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Application of Technologies for Influencing the Weather in Contempoprary Geopolitical Situation

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Abstract

The article discusses the use of technologies for influencing the weather by the main actors of international relations and the potential consequences of the use of these technologies on global security. The authors showed that technologies for influencing the weather are currently being actively studied and legally applied in developed countries of the world (for example, in the USA, China, Russia and the United Arab Emirates) for precipitation management. However, the use of such systems for military purposes can pose serious threats not only for countries using such technologies and their neighbors, but also on a global scale, especially since the consequences of using methods of influencing the weather are not well understood in the long term. The authors believe that one of the ways to control the use of technologies for influencing weather on global level is the creation of a special international monitoring service, which will be responsible for coordinating research and the use of weather management technologies by states.

KEYWORDS: *weather management, precipitation management, global security, climate change*

1. Introduction

Modern technologies make it possible to actively influence weather conditions in order to purposefully change the properties of the cloudy atmosphere, that is, increase or decrease the amount of precipitation. It is known that a number of states are actively working in the field of guaranteed impact on weather conditions over vast territories. The main technology for weather correction is active influence on clouds. The most famous way is to "seed" them with chemical reagents. This can stimulate precipitation or disperse clouds. Such technologies are actively used today in agriculture, aviation, as well as during festive events. The use of technologies for influencing the weather for military purposes is prohibited by the UN convention.

In the current international political and scientific community, there are different views on the causes of global climate change. However, the authors of the most authoritative and numerous climate community, represented by the Intergovernmental Panel on Climate Change (IPCC), emphasize "the dominant role of the anthropogenic factor and are convinced that human impact on the climate system is obvious" [1, p.42]. This approach is reflected in Article 1 of the United Nations Framework Convention on Climate Change (UNFCCC), which defines climate change as: "climate change, which is directly or indirectly caused by human activities, which causes changes in the global atmosphere and is superimposed on the natural fluctuations of the climate observed during comparative periods of time" [2]. This shows that the global climate is changing not only as a result of increasing concentrations of greenhouse gases in the atmosphere. Anthropogenic impacts on climate also include the availability or development of appropriate technologies that can affect the weather in a given area over a period of time with a pre-planned effect.

The purpose of the article is to assess whether the use of weather change technologies can affect the balance of power in modern international relations.

2. Method of investigation

The study of the use of technologies for influencing the weather is at the intersection of several areas, in particular, international relations, political science, international security, i.e. is multidisciplinary. It is this multidispilinarity and complexity of the problem that determined the methodological basis of the study, which consisted of the principles of objectivity, multifactoriality and consistency. To achieve the goals set in the article, the authors applied the

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interdisciplinary method of discourse analysis, since it is the most productive for studying the consequences of the application of technologies for influencing the weather in the modern geopolitical situation, since it answers the following questions: "how did the technologies for influencing the weather evolve, which countries are now using such technologies and for what purposes, the possible consequences of using technologies of influence on the weather for civil and military purposes, whether the use of technologies for influencing the weather can cause local and international conflicts in the contempopary world. "

To determine the potential consequences of the use of technologies for influencing the weather, a systematic approach and its component were used as a political analysis, which made it possible to present a holistic vision of the climatic challenges of influencing the weather in the modern geopolitical situation. The comparative method allowed authors to compare the potential of different countries that own and develop technologies for influencing the weather, and to assess the possible consequences of using technologies for influencing the weather for peaceful and military purposes. The use of the forecasting method showed high risks of uncertainty from the use of technologies for influencing the weather, since today the long-term consequences of the use of weather management technologies and their impact on the health of the population, the climate of the planet as a whole and individual regions have not been studied.

The empirical basis of the work was the data of the Uniten Nations, Intergovernmental Panel on Climate Change (IPCC), a study by the US Department of Defense school, data on issued patents for geoengineering and weather modifications [1-3], data on the development and application of technologies for influencing the weather from open sources [4-9].

3. Investigation Results

3.1.Development of technologies for influencing the weather.

Technologies for influencing the weather began to be actively developed back in the middle of the last century, when it was found that silver iodide and lead iodide contribute to the appearance of water crystallization centers in the clouds. When reagents get into the clouds, premature crystallization of moisture occurs, and as a result, precipitation occurs. Reagents are sprayed, as a rule, from aircraft. It has a similar effect on hail.

