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Options for Public Control of Atmospheric Management

Keywords

Regulation, Liability, Licensing, Negligence, Nuisance, Permits, Science and Technology, Sovereign Immunity, Strict Liability, Trespass

Options for Public Control of Atmospheric Management

RAY JAY DAVIS

INTRODUCTION

Intentional modification of weather is a goal which has been partly reached by treating the atmosphere with chemicals. Clouds have been "seeded" to trigger changes in their behavior. Although much needs to be learned before weather resources can be managed to the extent scientific theories postulate, several types of weather phenomena can now be influenced by weather modification technologies:

(1) Supercooled fog and stratus clouds can be treated to improve visibility;

(2) Snowpack, and the resulting runoff, can be augmented by modifying winter clouds rising over some mountain barriers;

(3) Rain can be increased from some kinds of summer cumulus clouds, and their potential for precipitation can be enhanced by increasing the size of clouds; and

(4) Hail suppression is attempted in many places, and although experiments are not conclusive, evaluations of some projects suggest that hail damage in some kinds of storms can be reduced.¹

Because the atmospheric environment deeply affects the quality of life,² management of atmospheric resources has been subjected to legal control by governmental institutions. In the United States, courts have been employed in a number of instances to provide public means for control of weather modification activities.³ There is cloud seeding legislation in several countries, including South Africa,⁴ Canada,⁵ Australia,⁶ and the

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1. WEATHER MODIFICATION ADVISORY BOARD, U.S. DEP'T OF COMMERCE, *THE MANAGEMENT OF WEATHER RESOURCES* 5 (1978) (Report to the Sec'y of Comm.). See also A. DENNIS, *WEATHER MODIFICATION BY CLOUD SEEDING* (1980); L. BATTEN, *HARVESTING THE CLOUDS: ADVANCES IN WEATHER MODIFICATION* (1969); B. MASON, *CLOUDS, RAIN AND RAINMAKING* (2d ed. 1975).

2. See M. GLANTZ, H. VAN LOON & E. ARMSTRONG, *MULTIDISCIPLINARY RESEARCH RELATED TO THE ATMOSPHERIC SCIENCES* (1978); W. SEWELL, *MODIFYING THE WEATHER: A SOCIAL ASSESSMENT* (1973); W. SEWELL, *HUMAN DIMENSIONS OF WEATHER MODIFICATION* (1966).

3. See Davis, *Weather Modification Law Developments*, 27 OKLA. L. REV. 409, 412-15 (1974).

4. Weather Modification Control Act, Act No. 78, June 12, 1972 (S. Afr.).

5. E.g., An Act Respecting Artificial Inducement of Rain, Bill 6, Mar. 11, 1970 (Que.).

6. E.g., Rain-making Control Act, Act No. 7637, Dec. 19, 1967 (Vict.).

United States.⁷ In some nations there are administrative rules and regulations concerning weather resources management.⁸

Some governmental control over intended weather alteration activities takes place at a local level.⁹ However, in the United States, it is more common to regulate cloud seeding through agencies of state governments.¹⁰ In many countries public control of atmospheric management takes place at the national level.¹¹

Various legal options are available for public control of atmospheric management. Among those which have been employed and which will be considered herein are:

- I. Incidental Control
 - A. Delivery of Seeding Materials
 - B. Water Resource Rights
 - C. Liability Claims
- II. Informational Control
 - A. Technological Expertise
 - B. Disclosure
- III. Administrative Control
 - A. Project Registration
 - B. Operational Permits
 - C. Professional Licensing
- IV. Contractual Control
 - A. Authorization Laws
 - B. Appropriation Statutes
 - C. Procurement Laws and Regulations
- V. Governmental Operations
- VI. Prohibition of Weather Modification Activities
 - A. Partial Ban
 - B. Complete Ban

I. INCIDENTAL CONTROL

Prior to the time of scientific cloud seeding there were no statutes,

7. National Weather Modification Policy Act of 1976, 15 U.S.C. § 330 (1976).

8. *E.g.*, 15 C.F.R. §§ 908.1-21 (1981); Rain-making Control Regulations, 1968, Statutory Rules 2237/68 (Vict.).

