

# IT'S RAINING, IT'S POURING, WEATHER MODIFICATION REGULATION IS SNORING: A PROPOSAL TO FILL THE GAP IN WEATHER MODIFICATION GOVERNANCE

MACKENZIE L. HERTZ\*

## ABSTRACT

Since the beginning of time, humans have attempted to control the weather.<sup>1</sup> However, in 1940, instead of rituals or dances, humans began to utilize science in this pursuit.<sup>2</sup> While this technology has developed, the law governing it has lagged behind. The common law, existing legislation, and current regulations lack the capacity to adequately govern weather modification and address its consequences. This article analyzes the potential harms and issues surrounding weather modification and proposes regulation at the state administrative level to fill the gap left by the common law and current governance.

Part I provides background on weather modification itself, the issues it presents, and the current means available to address those issues. Specifically, section I.A gives a brief overview of what weather modification is, and the extent of its use in the United States. Next, sections I.B and I.C discuss the goals and potential benefits of weather modification, followed by an analysis of its potential harms and costs. Section I.D discusses the common law's incongruity with weather modification. Section I.E critically evaluates current federal and state governance of weather modification, which fail to fill the gap left by the common law such that those injured are left with virtually no available remedy.

Finally, part II argues that states should fill this gap with all-encompassing regulation at the state administrative level, establishing an alternative to the tort system to compensate those injured by weather modification.

---

\*†Judicial Clerk, United States Court of Appeals for the Eighth Circuit. Former Judicial Clerk, United States District Court for the District of Nebraska. Juris Doctor with High Distinction, *Order of the Coif*, University of Nebraska College of Law, 2018. The views and opinions in this article are the author's alone. The author would like to thank Associate Dean and Professor Anthony Schutz for his guidance in this work and making agriculture classes available to law students. The author would also like to thank her family whose generation-spanning farm inspired this topic.

1. Melissa Currier, Comment, *Rain, Rain, Don't Go Away: Cloud Seeding Governance in the United States and a Proposal for Federal Legislation*, 48 MCGEORGE L. REV. 949, 949–50 (2017).

2. *Id.* at 952.

I.	BACKGROUND.....	33
	A. WHAT IS WEATHER MODIFICATION AND WHERE IS IT USED? .	33
	B. GOALS AND POTENTIAL BENEFITS OF WEATHER MODIFICATION .....	34
	C. FEARS AND POTENTIAL COSTS OF WEATHER MODIFICATION .	35
	D. COMMON LAW RELIEF FOR WEATHER MODIFICATION’S SIDE EFFECTS .....	37
	1. <i>Incredulous Causation Hurdle</i> .....	37
	2. <i>Common Law Causes of Action</i> .....	38
	a. Trespass .....	38
	b. Private Nuisance .....	40
	c. Negligence.....	42
	d. Res ipsa loquitur.....	42
	e. Strict liability .....	44
	f. Negligence per se.....	45
	E. EXISTING GOVERNING FRAMEWORK OVER WEATHER MODIFICATION .....	45
	1. <i>Federal</i> .....	45
	2. <i>State Governance: Existing Components and How to Effectively Utilize Them</i> .....	46
	a. Reporting .....	47
	b. Licensing and Permits .....	47
	c. Public Participation .....	49
	d. Liability .....	51
II.	ANALYSIS: COMPREHENSIVE REGULATORY AND ADJUDICATORY FRAMEWORK FOR WEATHER MODIFICATION AT THE STATE ADMINISTRATIVE LEVEL	52
	A. WHY IS STATE-LEVEL GOVERNANCE PREFERABLE? .....	52
	B. WHY ARE STATE ADMINISTRATIVE AGENCIES PREFERABLE? .	53
	C. WHAT SHOULD THE GOVERNING FRAMEWORK INCLUDE? .....	54
	1. <i>The Four Components</i> .....	55

2. *A New System to Compensate the Harmed: A Weather Modification Injury Compensation Program*..... 56

    a. Burden-Shifting Framework.....56

    b. Lower Standard of Proof .....59

III. CONCLUSION .....60

IV. APPENDIX A .....61

I. BACKGROUND

Put simply, weather modification is a technology that seeks to alter natural weather. Although infant forms of the technology have existed since 1940, the precise impact—and risks—of the technology remain unknown. This background explains what weather modification is and discusses its potential risks and benefits. This background shows that those allegedly injured by weather modification have no realistic avenue to relief. As discussed below, those injured by weather modification face unique challenges (such as proving causation) that bar recovery at the common law. And neither the federal government nor state governments have filled this gap left by the common law with substantive or meaningful governance over weather modification.

A. WHAT IS WEATHER MODIFICATION AND WHERE IS IT USED?

When precipitation forms naturally, water vapor inside of clouds attach to other particles, known as condensation nuclei, which together freeze into ice crystals.<sup>3</sup> These ice crystals eventually become varying forms of precipitation.<sup>4</sup> To generalize, weather modification technology seeks to alter this process by using airplanes or ground generators to insert seeding agents, such as silver iodide or dry ice pellets, into clouds to act as additional condensation nuclei in order for the water vapor to attach.<sup>5</sup> This complicated task requires operators to introduce specific quantities of the seeding agents

---

3. *Questions & Answers North Dakota Cloud Seeding*, N.D. ATMOSPHERIC RES. BD., [http://swc.state.nd.us/arb/ndcmp/pdfs/q\\_a.pdf](http://swc.state.nd.us/arb/ndcmp/pdfs/q_a.pdf) (last visited Oct. 24, 2020) [hereinafter *North Dakota Cloud Seeding*]; Ronald B. Standler, *History and Problems in Weather Modification*, RBS (Jan. 21, 2002), <http://www.rbs2.com/w2.htm>; ERIC I. HEMEL & CLIFFORD G. HOLDERNESS, AN ENVIRONMENTAL PRIMER ON WEATHER MODIFICATION 5 (1977).

4. *North Dakota Cloud Seeding*, *supra* note 3; Standler, *supra*, note 3.

5. Currier, *supra* note 1, at 953; Standler, *supra* note 3; HEMEL & HOLDERNESS, *supra* note 3, at 8-10.

into the right type of cloud at precise times in order to successfully alter precipitation formation.<sup>6</sup>

The precise effects of this process remain unknown.<sup>7</sup> This is partially due to the fact that detailed scientific knowledge of even *natural* precipitation is lacking.<sup>8</sup> Calculating the impact that weather modification has on natural precipitation, when natural precipitation itself still presents questions, is a complicated inquiry.<sup>9</sup> Current estimates widely gauge that weather modification can increase precipitation anywhere from 5 to 25 percent and decrease hail production from 25 to 75 percent.<sup>10</sup> Additionally, these effects may extend 90 to 150 miles downwind from the target location.<sup>11</sup> In sum, uncertainties persist regarding both weather modification and its effects.<sup>12</sup> This incertitude lies at the heart of the dissonance between weather modification and existing legal frameworks, as discussed below.<sup>13</sup>

Despite this uncertainty, since 1940, weather modification operations have taken place in approximately two-thirds of the states at one time or another.<sup>14</sup> Recent data shows that nine states have active weather modification operations, covering more than 150,000 square miles.<sup>15</sup>

## B. GOALS AND POTENTIAL BENEFITS OF WEATHER MODIFICATION

Weather modification has several potential uses and benefits.<sup>16</sup> The technology may produce, or prevent, rain and snow, dissipate fog, alter hailstorms, suppress lightening, and modify hurricanes and tornadoes.<sup>17</sup> The overarching goal of weather modification is to control nature in a way that benefits society by increasing certain types of precipitation to produce economic benefits for agriculture and other industries, while lessening the destructive effects of other types of weather.<sup>18</sup>

---

6. See Ray Jay Davis, *Weather Modification, Stream Flow Augmentation, and the Law*, 24 ROCKY MTN. MIN. L. INST. 22 (1978) [hereinafter Davis, *Weather Modification, Stream Flow*].

7. Standler, *supra* note 3.

8. *Id.*

9. *Id.*

10. *What is Cloud Seeding?*, WEATHER MODIFICATION ASS'N, <http://weathermod.org/> (last visited Oct. 24, 2020); Alan W. Witt, Comment, *Seeding Clouds of Uncertainty*, 47 JURIMETRICS J. 105, 111 (2016).

11. *North Dakota Cloud Seeding*, *supra* note 3; Standler, *supra* note 3.

12. HEMEL & HOLDERNESS, *supra* note 3, at 12-13.

13. See *infra* Part II.

14. HEMEL & HOLDERNESS, *supra* note 3, at 1.

15. *North Dakota Cloud Seeding*, *supra* note 3.

16. Gregory N. Jones, *Weather Modification: The Continuing Search for Rights and Liabilities*, 9 BYU L. REV. 1163, 1164 (1991); Witt, *supra* note 10, at 107.

17. Jones, *supra* note 16, at 1163; Ray Jay Davis, *Weather Modification Law Developments*, 27 OKLA. L. REV. 409, 410-11 (1974) [hereinafter Davis, *Weather Modification Law*].

18. Jamie Harris, *Law and Technological Change: The Case of Weather Modification*, 3 YALE REV. L. & SOC. ACTION 26, 29 (1973).

### C. FEARS AND POTENTIAL COSTS OF WEATHER MODIFICATION

With the potential benefits of weather modification, however, comes the risk of certain side effects. The first of these is public opposition rooted in the nature and uncertainties of the technology itself.<sup>19</sup> As one commentator noted: “[T]he opposition comes from adverse economic interests, religious beliefs, old wives tales, and downright superstition. Irrespective of the source, you can count on its being genuine, tough, and tenacious . . . .”<sup>20</sup> Thus, despite weather modification’s potential benefits, society’s view is riddled with suspicion, uncertainty, and doubt.<sup>21</sup>

Beyond social concerns, weather modification may cause economic damage and even threaten human life.<sup>22</sup> As weather is modified, some may experience, on one hand, unwanted deprivation of precipitation or, on the other, an undesired increase in precipitation. For example, unwanted snow, rain, and floods may be produced.<sup>23</sup> A hurricane’s path may be diverted away from some, but *towards* others.<sup>24</sup> Tornados, hail, or lightning may be suppressed, but along with it, precipitation that otherwise would have occurred.<sup>25</sup> Thus, weather modification may result in damage as it creates droughts, floods, or other conditions which threaten life and property.

