RUTGERS LAW RECORD

Volume 53

Issue I: Fall 2025

THE EVIDENTIARY ADMISSIBILITY OF EXTREME WEATHER EVENT ATTRIBUTION OPINIONS

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ABSTRACT

A new field of climate science seeks to link specific weather events—like hurricanes, wildfires, or heatwaves—to human-caused climate change. These types of expert opinions have often been touted as a means to support climate change litigation that seeks compensation for the emissions of greenhouse gases from specific companies or industries, or that challenges inaction by governmental entities in regulating greenhouse gas emissions. These "attribution opinions" are intended to show that a specific plaintiff has been harmed because of a specific extreme weather event and so has standing to seek relief or compensation for this harm. As most climate change cases have been resolved to date on justiciability concerns or other procedural grounds, there has been little analysis as to whether these types of attribution opinions would survive an evidentiary challenge as to their admissibility.

In addition to the standard set by the Federal Rules of Evidence, state courts have adopted a variety of different tests for determining the admissibility of expert opinions. However, there are common principles that are generally applicable. By examining the methodologies identified in published articles from prominent purveyors of attribution science, this article examines whether these types of extreme weather event attribution opinions would be considered to meet these admissibility standards for expert opinions. The article concludes that, as currently described in the scientific literature, these attribution opinions would have difficulty satisfying the evidentiary standards for admissibility.

I. INTRODUCTION.

An increasing number of lawsuits seek liability for alleged impacts from so-called human-caused (or anthropogenic) climate change ("anthropogenic climate change"). This litigation often targets energy companies that have extracted or refined oil and gas, which has functioned as a critical underpinning of modern society. This litigation has taken many forms but often depends upon a showing that certain extreme weather events within a local area were caused or exacerbated by human-caused climate change. In response to this rise in litigation, a new type of scientific opinion has gained prominence: attribution science.

In general, practitioners in the developing field of attribution science provide opinions as to whether an extreme weather event can be attributed to anthropogenic climate change. In addition to trying to influence public opinion as to the relevance and urgency of climate change policies, these opinions are directly intended to be used as evidence in climate change litigation. In scientific

articles outlining the merits of these types of opinions, a key feature is their purported ability to establish that (1) a particular extreme weather event was caused by anthropogenic climate change cases, and (2) that plaintiffs have standing to seek damages related to this weather event from defendants (usually oil and gas companies) for their alleged contribution to climate change. Putting aside the more fundamental question as to whether companies should be held legally responsible for damages as a result of extracting, producing, and/or refining oil – a commodity that has become a basic necessity since the Industrial Revolution – this article examines the evidentiary admissibility of attribution opinions for extreme weather events.

While the rules of evidence may differ between federal and state courts (and among each state), American courts universally apply certain basic rules. For instance, expert opinions must be based on reliable material that provides a reasonable basis for the opinion offered. Further, they must have some basis that the methodology is accurate. Lastly, the expert must not overstate the reliability and accuracy of his opinion.

For instance, the ongoing debate over forensic evidence illustrates the dangers of blindly admitting evidence from self-described experts without adequate scrutiny. For decades, trial courts routinely admitted expert opinions concerning forensic techniques (such as methods for comparing DNA samples, bitemarks, latent fingerprints, firearm marks, footwear, and hair) with little scrutiny of the reliability or accuracy of the methodologies used. Eventually, comprehensive investigations by various federal agencies showed that the results of many forensic techniques were unreliable and insufficiently standardized. As some courts continued to admit this forensic evidence in the same haphazard manner as before, Rule 702 of the Federal Rules of Evidence was recently amended in 2023, partly to emphasize the trial court's legal obligation to hold the proponents of expert testimony to their burden of establishing that the scientific opinions are reliable and based

on sound scientific principles.

Purveyors of attribution science must be held to the same burden. And based on how these scientists have described the manner in which these attribution opinions are crafted, this evidence should not meet any evidentiary standard for the admission of expert testimony. As discussed below, a recent article from the prominent academic collaboration known as World Weather Attribution reflects the inherent subjectivity in how it creates an "overarching message" for its extreme weather event attribution opinions. Moreover, the descriptions of its calculation method show how its opinions are skewed in favor of a finding of climate change contribution. Like other types of climate change predictions, attribution opinions are also not directly verifiable. Based on the inherent nature of climate predictions, it is not possible to run experiment models using a known control that can calculate the error rate for a calculation method.

As this article will discuss, expert testimony is subject to careful evidentiary standards, and attribution opinions concerning extreme weather events must comply with these standards to be admissible in litigation over climate change. For opinions that follow methodologies as described by the World Weather Attribution group, the legal standards for admissible expert testimony would likely not be satisfied.

II. TRIAL JUDGES HAVE AN OBLIGATION TO ENSURE AGAINST THE ADMISSION OF UNRELIABLE EXPERT OPINIONS.

Courts have long-recognized the dangers of allowing impressionable juries to hear unreliable expert testimony.[1] "Unlike an ordinary witness, an expert is permitted wide latitude to offer opinions, including those that are not based on firsthand knowledge or observation."[2] This

[1] *See generally* Fred K. Morrison, et al., *Climate Change Science and the Daubert Standard,* 44 WM. & MARY ENV'T. L. & POL'Y REV. 391, 407 (2020).
[2] Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579, 592 (1993).

relaxation of the evidentiary requirements "is premised on an assumption that the expert's opinion will have a reliable basis in the knowledge and experience of his discipline."[3]

In 1923, the D.C. Circuit Court of Appeals established the expert admissibility standard as the "general acceptance test."[4] The Court explained that "[w]hile courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle of 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."[5]

In adopting the *Frye* test, the courts recognized that, without steps to ensure the reliability and accuracy of expert testimony, juries will be unduly affected by the "white lab coat" effect – deferring to self-professed experts that have not sufficiently established that their opinions are well-grounded in a scientific methodology.[6] "[I]t is the jury system itself that requires the common law 'judge, in his efforts to prevent the jury from being satisfied by matters of slight value, capable of being exaggerated by prejudice and hasty reasoning to exclude matter which does not rise to a clearly sufficient degree of value'; 'something more than a minimum of probative value' is required."[7]

In 1993, the United States Supreme Court rejected *Frye's* general acceptance test and strengthened the judge's gatekeeper role in determining admissibility of expert evidence.[8] The Court explained that "'[g]eneral acceptance' is not a necessary precondition to the admissibility of

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[3] *Id.*; *see also* Kumho Tire Co. v. Carmichael, 526 U.S. 137, 148 (1999) (holding that both scientific and technical expert opinions must satisfy the foundational reliability requirements).
[4] *See* Frye v. United States, 293 F. 1013, 1014 (D.C. Cir. 1923).
[5] *Id.*
[6] *See, e.g.*, Rene L. Valladares & Hannah Nelson, *Feature: Effectively Excluding Prosecution Experts Using the Amendment to Federal Rule of Evidence 702*, 40 CHAMPION 28, 33 (2024) ("Proponents of the amendment also highlighted that the whole point of Rule 702 . . . and *Daubert* . . . is that these issues *cannot* be left to cross-examination due to the danger of the 'white lab coat effect' on the jury." (internal quotations omitted)).
[7] Herman Schwabe, Inc. v. United Shoe Machinery Corp., 297 F.2d 906, 912 (2d Cir. 1962) (quoting JOHN HENRY WIGMORE, EVIDENCE 409-10 (John Henry Wigmore, 3d ed. 1940).
[8] *Daubert*, 509 U.S. 579.

scientific evidence under the Federal Rules of Evidence, but the Rules of Evidence – especially Rule 702 – do assign to the trial judge the task of ensuring that an expert's testimony both rests on a reliable foundation and is relevant to the task at hand."[9] "Pertinent evidence based on scientifically valid principles will satisfy those demands."[10] Under the *Daubert* standard, trial judges, who are faced with a proffer of expert scientific testimony, must determine "whether the reasoning or methodology underlying the testimony is scientifically valid and of whether that reasoning or methodology properly can be applied to the facts in issue."[11]

"*Daubert* requires that trial courts act as 'gatekeepers' to ensure that speculative, unreliable expert testimony does not reach the jury."[12] "The opinion of a qualified expert witness is admissible if: (1) it is based on sufficient facts or data, (2) it is the product of reliable principles and methods, and (3) the expert has reliably applied the principles and methods to the facts of the case."[13] Expert evidence may be excluded if "there is simply too great an analytical gap between the data and the opinion proffered."[14]

Rule 702 of the Federal Rules of Evidence was amended in 2000 to codify the holdings of the *Daubert* line of cases.[15] The 2000 amendments added the three reliability-based requirements that are found in subdivisions (b), (c), and (d) of Rule 702. As stated in the Advisory Committee Notes for the 2000 Amendments to Rule 702:

> In *Daubert* the Court charged trial judges with the responsibility of acting as gatekeepers to exclude unreliable expert testimony, and the Court in *Kumho* clarified that this gatekeeper function applies to all

[9] *Id.* at 597.
[10] *Id.*
[11] *Id.* at 592–93.
[12] McCorvey v. Baxter Healthcare Corp., 298 F.3d 1253, 1256 (11th Cir. 2002).
[13] Union Pac. R.R. Co. v. Progress Rail Servs. Corp., 778 F.3d 704, 709 (8th Cir. 2015) (citing FED. R. EVID. 702) (affirming exclusion of appellant's expert's opinion as "there existed too great an analytical gap between the data and [his] ultimate opinion and that his opinion was thus unreliable.").
[14] *See* Gen. Elec. Co. v. Joiner, 522 U.S. 136, 146 (1997).
[15] The *Daubert* line of cases generally refers to the following Supreme Court decisions: *Daubert*, 509 U.S 579; *Kumho Tire Co.*, 526 U.S 137; *Joiner*, 522 U.S. 136.