9. *See, e.g.*, Pennsylvania *ex. rel. Township of Ayr v. Fulk*, No. 53 (C.P. Fulton County, Pa., Feb. 28, 1968).

10. Davis, *State Regulation of Weather Modification*, 12 ARIZ. L. REV. 35 (1970). *See also* Davis, *Weather Modification Interstate Legal Issues*, 15 IDAHO L. REV. 555 (1979).

11. Such efforts at national control have not been very successful in the United States. *See* Johnson, *Federal Organization for Control of Weather Modification*, 10 NAT. RESOURCES J. 222, 237-52 (1970). *See also* Taubenfeld, *Weather Modification and Control: Some International Legal Implications*, 55 CALIF. L. REV. 493 (1967). Legal control over use of weather modification as a weapons system is discussed in Davis, *Weather Warfare: Law and Policy*, 14 ARIZ. L. REV. 659 (1972). Proposed international rules respecting weather resources management are noted in Davis, *WMO/UNEP Weather Modification International Law Proposals*, 12 J. WEATHER MODIF. 127 (1980).

administrative regulations, or judicial decisions concerning weather modification activities. Many jurisdictions, including forty percent of the states in the United States, still have no legislation relating specifically to weather resource management.¹² This does not mean, however, that weather modification is uncontrolled by governmental agencies in such places. Control incidental to the use of other kinds of governmental power is widespread. Regulation of the delivery of seeding materials into the atmosphere is one type of control. Allocation of atmospheric water rights is another control device. A third type is legal response to liability claims.

A. *Delivery of Seeding Materials*

Flight control regulations in statutes and administrative rules are intended to protect the public convenience and safety. They include rules concerning transportation of hazardous materials. Carriage on board aircraft of inflammables in the United States is subjected to Federal Aviation Administration (FAA) rules.¹³ Some cloud seeding materials dispensed from aircraft are inflammable. Examples are pyrotechnics, which are mounted on racks on aircraft wings, and mixtures of silver iodide (the major cloud seeding chemical) with acetone, which are burned in wing tip generators. The FAA has given exemptions from its hazardous materials rules to weather modifiers.¹⁴ In doing so, or refusing to grant permission to drop pyrotechnics or burn generators, that agency regulates weather modification incidentally to its role as the guardian of aircraft safety.

In some parts of the United States over half of the opportunities for treating the atmosphere take place at night. The occupation of a cloud seeding pilot thus involves unusual hours. Pilots can spend many days grounded because no seedable clouds are available, and when there are seedable events it may be necessary for them to work many successive hours. Aviation control agencies, such as the Australian Department of Civil Aviation, have flight time rules. These restrictions are, however, waived for seeding aircraft operations. It is not necessary to employ duplicative pilots who actually work only when atmospheric conditions require seeding beyond the time set for usual aircraft piloting.¹⁵ Authority to make flight-time rules and then to grant or withhold waivers therefore constitutes the power to control airborne weather resources management.

Cloud seeding flights take place in and near storm clouds, and in-

12. Davis, *supra* note 3, at 415 (1974). See also Davis, *State Regulation of Weather Modification*, 12 ARIZ. L. REV. 35, 55-63 (1970).

13. 49 C.F.R. §§ 107.1-373, 175.1-90 (1980).

14. Exemptions are given under the procedures set forth in 49 C.F.R. § 107.113 (1980), and standardized in F.A.A. Weather Control Exemptions, 49 C.F.R. § 175.10(12) (1980). They are processed by the Exemption Branch of the Office of Hazardous Materials Regulation.

15. DIVISION OF RADIOPHYSICS, COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, *FOURTH COURSE OF INSTRUCTION IN CLOUD-SEEDING TECHNIQUES* 26 (1968).

volve problems of air traffic control. There must be coordination of flight instructions relayed from project managers on the ground who have weather radar information and traffic instructions from governmental air traffic controllers who direct commercial and general aviation movements. The formal agreement on flight control between the North Dakota state-operated weather modification managers and the FAA is an example of air traffic control cooperation.¹⁶ The administrative power to determine flight patterns can, however, be used to regulate seeding from aircraft.¹⁷

Much weather modification activity takes place on the ground. Persons who control access to ground facilities can exercise incidental control over treating clouds. Many of the prime areas for American seeding projects are on or in the atmosphere above federally owned land. Some National Forest Service units have asserted that persons wishing to use ground-based seeding generators or monitoring equipment must obtain special land use permits for those activities in the national forests.¹⁸ Issuance or denial of permits would be a form of control over cloud seeding incidental to the general permit-granting authority.