A flood in the Black Hills of South Dakota in 1972 offers an example of the potential threat that weather modification may pose to human life.<sup>26</sup> On June 9, 1972, following two cloud-seeding experiments, torrential rainfall<sup>27</sup> caused the Rapid Creek to overflow its banks, destroying parts of adjacent Rapid City, South Dakota.<sup>28</sup> The flood claimed the lives of 238 people, injured around 3,000 people, and caused over \$160 million in damage to homes and other property.<sup>29</sup> While it has never been established whether,

---

19. Jones, *supra* note 16, at 1166.

20. *Id.* (quoting Kirby, *Judicial Regulation of Weather Modification*, in WEATHER MODIFICATION TECHNOLOGY AND LAW 55, 55–56 (1978)).

21. See Witt, *supra* note 10, at 107; James N. Corbridge Jr. & Raphael J. Moses, *Weather Modification: Law and Administration*, 8 NAT. RES. J. 207, 209 (1968).

22. Jones, *supra* note 16, at 1165–66; see also Currier, *supra* note 1, at 956 (describing a blizzard in China allegedly caused by weather modification that resulted in 40 deaths and \$500 million in damage).

23. Donald D. Stark, *Weather Modification: Water—Three Cents Per Acre-Foot*, 45 CAL. L. REV. 698, 705 (1957); see Corbridge & Moses, *supra* note 21, at 213.

24. Harris, *supra* note 18, at 30.

25. Corbridge & Moses, *supra* note 21, at 223; Stark, *supra* note 23, at 705.

26. See Arnett Dennis, *Cloud Seeding and the Rapid City Flood of 1972*, 42 J. OF WEATHER MODIFICATION 124 (2010).

27. At its height, the storm produced fifteen inches of rain in six hours. *Black Hills Flood of 1972*, NAT’L WEATHER SERV., <https://www.weather.gov/unr/1972-06-09> (last visited Oct. 24, 2020).

28. *Id.*

29. *Id.*

or how much, weather modification contributed to the flood,<sup>30</sup> weather modifiers have seldom (if ever) operated in South Dakota since.<sup>31</sup>

A recent example of economic loss prompting opposition to weather modification can be seen in the response to the North Dakota 2017 drought. By June 2017, rainfall in North Dakota was 3.46 inches below the average annual amount.<sup>32</sup> The drought was estimated to have a \$1.12 billion impact on the agricultural economy and a \$4 billion impact on the state economy overall.<sup>33</sup>

In turn, public opposition arose against North Dakota's weather modification operations, specifically hail-mitigation efforts. Those affected by the drought, particularly farmers and ranchers, credited hail mitigation as contributing to the drought, alleging that in some instances clouds could actually be seen dissipating on radar after seeding.<sup>34</sup> One farmer studied North Dakota rainfall over the last thirty years<sup>35</sup> using data from the state climatologist.<sup>36</sup> He found that while precipitation amounts increased across North Dakota as a whole, precipitation actually decreased in areas where hail-mitigation efforts took place and immediately downwind.<sup>37</sup> Opposition in North Dakota resulted in at least one county suspending operations.<sup>38</sup>

---

30. See Dennis, *supra* note 26, at 126. A lawsuit was brought seeking damages caused by the flood, but the case was dismissed on procedural grounds, never reaching the substantive issue of causation. See *Lunsford v. United States*, 570 F.2d 221 (8th Cir. 1977).

31. Davis, *Weather Modification, Stream Flow*, *supra* note 6, at 851 (noting that South Dakota ended its program by defunding (and has since repealed all legislation)).

32. Chad Mira, *Drought Hits North Dakota Economy*, KX NET (Aug. 2, 2017, 9:26 PM), <https://www.kxnet.com/news/drought-hits-north-dakota-economy/>; *Drought in North Dakota*, NAT'L INTEGRATED DROUGHT INFO. SYS., <https://www.drought.gov/drought/states/north-dakota> (last visited Oct. 24, 2020).

33. April Baumgarten, *Drought's Toll Likely Billions of Dollars for N.D. Economy*, GRAND FORKS HERALD (Aug. 13, 2017), <http://www.grandforksherald.com/news/4311392-droughts-toll-likely-billions-dollars-nd-economy>.

34. Dave Kolpack, *In Parched North Dakota, Cloud-Seeding Irks Some Farmers*, U.S. NEWS (Sept. 24, 2017), <https://www.usnews.com/news/best-states/north-dakota/articles/2017-09-24/in-parched-north-dakota-cloud-seeding-irks-some-farmers>.

35. This is the time period over which weather modification has been used the most in North Dakota.

36. Telephone Interview with that Farmer (Dec. 26, 2017).

37. For example, New England, North Dakota, five miles downwind from hail-suppression efforts, experienced a 1.37-inch decrease in precipitation over 30 years, whereas Marmarth, North Dakota, only about 60 miles away from New England but outside the path of weather modification, experienced a 1.64-inch increase in precipitation. Memorandum from that Farmer to author (Dec. 29, 2017) (on file with author).

38. Jill Schramm, *In Drought, County Seeks to Suspend Cloud Seeding*, MINOT DAILY NEWS (July 19, 2017), <http://www.minotdailynews.com/news/local-news/2017/07/in-drought-county-seeks-to-suspend-cloud-seeding/>.

#### D. COMMON LAW RELIEF FOR WEATHER MODIFICATION'S SIDE EFFECTS

Weather modification's possible side effects in turn create the potential for liability. Because weather modification may cause harm, it is critical that a system exists to hold modifiers responsible. Currently, no adequate system exists.

As evaluated below, an array of causes of action at the common law may apply to weather modification activities.<sup>39</sup> Yet, an overall analysis shows that these existing legal theories break down when applied to injuries allegedly caused by weather modification.<sup>40</sup> Because of the common law's incompatibility with weather modification issues, those injured by modifiers are left with virtually no available remedy.<sup>41</sup> This is demonstrated by the scarcity of recorded cases in which parties have prevailed over weather modifiers for harms from weather modification.<sup>42</sup>

This section analyzes the various causes of action that may be applicable in the weather modification context and demonstrates the common law's inability to address weather modification's harms.<sup>43</sup>

##### 1. *Incredulous Causation Hurdle*

Under numerous common law causes of action, proving causation is a crippling barrier to relief for those harmed by weather modification. Indeed, the primary reason parties fail against weather modifiers is the inability to meet the staggering burden of showing causation and damages.<sup>44</sup> To establish causation, a plaintiff must show: (1) the weather modification in question actually modified the weather, (2) it was a substantial factor in causing some harm, and (3) without that modification, the damage would not have occurred.<sup>45</sup> In other words, to prevail in actions that require proof of causa-

---

39. See *infra* Section I.D.2.

40. See Jones, *supra* note 16, at 1173.

41. See *id.* at 1164; Julie Ferdon, *Federal Weather Modification Projects: Compensating the Landowner*, 26 ARIZ. L. REV. 681, 688 (1984).

42. Davis, *Weather Modification Law*, *supra* note 17, at 413. Few cases have reached the substantive issues of liability for weather modification in any meaningful way. See, e.g., Pa. Nat. Weather Ass'n v. Blue Ridge Weather Modification Ass'n, 44 Pa. D. & C.2d 749 (Pa. D. & C.2d 1968); Sw. Weather Rsch., Inc. v. Duncan, 319 S.W.2d 940 (Tex. Civ. App. 1958); Slutsky v. New York, 97 N.Y.S.2d 238 (N.Y. Sup. Ct. 1950); see also Saba v. Counties of Barnes, 307 N.W.2d 590, 596 (N.D. 1981) (not reaching the merits but finding class certification inappropriate partially because of complicated questions of causation).

43. This article does *not* address defenses available to weather modifiers at the common law. Of course, such defenses could equally hamper recovery.

44. Jones, *supra* note 16, at 1169; Stark, *supra* note 23, at 706; see also *Blue Ridge Weather Modification*, 44 Pa. D. & C.2d at 762 (finding plaintiffs failed to establish causal link between weather modification activities and injuries); Slutsky, 97 N.Y.S.2d at 731 (same).

45. Ferdon, *supra* note 41, at 686; Jones, *supra* note 16, at 1170.

tion, a plaintiff must demonstrate that but-for the weather modification, damages would not have occurred.<sup>46</sup>

Such proof is exceptionally difficult in weather modification cases because it is challenging to predict even the natural weather.<sup>47</sup> Weather is migratory, erratic, and variable even when it has not been modified.<sup>48</sup> Where no two storms or seasons are alike, there is no certainty regarding how much precipitation will naturally occur at any given time.<sup>49</sup> Proving causation is then further complicated because weather modification's precise effect on the natural weather is still unknown.<sup>50</sup> As such, it becomes impossible to determine with any specificity whether a particular operation impacted the natural weather, and beyond that, precisely how much precipitation, or deprivation thereof, is actually attributable to weather modification efforts.<sup>51</sup> Put another way, because both the natural weather and weather modification are unpredictable, determining if harmful precipitation or deprivation was the result of weather modification becomes perhaps an unanswerable question.<sup>52</sup>

In causes of action requiring proof of causation, plaintiffs are left virtually without remedy and courts are powerless to act.<sup>53</sup> Accordingly, this article advocates for a system of governance that takes this causation issue into account.<sup>54</sup> With the causation hurdle in mind, the remainder of this section analyzes specific common law causes of action potentially applicable in weather modification cases.

## 2. *Common Law Causes of Action*

### a. Trespass

Theoretically, a party could assert a trespass action based on intrusions by cloud-seeding planes, the seeds themselves, or the precipitation generated.<sup>55</sup> Generally, trespass liability is imposed where one "intentionally enters land in possession of [another], or causes a thing or a third person to do so,"

---

46. See Currier, *supra* note 1, at 958.

47. See *supra* Section I.A (discussing scientific uncertainty).

48. *Report of the Task Group on Legal Implications of Weather Modification*, in CONTROLLING THE WEATHER 3, 5 (Howard J. Taubenfeld, ed., 1970) [hereinafter *Report of the Task Group*].

49. See Ferdon, *supra* note 41, at 684; see Stark, *supra* note 23, at 706.

50. See *supra* text accompanying Section I.A (describing uncertainty of weather modification's effects); see Jones, *supra* note 16, at 1170 n.50.

51. See Stark, *supra* note 23, at 706.

52. See *Report of the Task Group*, *supra* note 48, at 5.

53. See Jones, *supra* note 16, at 1170; Ferdon, *supra* note 41, at 688.

54. See *infra* Part II.

55. Ray J. Davis, *Strategies for State Regulation of Weather Modification*, in CONTROLLING THE WEATHER 181, 191 (Howard J. Taubenfeld ed., 1970) [hereinafter Davis, *Strategies*].