> expert testimony, not just testimony based in science. The amendment affirms the trial court's role as gatekeeper and provides some general standards that the trial court must use to assess the reliability and helpfulness of proffered expert testimony.[16]

"Despite the clear guidance provided by the 2000 amendments, many courts 'continued to apply significantly more lenient standards for expert testimony than Rule 702 permits.'"[17] According to Professor David Bernstein, co-author of *The New Wigmore: Expert Evidence* treatise, many judges were "ignor[ing] the text of Rule 702" and, instead, relying on "precedents that predate[d] (and conflict[ed] with) not only the text of amended Rule 702, but also with some or all of the *Daubert* trilogy."[18]

Most state courts explicitly or implicitly adopted the federal courts' standard under the *Daubert* line of cases.[19] According to a recent American Law Review annotation, "[t]wenty-five states have affirmatively adopted the *Daubert* or similar test for use in their courts, or had previously abandoned *Frye* and had developed a similar test; Fifteen states and the District of Columbia adhere to *Frye*; Six states have not rejected *Frye* in toto but apply the *Daubert* factors; and four states have developed their own tests."[20]

For federal courts and the state courts that have explicitly or implicitly adopted the *Daubert* factors to evaluate an expert's methodology, trial courts would consider "its error rate; the standards governing its operation; whether it can be tested; whether it is subject to peer review; and whether it is generally accepted in the relevant scientific or expert community."[21] "But these

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[16] Fed. R. Evid. 702 advisory committee's notes on the 2000 amendment.
[17] Mark A. Behrens & Andrew J. Trask, *Federal Rule of Evidence 702: A History and Guide to the 2023 Amendments Governing Expert Evidence*, 12 TEX. A&M L. REV. 43 (2024) (quoting David E. Bernstein, *The Misbegotten Judicial Resistance to the* Daubert *Revolution*, 89 NOTRE DAME L. REV. 27, 30 (2013)).
[18] David E. Bernstein, *The Misbegotten Judicial Resistance to the Daubert Revolution*, 89 NOTRE DAME L. REV. 27, 30 (2013).
[19] Alice B. Lustre, Annotation, *Post-Daubert Standards for Admissibility of Scientific and Other Expert Evidence in State Courts*, 90 A.L.R. 5TH 453, § 2 (2024) (internal citations omitted).
[20] *Id*.
[21] *See* United States v. Hunt, 99 F.4th 161, 180 (4th Cir. 2024); s*ee also Daubert*, 509 U.S. at 593–94.

considerations are nonexclusive, and the court has broad latitude to account for any factors bearing on validity that the court finds to be useful, depending on the nature of the issue, the expert's particular expertise, and the subject of his or her testimony."[22]

In 2023, Rule 702 was "amended to clarify and emphasize that expert testimony may not be admitted unless the proponent demonstrates to the court that it is more likely than not that the proffered testimony meets the admissibility requirements set forth in the rule."[23] The Committee Note emphasized how juries were limited when evaluating expert testimony: "Judicial gatekeeping is essential because . . . jurors may also lack the specialized knowledge to determine whether the conclusions of an expert go beyond what the expert's basis and methodology may reliably support."[24] Multiple states have already taken steps to implement the powerful 2023 amendments to Rule 702 – and many more will likely follow the trend.[25]

Even for those states that still explicitly rely upon the *Frye* standard, courts in those states must consider "whether the accepted techniques, when properly performed, generate results accepted as reliable within the scientific community generally."[26] Further, regardless of whether the state courts have adopted the tests set forth in *Daubert*, *Frye*, or some third option, the admissibility standards have been augmented (and sometimes subsumed) by the courts'

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[22] *Hunt*, 99 F.4th at 180 (internal citation omitted).
[23] Fed. R. Evid. 702 advisory committee's note.
[24] *Id.*
[25] *See State Evidentiary Rule Reform: The Need for Reform in the States*, DON'T SAY DAUBERT (last visited Apr. 1, 2025), https://dontsaydaubert.com/state-evidentiary-rule-reform/; *see also* Linda Watson & Magy Shenouda, *Trial experts beware! Courts' duties under the newly amended FRE 702*, 103 MI. BAR J., 20, 21 (2024) ("Whether these changes will correct the misapplication of the rule by trial courts will take time to assess. Likewise, whether the amendment will lead to unintended increased scrutiny of expert witnesses will also be borne over time. In the months since the rule took effect, appellate and trial courts – as well as attorneys – are most certainly paying attention to it.").
[26] *See* People v. Williams, 35 N.Y.3d 24, 37 (N.Y. 2020); *see also* People v. Nelson, 43 Cal.4th 1242, 1257 (2008) ("The admissibility of expert testimony based on a new scientific technique requires proof of its reliability[.]" (internal citations omitted)); Molitor v. BNSF Ry. Co., 214 N.E.3d 324, 339 (Il. Ct. App. 2022) ("a trial court must ensure that an adequate foundation has been established that the information upon which an expert bases his or her opinion is 'reliable'"); State v. Wasuge, 32 Wash. App. 2d 226, 234 (2024); Grady v. Frito-Lay, Inc., 839 A.2d 1038, 1043-44 (Pa. 2003).

amendments of the relevant evidentiary rules.[27] As discussed further below, these evidentiary rules, particularly Rule 702 of the Federal Rules of Evidence (whether incorporating the 2023 amendments to the Federal Rules of Evidence or not) and the various state analogues, require that expert opinions must be based on a reliable and valid methodology.

III. THE TREATMENT OF FORENSIC EVIDENCE ILLUSTRATES THE DANGERS OF BLINDLY ADMITTING EVIDENCE WITHOUT ADEQUATE SCRUTINY.

The courts' cavalier treatment of forensic evidence (resulting in a need for increasingly restrictive admissibility rules) provides a compelling cautionary tale as courts and legislatures are starting to rely upon extreme weather event attribution opinions.[28] For decades, courts routinely admitted expert testimony of forensic evidence, providing opinions that a defendant was irrefutably connected to evidence collected at a crime site. Investigations by various agencies eventually showed that the results of most forensic techniques were unreliable and insufficiently standardized.[29] In 2009, a committee of the National Research Council released a report that "described a disturbing pattern of deficiencies common to many of the forensic methods routinely used in the criminal justice system, most importantly a lack of rigorous and appropriate studies establishing their scientific validity, concluding that 'much forensic evidence—including, for example, bitemarks and firearm and toolmark identifications—is introduced in criminal trials without any meaningful scientific validation, determination of error rates, or reliability testing to

[27] *See e.g.*, Parker v. Mobil Oil Corp., 7 N.Y.3d 434, 447 (2006) ("The *Frye* inquiry is separate and distinct from the admissibility question applied to all evidence—whether there is a proper foundation—to determine whether the accepted methods were appropriately employed in a particular case.").
[28] Sophie Marjanac & Lindene Patton, *Extreme Weather Event Attribution Science and Climate Change Litigation: An Essential Step in the Causal Chain?*, 36 J. ENERGY & NAT. RES. L. 265, 279 (2018) ("Courts are therefore likely to be comfortable and willing to accept event attribution science in climate change litigation, subject to its being robustly interrogated, as is the case with any other expert evidence.").
[29] Behrens & Trask, *supra* note 17, at 55.

explain the limits of the discipline.'"[30]

In turn, the President's Council of Advisors on Science and Technology ("PCAST") issued its own report in 2016 on the use of "forensic 'feature-comparison' methods—specifically, methods for comparing DNA samples, bitemarks, latent fingerprints, firearm marks, footwear, and hair."[31] The PCAST Report "concluded that there are two important gaps: (1) the need for clarity about the scientific standards for the validity and reliability of forensic methods and (2) the need to evaluate specific forensic methods to determine whether they have been scientifically established to be valid and reliable."[32]

The PCAST report also identified the type of evidence needed to fill these missing gaps. First, an expert must provide evidence that the forensic technique has "a well-defined, reproducible procedure for identifying and comparing the features in two samples and for determining whether they share sufficient similarity."[33] Second, "the method must be empirically tested, under conditions appropriate to the intended use, to determine its accuracy[.]"[34] Despite these reports, trial courts continued to admit expert opinions on forensic methods without requiring a showing as to the validity and reliability of the forensic methods, or any meaningful scientific validation, or determination of error rates.[35] As discussed by Eric S. Lander (President and Founding Director

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[30] President's Council of Advisors on Sci. and Tech., *Report to the President: Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature Comparison Methods*, EXEC. OFF. OF THE PRESIDENT OF THE UNITED STATES (Sep. 2016), https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/PCAST/pcast_forensic_science_report_final.pdf [hereinafter "PCAST Report"] (quoting Nat'l Rsch. Council of the National Academies, *Strengthening Forensic Science in the United States: A Path Forward*, THE NAT'L ACADEMIES at 107–08 (2009), https://www.ojp.gov/pdffiles1/nij/grants/228091.pdf).

[31] *See id.*

[32] PCAST Report, *supra* note 30 *; see also* Michael J. Saks, *The Disregarded Necessity: Validity Testing of Forensic Feature-Comparison Techniques*, 48 SETON HALL L. REV. 733 (2018).

[33] Eric S. Lander, Fixing Rule 702: *The PCAST Report and Steps to Ensure the Reliability of Forensic Feature-Comparison Methods in the Criminal Courts*, 86 FORDHAM L. REV. 1661, 1666 (2018).

[34] *Id.* at 1666–67.

[35] Saks, *supra* note 32, at 736 ("Neither the forensic science establishment nor the courts performed, respectively, their scientific or legal validity testing duties, and so the science and the nonsense were offered and received as an

of Broad Institute of MIT and Harvard), "[c]ourts routinely admit testimony about feature-comparison methods that claim to be able to identify the source of a sample with high accuracy – even when the reliability of the methods have never been tested or when the methods have been tested and found to be unreliable."[36]

As mentioned above, steps were also initiated to amend Rule 702 of the Federal Rules of Evidence in 2023.[37] The Advisory Committee Notes highlight the pertinence of this amendment to forensic experts, specifically noting that "[f]orensic experts should avoid assertions of absolute or one hundred percent certainty—or to a reasonable degree of scientific certainty—if the methodology is subjective and thus potentially subject to error."[38] The Committee Notes also advise that judges should "receive an estimate of the known or potential rate of error of the methodology employed, based (where appropriate) on studies that reflect how often the method produces accurate results."[39]

IV. ATTRIBUTION OPINIONS PURPORT TO ESTABLISH THAT CERTAIN CLIMATE EVENTS WERE CAUSED BY ANTHROPOGENIC CLIMATE CHANGE.

As comprehensive federal legislation on climate change has proven elusive, private citizens have sued state and local governments[40] and in turn, many of those governments have sued energy companies,[41] all trying to assign blame for the potential impacts of carbon emissions from

undifferentiated mix."); Lander, *supra* note 33, at 1676 ("many judges are also reluctant to challenge longstanding precedents concerning the admissibility of forensic methods, even when they were established long before current problems became apparent.").