In order to preserve certain areas from development, the United States Congress has designated nationally owned areas of primitive character and ecological significance as part of the national wilderness system.¹⁹ Both cloud seeding and the collection of hydrometeorological data needed to evaluate its impact may intrude upon wilderness areas. Through use of their power generally to prevent uses inconsistent with the wilderness character of such areas, some administrators of national forests and parks have taken the position that mechanized access to data collection instruments in wildernesses will not be allowed.²⁰ Proposals to reduce the impact of this sort of incidental control by setting up a procedure for approval of various means of data collection have not been enacted into law.²¹

B. *Water Resource Rights*

Precipitation enhancement is advocated by persons and organizations wishing to obtain additional water. They may not, however, be able to use

16. Interview with John Odegard, Department of Aviation, University of North Dakota (Oct. 30, 1980).

17. Interview with Thomas Henderson, President of Atmospheric Inc., Kenya Tea Growers Association, Department of Civil Aviation (Apr. 1975); interview with Alex Alusa, Meteorologist, Department of Agriculture (Kenya).

18. Sterns, *Weather Modification Activities and National Forest Land Use Permits*, in *HAIL SUPPRESSION: SOCIETY AND ENVIRONMENT* 241 (B. Farhar ed. 1977) [hereinafter cited as Farhar].

19. National Wilderness Preservation System, 16 U.S.C. §§ 1131-36 (1976 & Supp. III 1979).

20. Sterns, *Weather Modification and Collection of Hydrometeorological Data in Wilderness Areas*, in Farhar, *supra* note 18, at 238.

21. Davis, *Legal Response to Environmental Concerns about Weather Modification*, 14 *J. APPLIED METEOROLOGY* 681 (1975).

the water unless they have a legal right to exclude others from its use. Who owns the water in the atmosphere? The meager case law on this point is scattered, comes from lesser courts, and reaches different conclusions.²² Montana has a constitutional provision asserting state ownership of atmospheric waters;²³ and states have statutes reaching the same result.²⁴ These provisions, however, do not allocate water rights. They, like similar laws concerning surface and underground waters,²⁵ are merely intended to be a basis for exercise by states of the power to regulate the use of water rights.

Of more importance to sponsors of rain and snow augmentation projects than rights in the skies is the right to use additional waters on the ground and in the streams. Case law does not deal with this issue; three American states have statutes addressing it. Colorado's law provides that water flow generated by weather modification activities will be treated like other water. Seeding project sponsors can obtain a legal right of use if, but only if, they file to appropriate it.²⁶ A somewhat similar Utah statute has been interpreted to give the right of use to the added water to the appropriator whose unfilled water priority stood the highest in rank.²⁷ North Dakota by law rules that artificially induced precipitation will be treated the same as natural precipitation.²⁸ By granting or withholding inducements to mount projects, these rules form a type of control over atmospheric water resources management.

C. *Liability Claims*

When most persons think of law and weather modification their attention turns first to liability claims by land owners and others against weather modifiers. In spite of its fears about litigation the industry has been very successful in liability lawsuits. Plaintiffs have won only one

22. In *Slutsky v. City of New York*, 197 Misc. 730, 731, 97 N.Y.S.2d 238, 239 (1950), a trial court judge stated that property owners "clearly have no vested property rights in the clouds or the moisture therein." In *Southwest Weather Research, Inc. v. Duncan*, 319 S.W.2d 940, 945 (Tex. Civ. App. 1958), however, an intermediate appellate court judge said that the landowner has a right to "such precipitation as Nature designs to bestow . . . to such rainfall as may come from clouds over his own property that Nature, in her caprice, may provide." Yet another trial judge has declared that "every landowner has a property right in the clouds and the water in them," but that that right is subject to "weather modification undertaken under governmental authority." *Pennsylvania Natural Weather Ass'n v. Blue Ridge Weather Modification Ass'n*, 44 Pa. D. & C. 2d 749, 759-60 (C.P. Fulton County, Pa., 1968).

