

Evaluating Weather Warfare in Alternative Futures: A Game Changer in Future Power Rivalry

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Abstract— *Weather warfare or in other words weather modification, finds its place in warfare history in the past and in emerging technologies in the present context. During different eras of world history amidst being challenged for its legality and environmental impact, weather modifications survived under the shield of scientific purposes. Against this backdrop, weather warfare being the elephant in the room in power rivalry, this paper finds it imperative to evaluate its futuristic aspects in terms of alternative futures.*

Therefore, the problem statement of this paper is to answer the plausibility of weather warfare in alternative futures. In order to find feasible solutions, the methodology adopted in this paper is qualitative based on secondary sources including media and the internet and it is further analyzed using the four alternative scenarios for the future. The discussion includes evaluating the usage of weather warfare in the past, elaborating on the usage of weather warfare in the present context, revisiting the possible methods of weather warfare based on inventions in world history, critically examining the legality of weather warfare and finally to analyze weather warfare as a possible game changer in future world power rivalry. As a result, the main objective of this study is to unveil the plausibility of weather modification as a military strategy in alternative futures with its' possibility to identify as a game changer in world power rivalry.

Keywords— **Weather Warfare, Alternative Futures, Power Rivalry**

I. PROLOGUE

In the introduction, it is aimed to define the key terms of this paper, namely, weather warfare and alternative futures.

The term ‘weather warfare’ or ‘weaponizing weather’ means creating adverse weather conditions to result in a disastrous battlefield for hostile parties. In other words, weather warfare means the use of weather modification techniques for military purposes. ‘Weather’ and ‘War’ are two concepts closely linked. Warriors throughout the ages have used weather to their advantage, and some have suffered from its effects on the outcome of battles. As explained by Coble (1997), “*The timing of the Normandy invasion on D-day, 6 June 1944, was dictated*

by a favourable weather forecast. While the Allied weather forecasters got it right, the German forecasters felt the weather would prohibit the successful crossing of the English Channel. This forecast contributed to the unsuspecting mood of the German military on that particular day. During the same war but in a different theatre, the Japanese used the weather to conceal their approach to the Hawaiian Islands, enhancing their surprise attack on Pearl Harbor”. Similarly, there are various examples of situations where weather played a critical role in the outcome of war. Historically, the military adapts to the weather. In addition, even the training manoeuvres are framed in adapting the soldier to the changing environment or to the climate. Thus, what if military forces could shape the weather to enhance operations, hinder or prevent enemy operations, or both? Such is the futuristic promise of weather modification in alternative futures.

Further, in terms of scientific and commercial purposes the term ‘weather warfare’ is often used as ‘weather modification’, defining the means of artificially attempting or creating or altering climate for *bona fide* purposes.

Alternative futures are one of the main categories of Future Studies. Its four alternative scenarios for the future are developed by the University of Hawaii. Alternative futures can be defined as a series of imagined but plausible states of things which would occur in the future world. As per England’s Economic Heartland, alternative futures are not predictions of the future, rather they are plausible futures that reflect different drivers of change.

Weather warfare to be used on the battlefields as a military strategy requires high technological advances which could be afforded only by the superpowers in warfare. In order to test ‘weather warfare’ in alternative futures, it is a must for its plausible occurrence rather than to be a mere prediction. Weather warfare not being a novel concept, has been used in battlefields back during World

War II as per the recorded history and maybe the inventions trace back even to prior eras in which no written evidence has been found. On the other hand, in the present context, weather modification has been tested by many countries to advance their crops and also as a viable means to overcome climate change challenges. In these circumstances, it is apparent that there is a plausible occurrence of weather warfare in the world power rivalry in alternative futures.

II. RESEARCH METHODOLOGY

The problem statement, methodology and the objectives of this research are as follows;

The research problem of this paper is mainly focused on answering the plausibility of weather warfare in alternative futures.