According to www.freepatentsonline.com, more than 200 patents were issued for weather modification and geoengineering technologies between 1890 and 2014 (see Fig. 1). Since 2014, information on issued patents in this category has not been disclosed. For example, the first patent describing a method of producing rainfall was issued to Louis Gettmann back in 1891. In 1920, Paul Weiss patented a process and device for creating intense artificial clouds and fogs, and in 1924 Charles Miller created a mist dispersing compound. Later, a method of generating electric fields for recharging clouds, a method of artificially influencing the weather, means of communication through a layer of ionized gases, a communication system with a trap of electromagnetic radiation, a method of seeding clouds, an atmosphere modification satellite, a method and device for changing the area of the earth's atmosphere, ionosphere, and magnetosphere, the creation of artificial ionization clouds above the ground, a method and device for cleaning the atmosphere, methods for removing aerosols from the atmosphere, and many other were invented and patented. The analysis showed that the authors of the inventions are both civilian and military engineers.

Weather patenting peaks in the 1970s and 1990s, as shown in Figure 1, which can be explained to the tensions in international relations at that time.

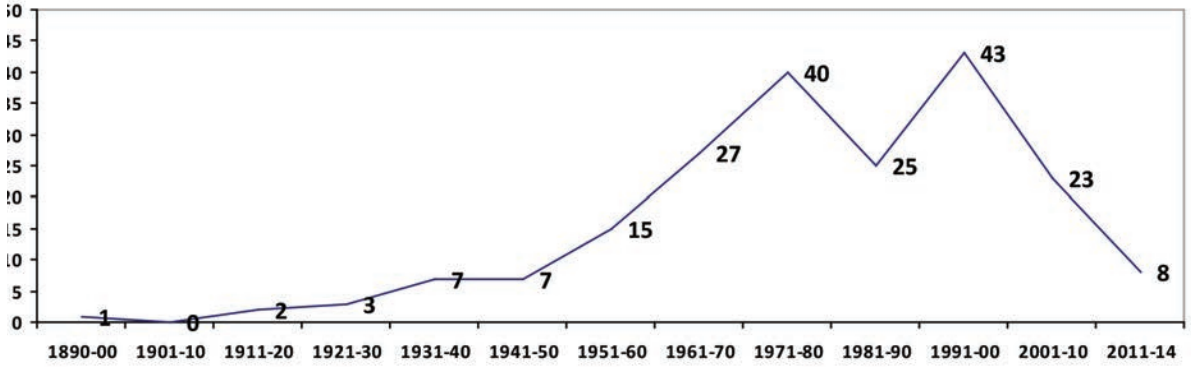

Figure 1: Number of patents for weather control and geoengineering
Source: compiled by the author based on [3]

Currently, the most famous and confirmed example of the application of technologies for changing weather is the provision of sunny weather during festive events. For example, in China, before the opening ceremony of the Olympic Games in 2008, it rained on the outskirts of Beijing, and during the ceremony itself, there were no clouds over the Olympic capital. In addition, fog dissipation is carried out in aviation to improve the safety of aircraft landing, in agriculture to increase precipitation and increase yields.

The only confirmed military use of climate change technology to date is Operation Popeye (Spinach) by the US military during the Vietnam War. As a result, a threefold increase in precipitation and the duration of the rainy season were recorded. This operation showed the danger of using technologies for influencing the weather.

Since 1976, military exposure to the weather has been prohibited by the Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modifications Techniques (ENMOD).

3.2. Modern geography of weather influence projects

Today, about 20 countries are actively applying weather management technologies in practice. The main purpose of their application is an attempt to replenish fresh water supplies, irrigate arid regions and reduce air pollution in large cities. Practical application of methods for managing natural factors is observed in the USA, Russia, China, the United Arab Emirates, etc.

USA. Because the United States is often plagued by tropical storms, in that country from 1962 to 1983, the government supported the Stormfury Science Project, which experimented with seeding clouds from an airplane with silver iodide to weaken the hurricane by turning it into regular rain.