23. MONT. CONST. art. IX, § 3(3).

24. *E.g.*, LA. REV. STAT. ANN. § 37:2201 (West 1974); NEB. REV. STAT. § 2-2401(1) (1977); N.M. STAT. ANN. § 75-3-3 (1978); S.D. COMP. LAWS ANN. § 46-3A-2 (Supp. 1980).

25. 1 R. CLARK, WATER AND WATER RIGHTS § 39.3 (1967).

26. COLO. REV. STAT. § 36-20-103 (1973); COLORADO LEGISLATIVE COUNCIL, CONTROLLING WEATHER MODIFICATION ACTIVITIES (Research Publication 147) 10 (1977).

27. 1980 7c UTAH CODE ANN. § 73-15-4 (Supp. 1979); R. DEWSNUP & D. DENSEN, LEGAL ASPECTS OF WEATHER MODIFICATION IN UTAH 72-73 (1977) (Report to Utah Div. Water Resources).

28. N.D. CENT. CODE § 2-07-01 (1975).

case.²⁹ Judicial control through use of tort law has been more of a threat than a reality. Of course, assessment of damages and imposition of injunctions could be an effective means of control when plaintiffs manage to prove the elements of their tort claims.

Various liability theories have been advanced. For example, in a Michigan lawsuit, a farmer whose crop had been damaged by a storm sued a weather modification company and sponsoring farmer groups asserting theories of trespass, negligence, nuisance, and ultrahazardous activity.³⁰ Although the jury found for the defendants, this multiple theory approach to litigation seems to be the best way of getting before the courts a theory upon which liability can be based.³¹

Probably the basic reason for failure by most complainants in weather modification litigation has been their inability to prove a causal relationship between the cloud seeding activity and their harm. For example, in a Pennsylvania case,³² plaintiffs alleged that hail suppression efforts had brought about a drought. They proved that there had been seeding and that there was a drought; but they could not establish any connection between the two. It is not surprising that this should be the case. Even scientists who use sophisticated statistical analyses of long-term projects debate findings.³³ Proof of a causal connection in a single instance of seeding is obviously more difficult.

If liability claims are proven, defendants still can prevail by proving an affirmative defense. The privilege of public necessity is one such defense. Anglo-American common law gives persons a right to protect the public from an imminent disaster by performing acts which might otherwise be tortious. For example, a firefighter may pull down buildings to form a fire break to stop a conflagration.³⁴ So too, it might be argued, could a cloud seeder bring about an inundation of forest lands to stop a fire. Public necessity and other defenses diminish the number of cases in which the judiciary would be able to control weather modification efforts.

29. *Southwest Weather Research, Inc. v. Rounsaville*, 320 S.W.2d 211 (Tex. Civ. App. 1958), and *Southwest Weather Research, Inc. v. Duncan*, 319 S.W.2d 940 (Tex. Civ. App. 1958), both *aff'd sub nom.*, *Southwest Weather Research, Inc. v. Hones*, 160 Tex. 104, 327 S.W.2d 417 (1959).

30. *Reinbold v. Sumner Farmers, Inc. and Irving P. Krick, Inc.*, No. 2734-C (Cir. Ct., Tuscola County, Mich., 1974); see Davis & St.-Amand, *Proof of Legal Causation in Weather Modification Litigation: Reinbold v. Sumner Farmers, Inc. and Irving P. Krick, Inc.*, 7 J. WEATHER MODIF. 127 (1975).

31. See, e.g., *Adams v. California*, Civil No. 10112 (Sup. Ct., Sutter County, Cal., 1964); Mann, *The Yuba City Flood: A Case Study of Weather Modification Litigation*, 49 BULL. AM. METEOROLOGICAL SOC'Y 690 (1968).