The methodology of this paper relied on qualitative methodology and further, according to the principles of alternative futures, weather warfare will be tested in terms of the four alternative scenarios of 1) growth, 2) Collapse, 3) Constraint and 4) Transformation. The application of these four scenarios to weather warfare could summarily be done as follows: the first component of *growth* stands for the modification or weaponizing of weather as a concept and its later application on the battlefields. The second component of *collapse* resembles the critics against the weather warfare aftermath of its application. The third component of *constraint* stands for the legal limitations against weather warfare and finally, the fourth component of *transformation* could be the plausible futuristic application of weather warfare as a game changer in world power rivalry which this paper strives to outline.

Furthermore, in order to answer the given problem statement, this study requires an extensive study of weather warfare, and as a result, the objectives of this research aim to:

- Evaluate the usage of weather warfare in the past
- Elaborate the usage of weather warfare in the present context.
- Revisit the possible methods of weather warfare based on inventions in world history.
- Critically examine the legality of weather warfare.
- Analyze weather warfare as a possible game changer in future world power rivalry.

III. HISTORICAL BACKGROUND

The evidence of the usage of weather warfare in the past is barely traceable due to the confidentiality and restrictive nature of those experiments. Few available records of Western examples are as follows:

Project Cirrus was the first scientific effort to seed clouds by the US Department of Defence (DOD) in the late 1940s when the US Army Signal Corps contracted to provide support for the project. During the 1950s and early 1960s, military interest in weather modification was limited, thus the interest appeared during the Vietnam War. As per Coble (1997), the first scientifically controlled and monitored effort generally recognized by the meteorological community as constituting weather modification occurred in 1948 when Dr Irving Langmuir first experimented with artificially seeding clouds in order to produce rain. It is stated that his experiments showed positive results, sparking tremendous interest in the field nearly overnight. Though no conclusive evidence could be traced, this paper suggests this may be the same attempt in weather modification where the DOD was involved as stated above.

The Tirpitz was the Nazis' most imposing warship and the largest battleship ever built by a European Navy. It was also nicknamed "The Lonely Queen of the North" by Norwegians and "The Beast" by Winston Churchill. The battleship had been anchored at Kafjord to threaten Allied ships bringing supplies to the Soviet Union. This massive vessel should have been an easy target for bombers. Therefore, Hitler's navy used a toxic artificial fog to conceal the ship when it was stationed in the Norwegian fjord. Gannon (2018) stated that "*Nazis released chlorosulfuric acid into the air, which attracts moisture and can create a smoke screen.The substance is known to be corrosive, and the group of soldiers responsible for producing this smoke had to wear special protection suits*". It is also recorded that the ship was finally sunk by Allied bombs in 1944. Thus, it is scientifically proved that the adverse environmental impact of this one military engagement during World War II is still evident in the forests of Norway.

Project Popeye, was a US mission used to weather modification in North Vietnam and in Laos during the Vietnam War back in 1967. Here, the environmental modification technique of cloud-seeding is applied by the US military. As per the records found in the Office of the Historian (1967), Volume XXVIII of Foreign Relations of United States 1964-1968 clearly spelt out that the objective of was to prolong the monsoon season and block enemy supply routes along the Ho Chi Ming Trail. This project was "*a test phase approved by State and Defense and conducted during October 1966 in a strip of the Lao Panhandle generally east of the Bolovens Plateau in the valley of the Se Kong River. The test was conducted without consultation with Lao authorities (but with Ambassador Sullivan's knowledge and concurrence) and, to the best of our knowledge, remains unknown to other*

than a severely limited number of U.S. officials". It is said that during the test phase, more than 50 cloud seeding experiments were conducted. The results are viewed by the DOD as outstandingly successful. The amount of rainfall-induced by seeding is believed to have been sufficient to have contributed substantially to rendering vehicular routes in this area inoperable. It is also mentioned that "*in one instance, the rainfall continued as the cloud moved eastward across the Vietnam border and inundated a U.S. Special Forces camp with nine inches of rain in four hours*". It is the writer's opinion that in this test attempt of weather warfare, the US military has developed advanced capabilities that enable it selectively to alter the weather patterns.

IV. WEATHER WARFARE IN THE PRESENT CONTEXT

In the present context, weather warfare can be twofold. One, is the scientific and/or commercial weather modification and the other, is the military application of weather modification.

