



ARTIFICIAL CLOUD SEEDING UNDER PUBLIC INTERNATIONAL LAW: REGULATORY GAPS AND THE LIMITS OF INTERNATIONAL LEGAL RESPONSIBILITY

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Received: 20/01 /2026

Accepted: 16/03 /2026

Published: 31/03 /2026

Abstract:

Artificial cloud seeding is one of the most legally intricate techniques of weather modification. It brings scientific intervention into direct contact with sovereign prerogatives, environmental constraints, and economic considerations, while operating in the absence of detailed international legal rules tailored to this emerging activity. As states have expanded the use of cloud seeding to address climate change impacts, particularly drought and water scarcity, the international legal framework has not kept pace with accelerating scientific developments. The difficulty is not the permissibility of cloud seeding in principle, but the structural weakness of existing international law in regulating its practice, identifying the legal responsibilities it generates, and addressing its potentially transboundary effects.

Keywords: Artificial cloud seeding, climate change, legal responsibility.

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Introduction:

Recent scientific and technological advances have enabled new forms of deliberate human intervention in natural phenomena. Artificial cloud seeding is among these techniques, designed to influence precipitation levels in response to water scarcity and the growing pressures associated with climate change. Although it may offer practical benefits for strengthening water security, it also raises sensitive legal questions within public international law, given its cross-border implications and the possibility of environmental and climatic impacts extending beyond the territory of the state conducting the operation.

These concerns are intensified by the absence of a specific international instrument governing cloud seeding, including its conditions, safeguards, and operational limits. The existing international framework largely relies on general principles drawn from international environmental law and the rules of state responsibility, without an express legal treatment of this form of climate intervention. This regulatory gap has allowed states to implement cloud seeding programs under the banner of sovereignty, while transparency and international cooperation remain limited, and while no clear obligations of notification or information-sharing are firmly established.

This context produces a central legal issue: how to determine responsibility for potential harm resulting from cloud seeding, particularly when effects reach other states or disturb regional environmental balances. Establishing a causal link is difficult, natural variability is intertwined with human intervention, and the applicable legal framework remains uncertain. Together, these factors complicate attempts to hold states internationally responsible for alleged damage.

Accordingly, this article examines artificial cloud seeding in public international law through the dual lens of regulatory insufficiency and the limits of international responsibility. It evaluates the adequacy of existing general rules, identifies the main deficiencies in their application to cloud seeding, and underscores the need for a clearer and more effective international legal framework that can accommodate scientific developments while protecting the environment and the shared interests of states.

**THE FIRST TOPIC: THE CONCEPTUAL FRAMEWORK OF
ARTIFICIAL CLOUD SEEDING**

In response to intensifying climate pressures, rising demand for water resources, and the increasing frequency of drought, artificial cloud seeding has emerged as a modern option for strengthening water security. Many states have shown growing interest in this technique because of its potential to support agricultural development and to supply water for domestic and industrial uses.



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As reliance on cloud seeding has expanded, it has increasingly been integrated into water resource management policies, particularly in countries facing severe rainfall scarcity. This trend has also triggered sustained debate over the technique's effectiveness and its potential impacts, especially given the limited availability of precise scientific data in certain respects. For that reason, adopting cloud seeding requires a balanced approach that takes development needs seriously while also meeting sustainability requirements.

FIRST REQUIREMENT: DEFINITION OF ARTIFICIAL CLOUD SEEDING

Artificial cloud seeding is a technical form of human intervention in atmospheric processes intended to modify precipitation levels and increase water resources. It is generally presented as a modern tool for addressing climate-related challenges linked to water scarcity and meteorological variability, and it has attracted increasing attention in scientific, technical, and legal discussions. This subsection clarifies the concept through the following points.

Firstly: Definition of Artificial Cloud Seeding

In linguistic usage it refers to seeking rain; it is said that people “went out to seek rain,” meaning that they went out to perform the rain-seeking prayer¹.

In technical terms, cloud seeding is defined as “an attempt to induce rainfall from clouds already present in the sky, whether those clouds naturally produce rain or do not.”² It is also defined as “an attempt to induce rainfall, or to accelerate its fall artificially, from clouds located above areas that need it, rather than allowing those clouds to move toward areas that do not require water due to their naturally favorable conditions for precipitation.” The concept further extends to attempts to increase a cloud's yield beyond what it could produce naturally, through a specific technical process. In this sense, it can encompass any operation aimed at artificially inducing rainfall, including efforts to generate clouds artificially and to enhance their components³.