[36] Lander, *supra* note 33, at 1676.

[37] Valladares & Nelson, *supra* note 6 ("These changes were sparked by the groundbreaking NAS and PCAST reports that noted significant problems with the state of forensic science in this country.").

[38] *Id.*

[39] *Id.*

[40] *See, e.g.*, Sagoonick v. State, 503 P.3d 777, 782 (Alaska 2022) (action by many young Alaskans alleging that the State of Alaska's "resource development is contributing to climate change and adversely affecting their lives").

[41] While these types of lawsuits have typically focused on companies involved in the production of oil and gas, plaintiff groups may eventually try to assign liability on other industries that are viewed as large emitters of greenhouse gases, such as dairy farmers, beef cattle industry, cement manufacturers, etc. *See, e.g.*, Oliver Lazarus, et al., *The climate*

hydrocarbon combustion.[42] To date, these lawsuits have typically been dismissed as nonjusticiable political questions or preempted by federal law.[43] However, to the extent that courts may decide to consider the merits of these claims, these claims will ultimately require evidence that: (1) the plaintiffs will be directly impacted from extreme weather events or other local manifestations of climate change and (2) that carbon emissions resulting from energy companies' operations can be attributed to causing or exacerbating these localized impacts.[44]

Until a few years ago, the assessment reports from the Intergovernmental Panel on Climate Change ("IPCC") (a panel providing policymakers with scientific assessments on climate change) conceded that the computer models for predicting climate change were unable to predict whether regional impacts were caused by climate change or by naturally occurring variations in weather.[45] However, in 2021, the IPCC published the first contribution to its Sixth Assessment Report

responsibilities of industrial meat and dairy producers, CLIMATIC CHANGE 165, 30 (2021), https://doi.org/10.1007/s10584-021-03047-7; *see also* Mahmure Övül Arıoğlu Akan, et al., *Greenhouse gas emissions in the construction industry: An analysis and evaluation of a concrete supply chain*, 167 J. OF CLEANER PROD. 1195, 1207 (2017) https://doi.org/10.1016/j.jclepro.2017.07.225.

[42] *See, e.g.*, Massachusetts v. Exxon Mobil Corp. 462 F. Supp. 3d 31, 36 (D. Mass. 2020) (action by a State alleging that company knew about risks of climate change and misrepresented impacts).

[43] Juliana v. United States, 947 F.3d 1159, 1171 (9th Cir. 2020) ("it is beyond the power of an Article III court to order, design, supervise, or implement the plaintiffs' requested remedial plan . . . to decrease fossil fuel emissions and combat climate change"); *Sagoonick*, 503 P.3d at 795 ("conclud[ing] that plaintiffs' injunctive relief claims present non-justiciable political questions"); *see also* City of N.Y. v. Chevron Corp., 993 F.3d 81, 100, 103 (2d Cir. 2021) (holding that New York City's state-law claims seeking to hold oil companies liable for climate change harms were preempted by federal law, interfered with federal regulations, and implicated foreign policy concerns); City of N.Y. v. Exxon Mobil Corp., 2025 N.Y. L.J. LEXIS 219, at *33, *36, *47 (N.Y. Sup. Ct. Jan. 14, 2025) (holding that the City failed to plausibly allege deception, finding many claims as non-actionable puffery or time-barred, and dismissing the City's claims).

[44] *See*, *e.g.*, *Juliana*, 947 F.3d at 1168 (relying upon plaintiffs' "evidence that climate change is affecting them now in concrete ways and will continue to do so unless checked"); Wash. Env't Council v. Bellon, 732 F.3d 1131, 1141–46 (9th Cir. 2013) (holding that the causal chain between regional agencies' failure to regulate five oil refineries and the plaintiffs' climate-change related injuries was "too tenuous to support standing" because the refineries had a "scientifically indiscernible" impact on climate change); Ctr. for Biological Diversity v. U.S. Dep't of Interior, 563 F.3d 466, 478 (D.C. Cir. 2009) (finding no standing because plaintiffs could "only aver that any significant adverse effects of climate change 'may' occur at some point in the future"); City of N.Y. v. BP P.L.C., 325 F.Supp.3d 466, 469 (S.D. N.Y. 2018) ("alleg[ing] that Defendants' ongoing conduct continues to exacerbate global warming and cause recurring injuries to New York City").

[45] Morrison, *supra* note 1, at 407 (discussing how the IPCC's Fifth Assessment Report ("AR5"), published between 2014 and 2018, "admits that the available science does not allow accurate predictions of how climate change will affect specific regions and local areas.").

("AR6").[46] In this report, the IPCC asserted that computer models had advanced to the point where they could predict whether certain regional events were caused by climate change with an increasing degree of confidence: "Since AR5, a more comprehensive assessment of past and future evolution of a range of climate variables on a regional scale has been enabled by the increased availability of coordinated ensemble regional climate model projections and improvements in the level of sophistication and resolution of global and regional climate models."[47]

These assertions have resulted in the creation of a new field of climate change science, described as "attribution science." The early papers discussing the development of attribution science reflect a transparent desire to create more judge-friendly scientific opinions that can be helpful in climate change litigation.[48] As one stated, "[c]ausation is a key challenge in climate litigation and attribution science has increasingly been brought up as a potential means to resolve that challenge."[49] Another article published in 2018 opined that "[t]he state of attribution science will be influential in evaluating causation issues in such lawsuits and for establishing the foreseeability of weather events that were previously regarded as unpredictable."[50]

These articles recognize that the traditional concept of causation is incompatible with the inherent randomness of weather: "Due to the inherent stochasticity of the climate system, attributing a single extreme event to human intervention into the climate system with certainty is

[46] *See generally Climate Change 2021: The Physical Science Basis*, IPCC SIXTH ASSESSMENT REPORT – WORKING GROUP 1: THE PHYSICAL SCIENCE BASIS (last visited Apr. 11, 2025), https://www.ipcc.ch/report/ar6/wg1/ [hereinafter "AR6 WGI"].
[47] *Id.*
[48] *See e.g.*, Marjanac & Patton, *supra* note 28, at 298 ("As attribution science continues to improve, this knowledge will inform the applicability and availability of legal theorem for liability adjudication . . .").
[49] *See*, *e.g.*, Tobias Pfrommer, et al., *Establishing Causation in Climate Litigation: Admissibility and Reliability*, 152 CLIMATIC CHANGE 67, 81 (2019); *see also* AR6 WGI, *supra* note 46 ("whether event attribution is an effectual tool for resolving questions of causation does not only depend on the state of the art in event attribution, but also on the legal framework in which it is employed.").
[50] Marjanac & Patton, *supra* note 28, at 266.

in general impossible."[51] "The traditional legal 'but for' test of deterministic necessary causation is, therefore, not suitable in this context, and attribution based on probabilistic notions appears to be the only possible option."[52] As a result, climate scientists have turned to the opinions known as "extreme weather event attribution." "Extreme weather event attribution (which we refer to simply as "event attribution") is the science that seeks to determine the extent to which anthropogenic climate change has altered the probability or magnitude of the particular weather event or class of weather events that are the subject of study."[53]

Attribution science generally refers to the use of models to provide an opinion on the degree that climate change influenced a specific weather event. In the study, authors would first identify the physical components that led to a specific extreme weather event.[54] The authors then use a variety of climate models to create a counterfactual world – for example, one where the Industrial Revolution did not occur – to determine the degree that anthropogenic climate change increased the intensity of a specific event.[55] "Attribution science comprises methods that generally use counterfactual enquiry to link observed trends or changes in the probability or intensity of climate-related events to human influence."[56] These attribution opinions frequently state that anthropogenic climate change has increased the likelihood or the intensity of a particular extreme

[51] Pfrommer, et al., *supra* note 49, at 68.
[52] *Id.*
[53]Marjanac & Patton, *supra* note 28, at 268; *see also* Rubert F. Stuart-Smith, et al., *Filling the Evidentiary Gap in Climate Change Litigation*, 11 NATURE CLIMATE CHANGE 651, 655 (2021) ("Attribution science comprises methods that generally use counterfactual enquiry to link observed trends or changes in the probability or intensity of climate-related events to human influence.").
[54] Michael Burger, Jessica A. Wentz & Radley Horton, *The Law and Science of Climate Change Attribution*, 51 ENV'T L. REP. 10646 (2021) ("There are several key sources of information and analytical techniques that are used in climate change, impact, and extreme event attribution studies: physical understanding, observational data, statistical analysis, and models. Physical understanding refers to scientific understanding of physical properties and processes, such as the heat-trapping effects of greenhouses gases (GHGs).").
[55] Marjanac & Patton, *supra* note 28, at 278 ("[E]vent attribution science can identify the extent to which all human greenhouse gas (GHG) emissions since the beginning of the industrial revolution have contributed to an extreme weather event.").
[56] Stuart-Smith, et al., *supra* note 53.

weather event by a certain percentage. A plaintiff can then file litigation against one or more energy companies seeking compensation for their relative contributions based on an assessment of the amount of carbon emissions attributable to that company's operations.[57]

V. The Methodology Behind Event Attribution Opinions.

In order to better explore the methodology used in creating event attribution opinions, this article explores the description provided by one of the most prominent purveyors of these opinions. World Weather Attribution (or "WWA") is an academic collaboration studying extreme event attribution and providing their calculations of the impact of climate change on extreme meteorological events such as heat waves, droughts, and storms.[58]

WWA launched in 2015 based on its "frustration that it took so long to determine whether climate change was behind an extreme weather event."[59] The group prepares attribution opinions using real-world weather observations and computer modeling to determine the likelihood of a particular event happening before and after climate change, and whether global warming affected its intensity.[60] WWA has thus positioned itself as a source for providing expedient opinions as to whether regional climate events were caused by anthropogenic climate change.