It is evident that in the recent past China, the United Arab Emirates and Saudi Arabia scaling up rainmaking. They perform these innovations as scientific experiments thus China's attempts in artificially altering weather also affect the neighbouring States such as its competitor India and similarly, between the Middle East rivals UAE and Saudi Arabia. For example, Dubai, a UAE emirate, commenced cloud-seeding back in 2010 in order to increase the groundwater level. According to the World Meteorological Organization, Mexico's Air Force, for example, has begun cloud-seeding in the past 12 months. The Arctic Ice Project, an NGO, intends to deploy small hollow glass beads, composed of silicon dioxide, across parts of the Arctic Sea's ice and in the Arctic Ocean to increase reflectivity and slow global warming. Australian universities are piloting a salt spray over the Great Barrier Reef to reflect more of the sun's heat in an attempt to conserve the reef. (Racsek, 2022) These are a few of many incidents that took place worldwide in terms of weather modification.

In terms of military application of weather modification: the one type of weather modification still used by the US military is fog suppression. Fairchild AFB in Spokane, Washington, has the only operational fog suppression system in the US military. Installation of this system occurred in the early 1970s as part of **Project Cold Wand**, an experiment to explore the possibilities of fog suppression. Two other systems were installed, one at Elmendorf AFB, Alaska, and the other at Hahn Air Base (AB), Germany. (Coble, 1997, p.21)

However, this paper argues that in the present context, ultimately, both folds of aforementioned weather modifications fall under weather warfare in terms of power rivalry despite the objective being scientific or commercial.

V. POSSIBLE METHODS OF WEATHER WARFARE

Coble (1997) mentions that most Benign Weather Modifications (BWM) efforts focus on four general areas: 1) precipitation or rainfall enhancement, 2) hail suppression, 3) fog dispersal, and 4) snow augmentation. All four areas are of commercial interest, encouraging continued research.

Agricultural interests continue to focus on rainmaking or precipitation enhancement to alleviate occasional drought, while hail suppression is important in reducing crop damage. The aviation community continues to explore the means needed to disperse fog in order to improve airport efficiency and safety as well as on-time rates. Ski resort operators use snow augmentation techniques in order to supplement the natural snowfall. In addition, local communities depending on snowpack for drinking water occasionally use snow augmentation to increase winter snowfall.

Moreover, Dr. Joseph Golden of the National Oceanic and Atmospheric Administration (NOAA) Office of Oceanic and Atmospheric Research at Silver Spring, Maryland assumed that three new likely areas of weather modification research in the future as: 1) ice storm suppression or abatement, 2) hurricane modification, and 3) tornado modification. (Coble, 1997, p.10)

In this regard, Racsek (2022) comments, "*The technology falls, generally, into three categories with different objectives: fertilizing the ocean to increase its uptake of carbon; brightening clouds or ice to reflect more sunlight back into space and thus reduce global or local warming; or the most common technology – as seen in agricultural communities or ski resorts – of injecting aerosols into the stratosphere to increase rainfall or snow, or to modify a storm*".

Furthermore, with regard to artificial earthquakes, though not yet a popular topic in weather warfare debate, have an imperative history based on an electro-mechanical oscillator which was a steam-powered electric generator patented by Nikola Tesla in 1893. Sources declare that later in life, Tesla claimed one version of the oscillator caused an earthquake in New York City in 1898, gaining it the popular culture title 'Tesla's earthquake machine'. Thus, sadly, the aftermath of this innovation is silent in world history even though some critics complain that the machine was stolen by a powerful State.

In addition, one of the earliest forms of lightning machines was recorded in ancient Greece with regard to stage machines as described by Julius Pollux in his *Onomasticon* and part of this was the *keranoskopeion*, which was a lightning machine. (Kuritz, 1988) Further, in the present context, a pocket-carrying Tesla Coil Lightning machine is available to purchase in online marketing. In these circumstances, there is a high possibility of using these mechanisms in weather warfare by the powerful States.

Therefore, this paper emphasizes that there is a plausible usage of artificial earthquakes as well as lightning in alternative futures apart from the other weather warfare techniques.

VI. LEGALITY OF WEATHER WARFARE

In short, United Nations (UN) treaties prohibit using weather modification to kill or maim people. Modifying weather to cause injury or death is outlawed. For instance, causing lightning to strike exposed enemy infantry is illegal as per the International Humanitarian Laws.