Cloud seeding is additionally described as “the dispersal of solid particles into seedable clouds that are saturated with water vapor, in order to trigger rainfall.”⁴

These solid particles are known as condensation or freezing nuclei, and are also referred to as cloud seeding agents or precipitation stimulants. Their role is to attract water vapor molecules so that they accumulate and build upon them. When this occurs under suitable conditions, it promotes the growth of cloud constituents, produces precipitation, and increases its volume⁵.

Secondly: The Legal Characterisation of Cloud Seeding

According to the prevailing view in legal scholarship, artificial cloud seeding is a consensual contract of a special nature, reflecting both the specificity of its subject matter and the particularities of its implementation⁶. It is treated as a form



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of concession contract used by states through public procurement arrangements and administrative contracts concluded with specialised economic operators. It is a bilateral, consensual contract under which a technically qualified operator undertakes cloud seeding experiments in exchange for a financial consideration paid by the contracting authority, which is most often the Ministry of Irrigation and Water Resources⁷.

With respect to the approach of the Algerian legislator, Article 77 of the 2005 Water Law subjects drilling and exploration activities, seawater desalination, and the construction of dams and water barriers to a water-use concession contract. Under this framework, the state, as the conceding authority, entrusts a concessionaire with the management and operation of a public water service for a defined period in return for a specified financial consideration. The same provision lists eight forms of groundwater and surface water exploitation, yet it does not include artificial cloud seeding. Instead, it focuses on the exploitation of terrestrial water sources and does not address authorisation to exploit atmospheric water sources. In practice, this results in a prohibition on the use of cloud seeding by any farmer, even in cases of drought⁸.

Thirdly: Advantages and Disadvantages of Artificial Cloud Seeding

Artificial cloud seeding offers several advantages, particularly for states experiencing drought and declining water levels. These benefits include:

- increasing water reserves in the ground and mitigating drought conditions;
- making clouds more effective in producing rainfall;
- supporting economic growth, especially for farmers, since greater water availability tends to improve the quality of agricultural output.

At the same time, the technique has notable drawbacks, including:

- cloud seeding involves dispersing chemical substances into clouds. If the operation fails, these substances may fall to the ground and become part of the environment, potentially harming soil, water, and various living organisms;
- the technique remains subject to experimentation and review, which means its outcomes are not fully guaranteed;
- cloud seeding may alter weather patterns in other areas, potentially depriving certain regions of moisture they would normally receive and affecting rainfall processes there⁹.

SECOND REQUIREMENT: AN ANALYTICAL READING OF THE INTERNATIONAL LEGAL FRAMEWORK ON ARTIFICIAL CLOUD SEEDING TECHNIQUES

Artificial cloud seeding is now one of the most prominent contemporary applications of weather modification science. States have expanded its use to



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respond to drought, wildfires, and changes in hydrological patterns. This scientific expansion, however, has not been matched by a parallel development in public international law. The existing international framework still does not provide a coherent and comprehensive regime that regulates the chemical substances used, safeguards airspace sovereignty, and protects states from transboundary harm. The result is a serious regulatory vacuum at the international level, despite limited and fragmented attempts through scattered treaty provisions that do not reflect the technique's complexity or its environmental and health risks.

Accordingly, this study focuses on the main relevant international instruments: the Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques (ENMOD); the Convention on Long-Range Transboundary Air Pollution (LRTAP); the United Nations Framework Convention on Climate Change (UNFCCC); and the Espoo Convention on Environmental Impact Assessment in a Transboundary Context.

Firstly: The 1977 ENMOD Convention¹⁰

The ENMOD Convention is among the few international instruments that address weather modification directly. It was adopted in the Cold War context, following disclosures of military experimentation with rainfall modification during the Vietnam War. These revelations reinforced the concern that human control over climatic processes could be transformed into a weapon of exceptional danger.

Article I prohibits the use of environmental modification techniques for military or hostile purposes¹¹. The Convention's notion of "environmental modification" is deliberately broad. It covers any intervention capable of altering the natural balance of the Earth, water, or the atmosphere, including modifications of rainfall, clouds, winds, temperature, and related natural phenomena.

