimony.

B. The Trial Judge Must Serve as a “Gatekeeper” and Exclude Scientific Evidence That Does Not Meet Evidence Rule 702 and the Daubert Standard.

As any trial lawyer knows, just because a witness is willing to testify to a fact truthfully and under oath does not mean a jury will hear the testimony. If the testimony is irrelevant, based on hearsay, speculative, privileged, or contrary to numerous other standards for admissibility, the trial judge will not allow the juror to hear it. The same holds true for scientific and other opinion testimony. The trial court acts as a “gatekeeper” of any expert evidence – protecting the jury from irrelevant or unverified evidence that may improperly sway its decision-making process.

Judges must own the role of the gatekeeper, actively engaging with the scientific expert to determine whether the expert’s evidence is admissible. Irrespective of the admissibility standard followed in their particular jurisdiction, the judge’s gatekeeping role is “what judges do.”⁸³ In performing this function with regard to scientific theories, judges “want to know to what extent the theory has been properly and sufficiently tested and whether or not there has been research that has attempted to prove the theory to be wrong.”⁸⁴

In the post-*Daubert* universe, it has been more apparent that judges are integral to the admissibility of expert testimony. The question is how judges engage in the gatekeeping function. In evaluating expert testimony, the court begins with the now-amended Evidence Rule 702.⁸⁵ The judge is tasked with

78. Indeed, the Supreme Court so held in *Daubert*. *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 587 (1993).

79. “Although under increasing attack of late, the rule continues to be followed by a majority of courts, including the Ninth Circuit.” *Id.* at 585.

80. FED. R. EVID. 702.

81. See generally FED. R. EVID. 702 advisory committee’s note on 2000 Amendments.

82. *Daubert*, 509 U.S. at 593; FED. R. EVID. 702 advisory committee notes.

83. Sophia I. Gatowski et al., *Asking the Gatekeepers: A National Survey of Judges on Judging Expert Evidence in a Post-Daubert World*, 25 LAW & HUM. BEHAV. 433, 443 (2001).

84. *Id.* at 444.

85. *Daubert*, 509 U.S. at 589 n.7, 600 (Rehnquist, C.J., dissenting) (“I do not doubt that Rule 702 confides to the judge some gatekeeping responsibility in deciding questions of the admissibility of proffered expert testimony.”).

assuring that the jury only hears expert testimony that is based on “scientific knowledge.”⁸⁶ *Daubert* held that a trial judge is to ensure that the testimony is “relevant to the task at hand” and that it has “a reliable foundation.”⁸⁷

The purpose of the gatekeeping role is often described as keeping “junk science” out of cases where expert testimony is particularly important.⁸⁸ In doing so, judges are more restrictive on the admissibility of any expert testimony. “Most judges . . . believe[] that one purpose of *Daubert* was to guard against . . . ‘junk science’.”⁸⁹ Judges cannot avoid this gatekeeping role by imparting their own reasoning, but “[t]he focus [of the admissibility inquiry], of course, must be solely on principles and methodology, not on the conclusions that they generate.”⁹⁰ Otherwise, the judge supplants the role of the jury, instead of focusing on determining “whether they could reliably follow from the facts known to the expert and the methodology used.”⁹¹

C. All Expert Testimony Must Be Based on Verifiable, Scientific “Knowledge.”

While cases and commentators may speak in terms of the need to bar “junk science” that is a shorthand that does not fully describe the scope of evidence that may fail to overcome a *Daubert* challenge. Few would consider AGW theories to be “junk science,” a pejorative that in the litigation context refers to science that has few adherents and may even have been concocted primarily or exclusively to support product liability claims. But under *Daubert* and its progeny, even serious, well-funded, and well-respected scientific theories that would never be called “junk science” must nevertheless be sufficiently reliable to be admissible.

Expert testimony is reliable if the knowledge underlying it “ha[s] a reliable basis in the knowledge and experience of [the pertinent] discipline.”⁹² To be admitted, “the subject of an expert’s testimony must be ‘scientific . . . knowledge.’”⁹³ *Daubert* defines “scientific” to mean “grounding in the methods and procedures of science.”⁹⁴ Knowledge “connotes more than subjective belief or unsupported speculation” and “applies to any body of

86. FED. R. EVID. 702.

87. *Daubert*, 509 U.S. at 597.

88. See, e.g., *General Elec. Co. v. Joiner*, 522 U.S. 136, 153 n.6 (1997) (Stevens, J., concurring in part and dissenting in part); *Tamraz v. Lincoln Elec. Co.*, 620 F.3d 665, 680 (6th Cir. 2010) (Boyce, C.J., dissenting); PETER W. HUBER, *GALILEO’S REVENGE: JUNK SCIENCE IN THE COURTROOM* (1991).

89. Gatowski, *supra* note 83, at 443; David G. Owen, *A Decade of Daubert*, 80 DENV. U. L. REV. 345, 362 (2002).

90. *Daubert*, 509 U.S. at 595.

91. *Heller v. Shaw Indus., Inc.*, 167 F.3d 146, 153 (3d Cir. 1999); *Ruiz-Troche v. Pepsi Cola of P.R. Bottling Co.*, 161 F.3d 77, 81 (1st Cir. 1998) (“[T]rial judges may evaluate the data offered to support an expert’s bottom-line opinions to determine if that data provides adequate support to mark the expert’s testimony as reliable.”); *Moore v. Ashland Chem., Inc.*, 151 F.3d 269, 279 (5th Cir. 1998) (en banc) (noting that “[s]everal post-*Daubert* cases have cautioned about leaping from an accepted scientific premise to an unsupported one,” and finding “no scientific support for [the expert’s] conclusion that exposure to any irritant at unknown levels triggers the asthmatic-type condition” experienced by the plaintiff).

92. *Kumho Tire Co. v. Carmichael*, 526 U.S. 137, 148 (1999).

93. *Daubert*, 509 U.S. at 589-90.

94. *Id.* at 590.

known facts or to any body of ideas inferred from such facts or accepted as truths on good grounds.”⁹⁵

In *Daubert*, the Supreme Court enumerated four factors⁹⁶ to guide trial courts in determining admissibility. The party offering the expert evidence must show the judge, by the preponderance of the evidence, that the offered expert testimony is derived from the scientific method.⁹⁷ In evaluating expert testimony, judges look to four main guidelines in considering whether expert testimony is reliable: (1) “falsification” or whether the theory or technique can be and has been tested, (2) “whether the theory or technique has been subjected to peer review and publication,” (3) whether there is a “known or potential rate of error” for a particular technique, and (4) whether there is “general acceptance” of the proposed testimony within the relevant scientific community.⁹⁸ These factors are discussed in detail below.

In evaluating the proposed expert testimony, a trial court focuses on whether that evidence would be admissible at trial and to ensure its reliability.⁹⁹ The party proposing a witness “must show that the expert’s findings are based on sound science, and this will require some objective, independent validation of the expert’s methodology.”¹⁰⁰ Although the court must not ignore the expert’s ultimate conclusions, it must determine whether the techniques by which the expert arrived at the proffered conclusions “fit” with the facts at the case in hand and the alleged science behind it.¹⁰¹ There must be a valid connection between those techniques and the conclusion, which must and should be tested.¹⁰² Courts should exclude expert testimony when “there is simply too great an analytical gap between the data and the opinion proffered.”¹⁰³

If the party offering the evidence does not or cannot submit evidence that satisfies “the gatekeeper,” the gatekeeper must refuse to admit the expert’s testimony into evidence.¹⁰⁴ And even though many trial court judges likely are not qualified in the expert’s chosen science, they must nevertheless evaluate whether the expert’s testimony is reliable.¹⁰⁵

95. *Id.*

96. *Id.* at 593-5. Often a fifth factor is considered – whether the method advocated was developed primarily for purposes of litigation or through independent research. *Daubert v. Merrell Dow Pharm., Inc.*, 43 F.3d 1311, 1317 (9th Cir 1995) (*Daubert II*).

97. *See generally* FED. R. EVID. 104(a).

98. *Daubert*, 509 U.S. at 593-95.

99. 4 JACK B. WEINSTEIN & MARGARET A. BERGER, WEINSTEIN’S FEDERAL EVIDENCE § 702.05 (Joseph M. McLaughlin ed., 2d ed. 2007); *Kumho Tire Co. v. Carmichael*, 526 U.S. 137, 148-49 (1999).

100. *Daubert II*, 43 F.3d at 1316.

101. *Id.* at 1315.

102. *See generally* *General Elec. Co. v. Joiner*, 522 U.S. 136, 146 (1997).

103. *Id.*

104. *See, e.g., McClain v. Metabolife Intern., Inc.*, 401 F.3d 1233, 1255 (11th Cir. 2005) (“[T]he trial court abused its discretion . . . by abdicating its gatekeeper responsibilities . . .”).

105. *See, e.g., Elsayed Mukhtar v. California State Univ.*, 299 F.3d 1053, 1066 (9th Cir. 2002) (vacating a district court’s admission of expert testimony when it found that the court “abdicated its gatekeeping role by failing to make *any* determination that [the expert’s] testimony was reliable”); *but cf. United States v. Alatorre*, 222 F.3d 1098, 1102 (9th Cir. 2000) (“[n]owhere in *Daubert* . . . does the Supreme Court mandate the form that the inquiry into relevance and reliability must take”).

Thus, once standing and other preliminary defenses are overcome, CO₂ plaintiffs will have to try to convince the gatekeeper that their claims are based on reliable and verifiable “scientific knowledge” to satisfy Evidence Rule 702 and *Daubert*.

D. The Touchstone of the Daubert Standard is Testing and Falsifiability Consistent with the Scientific Method.

The Supreme Court made clear in *Daubert* that the most important question the trial court must answer in performing the gatekeeping role is whether a scientific opinion has been tested consistent with the scientific method.¹⁰⁶ The Court in *Daubert* listed a number of considerations, but led the list with this:

Ordinarily, a key question to be answered in determining whether a theory or technique is scientific knowledge that will assist the trier of fact will be *whether it can be (and has been) tested*. “Scientific methodology today is based on generating hypotheses and testing them to see if they can be falsified; indeed, this methodology is what distinguishes science from other fields of human inquiry.” Green, at 645. See also C. Hempel, *Philosophy of Natural Science* 49 (1966) (“[T]he statements constituting a scientific explanation must be capable of empirical test”); K. 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*”).¹⁰⁷

Thus, not only did the Court lead off with the requirement of testability and falsifiability, it called it the “key question.”¹⁰⁸

In second place on the list of “pertinent” considerations is, “whether the theory or technique has been subjected to peer review and publication.”¹⁰⁹ But the Court went on to caution that “[p]ublication (which is but one element of peer review) is not a *sine qua non* of admissibility; it does not necessarily correlate with reliability.”¹¹⁰ After peer review, the Court listed “the known or potential rate of error.”¹¹¹

Lastly, the Court acknowledged that the former sole test under *Frye* is still a consideration: “Finally, ‘general acceptance’ can yet have a bearing on the inquiry.”¹¹² The Court stated it can be an “important factor,” since a theory that is not well-supported “may properly be viewed with skepticism.”¹¹³ But given the *Daubert* Court’s rejection of “general acceptance” and the *Frye* standard, the Court seems to have intentionally relegated acceptance to a much lesser role than considerations of the specific scientific method employed, testing, falsifiability, and the error rate of the method.