Unlike peer-reviewed studies, WWA posts the results of their opinions "as soon as they are available, often days or weeks after the event, to inform discussions about climate change and

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[57] *See, e.g.*, Jonathan D. Haskett, *Is That Climate Change? The Science of Extreme Event Attribution*, CONGRESS.GOV (2023), https://www.congress.gov/crs-product/R47583?q=%7B%22search%22%3A%22R47583%22%7D&s=2&r=1 ("Climate change attribution may have a role in domestic litigation in determining compensation for adverse impacts of climate change."); Christopher W. Callahan & Justin S. Mankin, *Carbon majors and the scientific case for climate liability*, 640 NATURE 893 (2025), https://doi.org/10.1038/s41586-025-08751-3 ("[S]cientific approaches that demonstrate causal linkages from emitters to impacts have been termed the Holy Grail of climate litigation").

[58] *See generally* WORLD WEATHER ATTRIBUTION (last visited Nov. 2, 2025), https://www.worldweatherattribution.org/about/.

[59] Suman Naishadham, *Deadly flooding in Central Europe made twice as likely by climate change*, ASSOCIATED PRESS (Sept. 26, 2024), https://apnews.com/article/central-europe-european-union-floods-climate-change-damage-rain-5e90744008e4bc1404bbfd181f09b32f.

[60] WORLD WEATHER ATTRIBUTION, *supra* note 58.

extreme weather."[61] As a result, WWA's studies have been featured in over a thousand news articles, generally to support an opinion that a particular weather event has been caused or worsened by climate change.[62] Law review journals discussing attribution science have also frequently cited the WWA.[63]

Researchers behind the World Weather Attribution (WWA) initiative explain that one of their key motives in conducting such studies is "increasing the 'immediacy' of climate change, thereby increasing support for mitigation."[64] WWA's chief scientist, Friederike Otto, explains that "[u]nlike every other branch of climate science or science in general, event attribution was actually originally suggested with the courts in mind."[65]

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[61] *Id.*; *see also* Seth Borenstein, *Climate change leaves fingerprints on July heat waves around the globe, study says*, ASSOCIATED PRESS, (Jul. 25, 2023), https://apnews.com/article/heat-wave-deadly-climate-change-europe-america-4c361736afa70766049acdb189ccfd64 ("Thanks to years of research and more powerful computers, scientists can now determine almost in real-time whether climate change is contributing to the intensity of heat, storms, floods and drought - and by how much.").

[62] *See, e.g.*, Austyn Gaffney, *Because of Climate Crisis, South Sudan's Heat Wave Was 10 Times as Likely*, N.Y. TIMES (Mar. 11, 2025), https://www.nytimes.com/2025/03/07/climate/sudan-heat-wave-climate-change.html; Dinah Voyles Pulver, *Hotter, drier, and more flammable: Scientists say climate change fueled LA fires*, USA TODAY (Jan. 29, 2025), https://www.usatoday.com/story/news/nation/2025/01/29/scientists-say-climate-change-fueled-la-fire-conditions/78003783007/; Seth Borenstein, *Climate Change Goosed Hurricane Wind strength by 18 mph Since 2019, Study Says*, ASSOCIATED PRESS (Nov. 20, 2024), https://www.yahoo.com/news/climate-change-goosed-hurricane-wind-110218481.html; Austyn Gaffney, *Climate Change Is Making Disasters Deadlier. Here's How Much.*, N.Y. TIMES (Oct. 31, 2024), https://www.nytimes.com/2024/10/31/climate/climate-disasters-cop29-election.html; Seth Borenstein, *An unusual hurricane season goes from ultra quiet to record busy and spawns Helene and Milton*, ORLANDO SENTINEL (Oct. 8, 2024), https://www.orlandosentinel.com/2024/10/08/an-unusual-hurricane-season-goes-from-ultra-quiet-to-record-busy-an; Austyn Gaffney, *Study Finds Climate Change Doubled Likelihood of Recent European Floods*, N.Y. TIMES (Sept. 24, 2024), https://www.nytimes.com/2024/09/24/climate/climate-change-europe-floods-boris.html; The Associated Press, *Climate change made killer heat wave in Southwest even warmer and 35 times more likely*, NBC NEWS (Oct. 16, 2024), https://www.nbcnews.com/science/environment/climate-change-made-heat-wave-more-likely-warmer-rcna158275 ("Her study found that this heat wave is now four times more likely to happen than it was in the year 2000, when it was nearly a degree (0.5 degrees Celsius) cooler.").

[63] *See, e.g.*, Michael Burger, et al., *The Law and Science of Climate Change Attribution*, 45 COLUM. L. J. OF ENV'T. L. 57, 99 (2020) ("The World Weather Attribution (WWA) project, founded in 2014, is at the forefront of these efforts: it conducts 'real-time' (i.e., rapid) attribution analysis of extreme weather events that happen around the world."); Aisha I. Saad, *Attribution For Climate Torts*, 64 B.C. L. REV. 867, 878 (2023); Robert L. Glicksman, et al., *Judicial Review of Scientific Uncertainty in Climate Change Lawsuits: Deferential and Nondeferential Evaluation of Agency Factual and Policy Determinations*, 46 HARV. ENV'T. L. REV. 367, 372 (2022).

[64] Geert Jan van Oldenborgh, et al., *Pathways and pitfalls in extreme event attribution*, 166 CLIMATIC CHANGE 13 (2021). https://link.springer.com/article/10.1007/s10584-021-03071-7.

[65] Maxine Joselow, *Science could aid climate cases. Big Oil is fighting it*, CLIMATEWIRE (2021), https://www.eenews.net/articles/science-could-aid-climate-cases-big-oil-is-fighting-it/9027db7ee289/?context=1530671&federationidp=JKDZ8X67420.

Recently, the WWA team has published a scientific article explaining how it determines whether a specific weather event has been caused by climate change.[66] The report makes a number of admissions that are meaningful and relevant in the litigation context.

First, it concedes that WWA's method of calculating a connection between a weather event and anthropogenic climate change is intentionally skewed to generate more false positives and fewer false negatives:

> While in science avoiding type-1 errors is usually treated as the highest priority, in the case of climate change attribution this could lead to dangerously false feelings of security; thus, we use the minimal-variance scheme to reduce the risk of type-2 errors.[67]

A Type 1 error is also known as a false positive, and a Type 2 error is a false negative.[68] So, WWA knowingly allows for more results that find that a certain weather event was exacerbated by climate change, while intentionally avoiding instances where a study found no connection for a weather event that was in fact worsened by climate change.

WWA also admits that it subjectively weighs the various models and observations in order to avoid "overly conservative estimates of the role of climate change."[69]

> Given that we combine models and observations and that observations tend to have a very large variance simply due to the very small sampling, an unweighted combination could have overly large variance and in many cases end up producing statistically insignificant results … ***and thus lead to overly conservative estimates of the role of climate change***.[70]

The WWA scientists also discuss how their conclusions include a high degree of

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[66] Friederike E. L. Otto. et al., *Formally combining different lines of evidence in extreme-event attribution*, 10 ADVANCES IN STAT. CLIMATOLOGY METEOROLOGY OCEANOGRAPHY 159-71 (2024), https://ascmo.copernicus.org/articles/10/159/2024.
[67] *Id.* at 161.
[68] *See* Amitav Banerjee, et al., *Hypothesis Testing, Type 1 and Type II Errors*, 18(2) INDUS. PSYCHIATRY J. 127, 129 (2009).
[69] Otto, et al., *supra* note 66, at 162.
[70] *Id.* (emphasis added); *see also id*. at 161 ("As a first step, we note that the obviously unrealistic models have already been dropped in the model evaluation stage prior to synthesis.").

subjectivity, where the final conclusion may be based on information not otherwise included in the model:

> The true representativity uncertainty and model uncertainty can be either smaller or larger than the spread. … However, without additional information these deviations cannot be estimated. The additional information would have to come from the observational dataset and model evaluations, but it is unclear at the moment how to best use these evaluations to weigh the results beyond the include–exclude step we have adopted. ***This additional knowledge can however be used after the analysis is carried out to decide whether to present the best estimate, the lower or upper bound respectively or the range as the overarching result***.[71]

Finally, even after all of the subjective tinkering of the data and modeling results to obtain a particular conclusion, the 2024 article also describes how the group's "overarching message" can further distort the available data:

> A lot of knowledge is available beyond what can be captured with formal, quantitative or qualitative model evaluation. The synthesis thus only represents the available data, not the available knowledge. For a meaningful overarching attribution statement, both need to be combined. To do this, we *qualitatively* address the lines of evidence and available knowledge beyond the statistical analysis. Based on these, ***we create an overarching message***.[72]

WWA's discussion of its methodology for attribution opinions reflects the substantial level of subjectivity that is necessary to provide opinions on an intricately complicated field such as climate predictions. While WWA has performed a vast amount of attribution opinions, there is no evidence that methodologies used by other attribution scientists are materially different from this approach. As discussed below, the subjectivity inherent in the methodology for these opinions, along with the lack of empirical validation and testing, should make it inordinately difficult to admit these types of expert opinions in litigation.

[71] *Id*. at 167 (emphasis added).
[72] *Id.* (emphasis added).

VI. An Attribution Opinion Following the WWA Methodology Should Be Inadmissible in Any U.S. Court, Federal or State.

Based on the descriptions discussed above, the methodology used for these attribution opinions pose a number of basic deficiencies that should render them incapable of being admitted as expert opinions. These basic problems will persist regardless of the court's venue or the specific evidentiary rules that should be applied in that courtroom. Any evidence submitted for admission in a federal or state court in the United States must meet certain basic requirements for reliability and validity.[73] These requirements will not be satisfied by an expert opinion that is subjective, unverifiable, and inaccurately presented as providing complete certainty.

a. Admissible Expert Opinions Require a Foundational Reliability that is Anathema to an Entirely Subjective Methodology.