This breadth allows the text to capture activities that turn environmental resources into instruments of conflict, whether by inducing intense rainfall that produces destructive flooding, generating storms, or redirecting cloud paths in ways that damage another state's economy. In this sense, ENMOD represents an early international attempt to curb the weaponisation of climatic processes.

At the same time, Article III permits the use of environmental modification techniques for peaceful purposes, such as combating drought or improving agricultural production. This constitutes an explicit recognition of the permissibility of artificial cloud seeding as a civilian tool, provided it is not used to harm others. Yet this recognition is not accompanied by a detailed legal framework governing civilian practice. The Convention contains no effective oversight architecture and establishes no international body responsible for monitoring such activities or verifying compliance, which significantly weakens implementation in practice.



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ENMOD also lacks a robust deterrence mechanism. Even if a breach is proven, the Convention does not provide a clear system for imposing sanctions or ensuring compensation for harm. As a result, compliance often appears more political or moral than legally enforceable.

In addition, the Convention is narrowly oriented toward banning military or hostile use and does not lay down specific rules for civilian deployment¹², even though the most pressing contemporary risks are associated with large-scale “peaceful” use and its environmental and health consequences. A further limitation is its failure to keep pace with scientific development. In 1977, scientific knowledge was not sufficiently advanced to identify and delimit the long-term effects of the substances used in cloud seeding in the way current research seeks to do. The Convention therefore does not address several risk categories highlighted by contemporary scientific understanding.

ENMOD can thus be viewed as an important milestone in the evolution of international environmental law, but it is not capable of providing an adequate legal framework for civilian cloud seeding. It was drafted for a specific political context, not for present-day environmental and scientific conditions, and it is therefore ill-suited to the regulatory challenges posed by this modern technique.

Secondly: The 1979 Convention on Long-Range Transboundary Air Pollution (LRTAP)¹³

The Convention on Long-Range Transboundary Air Pollution (LRTAP) is concerned with reducing airborne pollutants that travel from one state to another. Because such pollutants can be carried by wind over long distances, the Convention is relevant to civilian cloud seeding. LRTAP imposes a set of obligations on states, in particular to reduce emissions, monitor air quality, and cooperate scientifically through data exchange. These requirements align with the logic of environmental impact assessment for cloud seeding activities, especially in areas characterised by strong winds or open desert environments that can facilitate the movement of chemical substances.

Nevertheless, LRTAP remains insufficient to provide a clear legal and regulatory framework for artificial cloud seeding, for several key reasons:

1. **No permitted levels for the substances used¹⁴**: the Convention does not establish international standards setting allowable levels for releases of silver iodide¹ or other seeding agents, even though such substances may deposit in water systems and affect living organisms.

¹It is a chemical compound widely used in artificial cloud seeding. It is dispersed into clouds to stimulate the formation of ice crystals and, consequently, increase rainfall.



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2. **No prior notification obligations:** cloud seeding in one state may lead to artificially induced rainfall or changes in air patterns in a neighbouring state without that state's knowledge. This constitutes a serious legal gap.
3. **No rules on international responsibility:** the Convention does not specify who bears liability or compensation if harm occurs, such as unexpected flooding, changes in water reserves, agricultural damage, or disruption of natural rainfall patterns¹⁵.

LRTAP is therefore an important instrument, but it is not adequately designed to regulate cloud seeding. Its primary purpose is to combat industrial air pollution, not deliberate climate or weather modification.

Thirdly: The 1992 United Nations Framework Convention on Climate Change (UNFCCC)¹⁶

The 1992 UNFCCC does not address cloud seeding explicitly. It nonetheless sets out key principles that can be applied to it, notably the precautionary principle, sustainable development, and scientific cooperation. These principles are relevant because cloud seeding is a high-risk activity with outcomes that remain uncertain.

1. **Precaution in relation to potentially harmful climate-related activities:**¹⁷ cloud seeding is among the techniques that warrant assessment under the precautionary principle, given the continuing lack of sufficient studies and the possibility of adverse and unintended effects, such as flooding or reduced rainfall in other regions.
2. **Scientific cooperation and transparency:** the Convention emphasises cooperation and the exchange of climate data among states. In practice, however, many states operate cloud seeding programs with limited openness and without transparent international information-sharing.
3. **No cloud-seeding specific rules:** even if the UNFCCC's general principles can be applied, the Convention contains no direct provisions regulating weather modification. It sets no safety standards, does not specifically address transboundary risks linked to cloud seeding, and does not establish reporting mechanisms for potentially hazardous climate-related activities¹⁸.