“irrespective of whether he thereby causes harm.”<sup>56</sup> On its surface then, trespass may be an attractive option for weather modification complainants. This theory avoids the causation hurdle outlined above<sup>57</sup> because the harm is the unprivileged entry itself, meaning liability arises regardless of whether damage is caused.<sup>58</sup>

However, beyond superficial analysis, the compatibility of trespass with the weather modification context is limited. First, it is well settled that the upper atmosphere, where cloud-seeding planes operate, is public domain;<sup>59</sup> a successful trespass claim requires low-flying aircraft that “interfere substantially with the . . . use and enjoyment of the land.”<sup>60</sup> Thus, a theory based on the cloud-seeding planes fails because the aircraft operate in the public domain.<sup>61</sup>

Still, a complainant may assert a trespass claim based on the disseminated seeds or generated precipitation.<sup>62</sup> Trespass liability may arise where property is invaded by the “throwing, propelling, or placing” of projectiles into the airspace or onto the land of another.<sup>63</sup> Yet, most jurisdictions require such projectiles to be visible to the naked eye, and seeding agents are not.<sup>64</sup>

Intrusions by water, light, heat, and dust have all been deemed to constitute trespass, so it is possible that precipitation created by weather modification could as well.<sup>65</sup> However, if precipitation alone was the basis for an action, recovery would then necessarily be limited to precipitation unwelcomely generated by modifiers, leaving those with unwanted precipitation depletions still without remedy. Thus, trespass does not quite address the challenges for litigants in the weather modification context.

Despite these limitations, one of the only parties to ever prevail over a weather modifier in a recorded case did so on a trespass-like theory in *Southwest Weather Research, Inc. v. Duncan*.<sup>66</sup> In *Duncan*, the court en-

---

56. RESTATEMENT (SECOND) OF TORTS § 158 (AM. LAW INST. 1965).

57. See *supra* Section I.D.1 (discussing the near impossibility of establishing causation).

58. RESTATEMENT (SECOND) OF TORTS § 163 cmt. d (AM. LAW INST. 1965).

59. *Id.* § 159 cmt. i.

60. *Id.* § 159.

61. Ray Jay Davis, *Special Problems of Liability and Water Resources Law*, in WEATHER MODIFICATION AND THE LAW 103, 113 (Howard J. Taubenfeld ed., 1968) [hereinafter Davis, *Special Problems*].

62. See Jones, *supra* note 16, at 1174; see also RESTATEMENT (SECOND) OF TORTS § 158 cmt. i (AM. LAW INST. 1965) (stating that projectiles are trespassory).

63. RESTATEMENT (SECOND) OF TORTS § 158 cmt I (AM. LAW INST. 1965).

64. See Jones, *supra* note 16, at 1175; Ferdon, *supra* note 41, at 689; Davis, *Special Problems*, *supra* note 61, at 113–14.

65. Jones, *supra* note 16, at 1174–75.

66. *Sw. Weather Rsch. v. Duncan*, 319 S.W.2d 940, 945 (Tex. Civ. App. 1958). This rare success was quite limited, with no damages awarded or calculated. Davis, *Weather Modification Law*, *supra* note 17, at 414.

tered a temporary injunction against hail-suppression operations that allegedly diverted precipitation from farmers' land.<sup>67</sup> Some commentators note that although the court did not expressly state its decision was based in trespass, the fact that the order only restrained activities occurring *directly* above the farmers' land implies that success depended on the right to be free from trespass to one's own land and airspace.<sup>68</sup> But this victory reveals yet another limitation of a trespass theory: the remedy is confined to only those weather modification activities occurring immediately above one's land. This necessarily precludes relief for injuries from downwind effects.<sup>69</sup> Moreover, even if plaintiffs overcome the limitations outlined above, trespass should not be advanced as a theory of recovery for weather modification activities because it is too broad.<sup>70</sup> To deem the cloud-seeding planes, generated precipitation, or disseminated seeds trespassory is to then, in effect, outlaw weather modification altogether. Thus, comprehensive weather modification governance should follow those states that have recognized this problem and already expressly provide that weather modification does not constitute trespass.<sup>71</sup>

#### b. Private Nuisance

Private nuisance, unlike trespass, focuses not on physical invasion of land, but rather on interference with the use and enjoyment of land.<sup>72</sup> Generally, that interference must be both substantial and unreasonable.<sup>73</sup> Thus, plaintiffs must show damage from some real and appreciable intrusion, not just the mere existence of an intrusion.<sup>74</sup>

An interference must involve more than minor discomfort or apprehension in order to be considered substantial.<sup>75</sup> Accordingly, the mere dissemination of seeds or generation of precipitation alone likely are not sufficient

---

67. *Duncan*, 319 S.W.2d at 941.

68. *Id.*; see also *Legal Remedies for "Cloud-Seeding" Activities: Nuisance or Trespass?*, 1960 DUKE L.J. 305, 308–09 [hereinafter *Legal Remedies for Cloud-Seeding Activities*] (finding *Duncan* was based on trespass); see also *Sw. Weather Rsch, Inc., v. Jones*, 327 S.W.2d 417, 421–22 (Tex. 1959) (affirming the temporary injunction without reaching the merits but noting complicated questions of scientific problems).

69. *Legal Remedies for Cloud-Seeding Activities*, *supra* note 68, at 309; see also *supra* Section I.A (discussing the migratory effect of weather modification).

70. *Jones*, *supra* note 16, at 1175.

71. See, e.g., UTAH CODE ANN. § 73-15-7 (West 2020) (precipitation caused by an authorized weather modification project does not constitute trespass or nuisance).

72. *Ferdon*, *supra* note 41, at 690.

73. RESTATEMENT (SECOND) OF TORTS § 822 (AM. L. INST. 1979); HEMEL & HOLDERNESS, *supra* note 3, at 76.

74. RESTATEMENT (SECOND) OF TORTS § 821F cmt. c (AM. L. INST. 1979); *Ferdon*, *supra* note 41, at 690.

75. HEMEL & HOLDERNESS, *supra* note 3, at 76.

inferences.<sup>76</sup> But interference with “residential, agricultural, commercial, [or] industrial” uses is generally sufficient.<sup>77</sup> As such, damaging flooding or droughts caused by weather modification could satisfy the substantial interference prong for nuisance liability.<sup>78</sup>

However, the intrusion must still be unreasonable.<sup>79</sup> And an intrusion is only unreasonable if “the gravity of the harm outweighs the utility of the actor’s conduct.”<sup>80</sup> To make reasonableness determinations, courts balance the benefit from the conduct against the alleged harm.<sup>81</sup> While some commentators find this balancing approach an attractive option for the weather modification context,<sup>82</sup> this theory will too bar plaintiffs from access to relief.

To illustrate, two cases have applied versions of the nuisance theory in weather modification cases, and both plaintiffs failed. In *Slutsky v. New York*,<sup>83</sup> the plaintiffs requested a permanent injunction against rain-inducement experiments out of fear that the increased precipitation would negatively impact the success of their resort businesses.<sup>84</sup> The court rejected this argument and found the plaintiffs’ concerns were outweighed by the good that could come from increased precipitation.<sup>85</sup> The court’s decision was partially based on the plaintiffs’ failure to demonstrate the weather modification would *actually cause* the apprehended injuries.<sup>86</sup> In other words, the causation hurdle<sup>87</sup> barred relief because public good from increased precipitation outweighed speculative damages.<sup>88</sup>

*Pennsylvania Natural Weather Association v. Blue Ridge Weather Modification Association*<sup>89</sup> involved an alleged decrease in precipitation from hail-suppression operations. There, again the court found the plaintiffs

---

76. *Id.* at 76-77.

77. RESTATEMENT (SECOND) OF TORTS § 821D cmt. b (AM. L. INST. 1979).

78. See HEMEL & HOLDERNESS, *supra* note 3, at 77 (explaining how increased precipitation that tangibly affects the physical condition of property may be considered substantial); see also Ferdon, *supra* note 41, at 690 (recognizing physical damage to land, buildings, or vegetation, although minor, may be considered substantial). Of course, the difficulty of demonstrating causation must then again be taken into account. See *supra* Section I.D.1.

79. Jones, *supra* note 16, at 1175.

80. RESTATEMENT (SECOND) OF TORTS § 826 (AM. L. INST. 1979).

81. Ferdon, *supra* note 41, at 690.

82. Jones, *supra* note 16, at 1176-77 (noting that flexibility is particularly crucial where the technology is still developing).

83. 97 N.Y.S.2d 238 (N.Y. Sup. Ct. 1950).

84. *Slutsky*, 97 N.Y.S.2d at 239.

85. *Id.* at 239-40.

86. *Id.*; see also RESTATEMENT (SECOND) OF TORTS § 821F (AM. L. INST. 1979) (requiring appreciable harm); Jones, *supra* note 16, at 1168 (providing an in-depth analysis of the *Slutsky* decision).

87. See *supra* Section I.D.1 (discussing the causation burden).

88. *Slutsky*, 97 N.Y.S.2d at 239-40.

89. 44 Pa. D. & C.2d 749 (1968).

failed to prove beyond a mere possibility that the weather modification would actually cause harm.<sup>90</sup> Thus, as noted with the difficulties in proving causation,<sup>91</sup> the uncertainties surrounding weather modification's effects have barred plaintiffs from prevailing in nuisance suits, making this another incompatible theory of recovery for weather modification.

### c. Negligence

To prevail in a negligence action, a plaintiff must show: (1) the weather modifier had a duty to conform to some standard of care, (2) the weather modifier breached that duty, (3) that breach caused some harm, and (4) that harm was of the type that is legally compensable by damages.<sup>92</sup>

Negligence actions against weather modifiers are riddled with complication. First and foremost, the plaintiff is faced with the impossibility of establishing causation.<sup>93</sup> Additionally, demonstrating both that a weather modifier did not live up to a required standard of care and defining that standard of care are formidable tasks.<sup>94</sup> Courts have yet to address, let alone define, the standard of care for weather modifiers.<sup>95</sup> As a default, the standard of care would presumably be the industry standard—as a reasonable, prudent modifier would operate.<sup>96</sup> While under certain extreme circumstances claimants may establish that the standard of care was breached,<sup>97</sup> overall, this standard provides little guidance as the uncertainty surrounding the technology makes unclear how such an operator would act.<sup>98</sup> Thus, negligence is not a sound approach for plaintiffs against weather modifiers.

### d. Res ipsa loquitur

The Latin phrase *res ipsa loquitur* simply means “the thing speaks for itself.”<sup>99</sup> The doctrine typically applies in cases involving negligent acts.<sup>100</sup>

---

90. *Blue Ridge Weather Modification Ass'n*, 44 Pa. D. & C.2d at 761–62.

91. *See supra* Section I.D.1.