Trial courts have an obligation to guard against the introduction of expert opinions that are based on an unreliable, subjective methodology, which will unduly influence the jury. As Justice Gorsuch recently noted, "[t]he problem of junk science in the courtroom is real and well documented."[74]

"Under Rule 702 and *Daubert*, district courts must act as 'gatekeepers' which admit expert testimony only if it is both reliable and relevant."[75] "District courts are charged with this gatekeeping function 'to ensure that speculative, unreliable expert testimony does not reach the jury' under the mantle of reliability that accompanies the appellation 'expert testimony.'"[76] "'As the gatekeeper, the district court's role is to discern expert opinion evidence based on "good

[73] *See Daubert* 509 U.S. at 590, n. 9 ("In a case involving scientific evidence, *evidentiary reliability* will be based upon *scientific validity*." (emphasis in original)).
[74] Diaz v. United States, 602 U.S. 526, 551 (2024) (Gorsuch, J., dissenting).
[75] Rink v. Cheminova, Inc., 400 F.3d 1286, 1291 (11th Cir. 2005).
[76] *Id*.

grounds" from subjective speculation that masquerades as scientific knowledge.'"[77] And as emphasized by the new 2023 amendments, Rule 702 "does not permit the expert to make claims that are unsupported by the expert's basis and methodology."[78]

Even for those states that continue to apply a version of the *Frye* test, these states still require evidence of the foundational reliability of an expert's opinion.[79] Under California law, "a trial court must determine whether the matter relied on is of a type on which an expert may reasonably rely, and 'acts as a gatekeeper to exclude speculative or irrelevant expert opinion.'"[80] Other jurisdictions, such as "New York … follow the approach set out in *Frye v. United States* (293 F. 1013 [D.C. Cir. 1923]), which asks 'whether the accepted techniques, when properly performed, generate results accepted as reliable within the scientific community generally.'"[81] Under *Frye*, there must be "consensus[,] [which] . . . has been described as 'a surrogate for determining the reliability of a purported scientific methodology.'"[82] Thus, regardless of the evidentiary standard, all federal and state courts require a proposed expert to establish the reliability of a purported scientific methodology. In the PCAST report concerning the validity of

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[77] Sprafka v. Med. Device Bus. Servs., Inc. No. 24-1874, 2025 U.S. App. LEXIS 13581, at *8 (8th Cir. Jun. 4, 2025) (quoting Ackerman v. U-Park, Inc., 951 F.3d 929, 932 (8th Cir. 2020)).

78 Klein v. Meta Platforms, Inc., No. 20-cv-08570-JD, 2025 U.S. Dist. LEXIS 13366, at *19 (N.D. Cal. Jan. 24, 2025).

[79] *See, e.g.*, State v. Garland, 942 N.W.2d 732, 742 (Minn. 2020) ("In determining whether an opinion is foundationally reliable under Rule 702, 'the district court must analyze the proffered testimony in light of the purpose for which it is being offered . . . [and] consider the underlying reliability, consistency, and accuracy of the subject about which the expert is testifying'"); Sargon Enters., Inc. v. Univ. of S. Cal., 55 Cal.4th 747, 770 (2012) (holding that "a court may inquire into, not only the type of material on which an expert relies, but also whether that material actually supports the expert's reasoning.").

[80] San Francisco Print Media Co. v. The Hearst Corp., 44 Cal.App.5th 952, 961 (2020) (quoting *Sargon*, 55 Cal.4th at 770).

[81] People v. Wakefield, 38 N.Y.3d 367, 394-95 (Ct. App. 2022); *see also Grady*, 576 Pa. at 557 (2003) (affirming that "Frye's 'general acceptance' test is a proven and workable rule, which when faithfully followed, fairly serves its purpose of assisting the courts in determining when scientific evidence is reliable and should be admitted"); Lakey v. Puget Sound Energy, Inc., 176 Wash. 2d 909, 918–19 (2013) ("*Frye* and ER 702 work together to regulate expert testimony: *Frye* excludes testimony based on novel scientific methodology until a scientific consensus decides the methodology is reliable; ER 702 excludes testimony where the expert fails to adhere to that reliable methodology.").

[82] People v. Williams, 35 N.Y.3d 24, 37 (Ct. App. 2020), (quoting Michael M. Martin et al., NEW YORK EVIDENCE HANDBOOK § 7.2.3 at 644 (1997)).

forensic comparison techniques, the report discussed whether each branch of forensic science had achieved "foundational validity," which was defined as "the scientific standard corresponding to the legal standard of evidence being based on 'reliable principles and methods[.]'"[83] One of the key elements of foundational validity discussed in the PCAST Report was "a reproducible and consistent procedure for (a) identifying features within evidence samples; (b) comparing the features in two samples; and (c) determining . . . whether the samples should be declared to be a [match]."[84]

A reproducible and consistent procedure is incompatible with an entirely subjective procedure. The recent article on behalf of WWA shows how subjectivity is a fundamental part of the event attribution opinions.[85] The WWA authors admit to subjectively weighing the results of the various models and observations in order to avoid an "overly conservative estimate[] of the role of climate change."[86] They further admit that the overarching result is subjectively chosen from the various datasets, and that much of the rationale for choosing the final result is not available from "formal, quantitative or qualitative model evaluation."[87] Other published articles on attribution science have also shown how the reliability of attribution opinions can vary wildly based on the type of the event, the region, and the model itself,[88] and even can be greatly impacted by how the conditions of the extreme weather event are framed.[89] These descriptions, if used to provide foundational evidence regarding a proposed attribution opinion, would not support a

[83] PCAST Report, *supra* note 30, at 43 (quoting FED. R. EVID. 702) (emphasis omitted).
[84] *Id*. at 48.
[85] Otto, et al., *supra* note 66, at 159–71.
[86] *Id*. at 162.
[87] *Id*. at 167.
[88] Pfrommer, et al., *supra* note 49, at 77 ("More specifically, climate model reliability for simulating extreme events depends on the type of the event, the region, and the model itself.").
[89] *Id*. at 79 ("How different framing choices impact on the outcome of a FAR estimate is subject of an ongoing debate."). The Pfrommer article discussed how prior studies "obtain[ed] differing results for the attribution of the 2015 European drought to climate change, depending on framing and climate model choices [and] different metrics lead to different attribution assessments for the last California drought."

finding of a reproducible and consistent procedure, as required for foundational reliability and validity.[90]

In federal court, "Rule 702's reliability threshold requires expert testimony to be 'based on the methods and procedures of science, not on subjective belief and unsupported speculation.'"[91] "Courts look for rigor, not mere 'haphazard, intuitive inquiry.'"[92] State courts have adopted similar standards. For example, in *Taylor v. University of Utah*, the Supreme Court of Utah excluded an expert opinion where the "analytical gaps between the facts used as "principles" in [the expert's] opinion and her proximate cause logical deduction from them are too great to be sustained."[93] "Given these gaps, it cannot be said, and there is no showing, that the relevant expert community generally accepts the sufficiency of such facts as a basis for logical deduction."[94] This standard applies with even more force under the 2023 Rule 702 Amendments.

Similarly, the subjective methodology described as the basis of attribution opinions, such as by the WWA consortium,[95] would also leave large analytical gaps between the underlying data and the "overarching result" of a climate change contribution for a specific weather event. Where an "overarching result" comes from the vaguely-documented weighing of various model results in efforts to avoid "an overly conservative result," then such a result would be neither the result of a reliable methodology nor generally accepted in the scientific community.[96]

"[A]s with any other type of expert evidence, [the courts] recognize the danger in allowing

[90] PCAST Report, *supra* note 30, at 4–5.
[91] UGI Sunbury LLC v. A Permanent Easement for 1.7575 Acres, 949 F.3d 825, 833–34 (3d Cir. 2020) (citation and internal quotation marks omitted).
[92] *Id*. at 834 (citation and internal quotation marks omitted).
[93] *See* 466 P.3d 124, 128 (Utah 2020).
[94] *Id.*
[95] Otto, et al., *supra* note 66, at 161–62.
[96] *Klein*, 766 F. Supp. 3d at 963 (concluding that, while his propositions were not "bunkum" as a general concept, the expert's methodology and opinions were not reliable "[b]ecause that necessary third step in his theory of antitrust injury is without basis, and so rests on guesswork…").

unreliable or speculative information (or 'junk science') to go before the jury with the weight of an impressively credentialed expert behind it."[97] Experts may not cherry-pick only the data that is useful to bolster their case. "This cherry-picking 'undermines principles of the scientific method and is a quintessential example of applying methodologies (valid or otherwise) in an unreliable fashion.'"[98]

The WWA article describes how some climate scientists tip the scales in order to produce an outcome that appears reasonable.[99] However, courts routinely exclude expert opinions that simply rely on assumptions based on what that expert considers reasonable. The Third Circuit Court of Appeals said as much in a 2020 opinion excluding expert testimony on stigma damages:

> [I]n any case, there is no data supporting the application of [the expert's] theory to the Landowners' properties. Instead, as [the expert] explained, 'I put this all in my little mixing bowl and I come up with what I thought was common sense reasonable[.]' His theories on the effect of stigma on value, he concedes, 'can't be proven. That's the problem.' We agree that is the problem, and his testimony is unsupported by 'good grounds.'[100]

Attribution scientists may similarly be simply trying to combine a large amount of different data inputs into a "mixing bowl" to create an overarching result that they feel is common sense and reasonable, but that does not provide good grounds by which a trial court can find a reliable basis for the methodology used. Courts should be especially skeptical due to the recommendations in the scientific literature that climate scientists should work closely with litigators in order to provide the type of attribution opinions that would be useful in climate litigation:

> Closer integration of and better dialogue between the legal and scientific communities would ensure that lawyers are aware of, and able to request and access the type of attribution evidence that can be used to robustly evaluate the causal

[97] *Parker*, 7 N.Y.3d at 447 (applying Frye standards); *see also* United States v. Glynn, 578 F. Supp. 2d 567, 572 (S.D.N.Y. 2008).
[98] *See, e.g.*, In re Onglyza, 93 F.4th 339, 347 (6th Cir. 2024) (finding that the plaintiff's expert improperly relied on a randomized-controlled trial to the exclusion of all other human studies) (quoting In re Lipitor, 892 F.3d 624, 634 (4th Cir. 2018)).
[99] Otto, et al., *supra* note 66, at 159–71.
[100] *UGI Sunbury*, 949 F.3d at 835.