106. *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 593 (1993).

107. *Id.* (emphasis added).

108. This is apparently a widely held view among judges. Gatowski, *supra* note 83, at 444 (88% of judges surveyed “believed falsifiability to be a useful guideline for determining the merits of proffered scientific evidence”).

109. *Daubert*, 509 U.S. at 593.

110. *Id.*

111. *Id.* at 594.

112. *Id.*

113. *Id.*

E. Frye to the Forefront After AEP?

To say that the status of climate litigation is unsettled is an understatement. While the Supreme Court has put an end to the short life of greenhouse gas nuisance cases under federal common law, it seems unlikely that it has killed climate litigation altogether. As discussed above, plaintiffs will likely be able to pursue climate claims under state common law nuisance theories unless the *AEP* case goes back to the Supreme Court a second time and the court bars state-based claims as well. Moreover, a series of suits were filed earlier this year in federal¹¹⁴ and eleven state courts¹¹⁵ based on the “Public Trust Doctrine.”¹¹⁶

It seems climate litigation is becoming more and more a fact of life. But it remains an open question whether those cases will be brought in state or federal court. The *AEP* case illustrates the key issue. Absent a federal theory, the primary basis for subject matter jurisdiction is most likely diversity, under 28 U.S.C. § 1332.¹¹⁷ Complete diversity is lacking in the *AEP* case, because American Electric Power is a citizen of New York, and the State of New York and New York City joined as plaintiffs.¹¹⁸ But it would be easy to find any number of plaintiffs who could sue the same six defendants without destroying diversity.¹¹⁹ The question may be why would plaintiffs *want* to be in federal court?

Lacking a federal cause of action and faced with the *Daubert* challenge analyzed above, plaintiffs might well view state courts as viable fora. Indeed, if a state forum is viewed as particularly friendly, plaintiffs might well take care to ensure that diversity jurisdiction would be lacking if the defendants were to attempt removal to federal court. But on the other side of the coin, plaintiffs may want to take advantage of the current state of the law on standing. Under *AEP*, standing is established in federal court but could be highly uncertain in state courts.

Forced to consider state courts, plaintiffs’ lawyers may reap a side benefit of being able to avoid the *Daubert* challenge and instead proffer experts under what is generally viewed to be a more lax *Frye* test.¹²⁰ Assuming plaintiffs can put together viable nuisance cases based on the common law of one or more

114. See, e.g., Complaint for Declaratory & Injunctive Relief at 1, *Lorz v. EPA*, No. 11-2203 (N.D. Cal. May 4, 2011).

115. See, e.g., Answer of Defendants to Plaintiffs’ Amended Complaint for Declaratory & Injunctive Relief, *Svitak v. State*, No. 11-2-16008-4 (Wash. Super. Ct. King Co. June 24, 2011).

116. The 12 cases are coordinated by the Our Children’s Trust which asserts that, “[t]he government has a legal obligation to preserve these trust resources and to manage them for the equal benefit of everyone, not just for the benefit of the wealthy and politically-connected corporations.” *The Atmospheric Trust Litigation (ATL)*, OUR CHILDREN’S TRUST. <http://ourchildrenstrust.org/legal-action> (last visited Sept. 13, 2011). The complaints seek declaratory and injunctive relief to force federal and state governments to curb CO₂ emissions. *Id.*

117. 28 U.S.C. § 1332 (2006). Although, the complaint in *AEP* also alleged original federal jurisdiction over the Tennessee Valley Authority, as a federal agency. Complaint at 1, *Connecticut v. American Elec. Power Co.*, 582 F.3d 309 (2d Cir. 2009), *rev’d* *American Elec. Power Co. v. Connecticut*, 131 S. Ct. 2527 (2011) (No. 04-5669).

118. *American Elec. Power Co.*, 131 S. Ct. at 2529.

119. One need look no further than the non-New York plaintiffs in *AEP*: the states of Connecticut, California, Iowa, New Jersey, Rhode Island, Vermont, and Wisconsin. *Id.* at 2533 n.3.

120. Although legal scholars study and debate whether the two standards are all that different in practice. See, e.g., Edward K. Chang & Albert H. Yoon, *Does Frye or Daubert Matter? A Study Of Scientific Admissibility Standards*, 91 VA. L. REV 471 (2005).

states, then the evidence rules applicable in state courts will apply. Courts in roughly half of the states apply the *Daubert* standard.¹²¹ Depending on who is doing the counting, courts in 15 or more states apply the *Frye* test.¹²² The remaining 10 or so states blend the two tests or use a unique test of their own.¹²³ Interestingly, more populous states are more likely to use *Frye*, including five of the six most populous states: California, New York, Florida, Illinois, and Pennsylvania.¹²⁴ Only four of the ten most populous states use *Daubert*: Texas, Ohio, Michigan, and Georgia.¹²⁵

A thorough analysis of whether plaintiffs' scientific proof of causation should get past the gatekeeper in the states that apply *Frye* or its variations is left to another article and another day. But given that the problem with proving AGW is not "general acceptance"¹²⁶ – which is all that *Frye* requires – but rather proof in accordance with the scientific method – as *Daubert* requires – it seems logical that climate nuisance cases could stand a better chance in *Frye* states. This is not to say that defendants should concede admissibility, as there are actually two sides to the debate, but with a two-sided debate and general acceptance arguably on the side of the plaintiffs, it probably becomes a question for the jury. For example, the California Supreme Court held that "the *Frye* test does not demand 'absolute unanimity of views in the scientific community. . . . Rather, the test is met if use of the technique is supported by a clear majority of the members of that community.'"¹²⁷ The California Supreme Court tempered the "clear majority" test somewhat by noting that the trial court "must [also] consider the quality, as well as quantity, of the evidence supporting . . . a new scientific [theory]."¹²⁸ Similarly, the Kansas Supreme Court stated:

[T]he fact there may be some disagreement on the part of a few in the scientific and medical community as to the reliability of a particular test method is a matter affecting the weight of such evidence and not its admissibility. [Other courts] have held such evidence admissible as long as a qualified expert witness testifies that the particular test method employed in a given case is reliable and accurate in his opinion, and also that it is generally accepted as such by other experts in the field.¹²⁹

121. The exact number depends on who is doing the counting, since states sometimes adopt variants of the federal test. A recent article pegged the *Daubert* count at twenty-five. Note, *Admitting Doubt: A New Standard For Scientific Evidence*, 123 HARV. L. REV. 2021, 2024 (2010).

122. *Id.* at 2025.

123. *Id.*

124. David E. Bernstein & Jeffrey D. Jackson, *The Daubert Trilogy in the States*, 44 JURIMETRICS J. 351, 355 n. 25 (2004).

125. Victor E. Schwartz & Cary Silverman, *The Draining of Daubert and the Recidivism of Junk Science in Federal and State Courts*, 35 HOFSTRA L. REV. 217, 267 n. 300 (2006).

126. *But see Purpose of Petition*, GLOBAL WARMING PETITION PROJECT, <http://www.PetitionProject.org> (last visited Sept. 2, 2011) (identifying 30,000+ scientists rejecting the human-caused global warming and consequent climatological damage hypothesis) [hereinafter *Petition Project*]. See also discussion *infra* Part V.B.4.

127. *People v. Leahy*, 882 P.2d 321, 337 (Cal. 1994)(emphasis in original)(citing and quoting *People v. Guerra*, 690 P.2d 635 (Cal. 1984).

128. *Id.*

129. *City of Abilene v. Hall*, 451 P.2d 188, 193 (Kan. 1969) (discussing blood alcohol tests).

The highest court in another populous state has “noted that the particular procedure need not be ‘unanimously indorsed’ by the scientific community” to be considered “generally acceptable as reliable” under the *Frye* test.¹³⁰

Thus, while defendants are not likely to concede the *Frye* hearing, the test is probably friendlier to plaintiffs. Accordingly, plaintiffs may wish to seek out *Frye* fora. Defendants’ forum choosing options are much more limited, though removal should be sought if at all possible. The remainder of this article is focused on the *Daubert* standard, but the shortcomings of AGW theory in establishing causation discussed herein should prove helpful even to defendants in the *Frye* states.

F. Judges May Be Particularly Challenged in Attempting to Evaluate Proffered Scientific Theories as Complex as Global Warming.

Judges may be inadequately prepared to deal with certain types of expert evidence, particularly complex scientific evidence. In his dissent in *Daubert*, Chief Justice William Rehnquist cautioned that judges are not equipped as amateur scientists to fulfill their gatekeeping role.¹³¹ Science hardly gets more complex than AGW theory. New, soft sciences often raise questions of admissibility, and courts have been flexible as to the admissibility of certain sciences.¹³² “[A]lthough the judges surveyed reported that they found the *Daubert* criteria useful for determining the admissibility of proffered expert evidence, the extent to which judges understand and can properly apply the criteria when assessing the validity and reliability of the proffered scientific evidence was questionable at best.”¹³³ In fact, almost half of judges surveyed indicate that their education has left them inadequately prepared to deal with scientific evidence in the court room,¹³⁴ and 96% of judges stated “that they had *not* received [CLE] instruction about general scientific methods and principles.”¹³⁵ Compounding the problem, “the judge ruling on the admissibility of expert proof may be hampered not only by his or her lack of scientific expertise, but also by the scientific uncertainty surrounding the question on which an expert seeks to testify and consequent disagreements among scientists and scientific disciples.”¹³⁶

The opinion of one federal district court judge illustrated well the trials and tribulations trial courts face in trying to pass on the validity of complex scientific opinions:

Despite residual misgivings about its own competence to judge the opinion of another on a scientific matter under analysis, the court, bolstered by the thought that

130. *People v. Wesley*, 633 N.E.2d 451, 454 (N.Y. 1994).