32. *Pennsylvania Natural Weather Ass'n v. Blue Ridge Weather Modification Ass'n*, 44 Pa. D. & C. 2d 749 (C.P. Fulton County, Pa., 1968).

33. See A. DENNIS, *supra* note 1, §§ 6.1-6.5. A defendant who acts to prevent a threatening injury from some force of nature, or some other independent cause not connected with the threat, is said to be acting under necessity.

34. W. PROSSER, *LAW OF TORTS* 124-27 (4th ed. 1971).

II. INFORMATION CONTROL

Information about weather modifications is freely exchanged among scientists, cloud seeding companies, and nations.³⁵ A professional organization, the Weather Modification Association, holds semiannual meetings during which cloud seeders exchange information on techniques and activities. The organization also publishes a journal.³⁶ Other meteorological publications, such as the *Bulletin of the American Meteorological Society* and the *Journal of Applied Meteorology*, contain articles relating to weather management technologies.³⁷ Numerous official reports are also available.³⁸ Consequently persons knowledgeable in the field can keep current.

In spite of this cooperation and information exchange, much remains to be learned about the properties, dynamics, and behavior of the atmosphere and about its response to different seeding techniques. Additionally, there are many persons interested in weather resources management who are not well versed in the science and technology. Withholding information from such persons, or requiring information disclosure by people who propose and carry out experimental or operational projects has impeded proper seeding operations.

A. Technological Expertise

Persons who seek to launch cloud seeding projects in Australia usually have become aware of weather modification through reading of the activities of the Commonwealth Scientific and Industrial Research Organization (CSIOR). This science agency of the Australian government has been successfully involved in weather modification research and development for over thirty years. Although they share their expertise with state governments,³⁹ CSIOR scientists do not assist in private projects.⁴⁰ Through informational control the government has kept the private sector from performing cloud seeding.

35. J. HOBBS, *APPLIED CLIMATOLOGY* § 8.3 (1980).

36. The *Journal of Weather Modification*, published by the Weather Modification Association, P.O. Box 8116, Fresno, California 93747. The association has published a short explanation in lay terms of the processes involved in cloud seeding. *WEATHER MODIFICATION: SOME FACTS ABOUT SEEDING CLOUDS* (1977). Copies can be obtained from the Association.

37. The bulletin covers meteorology and climatology generally. The journal deals with the application of meteorological principles, including cloud physics and cloud seeding. Both are published by the American Meteorological Society, 45 Beacon Street, Boston, Massachusetts 02108.

38. *E.g.*, the series of reports by the World Meteorological Organization on its weather modification project, PEP. Through May 1980 there have been twenty reports in the series. Report No. 13, *WMO Training Workshop on Weather Modification for Meteorologists: Lecture Notes* (1979), is in essence a handbook on cloud seeding science and technology.

39. See Smith, *Cloud Seeding in Australia*, in W. HESS, *WEATHER AND CLIMATE MODIFICATION* 444 (1974).

40. See Davis, *The Law of Precipitation Enhancement in Victoria*, 7 *LAND & WATER L. REV.* 1, 6-9 (1972) [hereinafter cited as *Precipitation Enhancement in Victoria*].

B. *Disclosure*

The National Environmental Policy Act of 1969 directs that all agencies of the federal government shall include in every recommendation or report on proposals for legislation and other major federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on the environmental impacts and consequences of the proposed action.⁴¹ Federal projects, which include a large portion of experimental projects in the United States,⁴² must not be conducted without complying with this advance disclosure requirement if they will have a significant environmental impact. Preparation of adequate impact statements requires analysis of meteorological and hydrologic records and consideration of the "natural and social sciences and the environmental design arts in planning and decisionmaking."⁴³ Public access to environmental impact statements gives people a means of ascertaining whether environmental considerations have been adequately incorporated into the projects.

When there are laws and rules mandating that cloud seeding records be kept and that reports based upon them be made, the public also has access to information about weather resources management. The federal government in Canada has a record keeping and reporting statute⁴⁴ which is supplemented by administrative regulations.⁴⁵ Weather modification cannot legally be practiced without public and official knowledge. Adverse publicity can have a very real impact upon an industry.⁴⁶

III. ADMINISTRATIVE CONTROL

Weather modification activities are now regulated by state administrative agencies in about half of the United States.⁴⁷ Agencies, acting under statutory authority, use a variety of administrative control techniques. Among them are project registration, operational permits, and professional licensing.