> claims brought before the courts. This could be achieved through: (1) effective education of the legal and scientific communities about how they can support one another; (2) coordination through the development of a database of independent scientists with expertise in attribution science and a good overview of scientific developments (e.g. IPCC authors), who would support practitioners in soliciting relevant evidence; and (3) dedicated funding streams that support the continued development of science in this field and enable practitioners to access research needed to make well-evidenced claims.[101]

Further, "[t]he amount of foundation necessary to show reliability necessarily increases with the complexity of the case and the corollary likelihood the expert testimony will have a substantial impact on the fact finder."[102] Here, these attribution opinions deal with incredibly complex issues, purporting to provide certainty as to an issue (local weather) that any lay person can attest is very difficult to predict for any length of time. While it's commonly accepted that weather can only be predicted for a short window of time, attribution opinions purport to provide predictions as to whether a specific weather event would have occurred differently in an alternative scenario going back decades, if not centuries.[103]

As discussed above, the admissibility rules for expert testimony are specifically intended to keep unreliable opinions from the jury. "These comments are especially pertinent to an array of figures conveying a delusive impression of exactness in an area where a jury's common sense is

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[101] Rupert Stuart-Smith et al., *Attribution science and litigation: facilitating effective legal arguments and strategies to manage climate change damages*, ENV'T CHANGE INSTITUTE (Oxford, 2021), at 1-17, https://www.smithschool.ox.ac.uk/sites/default/files/20; *see also* Joanne Spalding & Daniel Hales, *The Uses Of Climate Change Attribution Science: The NGO Practitioner's View*, 51 ENV'T L. REP. 10654, 10657 (Aug. 2021) ("we endorse the authors' exhortation to researchers to craft climate attribution studies that are accessible to a lay audience and to take care when communicating the levels of scientific uncertainty, while also highlighting another crucial consideration: by speaking the language of the judiciary and attempting to frame a scientific concept of 'meaningful contribution,' attribution science can enhance its already substantial benefit to climate litigation"); Elisabeth A. Lloyd, et al. *Climate scientists set the bar of proof too high*, CLIMATIC CHANGE 165, 3 (2021) https://doi.org/10.1007/s10584-021-03061-9 ("In our view, the too narrow focus of climate science on extremely stringent levels of proofs is damaging in a legal context and can lead to confusion when communicating scientific findings more generally"); Marjanac & Patton, *supra* note 28 ("In order to be useful for a range of stakeholders and end-users of this highly relevant science, attribution studies should transparently explain the issues that may lead to uncertainty of result, and clearly quantify this so that model outputs can be compared on both a direct and relative basis").

[102] Ranes v. Adams Labs., Inc., 778 N.W.2d 677, 691 (Iowa 2010).

[103] Marjanac & Patton, *supra* note 28, at 278.

less available than usual to protect it."[104]

Notably, the PCAST report recognized a difference between "objective" and "subjective" forensic science methods. Objective methods "consist[] of procedures that are each defined with enough standardized and quantifiable detail that they can be performed by either an automated system or human examiners exercising little or no judgment," while subjective methods "includ[e] key procedures that involve significant human judgment."[105] For subjective methods, "the foundational validity . . . can be established only through empirical studies of examiner's performance to determine whether they can provide accurate answers" because "the black box in the examiner's head cannot be examined directly for its foundational basis in science."[106]

As such, the subjective methodology described in the WWA article would require "empirical studies" of the experts' performance to determine whether their opinions can provide accurate answers. But as discussed in the next section, such empirical studies are unavailable to directly study whether the methodology is accurate.

b. Attribution Opinions Cannot Meet the Criteria for Testable Empirical Accuracy.

"Among the most important criteria for testable empirical accuracy is whether 'error rates' have been taken into account, so that conclusions based on mere coincidence and association may be distinguished from reliable conclusions suggesting actual causality."[107] This standard plays a key role in the factors listed in *Daubert* as appropriate to guide trial courts in its reliability determination. According to *Daubert*, "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

[104] *United Shoe Machinery*, 297 F.2d at 912.
[105] PCAST Report, *supra* note 30, at 5.
[106] *Id.* at 49 (emphasis in original).
[107] Bader v. Johnson & Johnson, 86 Cal.App.5th 1094, 1137 (2022) (Streeter, acting P.J., concurring).

be (and has been) tested."[108]

Attribution opinions as to specific extreme weather events appear to be incapable of direct validation. An early article discussing the formation of attribution opinions recognized that attribution opinions would "likely" not satisfy the *Daubert* standard for reliability based on the factors for "testability" and "error rate."[109] Instead, these types of attribution opinions are often phrased according to the "fraction of attributable risk" ("FAR"), which is one metric that is used to quantify the proportion of an extreme weather "event" associated with anthropogenic climate change.[110] The FAR values describe the change in likelihood of a class of events based on anthropogenic climate change. [111] However, studies have noted that the "testability" criterion cannot be satisfied for any attribution opinion that provides an opinion on the fraction of attributable risk or the probability that a weather event would have occurred due to climate change: "This [testability] requirement presents an insurmountable hurdle for FAR estimates … and its application would thus likely result in any FAR estimate being inadmissible."[112] This hurdle is based on the inherent nature of how attribution opinions are made, which is through approximations:

> Any FAR estimate relies on climate model output. A climate model cannot be expected to exactly reproduce the climate system. It is a tool, which can be used to investigate and understand the climate system. Physical processes represented in climate models are, due to computational constraints, generally subject to approximations and parametrizations. In a strict sense, climate models are therefore

[108] *Daubert*, 509 U.S. at 593.
[109] Pfrommer, et al., *supra* note 49, at 69 ("The Daubert standard consists of five criteria that, unmodified, would likely exclude evidence based on event attribution on the basis of the criteria testability and error rate.").
[110] *Id*. at 70 ("The Fraction of Attributable Risk (FAR) has been proposed as a method to tackle the problem of causation in climate litigation . . . . FAR is a standard concept in attribution science and essentially quantifies the fraction of the total probability of an event which can be traced back to a climate alteration.").
[111] Attribution studies may also frame the conclusion using an analogous framework known as a "risk ratio" or RR. "The RR allows statements such as 'the probability of a class of events occurring is RR times what it would have been without anthropogenic influence on the climate' whereas FAR addresses the responsibility of a causal factor for the occurrence of a class of events." S. E. Perkins-Kirkpatrick, et al., *On the attribution of the impacts of extreme weather events to anthropogenic climate change*, 17 ENV'T. RES. LETT. Jan. 26, 2022, https://iopscience.iop.org/article/10.1088/1748-9326/ac44c8 [hereinafter "Perkins-Kirkpatrick 2022"].
[112] Pfrommer, et al., *supra* note 49, at 76.

known to be false.[113]

Similarly, studies have noted that error rates are not available for attribution opinions because it is impossible to know with scientific certainty whether a specific weather event was in fact made more likely as a result of climate change.[114] "One inherent challenge is that single event attribution is conducted for conditions at one specific place and time; the event only occurs once, and by construction, the attribution quantification pertains only to that event."[115] "Further, because extreme events are by definition rare, the available population of events with which to independently verify attribution results is limited, a challenge that is exacerbated for events that are unprecedented in the observational record."[116] At most, climate scientists can approximate a model's reliability by comparing the model's estimate of the number of extreme events against the actual historical record.[117] But this analysis cannot provide any insight into the accuracy as to any specific weather event, and it is also unhelpful where multiple models are added into the "mixing bowl" to provide an overarching result for a single weather event.

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[113] *Id*.

[114] *See, e.g.*, Noah S. Diffenbaugh, *Verification of extreme event attribution: using out-of-sample observations to assess changes in probabilities of unprecedented events*, 6 SCI. ADVANCES (March 2020) (noting that "independent observational verification of specific, quantitative attribution results remains elusive."); *see also Process-Based Modeling Approaches for Attribution Science: Challenges and Opportunities*, YOUTUBE (Mar. 11, 2025) at 3:05:45-3:06:00 (Noah Diffenbaugh: "I think something that is worthwhile for the committee to grapple with is the broad question of whether single event attribution is even possible at all, from a scientific point of view") (stated during information gathering webinar regarding update of the 2016 report, Attribution of Extreme Weather and Climate Events and their Impacts, by National Academy of Science, available at https://www.youtube.com/watch?v=bgZFNmx5TWY).

[115] Diffenbaugh, *supra* note 114; *see also* Perkins-Kirkpatrick 2022, *supra* note 111 ("FAR is not generally appropriate when estimating the magnitude of the anthropogenic signal behind a specific impact.").

[116] Diffenbaugh, *supra* note 114; *see also* Omar Bellprat et al., *Towards reliable extreme weather and climate event attribution*, 10 NATURE COMMUNICATIONS (2019), https://www.nature.com/articles/s41467-019-09729-2 ("Single extreme weather and climate events are unique—they happen only once in the exact same manner and their probability is therefore strictly speaking infinitely small, which inhibits any attribution."); Sjoukje Philip et al., *A Protocol for Probabilistic Extreme Event Attribution Analyses*, 6 ADV. STAT. CLIM. METEOROL. OCEANOGR. (2020) https://doi.org/10.5194/ascmo-6-177-2020 ("as a specific case cannot be exactly reproduced by a model and will not occur").

[117] Diffenbaugh, *supra* note 114, at 2 ("These verification ratios are compared with attribution ratios that quantify the contribution of historical climate change during the 1961-2005 attribution period, calculated from both the observational record [] and the [] global climate model ensemble.").