131. *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 601 (1993) (Rehnquist, C.J., dissenting).

132. *See generally* *Hawthorne Partners v. AT&T Techs., Inc.*, 831 F. Supp. 1398 (N.D. Ill. 1993); *Iacobelli Constr., Inc., v. County of Monroe*, 32 F.3d 19 (2d Cir. 1994); *In re Aluminum Phosphide Antitrust Litig.*, 160 F.R.D. 609 (D. Kan. 1995); *Isely v. Capuchin Province*, 878 F. Supp. 1021 (E.D. Mich. 1995); *Moore v. Ashland Chem. Inc.*, 151 F.3d 269 (5th Cir. 1997); *Petruzzi's IGA Supermarkets, Inc., v. Darling-Delaware Co.*, 998 F.2d 1224 (3d Cir. 1993); *Williams v. General Motors Corp.*, 639 So. 2d 275 (La. Ct. App. 1994).

133. *Gatowski*, *supra* note 83, at 452.

134. *Id.* at 442.

135. *Id.*

136. Margaret A. Berger, *Science for Judges*, 12 J.L. & POL'Y 1, 3 (2003).

no subject is so complicated as to be above the head of the gatekeeper, and after agonizing over the unfamiliar scientific principles that must be employed here, decides that Thompson's opinion does not pass *Daubert* muster.¹³⁷

Judges clearly could benefit from more science-based education,¹³⁸ and this article is intended as a modest starting point to give lawyers and judges a basic understanding of the basis for and limitations of climate science as well as where the key focus should be.¹³⁹ The next section, drafted by Dr. Roy Spencer, provides a critical understanding of what climate scientists know and don't know. That is followed by a legal analysis applying *Daubert* to the current state of climate science.

IV. A SCIENTIST'S EXPLANATION OF THE BACKGROUND, THEORY OF ANTHROPOGENIC GLOBAL WARMING, AND LIMITATIONS OF THE THEORY IN LAYMAN'S LANGUAGE

"No amount of experimentation can ever prove me right; a single experiment can prove me wrong." - Albert Einstein¹⁴⁰

A. *The Nature of Scientific Research*

The reliance of the courts on testimony from expert witnesses has required judges, attorneys, and juries to become better acquainted with the methods scientists and engineers use to study problems. We all know of cases where expert witnesses for both plaintiff and defendant arrive at diametrically opposed conclusions based upon the same evidence. How can this be, if both are following scientific methodological practices?

The answer is that following a scientific method of inquiry is no guarantee of arriving at truth. It is simply a structured approach for using quantitative measurements to support (or reject) hypotheses of how the physical world works. It is quite common for those measurements to support a range of hypotheses, which in general cannot all be true. While one or more related hypotheses might then become part of a more widely accepted scientific 'theory', the distinction between hypothesis and theory is not a well defined one.

A generally accepted requirement of any scientific hypothesis or theory is that it should be falsifiable.¹⁴¹ In other words, one should be able to conduct some experiment, the failure of which would disprove the theory.¹⁴² But there

137. *McCress v. Global Upholstery Co.*, 500 F.Supp.2d 1350, 1351-2 (N.D. Ala. 2007). The District Court had recently been reversed for allowing a jury to hear unreliable scientific testimony proffered by plaintiffs on the grounds "it lacked sufficient knowledge on the scientific subject matter to exclude the testimony." *McClain v. Metabolife Int'l, Inc.*, 401 F.3d 1233, 1237 (11th Cir. 2005).

138. *Gatowski*, *supra* note 83, at 454-55.

139. Although for any litigants in CO₂ nuisance cases, an article such as this will be barely a starting point. The fields of law and science implicated by such cases are both exceedingly complex, and many thousands of lawyer and climate scientist billable hours will be spent researching and developing hundreds or thousands of pages of briefing and affidavits for the court.

140. THE NEW QUOTABLE EINSTEIN 291 (Alice Calaprice ed., 2005).

141. *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 593 (1993).

142. Karl Popper was the leading 20th Century proponent of the importance of falsification. His belief that scientific explanation must be capable of empirical test was cited with approval by the Supreme Court in *Daubert. Id.*

have been philosophers of science who have disputed this requirement,¹⁴³ and the most vocal proponent of falsification, Karl Popper, advanced it as a pragmatically useful requirement and not as a hard requirement for the practice of science.¹⁴⁴

In the end, scientific theories are embraced based upon some combination of their ability to explain the observations and how well they conform to the worldview of the scientist. Nothing is ever proved to be true, and quite often what was assumed to be true is found to be most likely false.¹⁴⁵ In the case of global warming theory, carbon dioxide concentrations in the atmosphere have increased in the last century, and there has been a general warming trend roughly during the same period of time.¹⁴⁶ Therefore, it is entirely reasonable to then hypothesize that increasing CO₂ has caused most, if not all, of the warming.

The trouble is that alternative hypotheses for the cause(s) of the warming, such as natural climate cycles or indirect forcing by the sun, have seen relatively little research.¹⁴⁷ A considerable body of published literature exists which runs counter to the views represented by the most recent (2007) IPCC report,¹⁴⁸ and over 31,000 degreed professionals have signed a petition opposing the opinions of the IPCC.¹⁴⁹ However, media reports and politicians still usually represent the science of anthropogenic global warming as settled.¹⁵⁰

While one might think that simply taking sufficient measurements would establish the cause(s) of climate change, making measurements is typically a much easier task than determining what those measurements tell us in terms of cause and effect. Even perfect measurements are no guarantee of determining how nature works. “Correlation is not causation” – and even when it is, we might not be able to determine the direction of that causation. Two scientists can examine the same data and come to diametrically opposed conclusions about what the data mean in terms of cause and effect. As a result, it is much easier to be wrong than right in scientific research.

There can be many alternative hypotheses for some observed phenomenon, but typically only one of them will be the correct one. Not all scientific problems are created equal, and the more complex the system being studied, the easier it is to be wrong. As an example of a relatively simple scientific problem, being able to accurately quantify the gravitational force has allowed us to

143. KARL-OTTO APEL, *TOWARDS A TRANSFORMATION OF PHILOSOPHY* (MARQUETTE STUDIES IN PHILOSOPHY) 20 (Glyn Adey & David Fisby, trans., 1980).

144. Deborah A. Redman, *Karl Popper's Theory of Science and Econometrics: The Rise and Decline of Social Engineering*, 28 J. ECON. ISSUES (Mar. 1994), http://findarticles.com/p/articles/mi_qa5437/is_n1_v28/ai_n28638355.

145. John P. A. Ioannidis, *Why Most Published Research Findings Are False*, 2 PLOS MED. 696 (2005).

146. Thomas R. Karl et al., *Trends in U.S. Climate During the Twentieth Century*, 1 CONSEQUENCES 1 (Spring 1995).

147. ROY W. SPENCER, *THE GREAT GLOBAL WARMING BLUNDER: HOW MOTHER NATURE FOOLED THE WORLD'S TOP CLIMATE SCIENTISTS* 153-6 (2010).

148. CRAIG IDSO & S. FRED SINGER, *CLIMATE CHANGE RECONSIDERED: 2009 REPORT OF THE NONGOVERNMENTAL INTERNATIONAL PANEL ON CLIMATE CHANGE (NIPCC) 1* (Joseph L. Bast & Diane Carol Bast eds., 2009), available at <http://www.nipccreport.org/reports/2009/pdf/CCR2009FullReport.pdf>.

149. *Petition Project*, supra note 126.

150. ROY W. SPENCER, *CLIMATE CONFUSION: HOW GLOBAL WARMING HYSTERIA LEADS TO BAD SCIENCE, PANDERING POLITICIANS AND MISGUIDED POLICIES THAT HURT THE POOR* 171 (2008).

precisely predict the positions of the planets many years in advance or find the quickest way to send a satellite to Mars and land it safely on the surface. We might not fully understand why the force of gravity is what it is, but we routinely use it to make successful predictions and explain observed phenomena.

When we study complex systems involving a multitude of forces and processes which interact in myriad ways, the difficulty in answering specific questions escalates dramatically. The science of climate change is one of those disciplines. As previously noted, the causes of natural climate variability are still only poorly understood. Without knowing how much of climate change is natural, it is difficult to know with any objective level of confidence how much is caused by humans.

While it is likely true that none of the concepts underpinning putative global warming theory have been falsified,¹⁵¹ it is also true that there are alternative hypotheses for warming which have not been falsified. It is entirely possible that warming has been part natural and part anthropogenic but in proportions which are currently unknown. Even if we knew exactly what those proportions were, the attribution of specific weather events or even long-term regional changes in weather to the human portion would be as much an exercise in faith as it would be in science.

B. The Fundamental Role of Forcing in Climate Change Theory

The temperature of the climate system, just like the temperature of virtually anything, is the result of a balance between energy gained and energy lost. For example, when a pot of water is placed on a warm stove, its temperature will rise until the rate of energy loss by the pot to its surroundings equals the rate at which energy is gained from the stove. This is true whether the water boils or not. The resulting steady temperature reflects a balance between energy gained and energy lost. Thus, warming can be caused by either increasing the rate at which energy is gained (turning up the stove) or decreasing the rate at which energy is lost (putting a lid on the pot). This ‘energy balance’ concept, a consequence of conservation of energy, is the same one used to explain temperature changes in the climate system. In current climate theory, the average temperature of the climate system reflects a balance between the rate at which solar energy is absorbed by the Earth and the rate at which infrared (IR) energy is lost by the Earth to outer space. Both of these radiative energy flows are estimated to be about 240 Watts per square meter when averaged over the whole Earth.¹⁵² Anything which upsets this radiative energy balance between absorbed sunlight and emitted IR energy is called “radiative forcing” and can be expected to lead to a temperature change over time,¹⁵³ just as turning the stove up or putting a lid on the pot of water can be expected to cause the water’s temperature to increase.

151. *Id.*

152. *Historical Overview of Climate Change*, *supra* note 14, at 97; Kevin E. Trenberth, John T. Fasullo, & Jeffrey Kiehl, *Earth’s Global Energy Budget*, 90 BULL. AM. METEOROLOGICAL SOC’Y 311 (2009).

153. The focus of AGW theorists is human-caused forcing; *i.e.*, the emission of greenhouse gases. We know there are natural forcings as well because we know the earth’s climate and average temperature have varied considerably long before any human forcing occurred.