Accordingly, while the UNFCCC can function as a general frame of reference for assessing cloud seeding, it remains insufficient to regulate the technique as such.

Fourthly: The 1991 Espoo Convention¹⁹ on Environmental Impact Assessment in a Transboundary Context

The Espoo Convention addresses projects likely to cause significant transboundary environmental impacts. It can therefore apply to cloud seeding projects when they produce tangible effects on a neighbouring state. In this



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framework, the Convention requires notification of the potentially affected state, consultation, and the preparation of an environmental impact assessment.

However, the Espoo Convention does not expressly list artificial cloud seeding among the projects covered by its provisions. One reason may be the absence of agreed and operational methods for assessing the specific climate-related risks associated with cloud seeding, such as changes in hydrological systems or shifts in cloud trajectories, despite their potentially serious implications for the environment and climate²⁰.

Espoo thus offers useful general legal tools, but its scope would need to be broadened to explicitly encompass weather modification techniques.

THE SECOND TOPIC: LEGISLATIVE INADEQUACY IN THE INTERNATIONAL REGULATION OF ARTIFICIAL CLOUD SEEDING AND THE RESULTING PROBLEM OF LEGAL RESPONSIBILITY

Artificial cloud seeding is among the most contested weather modification techniques in international environmental law, not only because its environmental effects remain uncertain, but more fundamentally because of the structural shortcomings of the legal framework meant to govern it. Although the peaceful use of weather modification is implicitly accepted, the international legal order still does not provide precise rules that regulate the conditions for resorting to cloud seeding or that define the legal responsibilities arising from its potential harms. This section examines the main manifestations of this inadequacy by highlighting the absence of a dedicated international regime and the difficulties of attributing legal responsibility.

FIRST REQUIREMENT: LEGISLATIVE INADEQUACY IN THE INTERNATIONAL REGULATION OF ARTIFICIAL CLOUD SEEDING

Despite technical advances in cloud seeding and the growing interest in it as a tool to enhance water resources, the international legal framework remains incomplete. There are no clear rules governing these operations or defining states' responsibilities for potential harm. This legislative gap generates several legal difficulties, most notably how to determine civil or international responsibility when environmental or social damage results from cloud seeding, and the absence of binding mechanisms for cooperation and transparency among states. Examining these shortcomings, and the accompanying responsibility problem, is therefore necessary to understand the legal risks associated with the technique and to support calls for a more effective framework.



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Firstly: The Absence of a Dedicated International Convention on Cloud Seeding

The most immediate expression of legislative inadequacy is the absence of a specialised international convention that addresses cloud seeding directly and comprehensively. Despite the proliferation of environmental treaties, international law has not, to date, produced an instrument devoted exclusively to regulating cloud seeding, whether in terms of licensing conditions, limits of use, or oversight and accountability mechanisms. The 1977 ENMOD Convention, despite its importance, remains primarily a security- and military-oriented instrument. It seeks to prevent the use of environmental modification techniques as weapons in armed conflict, rather than to establish a comprehensive legal framework governing civilian or environmental uses of weather modification, including cloud seeding²¹.

This absence creates a legislative vacuum that allows states to undertake cloud seeding on the basis of unilateral discretion, without being bound by unified substantive rules or clearly defined procedural obligations at the international level. It also leads to significant divergence in national practice: some states adopt strict domestic regulatory frameworks, while others conduct cloud seeding without any clear legal regulation. This deepens legal uncertainty and undermines equality among states in benefiting from atmospheric resources.

Secondly: The Inability of General Environmental Treaties to Capture the Specificity of Cloud Seeding

Even if, in principle, cloud seeding can be assessed under certain general environmental treaties, those instruments remain ill-equipped to address the technique's distinctive characteristics. The 1979 LRTAP Convention and the 1991 Espoo Convention, for example, were not designed to regulate weather modification activities. Rather, they were developed to address conventional pollution sources or physical projects whose impacts are relatively measurable.