Courts routinely reject expert opinions based on a failure to test the accuracy of the opinion.[118] Generally, scientific methodology involves "generating hypotheses and testing them to see if they can be falsified."[119] In a recent Fourth Circuit opinion, the court held that an expert's "failure to test his hypothesis renders his opinions on the cause of [plaintiff's] accident unreliable."[120] The Fourth Circuit held that "[a]lthough [the expert's] theory is plausible and 'may even be right[,] . . . it is no more than a hypothesis, and it thus is not knowledge, nor is it based upon sufficient facts or data or the product of reliable principles and methods applied reliably to the facts of the case.'"[121]

Forensic science was heavily criticized because many testifying experts had not conducted validation testing prior to opining that the methods were reliable.[122] After comprehensive validation testing was conducted, it showed the unreliability of many forensic methods.[123] The PCAST report emphasized that "[t]he method need not be perfect, but it is clearly *essential* that its accuracy has been measured based on appropriate empirical testing and is high enough to be appropriate to the application."[124] "Without an appropriate estimate of its accuracy, a metrological method is useless—because one has no idea how to interpret its results."[125]

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[118] *See, e.g.*, Nease v. Ford Motor Co., 848 F.3d 219, 232 (4th Cir. 2017) ("[The expert] presented a hypothesis only—he failed to validate it with testing."); *see also* Bishop v. Triumph Motorcycles Am. Ltd., No. 21-2113, 2022 U.S. App. LEXIS 32558, at *5, *7 (4th Cir. Nov. 22, 2022) (excluding the expert's "highly speculative opinion" because he "supplied no test results of his own, peer-reviewed publications, potential rates of error, or other grounds with which to assess his opinion."); *see also* Small v. WellDyne, Inc., 927 F.3d 169, 177 (4th Cir. 2019) (remanding the case to determine whether the expert opinions satisfy *Daubert* standard because "without testing . . . expert opinion testimony can easily, but improperly, devolve into nothing more than proclaiming an opinion is true 'because I say so.'").
[119] *Daubert*, 509 U.S. at 593.
[120] *Nease*, 848 F.3d at 232.
[121] *Id.* (quoting Tamraz v. Lincoln Elec. Co., 620 F.3d 665, 670 (6th Cir. 2010) (internal quotation marks and alterations omitted)).
[122] PCAST Report, *supra* note 30, at 34–35 ("In short, the report concluded that 'much forensic evidence—including, for example, bitemarks and firearm and toolmark identifications—is introduced in criminal trials without any meaningful scientific validation, determination of error rates, or reliability testing to explain the limits of the discipline.'").
[123] *Id.* at 48.
[124] *Id.*(emphasis in original).
[125] *Id.*

Some articles have argued for the use of methodologies that systematically favor a finding of event attribution because certain models have historically underestimated the actual warming effects of climate change.[126] But given the wide variety of weather impacts around the world, these arguments cannot excuse the lack of direct empirical validation for a specific methodology. "In science, assertions that a metrological method is more accurate than has been empirically demonstrated are rightly regarded as mere speculation, not valid conclusions that merit credence."[127]

c. Expert Opinions Cannot Overstate the Reliability of their Methodology.

An expert opinion is inadmissible where the certainty of the opinion overstates the reliability of the underlying calculations.[128] The recent amendments to the Federal Rules of Evidence specifically highlight the fundamental concern about overstating the reliability and accuracy of an opinion: "Forensic experts should avoid assertions of absolute or one hundred percent certainty—or to a reasonable degree of scientific certainty—if the methodology is subjective and thus potentially subject to error."[129] As discussed above, the available descriptions of the methodology for attribution opinions show that it is subjective and without a clear means of assessing its potential for error.

Forensic experts faced similar challenges where the infallibility of an opinion was overstated. In a California case involving a forensic scientist, the appellate court held that "the trial

[126] *See, e.g.,* Diffenbaugh, *supra* note 114 ("[R]egional verification ratios for 2006–2017 frequently exceed the published attribution ratios calculated from the 1961–2005 data (Fig. 1), suggesting that the attribution framework underestimates the influence of historical global warming."); *but see* Bellprat et al., *supra* note 116 ("The magnitude of the attributable risk is, therefore, likely overestimated, and we therefore need to improve the reliability prior to the calculation of the FAR.").
[127] PCAST Report, *supra* note 30, at 55.
[128] Behrens & Trask, *supra* note 17, at 67 ("To address overstatement by experts, Rule 702(d) was changed to emphasize that each expert opinion must stay within the bounds of what can be concluded from a reliable application of the expert's basis and methodology.").
[129] Fed. R. Evid. 702 advisory committee's note to 2023 amendment.

court abandoned its gatekeeping role, allowing unfettered expert testimony that went far beyond what the underlying material supported."[130] Specifically, "the [trial] court allowed the expert to testify that the matching marks on the relevant projectiles are 'much more than can ever happen by random chance,' and therefore the projectiles came from the same gun, 'to the practical exclusion of all other guns.'"[131] "The expert did not support that conclusion with anything more definitive than a broad reference to having 'done numerous studies on the subject trying to see what can happen by random chance.'"[132] As recognized by the appellate court, "[s]uch a purportedly infallible conclusion is a leap too far from what the underlying method allowed."[133]

The conclusions provided by many attribution opinions are analogous to the purportedly infallible conclusion described in the *Azcona* decision.[134] According to the WWA article, the methodology involves weighing numerous studies to come up with an overarching message.[135] This message is most often expressed in the percentage that climate change purportedly increased the severity or likelihood of a specific weather event.[136] Framing these attribution opinions in this form creates the appearance that there is no doubt as to the certainty that anthropogenic climate change affected this specific weather event in some manner.

Further, the FAR approach is primarily used in fields such as epidemiology, for example, to estimate the increased likelihood of obtaining cancer or some other chronic disease due to a specific toxic exposure.[137] In the epidemiological setting, the FAR calculation is appropriate as

[130] People v. Azcona, 58 Cal. App. 5th 504, 513 (Cal. 2020).
[131] *Id.* at 513–14.
[132] *Id.* at 514.
[133] *Id.*
[134] *Azcona*, 58 Cal. App. 5th 504.
[135] Otto, et al., *supra* note 66, at 161 ("Our aim is to combine the model results in a single estimate by taking a weighted average . . . This is an approach used in meta-analyses to combine the results from multiple studies in a single minimal-variance result.").
[136] *Id*.
[137] Patrick T. Brown, *When the fraction of attributable risk does not inform the impact associated with anthropogenic climate change*, CLIMATIC CHANGE (2023) 176:115, available at https://doi.org/10.1007/s10584-023-03591-4.

these diseases are inherently discrete. A person is either diagnosed with cancer or they are not. In contrast, extreme weather events are only distinguishable as a matter of degree.

Also, by multiplying the FAR against the economic cost of that weather event, a plaintiff can create a damages assessment, also known as an IFAR, or Impact x Fraction of Attributable Risk.[138] As shown by a recent scientific article, "this IFAR calculation only produces reliably useful results when the weather or climate phenomena in question can be easily conceived of as a discrete binary 'event' (i.e., the entirety of the event either occurs or it does not).[139] However, "the IFAR calculation can produce misleading results when the weather or climate phenomena in question are on a continuum."[140]

In other words, this type of calculation assumes that a weather event will either occur or not occur (similar to the detection of cancer), but weather events exist on a continuum, and a slightly smaller weather event may still cause significant damage. For example, an IFAR calculation may analyze the likelihood that a Category 5 hurricane would occur in a specific location and the percentage of economic harm that would then be attributable to anthropogenic climate change. However, the calculation does not take into account that a Category 4 hurricane could have caused the same amount of damage. As they are couched in a way that minimizes the uncertainty embedded as part of these opinions, such attribution opinions can inherently overstate the certainty of the opinion. In these situations, courts have an obligation "to be skeptical."[141]

Problematically, these initial event attribution opinions are often used as a basis to impose

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[138] *Id.*
[139] *Id.*
[140] *Id.*; see also Bellprat, et al., *supra* note 116 ("Limitations of climate models to reliably simulate event probabilities remain overlooked in current practice of event attribution studies.").
[141] Chiles v. Salazar, 116 F.4th 1178, 1238 (10th Cir. 2024) (Hartz, J., dissenting) (citing studies showing that "[n]ot every study published in a peer-reviewed journal can be relied on") (cert. granted Mar. 10, 2025); *see also* LLT Mgmt. LLC v. Emory, 766 F.Supp.3d 576 (E.D. Va. 2025) (allowing claim for product disparagement or trade libel to proceed against authors of a scientific article that were alleged to have "knowingly misled the public about the safety of cosmetic talc products.").

"end-to-end attribution." End-to-end attribution has been described as a framework to "link [oil and gas] companies to specific impacts from their emissions[.]"[142] These studies use "emissions-driven climate models," such as the ones described above from WWA, "to simulate historical climates and counterfactual climates, in which the latter is the same as the former, save for the removal of one emitter's time-varying emissions (that is, a 'leave-out-out' experiment)."[143] These studies then calculate potential financial losses resulting from that company's emissions, for example, by calculating the purported reduction in a country's gross domestic product ("GDP") as a result of a short-term heat wave.[144] While beyond the scope of this article, these studies seem to make several logical leaps. First, GDP (even for small countries) is driven by a large number of variables beyond a single weather event.[145] In addition, the basis for liability on individual emitters seems to depend on the assumption that if oil and gas were not produced by that company, then no other firm would meet the demand by the global market[146] (which would run contrary to basic economic principles). But more fundamentally, all of these consequential studies face the same underlying admissibility problems if they are premised on subjective and untestable underlying models. However, by incorporating multiple layers of different studies into one "black box" opinion, these end-to-end attribution studies make it more difficult to determine whether the eye-catching damages claims are premised on a reliable scientific foundation.

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[142] Callahan & Mankin, *supra* note 57, at 895.
[143] *Id.* at 894.
[144] *See id.* at 896-98.
[145] *See, e.g.*, Martin Bodenstein & Mikaël Scaramucci, *On the GDP Effects of Severe Physical Hazards*, INT'L FIN. DISCUSSION PAPERS No. 1386, (Bd. of Governors of the Fed. Reserve Sys. Feb. 2024), https://doi.org/10/17016/IFDP.2024.1386 (finding that severe weather events reduce the level of GDP, but "for most events in the [] data set the effects are small . . . . These findings are robust across country groupings by development and alternative measures of the strength of the physical hazard.").
[146] *See* Callahan & Manick, *supra* note 57, at 902 (stating that this approach "is agnostic about whether … the fossil fuel production itself never took place (with opaque and unpredictable market and production implications)…").