On climate time scales, say at least several years, it has been assumed that there is a natural balance between global-average energy gain and energy loss, probably to much less than 1%.¹⁵⁴ Indirect evidence of this balance is the relatively small long-term changes in global average surface temperature, which appear to be stable to around 1°C or so over periods of centuries. Unfortunately, there is currently no way to directly verify the assumption of global energy balance, due to a lack of sufficiently accurate satellite observations of global absorbed solar energy and emitted infrared energy.¹⁵⁵

Only a few of the possible sources of forcing (imposed energy imbalance) of the climate system are reasonably well understood. There is a satellite-observed 0.1% change in the intensity of sunlight associated with the 11-year sunspot cycle; however, this is a very small forcing, and it is cyclic, not a long-term change.¹⁵⁶ Major volcanic eruptions, such as the 1991 eruption of Mt. Pinatubo can cause an energy imbalance of at least 1% leading to cooling, but these forcings are only temporary, as the volcanic aerosols in the atmosphere dissipate over a period of a few years.¹⁵⁷

The largest of the reasonably well known long-term forcings is the decrease in the rate of IR cooling by the Earth to space caused by increasing CO₂ in the atmosphere, believed by AGW theory proponents to be mostly or entirely due to the burning of fossil fuels by humanity. But this forcing has not actually been measured; it is instead theoretically calculated.¹⁵⁸ The theory, though, has been extensively tested and refined over the years, both in the laboratory and with satellite measurements of the IR emission to space at thousands of infrared wavelengths. Our knowledge of the forcing from increasing CO₂ is helped by the fact that CO₂ is reasonably well mixed in the global atmosphere, and we measure it accurately at a variety of locations from the Arctic to the South Pole.¹⁵⁹

But the same cannot be said for potential natural sources of warming. The possibility that there could be long-term energy imbalances caused by, say, natural changes in cloud cover, is seldom addressed, mostly because the satellite instrumentation to accurately measure long-term changes in global cloud cover has only existed since 2000 with the launch of NASA's Terra satellite.¹⁶⁰ In order to investigate whether the recent period of warming since the late 1970s has been mostly caused by a 1% or 2% decrease in cloud cover, we would have needed accurate and stable measurements of global cloud cover extending back

154. IDSO & SINGER, *supra* note 148, at 163.

155. D.F. Young et al, *Temporal Interpolation Methods for the Clouds and Earth's Radiant Energy System (CERES) Experiment*, 37 J. APPLIED METEOROLOGY 572 (1998).

156. There is some empirical and laboratory evidence that solar activity can indirectly cause larger forcings by affecting cloud formation processes, but the magnitude of this forcing is still unknown. In order to cause long-term climate change, it would need to be coupled to a long-term change in sunspot activity, for which there is also evidence.

157. See generally IDSO & SINGER, *supra* note 148.

158. *Id.*

159. *Atmospheric CO₂ Concentration from the CSIRO GASLAB Flask Sampling Network*, CARBON DIOXIDE INFO. ANALYSIS CTR. (Dec. 2002), http://cdiac.esd.ornl.gov/trends/co2/csiro/csiro_gaslab.html (providing monthly average CO₂ measurements for many surface observing stations around the world).

160. Norman G. Loeb et al., *Multi-Instrument Comparison of Top-of-Atmosphere Reflected Solar Radiation*, 20 J. CLIMATE 575 (2007).

to the early 1970s. These observations do not exist, and you cannot easily study that which you do not have the data to study.

As a result, there is currently no way to know with confidence how much of recent warming was natural versus human-caused. Most climate scientists simply assume it was due to humans, since we produce CO₂ from fossil fuel use, we know CO₂ has increased, and more CO₂ is theoretically expected to cause some amount of warming.¹⁶¹ But while the circumstantial evidence seems compelling, there is also evidence that other climate change forces are in play.

C. Climate Change over the Last 1,000 Years

Indirect evidence that there are other, natural sources of changes in the energy balance of the climate system is the existence of past temperature change before humans could have had a significant impact on the global environment. Throughout recorded history, humans have had to deal with climate change. For example, that the Medieval Warm Period (MWP) and Little Ice Age (LIA) were real events is difficult to dispute.¹⁶² The Vikings began farming in Greenland during the peak of a particularly warm period around 1000 AD. By the 14th Century, cooling caused them to abandon farms and settlements.¹⁶³

This cooling culminated in the Little Ice Age during which “frost fairs” were held on the frozen Thames River in London between the 15th and 19th Centuries, the last one being held in 1814.¹⁶⁴ The Thames no longer freezes over in winter. While global thermometer data are particularly sparse before the 20th Century, it is entirely possible that much of the average warming since the depths of the LIA was simply the result of the Little Ice Age ending.

Even the 20th Century saw climate changes we still cannot explain. Most of the all-time high temperature records in the United States were set in the 1920s and 1930s, a period of unexplained global warming, during a prolonged drought now called the “Dust Bowl.”¹⁶⁵ Newspaper reports as well as thermometer data¹⁶⁶ suggest that the Arctic region, where recent warming has been particularly strong, was nearly as warm in the 1920s and 1930s. Thus, the decrease in Arctic sea ice measured since satellite monitoring started in 1979 might not be a new phenomenon.¹⁶⁷

161. *Historical Overview of Climate Change*, *supra* note 14, at 97.

162. Before AGW theory became popular, hundreds of climate research papers were published on the Medieval Warm Period and Little Ice Age, events which are still studied and reported on today.

163. *See, e.g.*, L.K. Barlow et al., *Interdisciplinary Investigations of the End of the Norse Western Settlement in Greenland*, 7 *THE HOLOCENE* 489 (1997).

164. BRIAN M. FAGAN, *THE LITTLE ICE AGE: HOW CLIMATE MADE HISTORY: 1300-1850* (2001).

165. ARND BERNAERTS, *ARCTIC HEATS UP: SPITSBERGEN 1919-1939*, 30-32 (2009) (citing C.E.P. Brooks, *The Warming Arctic*, *THE METEOROLOGICAL MAGAZINE*, 1938, at 29-32), available at http://www.arctic-heats-up.com/pdf/chapter_3.pdf.

166. *See generally* P. Brohan et al., *Uncertainty Estimates in Regional and Global Observed Temperature Changes: A New Dataset from 1850*, 111 *J. GEOPHYSICAL RES.* D12106 (2006), available at http://www.metoffice.gov.uk/hadobs/hadcrut3/HadCRUT3_accepted.pdf (describing the global surface temperature dataset most commonly used for climate studies, “HadCRUT3”).

167. *See, e.g.*, The Associated Press, *Arctic Ocean Getting Warm; Seals Vanish and Icebergs Melt*, *WASH. POST*, Nov. 2, 1922, <http://wattsupwiththat.com/2008/03/16/you-ask-i-provide-november-2nd-1922-arctic-ocean-getting-warm-seals-vanish-and-icebergs-melt/> (“Great masses of ice have [now] been replaced by moraines of earth and stones . . . while at many points well-known glaciers have entirely disappeared.”).

Much of the temperature proxy evidence that has been published suggests that global warming – and cooling – in any given century is the rule, not the exception.¹⁶⁸ Yet, despite all of the evidence that climate has changed naturally in the past, with periods of warming and cooling, we are increasingly being told by AGW proponents that the scientific research community has reached a “consensus” on the cause of recent warmth.¹⁶⁹ Many mainstream climate researchers now claim that events like the MWP and LIA were only regional in nature - despite temperature proxy evidence to the contrary¹⁷⁰ - and were not caused by changes in the global energy balance.¹⁷¹ Yet, at the same time we are told by AGW theorists that more recent regional events (such as the busy 2005 hurricane season in the Atlantic Ocean) are evidence of “global” climate change. Such apparent contradictions weaken the credibility of AGW arguments.

Putting aside the question of whether the MWP and LIA were or were not global in nature, the fact that regional climate changes are now so often blamed on anthropogenic global warming begs the question: If recent, regional climate variations are indeed human-caused, then what caused the previous regional events? Has natural climate variability stopped, now replaced by anthropogenic variability?

Unfortunately, there is no unique ‘fingerprint’ of human-caused warming for us to tell the difference, since natural changes in cloud cover or atmospheric water vapor content could also account for most of the observed recent warming. The IPCC claim that recent climate changes are “consistent” with anthropogenic global warming¹⁷² leaves unstated the fact that those changes might also be consistent with other, natural sources of warming.

The question of whether any type of weather event has become more frequent or more severe remains an open question, due to a lack of accurate long-term records and a huge amount of natural variability from year to year. While it can be hypothesized that weather events have been made worse, more frequent, or less frequent by anthropogenic greenhouse gas emissions, we must be careful to separate what has actually been demonstrated scientifically from what is simply being assumed to be true.

For example, after a record number of land-falling hurricanes in the U.S. in 2005, average global tropical cyclone activity then decreased in the following years to a near-record low in 2011.¹⁷³ Also, it is well known that the number of strong to violent tornadoes in the U.S. has decreased since records began in the

168. Craig Loehle, *A 2,000 Year Global Temperature Reconstruction on Non-Tree Ring Proxies*, 18 ENERGY & ENV'T 1049 (2007).

169. See generally *Historical Overview of Climate Change*, *supra* note 14.

170. Loehle, *supra* note 168.

171. Eystein Jansen et al., 2007: *Paleoclimate*, in CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS; CONTRIBUTION OF WORKING GROUP I TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE § 6.6.1 (Box 6.4) (S. Solomon et al. eds., 2007), available at <http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-chapter1.pdf> [hereinafter *Paleoclimate*].

172. *Id.*

173. Ryan Maue, Ph.D. keeps a running record of global tropical cyclone activity. Dr. Ryan N. Maue, *Global Tropical Cyclone Activity Update*, POLICLIMATE, <http://www.policlimate.com/tropical> (last updated Sept. 30, 2011).

1950s, despite this being a period of general warming.¹⁷⁴ The particularly deadly 2011 tornado season has been reported to be the result of natural, internal climate cycles related to La Niña, and not to anthropogenic climate change.¹⁷⁵

Clearly, any legal claims involving anthropogenic global warming and associated climate change must inevitably face the reality that weather and climate are inherently variable. To prove causation under these circumstances in a court of law presents special challenges that should not be underestimated. While the science might strongly support the hypothesis that adding CO₂ to the atmosphere should cause some level of warming, the claim that recent warming – or any recent weather event – is mostly human-caused is another matter altogether.