92. Jones, *supra* note 16, at 1177.

93. *See supra* Section I.D.1. Indeed, in the sparse case law that does exist, plaintiffs have attempted to argue that cloud-seeding was done negligently, but such claims fail due to the causation barrier. *See Currier, supra* note 1, at 958.

94. HEMEL & HOLDERNESS, *supra* note 3, at 73.

95. Davis, *Strategies, supra* note 55, at 190.

96. *Id.*

97. For example, attempting to increase precipitation during flooding would presumably be inconsistent with how an ordinary, prudent modifier would operate. *See Jones, supra* note 16, at 1178 (delineating clear breaches of standard of care).

98. HEMEL & HOLDERNESS, *supra* note 3, at 73.

99. RESTATEMENT (SECOND) OF TORTS § 328D cmt. a (AM. L. INST. 1965); Mark Shain, *Res Ipsa Loquitur*, 17 S. CAL. L. REV. 187, 187 (1944). *Res ipsa loquitur* has origins dating back to 1863 and the historic case *Bryne v. Boadle* in which it was found the circumstances spoke for themselves and indicated negligence where a barrel fell out of a window hitting a passerby. *Bryne v. Boadle*, 2 H. & C. 722, 722 (1863).

Traditionally, *res ipsa loquitur* is applicable where: (1) the accident is of the kind which ordinarily does not occur absent negligence, (2) the injury was caused by instrumentality within the exclusion control of the defendant, and (3) the injury would have happened irrespective of any voluntary action by the plaintiff.<sup>101</sup> While some dispute the doctrine's effect in application,<sup>102</sup> generally, there are two views: the permissible-inference view and the presumption view.<sup>103</sup>

The majority, permissible-inference view finds that *res ipsa loquitur* merely allows a jury to consider the occurrence of the event itself as circumstantial evidence of the defendant's negligence.<sup>104</sup> Under this view, even where no rebuttal evidence is offered, a plaintiff cannot prevail on the *res ipsa loquitur* theory alone.<sup>105</sup> Conversely, the presumption view finds that *res ipsa loquitur* has a procedural effect such that when it applies, a rebuttable presumption of negligence is created and the burden of proof shifts to the defendant to prove that he was not negligent.<sup>106</sup>

Because weather modification actions are riddled with causation complexities, the burden-shifting feature of the presumption view is particularly attractive for plaintiffs. A presumption of causation would alleviate the primary barrier to relief for those injured by weather modification.

Yet, it is unlikely *res ipsa loquitur* would allow recovery in weather modification cases. In some instances, plaintiffs against weather modifiers may be able to satisfy the first requirement: that the accident was of the type that would not ordinarily occur absent negligence. For example, in *Duncan*,<sup>107</sup> the court was convinced by lay witness testimony describing how clouds dissipated immediately after they were seeded to suppress hail.<sup>108</sup> Thus, such dissipation immediately following seeding,<sup>109</sup> could be the type of incident which does not occur absent negligence.

Though plaintiffs could also likely meet the third requirement that they themselves took no voluntary act which contributed to the harm from

---

100. See Shain, *supra* note 99, at 187.

101. Graham L. Fricke, *The Use of Expert Evidence in Res Ipsa Loquitur Cases*, 5 VILL. L. REV. 59, 59 (1959).

102. RESTATEMENT (SECOND) OF TORTS § 328D cmt. a (AM. L. INST. 1965); Charles E. Carpenter, *Doctrine of Res Ipsa Loquitur*, 1 U. CHI. L. REV. 519, 519 (1934).

103. See William L. Prosser, *Res Ipsa Loquitur in California*, 37 CALIF. L. REV. 183, 186–87 (1949).

104. RESTATEMENT (SECOND) OF TORTS § 328D cmt. a (AM. L. INST. 1965); Murray B. Guterson, *Res Ipsa Loquitur*, 27 WASH. L. REV. & ST. B.J. 145, 148 (1952).

105. Guterson, *supra* note 105, at 149.

106. See Carpenter, *supra* note 102, at 524–26, n.45 (listing cases in which *res ipsa loquitur* was given procedural effect such that the burden of proof shifted to the defendant).

107. *Sw. Weather Rsch., Inc. v. Duncan*, 319 S.W.2d 940 (Tex. Civ. App. 1958).

108. *Id.* at 943.

109. Or, in turn, other changes in precipitation, such as flooding, immediately following weather modification efforts could indicate negligence.

weather modification, *res ipsa loquitur*'s compatibility with the weather modification context ends there. Plaintiffs could not meet the second requirement that the weather modifier had exclusive control over the instrumentality which caused the harm.<sup>110</sup> No weather modifier has exclusive control over the weather. Because in most cases the natural weather itself, not exclusively the modification efforts, contribute to the plaintiff's injuries, this requirement would act as a bar.<sup>111</sup>

In sum, although *res ipsa loquitur* is not a promising theory in the weather modification context, the burden-shifting framework of the presumption view could prove a viable way to more evenly distribute the costs of weather modification currently only borne by those injured.<sup>112</sup> Accordingly, this article proposes that each state prescribe an adjudicatory framework utilizing such a rebuttal presumption of causation.<sup>113</sup>

#### e. Strict liability

Strict liability—a standard of no-fault liability—is imposed only where one engages in “an abnormally dangerous activity,”<sup>114</sup> which may be actionable based on both negligence and nuisance.<sup>115</sup>

In strict liability actions, plaintiffs are not required to show that the defendant was negligent, fell below some articulated standard of care, or intent.<sup>116</sup> But plaintiffs must still show the defendant acted, the plaintiff was injured, and some causal relationship exists between the two.<sup>117</sup> In other words, the hurdle of causation persists.<sup>118</sup>

Moreover, a plaintiff must establish that weather modification is an abnormally dangerous activity, which, to date, no court has accepted.<sup>119</sup> While some scholars find weather modification's inherent uncertainties and capability for widespread harm make plausible that it is abnormally dangerous,<sup>120</sup> consideration of other factors, such as the potential value to the community, cut against that argument.<sup>121</sup> Thus, again, strict liability is not a viable theory for weather modification cases.<sup>122</sup>

---

110. See Carpenter, *supra* note 102, at 520.

111. See *supra* Section I.A. (detailing the uncertainty of the natural weather).

112. Davis, *Weather Modification, Stream Flow*, *supra* note 6, at 854-55.

113. See *infra* Part II.

114. RESTATEMENT (SECOND) OF TORTS § 519 (AM. L. INST. 1977).

115. *Id.* § 520 cmts. a & b; *id.* § 520 (collecting factors to determine whether an activity is abnormally dangerous).

116. Jones, *supra* note 16, at 1179.

117. *Id.*; Davis, *Strategies*, *supra* note 55, at 190.

118. *Report of the Task Group*, *supra* note 48, at 22.

119. HEMEL & HOLDERNESS, *supra* note 3, at 73; Ferdon, *supra* note 41, at 691.

120. *Report of the Task Group*, *supra* note 48, at 21.

121. See RESTATEMENT (SECOND) OF TORTS § 520 cmt. f (AM. L. INST. 1977); Jones, *supra* note 15, at 1180. And it was this same balancing consideration which defeated prior nuisance

#### f. Negligence per se

Finally, some governing bodies prescribe that violations of certain statutes or regulations constitute negligence.<sup>123</sup> For weather modification, this necessarily excludes relief from injuries caused by authorized operations. Moreover, for this to even be a feasible option, adequate statutory and regulatory governance of weather modification must first exist, which unfortunately is not the case.<sup>124</sup>

In sum, the common law lacks the capacity to address harms caused by weather modification. As a result, those injured by weather modification have virtually no available remedy at the common law. Without statutory or regulatory provisions to fill this gap left by the common law, those injured by weather modification bear its costs alone. Accordingly, this article proposes to fill this gap at the state administrative level with a system that includes a mechanism to compensate those harmed.

### E. EXISTING GOVERNING FRAMEWORK OVER WEATHER MODIFICATION<sup>125</sup>

Current governance over weather modification, at both the federal and state level, fails to fill the gap left by the common law. Federal regulation of weather modification is negligible and void of any substantive governance. States have primarily provided the substantive governance. And though an analysis of states' governance shows variation in type and comprehensiveness, all states have one thing in common: none offer an adequate avenue for relief from harm that may arise from weather modification. Accordingly, this article proposes a system of governance which sufficiently fills this gap.<sup>126</sup>

#### 1. Federal

As noted above, federal weather modification policy is limited.<sup>127</sup> Federal governance consists only of a reporting requirement for modifiers,<sup>128</sup>

---

claims. *See* Pa. Nat. Weather Ass'n v. Blue Ridge Weather Modification Ass'n, 44 Pa. D. & C.2d 749 (Pa. D. & C.2d 1968); *Slutsky v. New York*, 97 N.Y.S.2d 238 (N.Y. Sup. Ct. 1950).

122. Like for trespass, some states have adopted laws expressly providing that weather modification is not an abnormally dangerous activity. *See, e.g.*, TEX. AGRIC. CODE ANN. § 301.302 (West 2019).

123. Davis, *Special Problems*, *supra* note 61, at 190-91.

124. *See infra* Part II.

125. This section does *not* address who currently funds weather modification.

126. *See infra* Part II.

127. *See* George W. Bomar, *Legal Aspects of Weather Modification Operations*, in GUIDELINES FOR CLOUD SEEDING TO AUGMENT PRECIPITATION 53, 54 (Conrad G. Keyes, Jr. et al. eds., 3d ed. 2016); Currier, *supra* note 1, at 961. Notably, no federal funding is allotted for weather modification. *See* Witt, *supra* note 10, at 114.

without any substantive regulation, let alone guidance on rights and liabilities.<sup>129</sup> Under the National Weather Modification Policy Act (“NWMPA”), enacted in 1976, weather modifiers are required to report their activity to the Department of Commerce.<sup>130</sup>

Attempts to pass a comprehensive weather modification policy at the federal level have failed.<sup>131</sup> As such, the federal government has failed to fill the gap at the common law.