First, these treaties contain no scientific or legal standards that define the risks associated with cloud seeding or distinguish between short-term and long-term effects. Second, they set no quantitative or qualitative limits on the chemical substances used in cloud seeding operations, despite the possibility of cumulative environmental and health impacts. These gaps reduce their practical effectiveness and leave them as general instruments that are difficult to operationalise against the specific risks posed by weather modification techniques²².

**SECOND REQUIREMENT: LEGAL RESPONSIBILITY FOR
DAMAGE FROM ARTIFICIAL CLOUD SEEDING**

In the absence of specific international rules governing cloud seeding, a central issue arises: how to determine legal responsibility for damage that may result from these practices. Because cloud seeding entails direct intervention in climatic



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systems, it is difficult to delineate the harmful act and attribute it to a particular state, especially when effects extend beyond national territory. This problem is compounded by states' reliance on sovereignty to justify such activities, alongside the absence of explicit international obligations of notification or compensation. As a result, general rules of international responsibility do not fully capture the legal risks associated with cloud seeding.

Firstly: The Difficulty of Establishing Causation Between Cloud Seeding and Harm

Establishing causation is among the most complex issues in assessing legal responsibility for cloud seeding-related damage. Climatic phenomena are inherently multi-causal and shaped by interacting natural and human variables, making it difficult to link a specific harm to a specific seeding operation. This scientific complexity is often invoked as a legal argument to deny responsibility, even where serious allegations are raised, such as floods or unusual drought occurring after cloud seeding.

This situation weakens the position of injured parties, whether states or individuals, because they are required to prove a precise causal nexus in a field where scientific knowledge remains contested. It also undermines compensation mechanisms and limits the deterrent function of legal responsibility in this area.

Secondly: The Limits of Applying Traditional Rules of International Responsibility²³

Traditional international responsibility generally rests on two core elements: an internationally wrongful act and resulting damage. Applying these rules to cloud seeding raises structural difficulties, most notably the absence of an international rule that prohibits the activity or regulates it explicitly. States that conduct cloud seeding typically rely on the legitimacy of their objectives, presenting it as part of public policies aimed at combating drought or ensuring water security. This makes it difficult to characterise such conduct as internationally wrongful.

Moreover, the probabilistic nature of cloud seeding outcomes, and the scientific uncertainty surrounding them, weakens the operation of fault-based responsibility. This raises a broader question as to whether traditional responsibility rules are suited to environmental activities that are high-risk and uncertain, such as cloud seeding²⁴.

Thirdly: Responsibility for Transboundary Environmental Harm

The risks of cloud seeding become particularly acute when effects extend beyond the territory of the state conducting the operation. Weather modification may alter rainfall trajectories or precipitation patterns, potentially causing adverse impacts on neighbouring states. Yet the application of the principle of preventing transboundary harm remains limited in this context due to the absence of binding



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mechanisms for notification and consultation, the difficulty of proving harm, and the challenge of identifying the responsible state²⁵.

Fourthly: Airspace Sovereignty as a Regulatory Obstacle

The principle of territorial sovereignty requires states to exercise authority within their own territory without extending it to the territory of others, and to conduct peaceful activities in a manner that does not harm third parties²⁶. In practice, the principle of permanent sovereignty over national airspace is among the main obstacles to establishing an effective international regime for cloud seeding. Many states invoke this principle to justify weather modification without consulting neighbouring states or the broader international community. Airspace sovereignty is thus used as a legal shield against potential accountability for external effects.

However, this insistence on absolute sovereignty conflicts with contemporary developments in international environmental law, which increasingly emphasise that sovereignty is relative where activities may cause harm to others. Cloud seeding illustrates this tension clearly because its effects cannot be contained within political borders. This reality requires reconsidering airspace sovereignty in light of the demands of transboundary environmental protection.

Conclusion:

Artificial cloud seeding exposes a significant gap between rapid scientific development and the regulatory capacity of international environmental law. Legislative insufficiency, the difficulty of attributing responsibility, and the prioritisation of airspace sovereignty all impede effective legal control of this activity. Establishing a dedicated international legal regime for cloud seeding is therefore no longer a theoretical option, but a practical necessity driven by environmental protection, climate justice, and the need to balance states' sovereign interests with the international community's right to a healthy environment.

Findings

- Artificial cloud seeding is a modern technique capable of addressing certain manifestations of climate change.
- Cloud seeding remains an activity associated with serious legal and environmental risks, given the absence of precise and binding international regulation.
- Legislative gaps and the difficulty of attributing responsibility reveal a clear disconnect between scientific development and legal framing.
- Developing a dedicated international legal regime for cloud seeding is no longer optional; it is required by environmental protection imperatives and by the pursuit of climate justice among states.