D. Climate Models as Evidence

The primary scientific tool used to predict global warming – as well as explain previous warming – is the computerized climate model. It is arguably the most relied upon scientific tool used by the IPCC to explain recent warming, as well as to predict future anthropogenic climate change.¹⁷⁶ Its heritage is weather forecast models, which are quite successfully used every day to forecast weather several days in advance. Both climate and weather forecast models have similar equations that describe the time-dependent relationships between a variety of weather variables – temperature, humidity, wind, clouds, precipitation, and surface characteristics – on a three-dimensional global array of grid points in the atmosphere, ocean, and on land.¹⁷⁷

But a major difference between weather forecast models and climate models is that the weather forecast models have known error rates, since every day's forecast can then be verified in the coming days. Many years of such error statistics are routinely monitored by weather forecast centers around the world and used to gradually improve the components in the weather forecast models over time.¹⁷⁸ Climate model projections, however, are so far in the future that they cannot yet be verified. As a result, climate model predictions have no known error rate because what they are being used for – to predict anthropogenic global warming – is a one-of-a-kind event.

174. *U.S. Tornado Climatology: Historical Records and Trends*, NAT'L CLIMATIC DATA CTR., NOAA, <http://www.ncdc.noaa.gov/oa/climate/severeweather/tornadoes.html#history> (last updated Feb. 23, 2011).

175. A preliminary study by Dr. Martin Hoerling at NOAA's Earth System Research Laboratory concluded that the vigorous 2011 tornado activity could not be attributed to global warming. Martin Hoerling, *Preliminary Assessment of Climate Factors Contributing to the Extreme 2011 Tornadoes*, NOAA, <http://www.esrl.noaa.gov/psd/csi/events/2011/tornadoes/index.html> (last updated July 8, 2011).

176. David A. Randall et al., 2007: *Climate Models and Their Evaluation*, in CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS; CONTRIBUTION OF WORKING GROUP I TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 591 (S. Solomon et al. eds., 2007), <http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-chapter8.pdf> [hereinafter *Climate Models and Their Evaluation*].

177. *Climate Models*, WORLD METEOROLOGICAL ORG., http://www.wmo.int/pages/themes/climate/climate_models.php (last visited Sept. 17, 2011).

178. Ok-Yeon Kim et al., Improvement of LAPS Wind Analysis by Including Background Error Statistics, Presented at 22nd Conference on Weather Analysis & Forecasting/18th Conference on Numerical Weather Prediction (June 25, 2007), available at <http://ams.confex.com/ams/pdfpapers/124707.pdf>.

Rather than forecasting daily weather changes, climate models are expected to project how average weather will change decades in advance, primarily in response to the small, approximately 1%, energy imbalance caused by increasing CO₂. In response to this forcing, twenty or more climate models tracked by the IPCC produce a wide variety of global-average warming, 2.0 to 4.5°C by 2100, and an even wider variety of changes in regional weather conditions.¹⁷⁹ Significantly, the range of projected warming rates has not been reduced in over twenty years of climate model development,¹⁸⁰ which is indicative of our lack of understanding of the complex processes which determine climate “sensitivity” (the amount of surface warming resulting from a given forcing). Climate sensitivity is determined by “feedbacks,” which are discussed below.

Since the future predictions of climate models cannot yet be verified, the models are instead tested by using them to either explain past temperature variations, usually during the 20th Century, or to compare statistics of their average global weather patterns to similar observations of today’s weather patterns. In the first case, however, the potential role of natural forcings on 20th Century climate change cannot be included because we do not understand their source or their magnitude. For example, significant warming between 1920 and 1940 has remained unexplained.¹⁸¹ Also, climate modelers, in their attempt to explain why the late 20th Century did not warm as much as expected from increasing CO₂, then add assumed (but highly uncertain) cooling effects of increasing anthropogenic aerosol pollution in the models to reduce their rate of warming to that observed.¹⁸²

Of course, the practice of invoking two competing human-caused forcings to explain weaker-than-expected warming, while ignoring the possible role of natural climate variations, verges on blaming even a lack of climate change on humanity. The possibility that much, or even most, of observed climate change is caused by internally-generated, quasi-chaotic behavior – simply put, a long-time scale version of weather variability – cannot yet be ruled out. Virtually no research has been performed to determine (for instance) the extent to which multi-decadal changes in the circulation of the ocean could be to blame for the still-unexplained warming up until the 1940s, the lack of warming until the 1970s, and then another cessation of warming starting around 2003. And since it takes about 1,000 years for deep ocean waters to resurface as the global oceans

179. Richard B. Alley et al., 2007: *Summary for Policymakers*, in CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS; CONTRIBUTION OF WORKING GROUP I TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 1, 12 (S. Solomon et al. eds., 2007), available at <http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf> [hereinafter *Summary for Policymakers*].

180. Reto Knutti & Gabriele C. Hegerl, *The Equilibrium Sensitivity of the Earth’s Temperature to Radiation Changes*, 1 NATURE GEOSCIENCE 735, 739 (2008), available at <http://www.iac.ethz.ch/people/knutti/papers/knutti08natgeo.pdf>.

181. Gabriele C. Hegerl et al., 2007: *Understanding and Attributing Climate Change*, in CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS; CONTRIBUTION OF WORKING GROUP I TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 663, § 9.4.1.5 (2007), available at <http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-chapter9.pdf>.

182. Jeffrey T. Kiehl, *Twentieth Century Climate Model Response and Climate Sensitivity*, 34 GEOPHYSICAL RES. LETTERS L22710, 3 (2007), available at http://www.atmos.washington.edu/~ackerman/Kiehl_2007GL031383.pdf.

slowly overturn, even millennial time scale climate variations could be naturally caused by the oceans.¹⁸³

In the second method of testing climate models, the ability of a model to reasonably mimic the average behavior of the current climate system is no guarantee that the model will be able to predict what we are really interested in: how average weather and temperatures will change decades in the future. In fact, even the modelers themselves are aware that there is still no known method for preferring one model's warming rate over that from another model based upon the observed behavior of today's climate system.¹⁸⁴

Each model can be viewed as a scientific hypothesis about how the climate system works. Different research groups work on the different models, and they all use somewhat different approximations and assumptions about how the various components of the climate system behave. The role of clouds in amplifying or mitigating warming is especially uncertain,¹⁸⁵ theoretically having the potential to either reduce the impact of AGW to the level of noise (negative feedback) or to cause catastrophic warming (strong positive feedback).

In this context, it should be noted that while the average effect of clouds on the current climate system in response to solar heating is known to be one of cooling,¹⁸⁶ the models predict that cloud changes will instead amplify, rather than reduce, future temperature change in response to AGW.¹⁸⁷ That is, all current climate models exhibit positive cloud feedback by varying degrees.

Despite their shortcomings, models of some type are a necessary component of our understanding and learning about the climate system. But the current models are infinitely adjustable in their behavior, and the final model configuration that a modeler chooses is partly determined by whether the amount of warming the model produces seems "reasonable" to the modeler. And, in the context of *Daubert*, the models have no known error rate for the task at hand: to predict future climate change.

E. The Critical Role of Feedbacks

By way of summary, there are five necessary ingredients to anthropogenic global warming theory embodied by these models. If any of one of the five pillars crumbles, so does AGW theory.

First, the models assume there is indeed a greenhouse effect that keeps the surface of the Earth warmer than it would otherwise be without the greenhouse effect. Second, they assume carbon dioxide is a significant part of the greenhouse effect. Third, the models assume that carbon dioxide concentrations in the global atmosphere will continue to rise into the future as a result of

183. Jess F. Adkins & Claudia Pasquero, *Ocean Science: On Deep Ocean Overturn*, SCIENCE WEEK, <http://scienceweek.com/2004/sc041217-6.htm> (last visited Sept. 19, 2011) (citing Jess F. Adkins & Claudia Pasquero, *Deep Ocean Overturning – Then and Now*, SCIENCE, Nov. 12, 2004, at 1143, available at <http://www.sciencemag.org/content/306/5699/1143.full.pdf>).

184. See generally *Climate Models and Their Evaluation*, *supra* note 176.

185. *Id.* § 8.6.3.2.

186. V. Ramanathan et al., *Cloud-Radiative Forcing and Climate: Results from the Earth Radiation Budget Experiment*, SCIENCE, Jan. 6, 1989, at 57, available at http://web.iitd.ac.in/~akrishna/Courses/ISem_ester_2009-2010/ASL715/pdfs/Science_CloudRadiativeForcing_ERBE_Results_Ramanathan_etal.pdf.

187. See generally *Climate Models and Their Evaluation*, *supra* note 176, § 8.6.3.2.

humanity's emissions. Fourth, the models assume that the warming effect of CO₂ on the atmosphere is not already 'saturated,' so that adding more CO₂ will cause a further warming tendency. None of these four assumptions will be disputed here.

But it is the fifth pillar that constitutes what could be the Achilles Heel of AGW theory: that the direct warming tendency resulting from adding CO₂, which is known to be small, will cause indirect changes (positive feedbacks) such as increasing water vapor and decreasing clouds that will amplify the warming. All of the speculation about climate system tipping points – catastrophic global warming, a collapse of the Greenland ice sheet, etc. – are the result of the assumption of strongly positive feedback.¹⁸⁸

But if the true feedbacks in the climate system are negative and actually reduce the already small direct warming influence of more CO₂, estimated to be slightly more than 1°C for a doubling of atmospheric CO₂,¹⁸⁹ then anthropogenic global warming becomes for all practical purposes a non-issue.

Unfortunately, due partly to issues relating to the direction of causation, it has not yet been convincingly established whether atmospheric feedbacks in the climate system are positive or negative. For example, if an unusually warm year also had reduced cloud cover, is that then evidence of positive feedback (warming reducing the cloud cover), or did the reduced cloud cover cause the warming? Recent research suggests that the latter can give the 'illusion' of positive feedback, even if negative feedback really exists.¹⁹⁰

What this means from a practical perspective is that there is no way to test the feedback behavior of climate models because we still do not have a reliable method for measuring feedbacks in the real climate system. Yet, it is feedbacks that will determine whether past warming was mostly anthropogenic or natural, as well as how much anthropogenic warming will occur in the future.

F. Daubert Challenges to Climate Models

We believe that the use of climate models in global warming litigation will inevitably lead to significant *Daubert*-related challenges, invoking the trial judge's gatekeeper role. And in *Frye* states it may be more likely that scientists will be subject to challenging cross-examination of the basis and limits of their AGW theories in front of a jury.

While there is widespread acceptance of climate models in the climate research community, and they have been widely peer reviewed and published, the models still suffer from a critical shortcoming: they cannot be tested in the

188. J. Hansen et al., *Dangerous Human-Made Interference with Climate: A GISS ModelE Study*, 7 ATMOSPHERIC CHEMISTRY AND PHYSICS 2287 (2007), available at <http://www.atmos-chem-phys.org/7/2287/2007/acp-7-2287-2007.pdf>.