## 2. *State Governance: Existing Components and How to Effectively Utilize Them*

The bulk of substantive weather modification governance is formulated and enforced at the state level.<sup>132</sup> Twenty-nine states and Washington, D.C., have legislation which references weather modification in *some* way.<sup>133</sup> The scope and comprehensiveness of states’ governance varies considerably,<sup>134</sup> with the majority lacking precision.<sup>135</sup> While some states rely solely on statutory governance, other states delegate authority to state administrative agencies to carry out and refine the law,<sup>136</sup> the method preferred by this article.<sup>137</sup>

The most common (and essential) components to substantively govern weather modification are: (1) reporting; (2) licensing and permitting; (3) public participation; and (4) liability.<sup>138</sup> Only eleven states include all of

---

128. See National Weather Modification Policy Act, 15 U.S.C. § 330a (setting forth the reporting requirement).

129. See HEMEL & HOLDERNESS, *supra* note 3, at 98.

130. 15 U.S.C. § 330a–330e. Specifically, the National Oceanic and Atmospheric Administration, an agency of the Department of Commerce, collects reports and makes the information available to the Secretary of Commerce who may compile summaries to make available to the public. *Id.* § 330b; see also Bomar, *supra* note 127, at 53 (describing the reporting process). Failure to comply with the National Weather Modification Policy Act may result in up to a \$10,000 fine. 15 U.S.C. § 330d.

131. For a detailed description of the two most recent attempts to create a national weather modification policy, see Currier, *supra* note 1, at 961–62.

132. See Bomar, *supra* note 127, at 54; Currier, *supra* note 1, at 956; Davis, *Weather Modification Law*, *supra* note 17, at 412; HEMEL & HOLDERNESS, *supra* note 3, at 98.

133. See *infra* Appendix A (providing a table of all the states and Washington, D.C., with weather modification legislation with respective contents).

134. For example, eight states and Washington, D.C., have laws that simply grant emergency powers that include control over weather modification, but have no other statutory or regulatory authority addressing the technology. See, e.g., ALASKA STAT. § 26.23.150 (2020). Conversely, other states have extensive weather modification statutory and regulatory frameworks. See, e.g., COLO. REV. STAT. § 36-20-102 *et seq.* (2020).

135. See Witt, *supra* note 10, at 115–16; HEMEL & HOLDERNESS, *supra* note 3, at 90.

136. See Davis, *Weather Modification Law*, *supra* note 17, at 412, 419 (explaining the various state administrative frameworks for weather modification); see also COLO. REV. STAT. § 36-20-105(2) (2020) (delegating authority to state agency).

137. See *infra* Part II.

138. Witt, *supra* note 10, at 117; HEMEL & HOLDERNESS, *supra* note 3, at 90.



these components,<sup>139</sup> to varying degrees or comprehensiveness and utility.<sup>140</sup> Indeed, less than half of the states with weather modification governance in place even mention liability,<sup>141</sup> and, importantly, no state provides a realistic avenue to relief for harm caused by weather modification.<sup>142</sup> Each of these components (discussed below) are necessary for states to regulate weather modification in a meaningful way.

#### a. Reporting

In one way or another, most states that govern weather modification require modifiers to report their activities and associated data.<sup>143</sup> Data collection is critical to avoid conflicts between projects, ascertain compliance with other regulations, and evaluate operations' costs and benefits.<sup>144</sup> States vary on what information is available to the public and what information must be reported to the government, ranging from bare reporting requirements<sup>145</sup> to ones with both content and timing guidelines.<sup>146</sup> To be effective, reporting requirements ought not be too burdensome,<sup>147</sup> but must go beyond bare requirements in order to collect sufficient data about operations<sup>148</sup> and outcomes to accurately evaluate both compliance with regulations and the effects of weather modification operations.

#### b. Licensing and Permits

Many states also utilize license and permit requirements for weather modification.<sup>149</sup> Simply put, licenses determine who should engage in weather modification, while permits decide when, where, and how such activities are permissible.<sup>150</sup>

---

139. *See infra* Appendix A.

140. Witt, *supra* note 10, at 117.

141. *See infra* Appendix A.

142. Davis, *Strategies*, *supra* note 55, at 193.

143. *See infra* Appendix A (showing twenty states have reporting requirements).

144. *Report of the Task Group*, *supra* note 48, at 22; Davis, *Strategies*, *supra* note 55, at 199.

145. *See, e.g.*, ARIZ. REV. STAT. § 45-1604 (2020) (providing the vague guideline to “within ninety days after conclusion of any [project]. . . file . . . a final evaluation of the project”).

146. *See, e.g.*, OR. REV. STAT. § 558.110 (2020) (requiring detailed records of types of method, material, and equipment used, times and places of operation, those participating in the project, estimated precipitation from each project, and definition of gains or losses, all made available for public examination).

147. Otherwise, innovation will be stifled and governmental entities will be overwhelmed with information. *See Report of the Task Group*, *supra* note 48, at 22.

148. At a minimum, such information should include the timing, location, and amount and type of materials used.

149. *See infra* Appendix A (showing 18 states requires licenses and/or permits).

150. HEMEL & HOLDERNESS, *supra* note 3, at 91, 94.

Licensing is a way to ensure modifiers are competent.<sup>151</sup> While license requirements are relatively common, competency criteria varies widely from state to state.<sup>152</sup> Typically, criteria focuses on education and experience, considering, for example, whether the applicant has an academic degree relating to the field of meteorology, experience with weather modification projects, and proof of financial responsibility.<sup>153</sup> Licenses are generally only valid for a certain period of time and require renewal, with noncompliance or ineffectiveness being grounds for non-renewal.<sup>154</sup> Though some states have rather complete licensing frameworks,<sup>155</sup> most are so lax that licensing becomes nothing more than a fee-collecting mechanism<sup>156</sup> that does little to regulate weather modification.

Equally important, permits truly regulate weather modification by determining which projects are allowed.<sup>157</sup> Generally, permits give modifiers permission for a specific project,<sup>158</sup> time period, and location.<sup>159</sup> Though, like licensing, permit considerations vary considerably, the following are commonly taken into account: (1) personnel involved; (2) timing and methods of dispersal; (3) equipment for dispersal; (4) project area; (5) how the modifier intends to evaluate the results and impacts; and (6) anticipated costs of the project.<sup>160</sup>

Many states' permit requirements are so lax that, in practice, they primarily maintain a registry of projects.<sup>161</sup> For example, only about half of the states with permit requirements consider a conceptual operation plan before approval.<sup>162</sup> That being said, meaningful permit processes exist and some states even require environmental-impact studies before approval.<sup>163</sup>

---

151. Witt, *supra* note 10, at 117-18.

152. Davis, *Weather Modification, Stream Flow*, *supra* note 6, at 857; Corbridge & Moses, *supra* note 21, at 218; compare FLA. STAT. § 403.311 (2020) (providing relatively detailed license requirements) with LA. STAT. ANN. §§ 37:2203-07 (2020) (providing simply that a license is required and the commissioner will determine qualifications).

153. See Bomar, *supra* note 127, at 55; Witt, *supra* note 10, at 117. The availability of insurance to modifiers (proof of financial responsibility), is beyond the scope of this article.

154. Bomar, *supra* note 127, at 55.

155. See, e.g., MONT. ADMIN. R. 36.20.202 (2020) (setting forth detailed criteria which must be met in order for license).

156. Davis, *Strategies*, *supra* note 55, at 197. See, e.g., ARIZ. REV. STAT. §§ 45-1601 to -1603 (2020) (requiring applicants to merely list what they perceive to be their qualifications); ARIZ. ADMIN. CODE § R12-15-104 (2020) (supplementing only with fee requirements).

157. HEMEL & HOLDERNESS, *supra* note 3, at 94.

158. Including the project type (for example to increase precipitation or mitigate hail), the type of seeding agent, and the delivery method.

159. Bomar, *supra* note 127, at 60.

160. *Id.* at 59.

161. Davis, *Strategies*, *supra* note 55, at 198. And some states have only license, not permit, requirements. See, e.g., LA. STAT. ANN. §§ 37:2201-08 (2020).

162. Bomar, *supra* note 127, at 57. See *infra* Appendix A.

163. Bomar, *supra* note 127, at 59.

In order to be effective, states must utilize *both* licensing and permitting to ensure not only that modifiers are competent, but also that their projects are worthwhile.<sup>164</sup> States must expressly prescribe meaningful competency criteria and stringent merit controls<sup>165</sup> that spell out exactly what is required of applicants. Moreover, issuing entities must have power to deny and revoke permits and shape projects in a way that protects the interests of both the modifiers and those affected.<sup>166</sup> Finally, and perhaps most importantly, for either requirement to have any value, those in charge of issuing both licenses and permits must be qualified to effectively evaluate projects' merits and outcomes.<sup>167</sup> If issuing entities are not able to evaluate those costs and benefits, license and permits lose any protective purpose.

### c. Public Participation

Only sixteen states provide for public participation in weather modification regulation.<sup>168</sup> Again, states' methods to accomplish this vary, as does the extent of public participation allowed.<sup>169</sup> Public participation is usually facilitated by one or more of the following: (1) notice, (2) hearings, and (3) voter referendums.<sup>170</sup>

First, some states require weather modifiers to notify the public of proposed projects before the state will approve such projects.<sup>171</sup> That notice is meant to keep the public informed of prospective projects, though states vary on how much information the notice must include.<sup>172</sup>

To be effective, notice must actually reach the public, which can be a challenge.<sup>173</sup> Notice is ordinarily accomplished through publication by newspaper, electronically, or other approved means.<sup>174</sup> Allowing only newspaper publication<sup>175</sup> may limit the number of people who are actually

---

164. See HEMEL & HOLDERNESS, *supra* note 3, at 94 (noting that not all states have both).

165. Davis, *Strategies*, *supra* note 55, at 195-96.

166. Bomar, *supra* note 127, at 59; see, e.g., KAN. STAT. ANN. § 82a-1418 (2020) (allowing for suspension, revocation, and denial).

167. Bomar, *supra* note 127, at 56; Davis, *Strategies*, *supra* note 55, at 196-97.

168. See *infra* Appendix A.

169. Davis, *Weather Modification Law*, *supra* note 17, at 427.

170. HEMEL & HOLDERNESS, *supra* note 3, at 95-97.

171. Davis, *Strategies*, *supra* note 55, at 199; Bomar, *supra* note 127, at 57.

172. Some states notice requirements are vague, while others require detailed notice of every project proposed. For a relatively comprehensive notice mechanism, see OKLA. STAT. tit. 82, §§ 1087.10, 1087.12-1087.13 (2019) (requiring detailed notice).