Today, there are not many scientific studies on climate change technologies in the open access, it is easier to find journalistic materials. However, in 1996 a report prepared by American military analysts "Weather as a Force Multiplier: Owning the Weather in 2025" was published [4]. The document describes technologies that can be used to control the weather for military purposes. According to the document, by 2025, the US aerospace forces will be able to "control the weather" and use them in solving a wide range of military tasks. The purpose of the document is to indicate the use of the weather change system in military interests.

According to the document, the system for influencing the weather on a micro and macro scale should include specially trained specialists, access points to the global meteorological network containing observations and weather forecasts around the world, a system of sensors that provide high-precision weather sensing (ground, air, water, space), developed algorithms for modeling and forecasting weather changes in the required area in near real time, proven technologies weather interventions and simulations; and a feedback system. This weather network is shown schematically in Fig. 2.

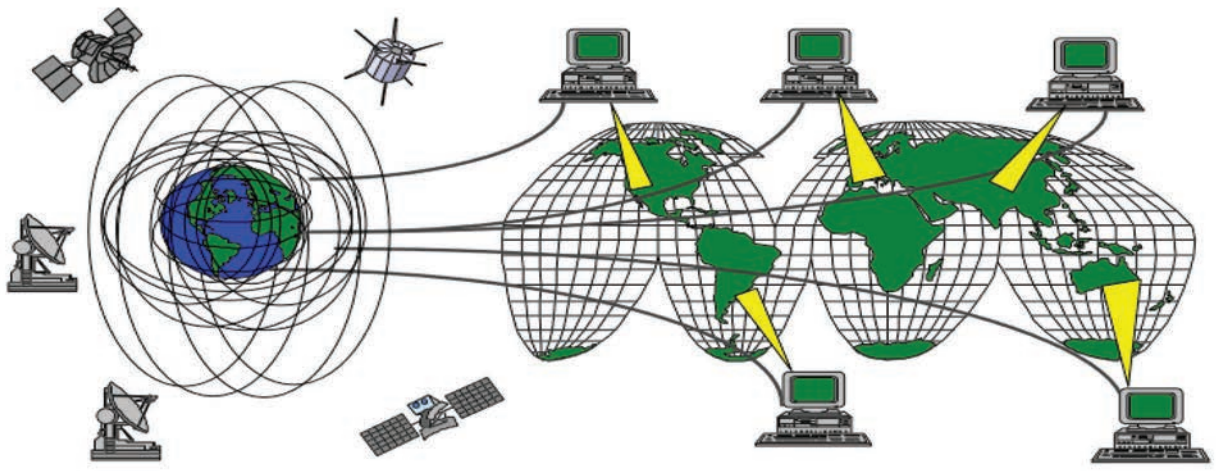

Figure 2. Global weather network. Source: [4]

The use of weather modification in combination with military analytics and forecasting will increase the effectiveness of military operations of the armed forces. In addition to weather modeling, this system will allow to quickly assess the probability of success of the operation, the resources required, the vulnerability of the enemy and the associated risk. The algorithm of the system, based on the initial data, selects the correct weather modification tools and uses them to achieve the desired effect in both offensive and defensive operations. Weather modification in defensive operations will help preserve critical infrastructure, weapons and human lives, and in offensive operations

- increase the enemy's vulnerability.

A year after the release of the report in 1997, a research project was launched in Alaska to study the interaction of the ionosphere with powerful electromagnetic radiation, the HAARP station (High Frequency Active Auroral Research Program). In addition, the United States owns two other similar stations in Puerto Rico HIPAS (English High Power Auroral Stimulation) and in Alaska. Both of these stations have similar instruments to HAARP.

In Europe, there are also two world-class complexes for the study of the ionosphere, which are located in Norway. They are EISCAT (European Incoherent Scatter radar site) and SPEAR (Space Plasma Exploration by Active Radar).

Similar research complexes exist in different countries ("Sura" in Russia, URAN-1 - the project of the Ionospheric Observatory of the Institute of the Ionosphere in Ukraine, the "Horizon" radio engineering system in Tajikistan, and others).

The official goal of all these systems is to study the ionosphere. But HAARP differs from these complexes by its high power and unique combination of research tools.

Russia. In Russia, weather management technologies are widely used to prevent rainfall. There is a special Russian cloud dispersal service.