189. Roy W. Spencer, *On the Relative Contribution of Carbon Dioxide to the Earth's Greenhouse Effect*, DRROYSPENCER.COM (Sept. 10, 2010), <http://www.drroyspencer.com/2010/09/on-the-relative-contribution-of-carbon-dioxide-to-the-earth%E2%80%99s-greenhouse-effect/> (last visited Sept. 4, 2011).

190. Roy W. Spencer & William D. Braswell, *On the Diagnosis of Radiative Feedback in the Presence of Unknown Radiative Forcing*, 115 J. GEOPHYSICAL RES. D16109 (2010), available at <http://www.drroyspencer.com/wp-content/uploads/Spencer-Braswell-JGR-2010.pdf>. See also Roy W. Spencer & William D. Braswell, *On the Misdiagnosis of Surface Temperature Feedbacks from Variations in Earth's Radiant Energy Balance*, 3 REMOTE SENSING 1603 (2011), <http://www.mdpi.com/2072-4292/3/8/1603/pdf>.

context of what they are being used for – predicting anthropogenic climate change. Just because a climate model – essentially, a scientific hypothesis – is published does not mean it can predict climate change with any known level of accuracy.

Of course, since the models cannot be tested for what they are being used for, they have no known error rate. In contrast, weather forecast centers have thousands of weather forecast model runs they have tested against the ensuing observed weather and, so, have extensive statistics on error rates. While it is true that the early climate models from twenty years ago predicted warming, and it has indeed warmed since then, this is a little like correctly predicting the result of a coin flip. The fact you are correct is, by itself, not very convincing evidence that you had a prior physical understanding of why the coin would land as it did.

A known error rate for a scientific methodology of prediction requires many independent events to test against.¹⁹¹ But the last 100 years during which we have had sufficient thermometer data, there have been only a handful of global temperature change events to explain, and no way to know, the extent to which any of the hypothesized explanations are correct.¹⁹²

Significantly, while the modelers claim that their models can explain the warming of the last fifty years or so, they have largely ignored natural cycles in the climate system, which might also explain the warming. In some sense, the lack of research into natural climate variability is understandable, since: (1) we do not understand it very well, and (2) we do not have sufficiently long-term and accurate global measurements of clouds, the oceans, etc., that would allow us to study the potential role of nature in climate change.

G. Downscaling AGW to Regional or Local Weather Events

To the extent that human causation of long-term trends in global average temperature has been difficult to convincingly establish, attributing regional or local events such as hurricanes, floods, and droughts is even more difficult. These events have always occurred, always will occur, and our long term records of them are not that good. Furthermore, while all climate models produce global-average warming, they differ widely in how regional weather patterns change with that warming.

When it comes to an individual event like Hurricane Katrina, it is virtually impossible to provide objective evidence that such an event was in any way different from previous events in a manner that would suggest a human influence. While 2005 was indeed unusual for land-falling hurricane events in the United States, two-year running average tropical cyclone activity worldwide has decreased by about 50% since then, to near-record lows in late 2011.¹⁹³ As a result of this natural variability, the attribution of past hurricane events to human

191. See generally Kesten C. Green & J. Scott Armstrong, *Global Warming: Forecasts by Scientists Versus Scientific Forecasts*, 18 ENERGY & ENV'T 997 (2007), available at <http://www.forecastingprinciples.com/files/WarmAudit31.pdf>.

192. *Id.*

193. Ryan Maue, Ph.D. keeps a running record of global tropical cyclone activity. Dr. Ryan N. Maue, *Global Tropical Cyclone Activity Update*, POLICLIMATE, <http://www.policlimate.com/tropical/> (last updated Sept. 30, 2011).

causes has been tenuous at best, with any anthropogenic changes continuing to be in the realm of theory and the distant future.¹⁹⁴

V. UNDER *DAUBERT*, THE AGW THEORY SHOULD NOT BE ADMISSIBLE TO PROVE A DEFENDANT'S CO₂ EMISSIONS PROXIMATELY CAUSE PLAINTIFF'S INJURIES.

With the foregoing high-level scientific background in mind, we return to the legal analysis. The formerly reluctant Alabama Federal District Court judge provided a good layman's explanation of how the trial court will approach the *Daubert* gatekeeping review to claims for damages against CO₂ emitters:

Under *Daubert*, even the most distinguished scientist or engineer *must strictly adhere to the rigors of the scientific method*. And the trial court, no matter how esoteric or difficult the subject, must understand it sufficiently well to dissect and critique an expert's proffered opinion. *Daubert* endows the trial court with that obligation, and ostensibly with the wisdom to discharge it. *The trial court does not have to find an expert to be a charlatan or a fool to keep the gate shut on him. The trial court opens the gate only if the scientific method has been totally complied with*. If Thompson's proffered expert opinion is infected with faulty or unreliable methodology, even if otherwise plausible, it must be excluded.¹⁹⁵

The plaintiffs' witnesses in CO₂ cases will likely be "distinguished scientists," certainly not "charlatans or fools." But given the state of climate science as discussed above, the plaintiffs' proof will inherently lack critical elements of the scientific method, which should make opinion testimony on causation inadmissible under a proper application of *Daubert*.

A. *Analysis of AGW Theories of Causation Begins with Evidence Rule 702, Guided by Daubert.*

The gatekeeping process starts with Evidence Rule 702,¹⁹⁶ and all admissibility issues are decided by the trial judge.¹⁹⁷ The assessment under Rule 702 takes place under the structure set forth in Rule 104(a), which provides:

Preliminary questions concerning the qualification of a person to be a witness, the existence of a privilege, or the admissibility of evidence shall be a determination by the court, subject to the provisions of subdivision (b). In making its determination it is not bound by the rules of evidence except those with respect to privileges.¹⁹⁸

Preliminary questions under Rule 104(a), such as the admissibility of opinions by the proffered expert, must be established by a preponderance of the evidence.¹⁹⁹ In addition, "the proponent of the expert . . . [bears] the burden of proving admissibility."²⁰⁰ To meet its burden, the proponent of evidence must

194. Thomas R. Knutson et al, *Tropical Cyclones and Climate Change*. 3 NATURE GEOSCIENCE 157 (2010).

195. *McCreeless v. Global Upholstery Co.*, 500 F. Supp. 2d 1350, 1359 (N.D. Ala. 2007) (emphasis added).

196. *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 589 (1993) (Rule 702 is the "primary locus.>").

197. *Bradley v. Brown*, 42 F.3d 434, 438 (7th Cir. 1994) (citing *Daubert*, 509 U.S. at 597) (district court must be the "gatekeeper").

198. FED. R. EVID. 104(a).

199. *Daubert*, 509 U.S. at 592 n.10 (citing *Bourjaily v. United States*, 483 U.S. 171, 175-176 (1987)).

200. *Lust v. Merrell Dow Pharm., Inc.*, 89 F.3d 594, 598 (9th Cir. 1996); *Daubert v. Merrell Dow Pharm., Inc.*, 43 F.3d 1311, 1316 (9th Cir. 1995).

submit sufficient testimony or other evidence to satisfy the *Daubert* standard. If adequate submissions are not made, the court cannot make the findings required by Rule 702 and must refuse to admit the expert's testimony into evidence.²⁰¹

B. Dissecting Daubert in the Context of AGW Nuisance Suits

1. Has the theory or technique been tested, or can it be tested?

As the science discussion above makes clear, the AGW theory of human causation of climate change has not been tested under the normal rigors of the scientific method. Indeed, under the current state of climate science, the theory cannot be tested. Scientists cannot experiment with the actual atmosphere, and any smaller scale experiments would lack the complexity of the global atmosphere. While individual elements of the hypothetical AGW process have been tested, the only attempt to "test" the whole theory has been through the creation of complex computer models. But the models are not "tests" in the true sense of the word, but rather each model is a hypothesis itself,²⁰² which says nothing about its superiority over competing hypotheses.

Computer models are not inherently unusable as the basis for scientific testimony. A prime and related example is weather forecasting models. Weather models have been under development for decades and have become quite good at forecasting weather a few days out. Because weather models only attempt to forecast weather for a few days to a few weeks, the models are literally tested every day and have been for many years. Accordingly, scientists have a good basis for understanding atmospheric behavior and cause and effect on a short term basis.²⁰³

Since climate trends are multi-year or decadal and longer in nature, testing of that range of predictions will require patience. In an effort to attempt to validate the models, scientists have therefore engaged in "hindcasting."²⁰⁴ In other words, they have applied their models to data about past CO₂ concentrations and temperatures. But hindcasting lacks the rigors of forecasting since the answer (the observed temperature record) is already known in advance. If the modelers did not know what the temperature variations of the 20th Century looked like, and then were asked to use AGW theory to hindcast them, it is unlikely that their "forecast" would have been considered to be successful.

Modelers have tried to explain weaker than expected warming in the second half of the 20th century through the cooling effect of particulate air pollution, so they have added routines into their computer programs that model the theorized impact of pollution.²⁰⁵ By making adjustments like this, modelers have been able to "fit" the temperature chart to their AGW models. While such an approach is certainly a valid scientific approach to developing a theory, it is not "testing" or "validation." Rather, it is the scientist adjusting a theory until it

201. *Claar v. Burlington N. R.R. Co.*, 29 F.3d 499, 502 (9th Cir. 1994) (experts failed to explain the reasoning and methods underlying their conclusion); *Lust*, 89 F.3d at 598 ("The . . . court can exclude the opinion if the expert fails to identify and defend the reasons [for] his conclusions.").

202. See discussion *supra* Section IV(D).

203. *Id.*

204. *Id.*

205. *Id.*

matches the past based on his or her belief in what constitutes a reasonable explanation for what happened. It is a far cry from proving that CO₂ rise was the primary driver of the temperature rise and not natural or other forces.

There is a special problem in proving causation that does not exist in most tort cases. This issue is which observation is “cause” and which is “effect”? One of the pillars of AGW theory is the correlation, based on hundreds of thousands of years of Antarctic ice core samples, between the rise in CO₂ and the rise in local temperature.²⁰⁶ But correlation is not causation. In toxic tort cases, this is not usually a problem. For example, the court can readily determine that lung cancer is not what caused the plaintiff to start smoking or that a child’s birth defect caused its mother’s exposure to Agent Orange.