173. Davis, *Strategies*, *supra* note 55, at 199.

174. Bomar, *supra* note 127, at 57.

175. See, e.g., OKLA. STAT. tit. 82, § 1087.13 (2019) (requiring publication in newspaper); see also HEMEL & HOLDERNESS, *supra* note 3, at 96 (explaining limitation of publication by newspaper).

notified of proposed projects.<sup>176</sup> Recognizing this limitation, some states allow notice by television, radio,<sup>177</sup> or mail.<sup>178</sup>

Some states limit public participation to merely a notice requirement, not allowing for further public input.<sup>179</sup> But other states give the public a chance to express their concerns at a hearing before project approval.<sup>180</sup> While no state mandates the modifier to take action based on information shared at hearings, in the past, such input has proven at least somewhat influential.<sup>181</sup>

A few states go beyond hearings and allow for direct public involvement in weather modification regulatory decisions through voter referendums on specific projects.<sup>182</sup> Still other states hold public votes on proposed tax levies to support the projects.<sup>183</sup> While this direct public input may be expensive, the potential consequences of weather modification warrant that expense.<sup>184</sup>

In sum, to be effective, states should include at least some mechanism for *both* public notice and input. Considering the potential for harm posed by weather modification, states must allow those affected an adequate opportunity to voice their views and be, in some way, involved in the regulatory process.<sup>185</sup> Importantly, then, this participation must not be overly geographically restricted so that all of those affected by weather modification activities may be reached.<sup>186</sup>

---

176. HEMEL & HOLDERNESS, *supra* note 3, at 96.

177. *See, e.g.*, COLO. REV. STAT. §§ 36-20-104(7), -112 (2020) (allowing modern forms of publication).

178. *See, e.g.*, 35 ILL. COMP. STAT. 200/27-30 (2020) (allowing notice by mail).

179. *See, e.g.*, NEV. REV. STAT. § 544.180 (2020) (requiring notice of proposed projects but not hearings); UTAH CODE ANN. § 73-15-4 (West 2020) (same).

180. Bomar, *supra* note 127, at 57; Davis, *Weather Modification Law*, *supra* note 17, at 428. Some states expressly require hearings, while others only provide one where protestors request it. *See, e.g.*, OKLA. ADMIN CODE. § 785:15-3-14 (2020).

181. *See* Davis, *Weather Modification Law*, *supra* note 17, at 428 (describing public influence over many Montana agency decisions).

182. *See, e.g.*, 35 ILL. COMP. STAT. 200/27-80 (2020) (providing that a voter referendum must be held in the county of the proposed project).

183. *See, e.g.*, KAN. STAT. ANN. § 829-1425 (2020) (allowing elections for tax levies for government weather modification projections).

184. HEMEL & HOLDERNESS, *supra* note 3, at 97.

185. Davis, *Strategies*, *supra* note 55, at 199.

186. To account for downwind effects, such requirements should extend at least to regions adjacent to the actual modification site. *See, e.g.*, OKLA. STAT. tit. 82, § 1087.13 (2020) (requiring notice be given in the county of operation *as well as* all adjacent counties) TEX. AGRIC. CODE ANN. § 301.166 (West 2019) (calling for petitions in adjacent counties); *see also supra* Section I.A (describing the migratory effect of weather modification).

#### d. Liability

The majority of states do not address the question of liability for weather modification.<sup>187</sup> Currently, twelve states have laws that relate to weather modification liability in some way.<sup>188</sup> Six of these states only reference liability in the most limited sense by providing that the government may not be held liable for private parties' weather modification activities and that other rights, duties, or liabilities are otherwise unaffected.<sup>189</sup>

The remaining six states<sup>190</sup> directly address liability in one way or another. Five states expressly limit what theories of recovery are available to those injured by weather modification.<sup>191</sup> Some states specifically provide that disseminating cloud-seeding agents does not constitute trespass<sup>192</sup> or nuisance.<sup>193</sup> Further, some states rule out no-fault liability, finding that weather modification activities are not abnormally dangerous.<sup>194</sup> Finally, two states provide that unauthorized operations, or those which otherwise violate the terms of a permit, constitute negligence per se.<sup>195</sup>

Pennsylvania is the only state that empowers its administrative agency to impose damages under certain circumstances. Specifically, the agency may demand modifiers to compensate farmers when the agency determines that weather modification caused a drought.<sup>196</sup> Similarly, the agency may demand compensation to *all* property owners for heavy downpours or storms it determines were caused by modification.<sup>197</sup> Yet, Pennsylvania fails to prescribe how such determinations will be made or how those injured can overcome the causation hurdle.

Though Pennsylvania more directly addresses liability than most states, all of the states fall short in the providing a framework that allows liability

---

187. Currier, *supra* note 1, at 959; Witt, *supra* note 10, at 118.

188. *See infra* Appendix A.

189. *See infra* Appendix A (Montana, Kansas, New Mexico, Oklahoma, Washington, and Wyoming).

190. *See infra* Appendix A (Colorado, North Dakota, Pennsylvania, Texas, Utah, and Wisconsin).

191. *See infra* Appendix A (Colorado, North Dakota, Utah, Wisconsin, and Texas).

192. *See* TEX. AGRIC. CODE ANN. § 301.302 (West 2019); WIS. STAT. § 93.35(14) (2020); UTAH CODE ANN. § 73-15-7 (West 2020); N.D. CENT. CODE § 61-04.1-37 (2019); COLO. REV. STAT. § 36-20-123 (2020); *see also supra* Section II.D.2.a (discussing trespass).

193. UTAH CODE ANN. § 73-15-7 (West 2020); *see also supra* Section I.D.2.b (discussing nuisance).

194. TEX. AGRIC. CODE ANN. § 301.302 (West 2019); WIS. STAT. § 93.35(14) (2020); N.D. CENT. CODE § 61-04.1-37 (2019); *see also supra* Section I.D.2.e (discussing strict liability).

195. WIS. STAT. § 93.35(14) (2020); COLO. REV. STAT. § 36-20-123(2) (2020). Again, for this to be a meaningful avenue to recovery, adequate governance must first be in place. *See supra* Section I.D.2.f. (discussing negligence per se).

196. 3 PA. CONS. STAT. § 1114 (2020).

197. *Id.*

for damages caused by weather modification.<sup>198</sup> In other words, no state provides a realistic avenue for relief for those harmed. Perhaps most glaringly, none of the states provide a mechanism that enables plaintiffs to overcome the impossible hurdle of proving causation. Accordingly, courts in these jurisdictions, and certainly those jurisdictions which fail to reference liability at all, are left to fill the gaps—which has been demonstrably unsatisfactory.<sup>199</sup>

In sum, federal and state governance over weather modification has failed to fill the gap left by the common law. While the federal government provides no substantive guidance, only twenty-nine states have statutes or regulations that mention weather modification.<sup>200</sup> Of those states, few govern weather modification in a meaningful way. Importantly, no state has a framework under which those injured by weather modification may be compensated.

## II. ANALYSIS: COMPREHENSIVE REGULATORY AND ADJUDICATORY FRAMEWORK FOR WEATHER MODIFICATION AT THE STATE ADMINISTRATIVE LEVEL

Existing legal frameworks fail to effectively regulate weather modification. The common law lacks the capacity to address harms that may result from weather modification. The federal government has not taken a substantive regulatory role. State governance is uncomprehensive and fails to fill this gap left by the common law. Each state should develop a comprehensive regulatory framework over weather modification at the administrative level. This framework should effectively utilize *all* four components of governance: (1) reporting, (2) licensing and permitting, (3) public participation, and (4) liability framework.<sup>201</sup> Most importantly, states must develop a means to redistribute the costs of weather modification, currently borne by those harmed alone, with a defined liability and adjudicatory framework, such as one mirroring the Vaccine Injury Compensation Program or the Veterans Benefits Program.

### A. WHY IS STATE-LEVEL GOVERNANCE PREFERABLE?

State, rather than federal or local, is the appropriate level of government for weather modification. Of course, the federal government *could*

---

198. Corbridge & Moses, *supra* note 21, at 219.

199. *See supra* Section I.D.

200. *See infra* Appendix A.

201. This section does *not* propose who should fund or engage in weather modification (i.e. government or private operations).

substantively regulate weather modification<sup>202</sup> given that weather is not a local phenomenon and moves without regard to government boundaries.<sup>203</sup> Accordingly, weather modification operations may inevitably affect more than one state, becoming a multi-state issue.<sup>204</sup>

Yet, the state level remains the preferential level of government. First, the federal government has demonstrated an unwillingness, or inability, to offer comprehensive weather modification governance.<sup>205</sup> Next, though weather modification effects have the potential to cross state lines, no such interstate disputes have arisen.<sup>206</sup> To the contrary, states have historically entered into interstate compacts to cooperatively execute weather modification projects,<sup>207</sup> with some state legislation providing for the same.<sup>208</sup> Moreover, with governance at the state level, states may tailor their approaches for their unique needs and preferences, while keeping governance close to those affected by projects and, as such, more susceptible to influence.<sup>209</sup>

Finally, the state level is preferable to local governance because local governments, such as counties, are too geographically small and lack the resources to address weather modification issues.<sup>210</sup> Local government units too severely restrict geographical control over weather modification, failing to account for the migratory nature of weather and the potential downwind effects of weather modification operations.

## B. WHY ARE STATE ADMINISTRATIVE AGENCIES PREFERABLE?

State governments should delegate authority to state administrative agencies to carry out and refine weather modification regulation.<sup>211</sup> Regula-

---

202. Davis, *Strategies*, *supra* note 55, at 202.

203. Peter H. Wyckoff, *Some Problems and Objective of the Federal Effort in Weather Modification*, in *CONTROLLING THE WEATHER* 115, 118 (Howard J. Taubenfeld, ed., 1970).

204. See Currier, *supra* note 1, at 965-66 (advocating for weather modification at the federal level).

205. See *id.* at 960 (detailing failed attempts of the federal government to pass weather modification legislation); Davis, *Strategies*, *supra* note 55, at 202.

206. Currier, *supra* note 1, at 963.

207. See Davis, *Strategies*, *supra* note 55, at 205 (detailing history of interstate weather modification compacts).

208. See, e.g., UTAH CODE ANN. § 73-15-8 (West 2020) (providing for interstate weather modification compacts); TEX. AGRIC. CODE ANN. § 301.056 (West 2019) (same).

209. HEMEL & HOLDERNESS, *supra* note 3, at 99.

210. See Davis, *Weather Modification Law*, *supra* note 17, at 421.

211. Davis, *Strategies*, *supra* note 55, at 195. What form of state administrative agency (whether a new agency should be made, a department should be added to an existing agency, etc.), is beyond the scope of this article. For a comparison of the different options available, see HEMEL & HOLDERNESS, *supra* note 3, at 93.

tion at the state administrative level offers the following advantages: (1) expertise, (2) flexibility, and (3) comprehensiveness.<sup>212</sup>

First, experts in fields relevant to weather modification are likely to staff administrative agencies.<sup>213</sup> Because weather modification is a complicated science, it is critical that those governing it understand the technology and potential consequences. While there is no guarantee that agencies will always employ experts, it is more likely that those administrators will have expertise than legislators or judges.<sup>214</sup> And even if administrators are not experts at the time they start with an agency, because their work will focus solely on weather modification, they will gain expertise during their time with the agency.<sup>215</sup>

Next, in agencies empowered to create and change weather modification regulations, administrators will be able to adjust regulations as technology develops.<sup>216</sup> Indeed, it is easier to amend regulations than statutes.<sup>217</sup> Flexibility is necessary for evolving technology.<sup>218</sup>

Finally, administrative agencies provide comprehensive governance. Most judicial and statutory regulation has been incomplete.<sup>219</sup> Administrative governance, which can take on both quasi-legislative and quasi-judicial roles, would be all-encompassing.<sup>220</sup> Moreover, a specialized regulatory body can facilitate continuous supervision.<sup>221</sup> In short, administrative governance is preferable because of these benefits—expertise, flexibility, and comprehensiveness.