However, the best mechanism for policing such interventions is found in a UN convention that dates back to the end of the Vietnam War following the ethical concerns of Operation Popeye. The Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques, known as the ENMOD Convention, came into force in 1978 and has been ratified by 78 countries, including Russia, the United States, Britain, China and Germany.

ENMOD's Article I emphasize that signatories are 'not to engage in military or any other hostile use of environmental modification techniques having widespread, long-lasting or severe effects as the means of destruction, damage or injury to any other State Party'. Article II outlines 'any technique for changing – through the deliberate manipulation of natural processes – the dynamics, composition or structure of the earth, including its biota, lithosphere, hydrosphere and atmosphere, or of outer space'. This covers all weather- and climate-modifying technology currently in use.

Chossudovsky (2008) comments, "*While the substance of the 1977 Convention was reasserted in the UN Framework Convention on Climate Change (UNFCCC) signed in the 1992 Earth Summit in Rio, debate on weather modification for military use has become a scientific taboo. Military analysts are mute on the subject. Meteorologists are not investigating the matter environmentalists are focused on greenhouse gas emissions under the Kyoto*

Protocol. Neither is the possibility of climate or environmental manipulations as part of a military and intelligence agenda, while tacitly acknowledged, part of the broader debate on climate change under UN auspices" Therefore, it is clear that though military tampering with climate and environment is illegal thus it seems operative under the shield of scientific purposes.

VII. AS A GAME CHANGER IN WORLD POWER RIVALRY

With the afore discussed, it is apparent that there is a plausible usage of weather warfare in alternative futures which will become a potential tool in the world power rivalry. Therefore, in order to establish weather warfare as a game changer in the alternative future, the following has considered one example of cloud-seeding or rainmaking in the evaluation.

As the Science for the People Magazine publication in 1972 on weather warfare elaborating on Project Popeye, it suggested that weather modification could be used to achieve longer-range military, economic, or political effects despite the general expectations in conventional warfare, "*strategic rain-making could be used to slow infiltration. Or adjustments of dry and wet weather during growth and harvest times could disrupt the economy and social structure of a small country; it could create famine or at least extreme hardship"* In this backdrop, it is clear that further to the disastrous effects that rain-making, if weather warfare constructed rain stopping, it could have cause a major devastation on human society, for instance, crop destruction, floods, drought, etc and the potential ecological effects. On the other hand, increasing rainfall beyond the watershed capacity of the land could create flooding and landslides. Weather modification would probably alter the structure of plant and animal communities due to changes in their reproduction, growth and mortality rates in weather-sensitive species. The danger is irreparable as the causes would require several years for the ecological changes to be noticed.

Most importantly, aside from these plausible environmental consequences, at a time of increasing geopolitical tensions a well-intentioned weather manipulation has a greater chance to be viewed as hostile. For example, weather manipulation tools could be used to disrupt a neighbour's agriculture or military planning. Experts even predict that future warfare will be fought on natural resources as the world already witnessed in the Middle East. As a result, weather modification even in terms of overcoming climate change by one country will have adverse effects on neighbouring States despite the reason not being a pure military-minded weather warfare.

VIII. CONCLUSION

Thereby, the results of weather warfare can be favourable to one country while being hostile to another. In fact, the advancement of technology has become the major cause in making the winner in the world power rivalry. Technology has never developed without an objective, it is fair to inquire what to do with the advanced technology. The future of weather warfare is highly dependent on the advancement of technology. Therefore, it is crystal clear that rather than praising technology the real matter is to question what is the purpose of the technology. In alternative futures, there seems a plausible possibility of the powerful states using weather warfare to dominate the regions in the world and the pathway to this process is guided under the veil of scientific or commercial purpose whereas the true face of military purposes. In this backdrop, revisiting the ENMOD is a timely requirement in order to control the weather warfare in alternative futures due to its high plausibility as a military strategy in future warfare as well as in diplomacy which could be used in both ways as a hard power and as a soft power. Therefore, finally, it is evident that there is a plausibility of weather warfare as a military strategy in alternative futures, especially as a potential method to become a game changer in world power rivalry in the future.

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