But the direction of causation in climate science is not so simple.²⁰⁷ Although many AGW proponents believe that it was the CO₂ change that caused the temperature changes in the ice core record, it is well known that the temperature changes actually preceded the CO₂ changes by, on average several hundred years.²⁰⁸ While there are elaborate hypotheses about how a supposed effect can seem to precede its cause, given that these are hypotheses that have not been tested and are inherently not subject to testing or falsification, even evidence of the direction of causation should not be admissible under *Daubert*.

As the Court in *Daubert* made clear, scientific knowledge “connotes more than subjective belief or unsupported speculation.”²⁰⁹ Yet, as explained above, each climate model developed contains assumptions about how natural systems will behave in response to the presumed forcing caused by the increase in CO₂.²¹⁰ The key assumption is that in response to the relatively small forcing caused by CO₂ increases, cloud changes will amplify, rather than reduce, future temperature changes.²¹¹ This assumption of positive feedback has never been tested and therefore is properly characterized as subjective or unsupported belief, rather than “scientific knowledge,” as *Daubert* requires.

2. Has the theory or technique been subjected to peer review and publication?

The AGW theory has been published widely in peer-reviewed scientific publications.²¹² A smaller, but not insignificant, number of peer-reviewed papers have been published that question AGW theory or offer natural causes to explain recently observed global warming.²¹³ However, it may be surprising to many judges and laymen that peer reviewed papers purporting to show that natural climate cycles cannot explain recent warming trends are rare to nonexistent.²¹⁴

206. *Id.*

207. *Id.*

208. *Id.*

209. *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 590 (1993).

210. *See* discussion *supra* Section IV(D).

211. *Id.*

212. *See, e.g., Historical Overview of Climate Change, supra* note 14, §1.2.

213. *See, e.g., IDSO & SINGER, supra* note 148, at 880.

214. The lack of solid scientific evidence of natural causes of climate variation may help defendants counter plaintiffs’ opinions on causation but probably will not be determinative of the *Daubert* challenge, since an inherent element of AGW theory is that there is no other explanation besides greenhouse gases.

The vast majority of peer reviewed papers on the subject of global warming simply take the theory as essentially proved and, then, study the impacts of the presumed anthropogenic warming.

A thorough review of the scientific literature is beyond the scope of this article.²¹⁵ We do not think the numbers of peer-reviewed papers on each side should be dispositive of *Daubert* challenges in CO₂ nuisance cases simply because there is a debate, however lopsided.²¹⁶ More importantly, proponents of AGW must admit that their “proof” of both causation and magnitude is based on models that contain unproven assumptions. In a court of law, no amount of subjective consensus should be allowed to substitute for objective testing and proof. If a jury were allowed to weigh competing experts’ opinions on AGW, its verdict would necessarily have to be based on the subjective assumptions and beliefs underlying models (theories), rather than on actual scientific testing and validation as envisioned by the *Daubert* Court.²¹⁷

3. Is the known or potential rate of error acceptable?

The error rate of the AGW theory and predicted consequences is not only unknown, it is presently unknowable.²¹⁸ As discussed above, the twenty or so models tracked by the IPCC produce a wide variety of global-average warming and an even wider variety of changes in regional weather conditions,²¹⁹ none of which has yet been demonstrated to exist or be outside the range of natural variability. The reason for such wide variation is each model, being at present merely a hypothesis, makes different subjective assumptions on how the atmosphere will react to presumed inputs and amplifications.²²⁰ If climate science had arrived at the point of “scientific knowledge,” many of the assumptions would be agreed upon based on observation, testing, and validation, and at the very least would be reduced to a reasonable range of probabilities.

Again, weather models are a helpful analogy. If a weather model forecasts rain for a given location tomorrow, the modelers know the statistical skill of that forecast based upon past forecast model statistics. The climate modelers, in contrast, can produce no such statistics, because what they predict has not actually happened yet.

It is critically important to the *Daubert* review to know the error rate of a scientifically based methodology. If the error rate is not at least less than 50%, then it is more probable than not that the purported “cause” of plaintiff’s harm was not due to AGW at all, even if one assumes but a single link in the alleged chain of causation. The problem is compounded in cases where there are

215. However, the defense counsel and experts in CO₂ cases may well undertake such a review to their benefit. See, e.g., Klaus-Martin Schulte, *Scientific Consensus on Climate Change?*, 19 ENERGY & ENV’T 281 (2008); see also *Petition Project*, *supra* note 126 (31,000+ scientists).

216. It must be remembered that the focus of the IPCC and many climate scientists is on influencing policy; i.e. urging governments to act to reduce emissions of greenhouse gases. See, e.g., *Summary for Policymakers*, *supra* note 179. As a policy matter relating to possible harms occurring years after avoidance action may be needed, it may well be prudent to act even before theory has become “knowledge.”

217. Although in *Frye* states, such a basis for liability might well be considered adequate.

218. Roy W. Spencer, *Should Climate Models Be Accepted as Evidence in a Court of Law?*, CLIMATE REALISTS, June 9, 2009, <http://www.climaterealists.com/index.php?id=3555>.

219. See discussion *supra* Section IV(D).

220. *Id.*

multiple layers of alleged cause and effect. For example, if the error rate for AGW as a theory (CO₂ emissions warms the globe) were 50% and there is also a 50% probability that AGW caused a given hurricane, then the probability the CO₂ emissions of defendant contributed even a small amount to the destruction of plaintiff's home is only 25%. This is obviously not sufficient certainty to meet the burden of establishing proximate cause by a "preponderance" of evidence. Instead the likelihood is 75% that the harm was solely due to natural causes.

The existence of natural causes for climate change is particularly vexing for AGW proponents and will be for CO₂ nuisance plaintiffs as well.²²¹ The earth's climate has constantly changed for millions of years ranging from vast ice ages to ice-free periods.²²² As discussed above, even in the "modern" era of recorded human history, global temperatures have fluctuated significantly before humans added significant amounts of CO₂ to the atmosphere.²²³ Without testing of climate models and a known error rate, it is impossible for scientists to rule out natural causes of temperature increases and alleged consequences.

4. Is the theory or technique employed by the expert generally accepted in the scientific community?

The outcome of *Daubert* was to allow a new theory that had not yet become widely accepted to be potentially admissible.²²⁴ Even if an opinion is a minority opinion in the scientific community, it may be admissible if it is shown in some objectively verifiable manner that a reliable scientific method has been followed.²²⁵ The jury can properly weigh two competing theories that are based on scientific knowledge. Ironically, with AGW, the situation is arguably the opposite of that in the *Daubert* case. AGW is widely (but not universally) accepted by climate scientists, yet it has never been tested or validated in accordance with the scientific method.²²⁶ Nor have competing theories for recently observed global warming been falsified.²²⁷

Thus the dilemma that may face the courts in CO₂ cases is whether the "generally accepted" factor can outweigh a lack of proof consistent with the scientific method. But even "general acceptance" may be successfully challenged by defendants. Opponents of taking drastic or costly action to curb greenhouse gas emissions have circulated a petition, gathering over 31,000 signatures of "American scientists." The scientists endorsed a short statement that urges the U.S. to reject the Kyoto treaty and states that, "[t]here is no convincing scientific evidence that . . . greenhouse gases [are] causing . . .

221. Even plaintiffs in *Frye* states will have difficulty with this fact. While they may get past the gatekeeper and to a jury, defendants will be able to show that climate has varied substantially over the millennia and that current studies have largely ignored natural variability. *Id.*

222. See discussion *supra* Section IV(C).

223. See discussion *supra* Section IV(D).

224. Although on remand, the Ninth Circuit held that plaintiff's theory failed the *Daubert* test as well as the *Frye* test. *Daubert v. Merrell Dow Pharm., Inc.*, 43 F.3d 1311 (9th Cir. 1995) (*Daubert II*).

225. *Hall v. Baxter Healthcare Corp.*, 947 F. Supp. 1387 (D. Or. 1996).

226. Dr. John R. Christy et al., *Cirrus Disappearance: Warming Might Thin Heat Trapping Clouds*, SCIENCE DAILY, Nov. 5, 2007, <http://www.sciencedaily.com/releases/2007/11/071102152636.htm>.

227. *Id.*

disruption of the Earth's climate."²²⁸ While such a petition may be useful to influence policy decisions by politicians, it seems almost silly to admit such "evidence" in a court of law.²²⁹ And the wide range of scientific disciplines represented by the 31,000 scientists illustrates a major issue for determining general acceptance: what is the relevant "scientific community"?

The authors posit that juries should not be permitted to render verdicts based on expert testimony of what a majority of scientists believe, just as juries should not be able to convict a defendant of crimes based on a prevailing community view of guilt. There must be an element of scientific proof, in addition to even the most widely-held belief. This view is certainly supported by the *Daubert* Court's rejection of exclusive reliance on "general acceptance" under the *Frye* standard and the Court's expansion of the inquiry to consideration of the specific scientific method employed, testing, falsifiability, and the error rate of the method.²³⁰

The Court in *Daubert*, while not eliminating general acceptance from the test entirely, gave emphasis and primacy to testing and validation in accordance with the scientific method.²³¹ Where validation is utterly lacking, "general acceptance" – even if found to exist for AGW theories – should not suffice for admissibility.²³²

C. Damages Plaintiffs Will Face a Two-Stage Daubert Hurdle.

A determination of scientific knowledge entails a two-part preliminary assessment.²³³ First, the court must determine whether there is general causation by assessing whether the reasoning or methodology used by the expert and the underlying testimony are scientifically valid.²³⁴ Second, the court must test specific causation, determining whether "the proposed expert testimony is 'relevant to the task at hand,' . . . i.e., that it logically advances a material aspect of the proposing party's case."²³⁵ If a method is deemed reliable and has been followed carefully, the court must then undertake the second part of the analysis to determine specific causation, whether the testimony advances a material aspect of a party's case.²³⁶

Applying this two-stage analysis in CO₂ cases, the chain will likely look like something like this:

1. The earth has warmed and it is more likely than not that all or a significant portion of the warming was caused by human emissions of CO₂; and
2. Because global warming is believed to cause or increase the likelihood of the alleged instrument of harm to the plaintiff (e.g. flood, drought,

228. *Petition Project*, *supra* note 126.

229. Yet, seemingly, that is exactly what the focus of a *Frye* hearing might be in states using the *Frye* test.

230. *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 593-95 (1993).

231. *Id.*

232. *Id.* at 595-96.

233. *Daubert v. Merrell Dow Pharm., Inc.*, 43 F.3d 1311, 1315 (9th Cir. 1995) (*Daubert II*).

234. *Id.*

235. *Id.* (quoting *Daubert*, 509 U.S. at 597) (the second prong is known as the "fit" requirement).