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Recommendations

- Neighbouring states should be notified when cloud seeding is used, so that they can take precautions against potential risks.
- A specific international framework should be established, either through an independent convention or through a protocol attached to existing climate treaties. This framework should include clear rules on prior authorisation, environmental impact assessment, and notification and consultation where potential transboundary effects exist.
- Oversight and accountability mechanisms should be strengthened through the creation of an international mechanism to monitor cloud seeding activities, collect scientific data, track environmental impacts, and facilitate dispute resolution between states. Embedding the precautionary and prevention principles at the core of this framework is essential to ensuring responsible and sustainable use of the technique.

¹Ahmed Moukhtar Abd al-Hamid Omar. (2008). *Mujam al-Lugha al-Arabiyya al-Muasira* [Dictionary of Contemporary Arabic Language] (Vol. 1, Pt. 3, 1st ed., p. 2017). Cairo: Alam al-Kutub.

²Dennis, A.S , Weather modification by cloud seeding, Academic press, New York, 1980, p 12.

³Souad Muhammad Abd al-Jawwad Baltaji, artificial cloud seeding between prohibition and permissibility, *Majallat al-Shari'a wa al-Qanun* [Journal of Sharia and Law], vol. 02, issue 30, 2015, p. 424.

⁴Mayer Benoit, The International Law on climate change, Cambridge University Press, 2018, p 20.

⁵Sami Muhammad Abd al-Aal, cloud seeding as an effect of climate change in light of the rules of public international law, *Majallat Huquq Damietta lil-Dirasat al-Qanuniyya wa al-Iqtisadiyya* [Damietta Law Journal for Legal and Economic Studies], issue 8, July 2023, p. 52.

⁶Ali Ahmed Mahdi Aissa, the legal regulation of the cloud seeding contract, doctoral dissertation, Faculty of Law, University of Karbala, 2022, p. 65.

⁷Bouziyan Aliyan, toward an international law to regulate cloud seeding within the framework of sustainable development, *Journal of Scientific Research in Environmental Legislation*, vol. 14, no. 01, 2024, p. 10.

⁸Ordinance 09/02 of 22 July 2009, amending and supplementing Law 05/12 of 04 August 2005 on water, Official Gazette No. 44, issued on 26 July 2009.

⁹Saad bin Ali bin Turki al-Jaloud, cloud seeding: its nature and its Islamic legal ruling, *Majallat Kuliyat Dar al-Ulum* [Journal of the College of Dar al-Ulum], issue 148, January 2024, pp. 356–357.

¹⁰Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques (ENMOD), 1977, available at the following link:

https://treaties.un.org/doc/Treaties/1978/10/19781005%2000-39%20AM/Ch_XXVI_01p.pdf

¹¹Sami Muhammad Abd al-Aal, *op. cit.*, p. 93.

¹²Erica.C.Smit , Geoengineering Issues of Accountability in international law, *Nevada Law Journal*, Vol.15, 2015, p 1074.

¹³Convention on Long-Range Transboundary Air Pollution (LRTAP), 1979, available at the following link:

<https://unece.org/sites/default/files/2021-05/1979%20CLRTAP.e.pdf>

¹⁴Mukhlis Mukhlis et al , Legal and regulatory issues concerning the concept of cloud seeding in climate change mitigation, *Indonesian journal of environmental law and sustainable development*, Vol 04, June 2025.



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¹⁵Mukhlsh Mukhlsh et all, op.cit , p 138, 139

¹⁶Convention on the United Nations Framework Convention on Climate Change (UNFCCC), 1992, available at the following link: https://treaties.un.org/doc/source/recenttexts/unfccc_eng.pdf

¹⁷ Houria Ben Aouda, the legal nature of the precautionary principle in international environmental law, *Majallat al-Dirasat al-Huquqiyya* [Journal of Legal Studies], vol. 08, issue 02, 2021, pp. 850–851

¹⁸See Articles 4, 5, and 12 of the United Nations Framework Convention on Climate Change (UNFCCC).