### C. WHAT SHOULD THE GOVERNING FRAMEWORK INCLUDE?

Unlike existing state frameworks, effective regulation of weather modification must be comprehensive.<sup>222</sup> To accomplish this, states must *effectively* employ all four components discussed above.<sup>223</sup> Most importantly, states must provide a realistic avenue to relief for those injured by weather modification.

---

212. See Jones, *supra* note 16, at 1193.

213. See Davis, *Weather Modification Law*, *supra* note 17, at 421 (explaining, for example, state administrators likely will have knowledge in the fields of meteorology, hydrology, engineering, and so on).

214. HEMEL & HOLDERNESS, *supra* note 3, at 101.

215. *Id.* at 101.

216. Jones, *supra* note 16, at 1193.

217. HEMEL & HOLDERNESS, *supra* note 3, at 101; Davis, *Weather Modification Law*, *supra* note 17, at 421.

218. Jones, *supra* note 16, at 1193.

219. See *supra* Sections I.D & I.E.

220. Davis, *Strategies*, *supra* note 55, at 196.

221. *Id.*

222. *Id.* at 193.

223. See *supra* Section I.E.2.



### 1. *The Four Components*

To summarize the four components for effective regulation,<sup>224</sup> first, states must require weather modifiers to report their activities and the outcome.<sup>225</sup> States should provide detailed reporting guidelines<sup>226</sup> to collect sufficient data to evaluate regulatory compliance and the operations' effects. Second, *both* licensing and permitting requirements are necessary so regulators can control not only *who* engages in weather modification, but also *which* projects occur.<sup>227</sup> License and permit criteria must be clear and stringent for genuine competency and merit controls.<sup>228</sup> Moreover, administrators themselves must have the requisite expertise to make informed decisions.

Third, a state must have *both* mechanisms for public participation: notice and input.<sup>229</sup> Participation must be available to *all* affected parties, not just those in the most immediate geographical location of projects. While voter referendums may prove too costly for some states,<sup>230</sup> at a minimum, hearings should be required prior to project approval to allow interested parties to express their concerns.

Finally, states must address liability and implement systems to fill the gap left by the common law in order to give those injured by weather modification a realistic avenue to relief.<sup>231</sup> Existing state statutes which provide that weather modification does not constitute trespass should be utilized to avoid outlawing weather modification in practice. Beyond that, negligence per se provisions, as well as the liability provision utilized in Pennsylvania,<sup>232</sup> are useful but are not comprehensive enough to redistribute the costs of weather modification or alleviate associated causation or standard of care questions. For this reason, this article instead proposes a burden-shifting liability framework<sup>233</sup> at the state administrative level that mirrors that of the Vaccine Injury Compensation Program. Alternatively, those states not prepared to adopt a burden-shifting framework could instead employ the "ben-

---

224. *See supra* Section I.E.2

225. *See supra* Section I.E.2.a.

226. *See, e.g.*, OR. REV. STAT. § 558.110 (2020).

227. *See supra* Section I.E.2.b. States *must* have the authority to deny requests, not renew previously issued requests, and punish those who do not comply with regulations.

228. Mere fee collection and registry functions accomplish little in the way of regulation and control.

229. *See supra* Section I.E.2.c.

230. However, this cost is warranted when weighed against the potential for widespread consequences from weather modification.

231. *See supra* Section I.E.2.d.

232. *See supra* Section I.E.2.d (discussing the Pennsylvania framework).

233. *See supra* Section I.D.2.d (discussing the benefits of burden-shifting).

efit of the doubt” standard of proof like that found in the Veterans Benefits Program. Both options are discussed below.

## 2. *A New System to Compensate the Harmed: A Weather Modification Injury Compensation Program*

### a. Burden-Shifting Framework

Traditional legal norms have failed to provide those injured by weather modification a realistic avenue to relief. Therefore, in order to redistribute weather modification’s costs so they are no longer borne by affected parties alone, each state should implement an adjudicatory framework to be carried out by state administrative agencies, taking into account the unique complexities of weather modification. States should look to other adjudicatory frameworks that exist for matters that pose similar complications. The National Vaccine Injury Compensation Program (“NVICP”) is one such framework that removes the impossible barrier of causation.

At its heart, the NVICP is a statutorily created alternative to tort law that directly compensates individuals for enumerated vaccine-related injuries from a federally established and maintained Vaccine Injury Compensation Trust Fund.<sup>234</sup> Excise taxes imposed on vaccine manufacturers fund the Trust Fund.<sup>235</sup> The NVICP is a no-fault system which does not eliminate recourse to tort, but rather, requires injured parties to seek initial recourse through the NVICP.<sup>236</sup> Under this framework, victims of enumerated vaccine injuries enjoy a presumption of causation.<sup>237</sup>

Congress’ reason for creating the NVICP was twofold: (1) reduce tort litigation and (2) remove the difficulties in proving causation and negligence in order to compensate the injured.<sup>238</sup> First, Congress feared that if injured parties continued to seek relief through the tort system, litigation costs would stifle vaccine innovation, cause vaccine shortages, or even end vaccine production altogether, leading to unimmunized children.<sup>239</sup> Second, Congress recognized that the tort-system offered unsatisfactory remedies for injured parties with long, expensive trials frequently resulting in no re-

---

234. Christopher J. Rogers, *Primer on the National Vaccine Injury Compensation Program*, 21 UTAH B.J. 25, 25 (2008); Whitney S. Waldenberg & Sarah E. Wallace, *When Science is Silent: Examining Compensation of Vaccine-Related Injuries When Scientific Evidence of Causation is Inconclusive*, 42 WAKE FOREST L. REV. 303, 303 (2007).

235. See 26 U.S.C. § 4131; 42 U.S.C. § 300aa-15(i).

236. Robert L. Rabin, *The Vaccine No-Fault Act: An Overview*, 8 IND. HEALTH L. REV. 269, 271 (2011).

237. Waldenberg & Wallace, *supra* note 234, at 305.

238. Katherine E. Strong, *Proving Causation under the Vaccine Injury Act: A New Approach for a New Day*, 75 GEO. WASH. L. REV. 426, 442 (2007).

239. Rabin, *supra* note 236, at 237; Waldenberg & Wallace, *supra* note 234, at 304.

covery.<sup>240</sup> Failure to recover was largely attributable to scientific incertitude which made establishing that the vaccine caused the injury exceptionally difficult.<sup>241</sup>

The no-fault program is an adversarial process that removes the unpredictable litigation costs for vaccinators and the hurdle of causation for those suffering enumerated injuries.<sup>242</sup> First, injured persons file a petition against the Department of Health and Human Services, the guardian of the Trust Fund, in the United States Court of Federal Claims.<sup>243</sup> Then a Special Master, a judge who only hears vaccine cases, determines whether the petitioner has shown an enumerated injury.<sup>244</sup>

An Advisory Committee sets forth enumerated injuries in a table listing qualifying vaccines and related injuries.<sup>245</sup> If the Special Master determines the petitioner has established by a preponderance of the evidence that they suffered an enumerated injury, the petitioner enjoys a presumption that the vaccine caused the injury and the burden shifts to the government to show otherwise.<sup>246</sup> In other words, the petitioner need not prove causation in order to prevail.

Prevailing petitioners are awarded compensation from the Trust Fund (again, funded by taxing vaccine manufacturers<sup>247</sup>) with damages caps to ensure the Fund's vitality.<sup>248</sup> Within ninety days, petitioners who fail or wish to reject their award may sue in federal or state court under traditional tort theories without the benefit of the burden-shifting framework.<sup>249</sup>

This framework has obvious benefits. First, it is an efficient process that is less expensive than the tort system.<sup>250</sup> Next, it is an expertise model built around scientific evidence and a Special Master who is knowledgeable about the subject matter.<sup>251</sup> Finally, it provides petitioners a realistic avenue to relief by removing the barrier of causation and complicated questions of the standard of care. Notably, 60 percent of petitioners prevail under this

---

240. Strong, *supra* note 238, at 442.

241. *Id.* at 446–47; *see also* Waldenberg & Wallace, *supra* note 234, at 309 (“Courts and the medical community appear pervasively incongruous on the issue of causation.”).

242. Rabin, *supra* note 236, at 269.

243. Waldenberg & Wallace, *supra* note 234, at 305.

244. Rabin, *supra* note 236, at 270.

245. Waldenberg & Wallace, *supra* note 234, at 306–07. For example, chronic arthritis after a rubella virus vaccine is an enumerated injury. *Vaccine Injury Table*, HEALTH RES. & SERVS. ADMIN. 2, <https://www.hrsa.gov/sites/default/files/hrsa/vaccine-compensation/vaccine-injury-table.pdf> (last visited Oct. 24, 2020).

246. Strong, *supra* note 238, at 437. If the injury is not enumerated, a petitioner may still proceed but without the benefit of the presumption. *Id.* at 438.

247. Rabin, *supra* note 236, at 271.

248. For example, a \$250,000 cap is imposed on death suits. *Id.*

249. Waldenberg & Wallace, *supra* note 234, at 310.

250. Rabin, *supra* note 236, at 272.

251. *Id.*

framework.<sup>252</sup> Though Congress recognized that some petitioners could recover for injuries not actually caused by vaccines, that possibility is accepted in order to protect those harmed who otherwise would have virtually no access to relief.<sup>253</sup>

Plaintiffs seeking relief from alleged injuries from weather modification face similar hurdles to those which prompted the formation of the NVICP, particularly, the impossible burden of causation. Accordingly, states could utilize a similar no-fault alternative to tort law to compensate enumerated weather modification injuries. State legislatures would prescribe the system and delegate authority to state administrative bodies to adjudicate claims, appoint expert Special Masters, and determine awards. States implementing this system should establish and maintain a Weather Modification Trust Fund to compensate those harmed by weather modification, funded by a tax on modifiers, fees from licenses and permits, or both.