236. *Daubert*, 509 U.S. at 591; *Daubert II*, 43 F.3d at 1315.

hurricane, tornado, fire, blizzard, sea level rise, ice melt), it is more likely than not that the warming caused the specific harm plaintiff alleges occurred.

Thus, the plaintiff will have to prove at least two stages of causation and possibly more for some types of alleged harms.

The difficulty of meeting the *Daubert* test increases as the plaintiffs extend the basic AGW theory to specific instruments of harm. Even the basic AGW theory itself should not be admitted because of the lack of proof and the knowledge of historic natural warming periods.²³⁷ When it comes to specific or regional weather events, such as hot days, drought, hurricanes, tornadoes, and a host of other events that some scientists have tied to AGW but which occur naturally every year or even every day somewhere on the globe, the difficulty of establishing that scientific opinion testimony is relevant and admissible under Rules 104 and 702 is challenging and likely impossible given the current state of science.

D. The Plaintiffs Will Have to Show at Least a 50% Probability That CO₂ Emissions Proximately Caused the Harm They Suffered.

The Ninth Circuit's treatment of the *Daubert* case on remand is instructive on the analysis of the challenges to expert testimony that CO₂ nuisance plaintiffs will face given the uncertainties of the science on which their claims must be based.²³⁸ *Daubert II*, and other "toxic tort" cases are analogous, because just as CO₂ may or may not cause global warming generally and weather events in particular, exposure to toxins may or may not cause bodily harm in every instance. Additionally, in both types of cases, there are known natural causes. Indeed, toxic tort precedent may be even more relevant than pollution cases. The issue in most pollution cases is whether the defendants contributed to a known harm of pollution, not whether the pollution the plaintiffs suffered was harmful at all.²³⁹ CO₂ emitters are certainly "contributors" to whatever CO₂ causes. But what can CO₂ be said to cause with sufficient certainty to permit an expert to support the proximate cause element of a nuisance damage claim?

In *Daubert*, the case was remanded to the Ninth Circuit to re-evaluate plaintiffs' proffered scientific opinions under the Supreme Court's new standard.²⁴⁰ The plaintiffs were two minors who sued Merrell Dow Pharmaceuticals, "claiming they suffered limb reduction birth defects because their mothers had taken Bendectin, a drug prescribed for morning sickness."²⁴¹ The Ninth Circuit did not remand the case to the trial court, instead finding that as a matter of law the plaintiffs' proffered evidence would have to be excluded at trial.²⁴²

The court in *Daubert II* undertook the two-stage analysis described above. It was highly skeptical of the basic science underlying plaintiffs' experts'

237. Christopher R. Reeves, *Climate Change on Trial: Making the Case for Causation*, 32 AM. J. TRIAL ADVOC. 495, 519 (2009).

238. *Id.* at 515.

239. *Id.* at 509.

240. *Daubert*, 509 U.S. at 597-98.

241. *Daubert II*, 43 F.3d at 1313.

242. *Id.* at 1315.

theories.²⁴³ But ultimately, the decision to affirm dismissal and rejection of the evidence turned on the second stage, the “‘fit’ between the testimony and an issue in the case.”²⁴⁴ Since applicable California tort law requires plaintiffs to show that Bendectin, “more likely than not caused [plaintiffs’] injuries,” in order to rely on statistical proof the plaintiffs had to, “establish not just that their mothers’ ingestion of Bendectin increased somewhat the likelihood of birth defects, but that it more than doubled it – only then can it be said that Bendectin is more likely than not the source of their injury.”²⁴⁵

Applying the *Daubert II* approach to the scientific evidence for the alleged localized effects caused by AGW, the hurdle in most, if not all, cases should be insurmountable. The discussion above explains the uncertainties in downscaling AGW to regional or local events. And even the IPCC – the leading proponent of the seriousness of AGW – itself cautions:

Difficulties remain in simulating and attributing observed temperature changes at smaller scales. On these scales, *natural climate variability is relatively larger, making it harder to distinguish changes expected due to external forcings.* Uncertainties in local forcings, such as those due to aerosols and land-use change, and feedbacks also make it difficult to estimate the contribution of GHG increases to observed small-scale temperature changes. . . .

Limitations and gaps currently prevent more complete attribution of the causes of observed natural system responses to anthropogenic warming. The available analyses are limited in the number of systems, length of records and locations considered. *Natural temperature variability is larger at the regional than the global scale, thus affecting identification of changes to external forcing. At the regional scale, other non-climate factors (such as land-use change, pollution and invasive species) are influential.*²⁴⁶

Plaintiff’s seeking damages, even on the scale of an entire state, should face very skeptical trial court judges on the question of whether the defendants’ CO₂ emissions “more likely than not” caused the regional effects complained of. At a regional scale, even the IPCC acknowledges that natural causes of the kinds of effects that AGW might also cause cannot be ruled out.²⁴⁷

E. The Supreme Court’s Decision in Massachusetts v. EPA Does Not Foreclose Nuisance Defendants’ Daubert Challenges.

“The harms associated with climate change are serious and well recognized.”²⁴⁸ Nuisance plaintiffs will undoubtedly liberally quote this and other passages from the Supreme Court’s opinion in support of their assertion that the science behind their experts’ AGW theories is “settled” or at least solid

243. *See generally id.*

244. *Id.* at 1320.

245. *Id.*

246. Lenny Bernstein et al., *Causes of Change*, in CLIMATE CHANGE 2007: THE AR4 SYNTHESIS REPORT; CONTRIBUTION OF WORKING GROUPS I, II AND III TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 40-41 (Abdelkader Allali et al. eds., 2007) (emphasis added), available at http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf.

247. *Id.*

248. *Massachusetts v. EPA*, 549 U.S. 497, 521 (2007).

enough to be presented to the jury.²⁴⁹ But under a proper reading of the case, the Court's statements must be limited to the context of that particular case. Taken in proper context, the case has no bearing on a *Daubert* challenge in a nuisance case.

In *Massachusetts v. EPA*, the plaintiff states and local governments sought to require the U.S. Environmental Protection Agency to issue standards for the emission of CO₂ by new motor vehicles manufactured and sold in the U.S.²⁵⁰ The case arose from plaintiffs' petition to the EPA for a rulemaking, which the EPA denied, for two reasons: "that (1) the [Clean Air] Act does not authorize it to issue mandatory regulations to address global climate change, and (2) even if it had the authority to set greenhouse gas emission standards, it would have been unwise to do so at that time"²⁵¹ Thus, the EPA's first reason was reviewed solely under the standards of the Clean Air Act and turned on the agency's and then the Court's interpretation of section 202(a)(1) of the Clean Air Act.²⁵² The second reason essentially raises a public policy defense. The Court also had to determine the threshold question of whether any of the plaintiffs had suffered a sufficiently "particularized injury" sufficient to have standing to seek to enforce the Act.²⁵³

In the context of the case, the Court's holdings were quite limited. First it held "that petitioners have standing to challenge the EPA's denial of their rulemaking petition."²⁵⁴ Since the EPA did not contest the AGW theory behind Massachusetts' alleged harms,²⁵⁵ the Supreme Court was able to find the state had standing, without having to determine the level of probability that the harms were causally linked to the EPA's decision not to regulate CO₂ emissions at the time. Second, it held "that EPA has the statutory authority to regulate the emission of [greenhouse] gases from new motor vehicles."²⁵⁶

It is the Court's third explicitly limited holding that is the key to understanding why *Massachusetts v. EPA* has no bearing on *Daubert* challenges in CO₂ nuisance cases. The Court responded to the EPA's alternative argument, which cited uncertainty regarding climate change science, in part, as follows:

If the scientific uncertainty is so profound that it precludes EPA from making a reasoned judgment as to whether greenhouse gases contribute to global warming, EPA must say so. That EPA would prefer not to regulate greenhouse gases because

249. Indeed, the Court's opinion begins: "A well-documented rise in global temperatures has coincided with a significant increase in the concentration of carbon dioxide in the atmosphere. Respected scientists believe the two trends are related." *Id.* at 504-5.

250. *Id.* at 505.

251. *Id.* at 497.

252. *Id.* at 528.

253. *Id.* at 517.

254. *Id.* at 526. The Court further stated, "EPA does not dispute the existence of a causal connection between manmade greenhouse gas emissions and global warming. At a minimum, therefore, EPA's refusal to regulate such emissions 'contributes' to Massachusetts' injuries." *Id.* at 523.

255. *Id.* at 526. The decision not to contest causation could have been a strategic litigation tactic and may have further been influenced by political considerations. The EPA under the Bush administration may have felt that scientific uncertainty remained as to the degree of harm from CO₂, if not as to causation itself. But to challenge the theory might have made it more difficult for future administrations to regulate CO₂ when the political calculation changed.

256. *Id.* at 532.

of some residual uncertainty . . . is irrelevant. *The statutory question is whether sufficient information exists to make an endangerment finding.*

In short, *EPA has offered no reasoned explanation for its refusal to decide whether greenhouse gases cause or contribute to climate change.*²⁵⁷

So the court acknowledged the scientific uncertainty and held “*only that EPA must ground its reasons for action or inaction in the statute.*”²⁵⁸ Further, it limited its holding by stating, “*We need not and do not reach the question whether on remand EPA must make an endangerment finding . . .*”²⁵⁹ The Supreme Court made it clear that EPA was free to find no endangerment on remand, which the EPA could not have done if the Supreme Court had already ruled on the validity of AGW theories. The question was not decided.²⁶⁰

VI. CONCLUSION

While the theory of AGW may be sufficient for policy makers to make policy decisions (based on an abundance of caution or furtherance of other legitimate public policy goals, such as reduced dependence on foreign oil), it has not been proven yet via the scientific method and therefore cannot—or at least should not—provide the basis for civil liability for damages in a tort case. This problem is compounded in cases based on specific local or regional weather events or trends due to the inability of scientists to demonstrate with any degree of certainty that such an event was more likely than not caused by the emissions of CO₂. Trial judges should approach any scientific evidence on causation carefully and with a healthy dose of skepticism. Ultimately, we do not believe the current state of climate science should permit such evidence to be admitted under Evidence Rule 702 and *Daubert*.

257. *Id.* at 534 (emphasis added).

258. *Id.* at 535 (emphasis added).

259. *Id.* at 534 (emphasis added).

260. Nor was the question decided in *AEP*. “The Court, we caution, endorses no particular view of the complicated issues related to carbon-dioxide emissions and climate change.” *American Elec. Power Co. v. Connecticut*, 131 S. Ct. 2527, 2533 n.2 (2011).