The most famous Russian radio complex for the study of the ionosphere "Sura" was put into operation in 1981. Here, research is carried out in various fields, in particular, the study of the laws governing the generation of artificial turbulence and artificial electromagnetic radiation of ionospheric plasma in various ranges when exposed to powerful radio waves. At present, the project has been transferred by the Ministry of Defense to the balance of the Federal State Scientific Institution "Research Radiophysical Institute".

During preparation for the Winter Olympics in Sochi, weather management technologies were adapted to the weather conditions in the region, in particular, a comprehensive environmental monitoring system was launched, including a network of stationary and mobile stations. The peculiarity of this region is mountainous relief and possible sharp changes in temperature. In addition to precipitation management, a method for the forced descent of avalanches with a threatening thickness of snow cover and the possibility of using an artificial snow system was developed.

China. The political, economic and military strength of China has led to the fact that this country is also actively developing technologies for influencing the weather. Between 2012 and 2017, the government spent more than $ 1.34 billion on weather change programs. Cloud seeding technology is now used by about 50,000 Chinese municipalities to create sunny weather.

In December 2020, the State Council of the People's Republic of China issued a directive on measures to "develop a quality weather modification project", which is to be launched in 2025 [5].

Officially, the goal of this program is to more effectively combat natural disasters such as droughts, hail, forest fires, as well as the development of agricultural regions and the protection of the environment. It is assumed that the project will make it possible to cause snowfall, rain or prevent hail on an area of more than 5.50 million square kilometers. And it will be possible to prevent hail over an area of about 0.58 million square kilometers.

Until 2035, the Chinese government plans to achieve "comprehensive prevention of security risks." It is also difficult to find more detailed information about this program in China in open sources. It can be assumed that China's successes in the field of weather change will lead to the implementation of more ambitious geoengineering and climate projects, which could lead to unforeseen serious consequences.

Although the technology of "seeding clouds" is used not only in China, but also in many other countries of the world, but the scale of Chinese projects surpasses those of other states.

Middle East. Another region of the Earth where governments have a keen interest in managed climate change is the Middle East. Especially the oil-producing countries of the Arabian Peninsula.

The first installation to artificially induce a thunderstorm front was installed and tested in Abu Dhabi (United Arab Emirates) in the summer of 2010. The system consists of 20 ionizers, which during 122 days of test operation were able to provoke 52 cases of precipitation. Also, the UAE leadership invested $15 million in nine different rain amplification projects, one of which is rain control drones developed by the UK's University of Reading. Drones themselves do not create rain, but help accelerate rain production by seeding clouds. Since early 2021, the National Center for Meteorology (NCM) has conducted 126 cloud seeding operations. [6]

Another project to change the arid climate in the UAE is the construction of an artificial mountain, for which $ 400 million has been allocated. Research is carried out jointly with the National Center for Meteorology and Seismology and the National Center for Atmospheric Research (USA). It is necessary to determine the overall size of the artificial structure, its height and flatness of the slopes, as well as in which region of the country it is best to build it. Rain clouds will form near the mountain, which can later be dispersed across different regions of the country.

Europe. There is also serious research being done in Europe on weather and precipitation management. One of the most ambitious projects is the creation of a system for the formation of an artificial thunderstorm front

by the Swiss company Weathertec. Their installations operate in Jordan and the UAE. Thus, according to the report of the Department of Meteorology of the Ministry of Transport of Jordan, "the implementation of the Weathertec project has helped to change the entire ecosystem of the country" [7]. The project developers believe that their installation will help to extinguish large-scale forest fires in different countries more quickly and cheaper.

3.3 Consequences of using technologies of influencing the weather for civil and military purposes

Today, weather management technologies can prevent fog, rain, avalanches and hail, and, if necessary, ensure precipitation in a specific area.

Thus, the dispersion of fogs in airport areas contributes to an increase in visibility and ensures safe takeoff and landing of aircraft; increased rainfall, rising water levels in rivers and improved irrigation in arid zones can solve the problem of crop loss due to drought; dispersing fog over power transmission lines and highways, will protect the wires from the adhesion of snow and gusts, and the mains from ice.