VII. The Unsettling Proposal of Legislation Adopting Attribution Opinions as Settled Fact.

Scientific expert opinions are subject to stringent admissibility requirements because of the expectation that a jury will provide undue deference to them regardless of their reliability and accuracy.[147] This concern is especially relevant in subjects that are inherently complicated and have been highly politicized – like anthropogenic climate change.[148] Careful consideration of expert opinions is particularly necessary in climate change litigation as this type of litigation already strays far from traditional areas of the judicial branch and into political issues that more properly fall within the legislative and executive branches of government.[149] As currently described, event attribution opinions should not satisfy this scrutiny.

Courts are careful not to side-step these admissibility requirements through the use of judicial notice.[150] For instance, "courts have refused to [take judicial notice of scientific studies] when dealing with specific findings in scientific literature and no expert is available to vouch for the 'authors' methodology or the accuracy of their results.'"[151] Judicial notice of reliability is "particularly inappropriate" where there are "conflicting strands of scientific literature."[152] As

[147] *See, e.g.*, Valladares & Nelson, *supra* note 6, at 33.
[148] *See, e.g.*, United States v. Skrmetti, 605 U.S. 495, 547 (2025) (Thomas, J., concurring) ("This case carries a simple lesson: In politically contentious debates over matters shrouded in scientific uncertainty, courts should not assume that self-described experts are correct"); Students for Fair Admissions, Inc. v. President & Fellows of Harv. Coll., 600 U.S. 181, 268 (2023) (Thomas, J., concurring) ("experts and elites have been wrong before—and they may prove to be wrong again").
[149] *See, e.g.*, California v. GMC, No. C06-05755 MJJ, 2007 U.S. Dist. LEXIS 68547 (N.D. Cal. Sep. 17, 2007) (dismissing California's public nuisance claim against automakers for greenhouse gas emissions, holding that the claim raised nonjusticiable political questions).
[150] *See, e.g.*, Milward v. Acuity Specialty Prods. Grp., 969 F. Supp. 2d 101, 113 (D. Mass. 2013); *see also* Meschino v. N. Am. Drager, Inc., 841 F.2d 429, 434 (1st Cir. 1988) (finding no error in exclusion of scientific article when no expert available to comment on its reliability); United States v. Turner, 104 F.3d 217, 221 (8th Cir. 1997) (finding no error in excluding medical texts when "there was no expert testimony establishing the texts as authoritative").
[151] *Milward*, 969 F. Supp. 2d at 113 (quoting Gilhool v. Chairman Phila. Cnty. Bd. of Elections, 306 F. Supp. 1202, 1208 (E.D. Pa. 1969), *aff'd*, 397 U.S. 147 (1970).
[152] *Milward*, 969 F. Supp. 2d at 113 (noting that "[t]his case clearly calls for an expert witness to 'explain and assist in the application' of conflicting strands of scientific literature,") (quoting FED. R. EVID. 803(18) advisory committee note).

discussed above, the scientific literature shows "conflicting strands" concerning the reliability of these attribution opinions as applied to single events.[153] And even where a court takes judicial notice of the reliability of a certain scientific method where it is "broadly and generally accepted, . . . the methodology is still subject to the requirements for admissibility of expert testimony."[154]

For these reasons, legislators should be extremely wary of bills that would allow any attribution opinion to form the basis for imposing strict liability on particular companies for damages from weather events purportedly caused by climate change. Vermont and New York have already passed bills that will require a narrow set of energy producers to pay for damages allegedly incurred by the State as a result of anthropogenic climate change.[155] These laws (which are currently under legal challenge)[156] impose strict liability on certain producers based on the amount of historic greenhouse gas emissions attributable to greenhouse gas-producing fossil fuels which they are responsible for extracting and refining. While New York's law established a fixed amount of damages allegedly incurred by the State ($75 billion dollars), Vermont's law provided for a state agency to create a "cost recovery demand amount.[157] In its initial report to the General Assembly, the Vermont Agency of Natural Resources requested that the Legislature provide them with additional flexibility given the limits of the current capabilities of attribution science.[158]

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[153] *See, e.g.*, Pfrommer, et al., *supra* note 49, at 76; Diffenbaugh, *supra* note 114.
[154] Muldrow v. State, 259 Md. App. 588, 617–18 (2023); *see also* United States v. Ware, 69 F.4th 830, 846 (11th Cir. 2023).
[155] *Vermont's Climate "Superfund" Act*, 2024 Vt. Acts and Resolves No. 122 (S.259) (codified at 10 V.S.A. ch. 24A § 596 et seq. (2024)).
[156] Compl., Chamber of Commerce v. Moore, No. 2:24-cv-01513 (D. Vt. Dec. 30, 2024); Compl., Chamber of Commerce v. James, No. 1:25-cv-01738 (S.D.N.Y. Feb. 28, 2025).
[157] *N.Y. Envtl. Conserv. Law* § 76-0101-6 ("Cost recovery amount' means seventy-five billion dollars").
[158] Act 122: *Climate Superfund Cost Recovery Program, report to the General Assembly* at 7-8 (Vt. Agency of Naturl Resources Jan. 15, 2025), https://outside.vermont.gov/agency/anr/climatecouncil/Shared%20Documents/2025FeasibilityReportAct122.pdf ("While attribution science is key to the development of the cost assessment, it will require further development to address the full scope of climate impacts contemplated by the Act… The jurisdiction-specific and relatively nascent character of this particular area of climate science are primary drivers of the need for additional time and funds. . . .").

Several climate change bills have also been introduced in various state legislatures, such as in California,[159] Oregon,[160] New Hampshire,[161] Illinois[162] and Hawaii.[163] In contrast to the laws newly enacted in New York and Vermont, these bills would impose strict liability on companies for damages if an attribution opinion merely *asserted* that a weather event was substantially worsened or caused by climate change from responsible parties' hydrocarbon products.[164]

Given the severe problems concerning the reliability of these types of attribution opinions, it would be gravely troubling for a statute to circumvent the trial court's role in analyzing the accuracy and reliability of specific attribution opinions.

VII. Conclusion.

In recent years, there has been a massive increase of media stories regarding the extent that extreme weather events have been made more likely or worse due to the release of carbon emissions from industrial activities.[165] While this is a highly complicated issue, interwoven with political and technical considerations, public and private organizations are increasingly pursuing litigation to impose liability on companies for their purported responsibility for damages incurred

[159] S.B. 222, Cal. Se., 2025-26 Reg. Sess. (Jan. 27, 2025).
[160] S.B. 679, Or. Sen., 2025 Reg. Sess. (Jan. 13, 2025).
[161] H.B. 601, N.H. Hous., 2025 Reg. Sess. (Jan. 9, 2025).
[162] S.B. 1790, Ill. Sen., 104th Gen. Assembly (Feb. 5, 2025).
[163] S.B. 1166, Haw. Sen., 33rd Leg., Reg. Sess. (Jan. 17, 2025).
[164] S.B. 222, Cal. Se., 2025-26 Reg. Sess. (Jan. 27, 2025) ("The bill would make responsible parties jointly, severally, and strictly liable to a plaintiff for the climate disaster or extreme weather or other events attributable to climate change"); S.B. 679, Or. Sen., 2025 Reg. Sess. (Jan. 13, 2025) ("Digest: The Act says that parties that made greenhouse gas are strictly liable for damages due to climate change"); S.B. 1790(d), Ill. Sen., 104th Gen. Assembly (Feb. 5, 2025) ("Responsible parties are jointly and severally liable to the plaintiffs for strict liability if they are a harmed party"); S.B. 1166, Haw. Sen., 33rd Leg., Reg. Sess. (Jan. 17, 2025) ("All responsible parties in any civil action that is filed pursuant to this section shall be jointly, severally, and strictly liable to a plaintiff for damages found to have been caused by a climate disaster or extreme weather or other event attributable to climate change"); H.B. 601, N.H. Hous., 2025 Reg. Sess. (Jan. 9, 2025) ("Responsible parties are jointly and severally liable to plaintiff(s) for strict liability if they are a harmed party.").
[165] Parker Bolstad & David G. Victor, *The Growing Divide in Media Coverage of Climate Change*, BROOKINGS (July 24, 2024), https://www.brookings.edu/articles/the-growing-divide-in-media-coverage-of-climate-change/ ("A huge literature on media coverage of climate change has tracked attention to climate change by focusing on media sources that are easy to query—the newspapers of record such as The New York Times, The Washington Post, The Los Angeles Times, and The Wall Street Journal. These papers have seen surging coverage of climate change—a 300% increase since 2012."); *see also, e.g.*, The Associated Press, *supra* note 62.

from these weather events.[166] Attribution science has been put forward as an evidentiary basis to support these lawsuits. However, for the litigation process to provide all parties with the constitutionally guaranteed safeguards of a fair trial, any expert testimony admitted into evidence on these grounds must be based on a reliable and valid methodology.

"It is not for a trial court to bless new 'inspired' science theory; the goal is to permit the jury to hear reliable science to support the expert opinion."[167] Despite their acceptance in the media, the experts providing these attribution opinions are required to establish sound scientific foundation for their opinions, which are not subjective, unverifiable, and overstated. And regardless of the evidentiary standard being applied (e.g., *Daubert*, *Frye*, or post-2023 adoption of Rule 702 amendments and state analogs), trial courts have a responsibility to ensure that this type of speculative, unreliable expert testimony does not unduly prejudice the jury.

[166] Edmund H.S. Brose, *Notes: Admitting Evidence of Climate Change Under Daubert: Climate Experts As Reliable, Hyper-Qualified Technicians*, 98 N.Y.U. L.REV. 1979, 1980 (2023) ("Environmental protection groups, municipalities, and states have initiated litigation against the worst polluters, seeking renumeration for alleged environmental degradation and destruction caused by the defendants' emissions.").
[167] In re Accutane Litigation, 234 N.J. 340, 397 (N.J. Sup. Ct. 2018); *see also* Rosen v. Ciba-Geigy Corp., 78 F.3d 316, 319 (7th Cir. 1996) ("[T]he courtroom is not the place for scientific guesswork, even of the inspired sort.").