A. *Project Registration*

In Idaho persons doing cloud seeding must register with the state

41. 42 U.S.C. § 4332 (2)(c) (1976).

42. For a number of years a federal Interdepartmental Committee on Atmospheric Sciences made annual reports on expenditures of national agencies for weather alteration research and development, and since 1972 federal agencies report their activities to the Department of Commerce. See M. CHARAK, WEATHER MODIFICATION REPORTING PROGRAM, 1973-1978 (1979), which lists, among others, all federal projects.

43. 42 U.S.C. § 4332 (2)(A) (1976).

44. Weather Modification Information Act, 1971, ch. 59 (Can.).

45. See Canada: Weather Modification Information Act and Regulation Administrative Guidelines (1974) (government publication).

46. See Gellhorn, *Adverse Publicity by Administrative Agencies*, 86 HARV. L. REV. 1380 (1973).

47. Davis, *supra* note 3, at 415; see also Davis, *State Regulation of Weather Modification*, 12 ARIZ. L. REV. 35, 55-63 (1970).

Department of Agriculture.⁴⁸ Although the department has no discretion to reject attempted registration of inappropriate seeding projects, it at least has an official register of operations in the state.

The World Meteorological Organization (WMO) also has a register of projects.⁴⁹ Member nations in the organization pass along to WMO information as to what projects are being carried out in their jurisdictions. One of the rather hesitant steps toward international legal control over weather modification is the recommendation by experts designated by member governments that the register be maintained by WMO and that members report the required information needed for it.⁵⁰

B. *Operational Permits*

Use of the power to issue operational permits is a more effective form of administrative regulation. Illinois has a law under which state officials have the power to impose conditions upon persons who desire to carry out weather modification operations in the state.⁵¹ The time and place of seeding, materials and amounts, radar, kinds and numbers of personnel, target and control areas, and other particulars of proposed operations are reviewed by the regulators. They can shape permits to fit their perception of the public interest as well as that of the project sponsors.

Interim administrative modification of permits allows for adjustments required by unforeseen or changed circumstances. The Council of State Governments' recommended that weather control law delegates administer such power.⁵² There are also provisions for emergencies when permits can be suspended, for revocation and refusals to renew permits and for hearings to protect the rights of permit holders.⁵³ In order for these requirements to be effective it is necessary to have competent administrative personnel who monitor projects so they can know when administrative intervention is needed.⁵⁴

C. *Professional Licensing*

People selling their services as cloud seeders should be both competent and honest. The Weather Modification Association has a system for

48. IDAHO CODE ANN. §§ 22-3201, 3202 (1977).

49. WORLD METEOROLOGICAL ORGANIZATION, REGISTER OF NATIONAL WEATHER MODIFICATION PROJECTS (1979).

50. DAVIS, *WMO/UNEP Weather Modification International Law Proposals*, 12 J. WEATHER MODIF. 127, 129 (1980).

51. ILL. STAT. ANN. ch. 111 § 7391 (d) (1978). See Ackerman, Changnon & Davis, *The New Weather Modification Law for Illinois*, 55 BULL. AM. METEOROLOGICAL SOC'Y 743 (1974).

52. 1978 SUGGESTED STATE LEGISLATION, Weather Modification Control Act, § 409 at 9, 20 (Council of State Governments, 1977).

53. *Id.* § 410.

54. Davis, *supra* note 3, at 415. There has been effective monitoring in, for example, Illinois, North Dakota, South Dakota, Texas, and Utah. Those states have been given resources necessary to carry out monitoring.

certification of weather modification managers and operators. They must demonstrate competency to be certified.⁵⁵ Unfortunately, some cloud seeders are not members of the Association. It is necessary, therefore, for governments wishing to check on the qualifications of seeders to set up a licensing system. California, as an example, requires minimum levels of educational and practical experience as a prerequisite to being licensed.⁵⁶

In addition to competency, there is a need for integrity by weather modifiers. Literature is full of stories of swindling "rainmakers," boastful "experts," and athletic "rain dancers."⁵⁷ Arizona, in order to protect the public from persons who promise much and deliver somewhat less, requires that persons seeking authority to modify the clouds file with the regulatory agency copies of their advertising.⁵⁸ Revelation of dishonesty can be a step in the direction of its prevention.