¹⁹Convention on Environmental Impact Assessment in a Transboundary Context (ESPOO), 1991, available at the following link: <https://unece.org/sites/default/files/2021-03/Espoo%20Convention.pdf>

²⁰ See Articles 2, 3, and 5 of the Convention on Environmental Impact Assessment in a Transboundary Context (ESPOO).

²¹Mukhlsh Mukhlsh et all, op.cit , pp 140-142.

²²Ibid , p 142.

²³Ali Ahmed Mahdi Issa, *op. cit.*, p. 141.

²⁴Mukhlsh Mukhlsh et all, op.cit , pp 143,144.

²⁵Ibid, p 144.

²⁶ Ismail Abd al-Rahman, the extent of the legality of artificial cloud seeding within states' airspace in Islamic jurisprudence, *Majallat al-Dirasat al-Qanuniyya* [Journal of Legal Studies], Part 03, issue 68, June 2025.

Bibliography

FIRST: LEGAL TEXTS

- Ordinance 09/02 of 22 July 2009, amending and supplementing Law 05/12 of 04 August 2005 on water, Official Gazette No. 44, issued on 26 July 2009.
- Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques (ENMOD), 1977, available at the following link: https://treaties.un.org/doc/Treaties/1978/10/19781005%2000-39%20AM/Ch_XXVI_01p.pdf
- Convention on Long-Range Transboundary Air Pollution (LRTAP), 1979, available at the following link: <https://unece.org/sites/default/files/2021-05/1979%20CLRTAP.e.pdf>
- Convention on the United Nations Framework Convention on Climate Change (UNFCCC), 1992, available at the following link: https://treaties.un.org/doc/source/recenttexts/unfccc_eng.pdf
- Convention on Environmental Impact Assessment in a Transboundary Context (ESPOO), 1991, available at the following link: <https://unece.org/sites/default/files/2021-03/Espoo%20Convention.pdf>
- See Articles 4, 5, and 12 of the United Nations Framework Convention on Climate Change (UNFCCC).
- See Articles 2, 3, and 5 of the Convention on Environmental Impact Assessment in a Transboundary Context (ESPOO).

SECOND: BOOKS

- Ahmed Moukhtar Abd al-Hamid Omar. (2008). *Mujam al-Lugha al-Arabiyya al-Muasira* [Dictionary of Contemporary Arabic Language] (Vol. 1, Pt. 3, 1st ed., p. 2017). Cairo: Alam al-Kutub.
- Dennis, A.S , Weather modification by cloud seeding, Academic press, New York, 1980, p 12.



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- Mayer Benoit, The International Law on climate change, Cambridge University Press, 2018, p 20.

THIRD: MEMORY

- Ali Ahmed Mahdi Aissa, the legal regulation of the cloud seeding contract, doctoral dissertation, Faculty of Law, University of Karbala, 2022, p. 65.

FOURTH: ARTICLES

- Souad Muhammad Abd al-Jawwad Baltaji, artificial cloud seeding between prohibition and permissibility, Majallat al-Shari'a wa al-Qanun [Journal of Sharia and Law], vol. 02, issue 30, 2015, p. 424.
- Sami Muhammad Abd al-Aal, cloud seeding as an effect of climate change in light of the rules of public international law, Majallat Huquq Damietta lil-Dirasat al-Qanuniyya wa al-Iqtisadiyya [Damietta Law Journal for Legal and Economic Studies], issue 8, July 2023, p. 52.
- Bouziyan Aliyan, toward an international law to regulate cloud seeding within the framework of sustainable development, Journal of Scientific Research in Environmental Legislation, vol. 14, no. 01, 2024, p. 10.
- Saad bin Ali bin Turki al-Jaloud, cloud seeding: its nature and its Islamic legal ruling, Majallat Kuliyat Dar al-Ulum [Journal of the College of Dar al-Ulum], issue 148, January 2024, pp. 356–357.
- Erica.C.Smit , Geoengineering Issues of Accountability in international law, Nevada Law Journal, Vol.15, 2015, p 1074.
- Mukhlis Mukhlis et al , Legal and regulatory issues concerning the concept of cloud seeding in climate change mitigation, Indonesian journal of environmental law and sustainable development, Vol 04, June 2025.
- Houria Ben Aouda, the legal nature of the precautionary principle in international environmental law, Majallat al-Dirasat al-Huquqiyya [Journal of Legal Studies], vol. 08, issue 02, 2021, pp. 850–851