Within the state administrative agency, a qualified advisory committee is necessary to prescribe enumerated injuries under the Program. Like for vaccine-related injuries, a table could set forth specific weather modification operations and associated injuries.<sup>254</sup> For example, cloud dissipation or decreased precipitation occurring within a specified time of hail-mitigation efforts could be an enumerated injury.

Those injured by weather modification could then file petition against the state administrative agency or other designated entity defined by each state to act as guardian of the Trust Fund. A Special Master, assigned by the agency with expertise in the field of weather modification, would then determine if the petitioner established by a preponderance of the evidence that an enumerated injury was suffered. If so, the petitioner would enjoy a presumption that weather modification caused the injury, and the burden would shift to the designated entity to show otherwise. Thus, the causation burden would be removed.

The Special Master would then calculate appropriate compensation with a damages cap to ensure the vitality of the Fund.<sup>255</sup> Like under the NVICP, tort recourse would still be available to unsuccessful claimants and those unsatisfied with their award. But exhausting a claim through the Program would be a prerequisite for judicial relief.

---

252. Rogers, *supra* note 235, at 26.

253. Strong, *supra* note 238, at 442.

254. Unenumerated injuries could still be brought as well, but again without the Program's benefits.

255. Additionally, as under the traditional tort system, duplicative damages would be barred such that if, for example, a farmer already received compensation for 70 percent of her historic yield through drought insurance, only the remaining 30 percent of the yield would be subject to recovery under the Program.

This framework would fill the gap left by the common law and existing governing frameworks, providing a realistic avenue to relief for those injured by weather modification. While it is possible that in some cases injuries not actually caused by weather modification could be compensated, this risk is warranted where the alternative, being the current system, is those harmed bearing weather modification's costs alone. This expertise-based adjudicatory framework would effectively alleviate issues such as proving causation and defining modifiers' standard of care. Moreover, a system that makes relief accessible and holds weather modifiers accountable for injuries will incentivize weather modifiers (and its regulators) to carefully pursue weather modification operations in order to avoid situations in which they must provide compensation.

b. Lower Standard of Proof

States not prepared to create a causation presumption and shift the burden of proof could instead implement a somewhat less petitioner-friendly system. For example, states could implement a framework like that under the Veterans Benefits Program. Under that program, veterans are entitled to compensation for injuries<sup>256</sup> suffered as a result of their service. However, instead of enjoying a presumption of causation, veterans enjoy a lower, "benefit of the doubt" standard of proof.<sup>257</sup> Under that standard, if the Secretary of Veteran Affairs determines that the evidence weighs equally in favor of both sides, the Secretary must rule in the veteran's favor.<sup>258</sup> While this standard is slightly less-petitioner friendly, it does lessen the burden to show causation by allowing compensation in close cases.<sup>259</sup>

States could employ the benefit-of-the-doubt standard of proof in a Weather Modification Injury Compensation Program instead of the burden-shifting framework employed under the NVICP. This framework would operate in the same manner described above, except a table of enumerated injuries is unnecessary.<sup>260</sup> Instead of enjoying a causation presumption for enumerated injuries, injured parties would simply bear a lower standard of proof.

Plaintiffs alleging an injury from weather modification would file petition, and a Special Master would determine if weather modification was the cause of the injury. Where it is equally likely that the injury was caused by weather modification as it was not, the injured party would prevail. This

---

256. Unlike under the previous framework, these injuries are not limited to specifically enumerated injuries.

257. Strong, *supra* note 238, at 453.

258. *Id.*

259. *Id.* at 457.

260. Meaning *all* alleged injuries enjoy the benefit of the Program.

would at least ease the causation hurdle, though to a lesser extent. Indeed, in some instances the uncertainty surrounding weather modification that usually plagues claims against modifiers could instead benefit plaintiffs. For example, if it was equally unclear whether natural precipitation or weather modification caused the plaintiff's harm, the plaintiff may prevail. Both of these proposed versions of a Weather Modification Injury Compensation Program would fill the gap left by the common law and existing governing frameworks to provide those allegedly injured by weather modification a realistic avenue to relief.

### III. CONCLUSION

Weather modification technology has several potential benefits, but with that comes possible side effects. Currently, no system exists to provide relief to those injured by weather modification. The common law lacks the capacity to address weather modification's harms. Existing federal and state regulation fails to fill this gap. As such, those harmed by weather modification will continue to have virtually no available remedy until a system is adopted which fills the gap left by the common law and existing governance.

Each state should implement comprehensive weather modification regulation at the state administrative level. In order to fill the current gap in weather modification regulation, this framework should include an adjudicatory alternative to the tort system to compensate those injured by weather modification's side effects. States should follow existing frameworks that compensate individuals harmed in other contexts with unique complexities, such as in establishing causation. A burden-shifting framework like that found in the NVICP would remove the existing barrier to relief by allowing those injured to enjoy a presumption of causation. Alternatively, requiring a lower, benefit-of-the-doubt standard of proof like under the Veterans Benefits Program would mitigate the causation barrier and provide a realistic avenue to relief for those harmed by weather modification.

IV. APPENDIX A<sup>261</sup>

States	Reporting	License & Permit	Public Participation	Liability
Alaska <sup>*262</sup>				
Arizona <sup>263</sup>	X	X		
Arkansas <sup>*264</sup>				
California <sup>265</sup>	X			
Colorado <sup>266</sup>	X	X	X	X
Florida <sup>267</sup>	X	X	X	
Idaho <sup>268</sup>	X		X	
Illinois <sup>269</sup>			X	
Kansas <sup>270</sup>	X	X	X	X
Louisiana <sup>271</sup>	X	X		
Maryland <sup>272</sup>	X	X		
Montana <sup>273</sup>	X	X	X	X
Nebraska <sup>*274</sup>				
Nevada <sup>275</sup>	X	X	X	
New Hampshire <sup>*276</sup>				
New Mexico <sup>277</sup>	X	X	X	X
North Dakota <sup>278</sup>	X	X	X	X

261. This Table updates, and is modeled after, the one found in *Bomar, supra* note 127, at 58.

262. See ALASKA STAT. § 26.23.150 (2020) (referencing weather modification only in emergency powers).

263. See ARIZ. REV. STAT. ANN. §§ 45-1601 to -1607 (2020).

264. See Ark. Code Ann. § 12-75-115 (2020) (referencing weather modification only in emergency powers).

265. See CAL. WATER CODE § 235 (West 2020).

266. See COLO. REV. STAT. §§ 36-20-101 to -126 (2020); COLO. CODE REGS. §§ 401-1:1 to :23 (2020).

267. See FLA. STAT. §§ 403.281-.411 (2020).

268. See IDAHO CODE §§ 22-4301 to -4302 (2020); *id.* § 42-1805(11).

269. See 35 ILL. COMP. STAT. 200/27-30 (2020); *id.* 200/27-80; *id.* 200/27-85.

270. See KAN. STAT. ANN. §§ 82a-1401 to -1425 (2020); KAN. ADMIN. CODE §§ 98-4-1 to -8 (2020).

271. See LA. STAT. ANN. §§ 37:2201-08 (2020).

272. See MD. CODE ANN. LOCAL GOV'T § 13-701 (West 2020) (licensing and reporting for select counties); *id.* § 14-106 (mentioning weather modification only in emergency powers).

273. See MONT. CODE ANN. §§ 85-3-101 to -424 (2019); MONT. ADMIN R. 30.20.102 to .401 (2019).

274. See NEB. REV. STAT. § 2-3237 (2020) (mentioning weather modification only to authorize districts).

275. See NEV. REV. STAT. §§ 544.010-.240 (2020).

276. See N.H. REV. STAT. ANN. § 12-F:1 (authorizing governor to experiment with weather modification).

277. See N.M. STAT. ANN. §§ 75-3-1 to -15 (2020); N.M. CODE R. § 19.17.2 (2020) (same).

Oklahoma <sup>279</sup>	X	X	X	X
Oregon <sup>280</sup>	X	X	X	
Pennsylvania <sup>281</sup>	X	X	X	X
Rhode Island* <sup>282</sup>				
Tennessee* <sup>283</sup>				
Texas <sup>284</sup>	X	X	X	X
Utah <sup>285</sup>	X	X	X	X
Virginia* <sup>286</sup>				
Washington <sup>287</sup>	X	X	X	X
West Virginia* <sup>288</sup>				
Wisconsin <sup>289</sup>	X	X	X	X
Wyoming <sup>290</sup>	X	X		X
Washington, D.C.* <sup>291</sup>				
<b>30</b>		<b>18</b>	<b>16</b>	<b>12</b>

\*Have laws which only reference weather modification in passing.

---

278. See N.D. CENT. CODE §§ 61-04.1-01 to -41 (2019); N.D. ADMIN CODE §§ 89-07-02-01 to -26 (2020).

279. See OKLA. STAT. tit. 82, §§ 1087.1-.2 (2020); OKLA. ADMIN. CODE §§ 785:15-1-1 to -7; *id.* §§ 785:15-3-1 to -20; *id.* §§ 785:15-5-1 to -4; *id.* § 785:15-7-1.

280. See OR. REV. STAT. §§ 558.010-.990 (2020).

281. See 3 PA. CONS. STAT. §§ 1101-18 (2020).

282. See R.I. GEN. LAWS § 30-15-7 (2020) (mentioning weather modification only in emergency powers).

283. See TENN. CODE ANN. § 58-2-116 (2020) (mentioning weather modification only in emergency powers).

284. See TEX. AGRIC. CODE ANN. §§ 301.001-.302 (West 2020); 16 TEX. ADMIN. CODE §§ 79.1-.80 (2020).

285. See UTAH CODE ANN. §§ 75-15-3 to -8 (West 2020); UTAH ADMIN CODE r. 653-5-1 to -9 (2020).

286. See VA. CODE ANN. § 44-146.22 (2020) (mentioning weather modification only for emergency powers).

287. See WASH. REV. CODE §§ 70A.10.10-.210 (2020); WASH. ADMIN CODE §§ 173-495-1010 to -1020 (2020).

288. See W. VA. CODE § 15-5-20 (2020) (mentioning weather modification only in emergency powers).

289. See WIS. STAT. § 93.35 (2020); Wis. Admin. Code ATPC §§ 54.01-.06 (2020).

290. See WYO. STAT. ANN. §§ 9-1-901 to -909 (West 2020); 37-1 WYO. CODE R. §§ 1-8 (2020); 37-2 WYO. CODE R. §§ 1-11 (2020).

291. See D.C. CODE § 7-2305 (2020) (referencing weather modification only in emergency powers).