IV. CONTRACTUAL CONTROL

Mr. Justice Holmes once remarked that "men must turn square corners when they deal with the government."⁵⁹ By requiring people who use government monies to meet conditions imposed by contract, officials can exercise very extensive control over publicly funded weather resource management.⁶⁰ Three types of laws relate to such contractual control: authorization laws, appropriations statutes, and procurement laws and regulations.

A. *Authorization Laws*

Under the Anglo-American system of jurisprudence, government spending programs cannot be undertaken without prior legislative approval. Such authorization legislation in some jurisdictions takes the form of giving power to agencies which are already in existence to carry out cloud seeding. Thus in New York there is a law which authorizes incorporated municipalities to spend money on weather modification;⁶¹ in California the law stipulates that any agency empowered to develop water resources can seed clouds;⁶² and a 1980 Illinois law grants the state water survey authority to evaluate cloud seeding.⁶³

In the Great Plains states, statutes authorize the creation of special weather modification districts which may levy and collect taxes and then

55. The Association's qualifications and procedures for certification are set forth at 12 J. WEATHER MODIF. 142-44 (1980).

56. CAL. WATER CODE § 408.5 (Supp. 1981).

57. See D. HALACY, THE WEATHER CHANGERS (1968).

58. ARIZ. REV. STAT. ANN. § 45-2405 B (Supp. 1980).

59. *Rock Island, A. & L. R.R. v. United States*, 254 U.S. 141, 143 (1920).

60. R. DAVIS, THE LEGAL IMPLICATIONS OF ATMOSPHERIC WATER RESOURCES DEVELOPMENT AND MANAGEMENT § 13 (1968).

61. N.Y. GEN. MUNIC. LAW § 119 (p) (McKinney Supp. 1980).

62. CAL. GOV'T CODE § 53063 (West 1966).

63. Ill. H.B. 2841 (1980) (final version).

spend their funds on weather resource management.⁶⁴ These authorization laws stipulate procedures for creation of the districts, outline procedures for them to follow, and provide means for their dissolution. In North Dakota, for example, a petition process has been used to set up and dissolve weather modification authorities.⁶⁵

B. Appropriation Statutes

In addition to authorization legislation, it is necessary that expenditure of governmental funds be carried out in accordance with the purposes of appropriation. When appropriations are not forthcoming, government supported programs must shut down. For example, in South Dakota, which was the first state to have a statewide weather modification program, failure by the legislature to continue funding killed the program.⁶⁶ The appropriations power is a double-edged sword: the public can use it to encourage cloud seeding by paying the bill, or can use it to halt government-funded weather resources management.

C. Procurement Laws and Regulations

In addition to the sort of fiscal arrangements found in most contracts, government contracts contain clauses inserted because of the requirements of procurement legislation. Bidders also must comply with negotiated terms of the agreement. The manner of cloud seeding can thereby be controlled. Accordingly, federal agencies, which are the major source of research and development funds, have been able to control weather modification experimentation in the United States. They use the power of the purse and of contract to get their way.⁶⁷

V. GOVERNMENTAL OPERATIONS

At one time the Utah cloud seeding law permitted only the Utah Division of Water Resources to perform atmospheric water resource development in the state.⁶⁸ In the Australian state of Victoria, seeding permits are given only to governmental entities.⁶⁹ In communist and many socialist countries cloud seeding is a government monopoly.⁷⁰ At least in the-

64. S. CHANGNON, R. DAVIS, B. FARHAR, J. HAAS, J. IVENS, M. JONES, D. KLEIN, D. MANN, G. MORGAN, S. SONKA, E. SWANSON, C. TAYLOR & J. VAN BLOCKLAND, *HAIL SUPPRESSION: IMPACTS AND ISSUES* 146-48 (1977).