It can be assumed that the introduction of such technologies is justified from an economic point of view, since an alternative option for irrigating territories, for example, can be the purchase of water, laying pipe systems and using aviation, which requires significant investments. Atmospheric moisture is not only essential for agriculture, it is also a promising source of renewable energy.

On the other hand, the implementation of projects to increase precipitation can have negative effects such as flooding. Also, when "cloud seeding" occurs, large amounts of silver iodide in the air can potentially adversely affect the health of people on earth. Artificial formation of precipitation in a certain area can have unpredictable consequences for other areas, since the creation of rain in one place means that water is taken from the air in another, where it should have been spilled.

From a military point of view, weather control involves the creation and use of climate weapons of great destructive power, which is disguised as natural phenomena, does not cause damage to personnel and military equipment, and the use of which is difficult to prove. In a general sense, influencing the weather for military purposes is necessary to solve two main problems: helping one's own and allied forces, and weakening the enemy's armed forces.

The first point concerns the creation of favorable weather conditions to facilitate the conduct of hostilities, in particular, improving visibility, ensuring the safe operation of aviation, eliminating interference and improving the quality of radio communications, accurately predicting the weather and countering possible attempts to influence the weather by the enemy. Fulfillment of the opposite task (weakening the enemy) is achieved thanks to a set of measures such as artificially increasing the level of precipitation in order to cause floods and paralyze the enemy's transport communications; artificially reducing the level of precipitation, in order to cause drought in enemy territories and difficulties in the supply of fresh water; the creation of unfavorable weather conditions that impede the conduct of hostilities (increased wind speed, deterioration of visibility); violation of radar and radio communication by direct impact on the Earth's ionosphere. The use of technologies for changing the weather for military purposes leads to the destruction of infrastructure, paralysis of the economy, losses in agriculture, disruption of the work of state and commercial structures, mass casualties, large financial losses and demoralization of the local population.

As mentioned above, active influence on the weather for military purposes is prohibited in accordance with the 1976 UN international convention.

Ukraine supports this position. In 2013, a bill was registered on the prevention of negative phenomena as a result of activities aimed at artificial changes in the state of the atmosphere and atmospheric phenomena. [8] One of the reasons for this was the massive protests of Ukrainian ecologists and farmers against interference in the atmosphere due to the harm of agricultural products. The use of rain dispersal technologies led to the fact that from 2011-2013 the harvest loss in the regions of Ukraine ranged from 30 to 60%.

3.4. Potential international conflicts due to influence on the weather

In September 2012, Iranian President Mahmoud Ahmadinejad, accused "enemies of dispersing rain clouds over Iran, which led to droughts and loss of crops in the country" [9]. In July 2021, Iran faced the worst drought in the past 50 years, due to a lack of water, citizens took to the streets with anti-government slogans, during which two people were killed.

And while other countries, including the United States, are also investing in weather management technologies, China's activity in this area is alarming, especially in neighboring India. Its agriculture is heavily influenced by monsoons, which have already been compromised by climate change. Relations between India and China are quite tense today, as evidenced by the 2020 border conflict. It is possible that controlling the weather will give China a big advantage

in fighting in the mountains, where the ability to move troops is highly dependent on weather conditions.

Taiwan is also concerned about China's application and development of weather-influencing technologies and fears that, in addition to "seeding the clouds," China will introduce even more extensive geoengineering technologies like solar radiation management without consulting other states.

4. Conclusions

Thus, it is clear that any methods of using technologies for influencing the weather (both for civilian and military purposes) can seriously affect the balance of power of all actors of international relations and create significant problems for regional and global security. This is because the overall process of weather change can be a continuous cycle of real-time weather interventions (actions and feedback) that can provide the desired weather behavior.

The danger of using weather management technologies also lies in the fact that to date, their long-term consequences and impact on the health of the population, the climate of the planet in general and individual regions have not been studied. Since the term "climate" means a long-term weather regime, i.e. the average state of the atmosphere over a long period of time in a certain area, the long-term application of weather change technologies can become one of the significant causes of climate change on the planet.

Therefore, one of the ways to resolve the situation, reduce the danger from the use of weather technologies, and prevent conflicts between states can be the creation of an international body that will coordinate the actions of states and other international actors regarding the development and application of weather management technologies.

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