65. N.D. CENT. CODE § 2-07-06.5 (1975).

66. See Donnan, Pellet, Leblang & Ritter, *The Rise and Fall of the South Dakota Weather Modification Program*, 8 J. WEATHER MODIF. 2 (1976).

67. Davis, *State Regulation of Weather Modification*, 12 ARIZ. L. REV. 35, 60-62 (1970).

68. UTAH CODE ANN. § 73-15-1 (Supp. 1973). The law provided that the "State of Utah . . . shall be the only entity . . . that shall have authority to sponsor and develop cloud seeding research or implementation projects to alter precipitation or cloud forms within the State of Utah."

69. *Precipitation Enhancement in Victoria*, *supra* note 40, at 10-11.

70. See WORLD METEOROLOGICAL ORGANIZATION, REGISTER OF NATIONAL WEATHER MODIFICATION PROJECTS (1979).

ory, government operation of atmospheric alteration programs is a complete form of public control over them.

VI. PROHIBITION OF WEATHER MODIFICATION ACTIVITIES

A. *Partial Ban*

One of the most intrusive forms of control over atmospheric management is a partial ban of cloud seeding activities. The ban could be partial in that it bars seeding unless some condition is met. The Illinois law provides that there shall be no cloud seeding in the state unless it is done under the authority of a permit and carried out under the supervision of a licensed cloud seeder.⁷¹ Such conditional bans form the basis for administrative controls.

Another type of partial ban is a prohibition of a particular kind of activity. Minnesota, for example, bans delivery of cloud seeding materials from ground-based generators.⁷² Pennsylvania disallows seeding for the purpose of suppressing lightning.⁷³

B. *Complete Ban*

The most intrusive type of regulation of atmospheric alteration is a complete ban. Maryland is the only jurisdiction which has enacted such a law. The ban there, however, is no longer in effect.⁷⁴

SUMMARY AND CONCLUSION

Intentional weather modification is partially attained by treating the atmosphere with chemicals. Government institutions at all levels and within each branch control atmospheric resources management because the atmospheric environment deeply affects the quality of life. Various legal options available for public control of atmospheric management have been considered in this article.

Incidental control includes regulation of delivery of seeding materials and allocation of atmospheric and ground water rights. Rules governing carriage on board aircraft of inflammable and other hazardous materials, flight time, flight patterns, access to ground facilities and activities, and the use of water rights have proved effective means of control. Judicial control through the use of civil liability claims has been rendered ineffective by plaintiffs' inability to prove a causal relationship, and by defendants' ability to prove the affirmative defense of public necessity.

Informational control of technological expertise curtails improper seeding operations, and the National Environmental Policy Act of 1969 requirement of advance disclosure by a responsible official concerning en-

71. ILL. STAT. ANN. ch. 111, § 7310 (1978).

72. MINN. STAT. § 42.09 (6) (Supp. 1980).

73. PA. STAT. ANN. tit. 3, § 1115 (Supp. 1980).

74. MD. CODE ANN. art 66C, § 110A (1967).

vironmental impact provides public knowledge of seeding operations. Adverse publicity insures incentives for self-regulation of the cloud seeding industry.

Administrative agencies use a variety of control techniques including project registration, operational permits and professional licensing. State and national requirements to register projects within the respective jurisdictions provide observation of activities. Member nations of the WMO pass along this information to maintain international coordination of weather modification. Operational permits impose conditions on the time, place, and manner of seeding, while governmental licensing encourages competent and honest weather modifiers.

Governments exert control over seeding programs through authorization by legislative approval and evaluation of weather resource management districts. These districts secure control through negotiated terms of the contract and through expenditure of governmentally appropriated funds. Some governments either grant permits only to governmental entities or completely prohibit weather modification activities. Although no complete ban is in effect now, governmentally imposed conditions provide one of the most intrusive forms of control over atmospheric management.

Many routes have been taken for public control of atmospheric management. Control strategy usually relies upon a mix of options. It is important that there be careful consideration of control devices so that a proper combination of them will protect against indiscriminate weather modification programs, and secure an atmospheric environment favorably affecting the quality of life.

