Chapter 2
Required Capability

Why Would We Want to Mess with the Weather?

According to Gen Gordon Sullivan, former Army chief of staff, "As we leap technology into the 21st century, we will be able to see the enemy day or night, in any weather- and go after him relentlessly."[3] A global, precise, real-time, robust, systematic weather-modification capability would provide war-fighting CINCs with a powerful force multiplier to achieve military objectives. Since weather will be common to all possible futures, a weather-modification capability would be universally applicable and have utility across the entire spectrum of conflict. The capability of influencing the weather even on a small scale could change it from a force degrader to a force multiplier.

People have always wanted to be able to do something about the weather. In the US, as early as 1839, newspaper archives tell of people with serious and creative ideas on how to make rain.[4] In 1957, the president's advisory committee on weather control explicitly recognized the military potential of weather-modification, warning in their report that it could become a more important weapon than the atom bomb.[5]

However, controversy since 1947 concerning the possible legal consequences arising from the deliberate alteration of large storm systems meant that little future experimentation could be conducted on storms which had the potential to reach land.[6] In 1977, the UN General Assembly adopted a resolution prohibiting the hostile use of environmental modification techniques. The resulting "Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Technique (ENMOD)" committed the signatories to refrain from any military or other hostile use of weather-modification which could result in widespread, long-lasting, or severe effects.[7] While these two events have not halted the pursuit of weather-modification research, they have significantly inhibited its pace and the development of associated technologies, while producing a primary focus on suppressive versus intensification activities.

The influence of the weather on military operations has long been recognized. During World War II, Eisenhower said,

[i]n Europe bad weather is the worst enemy of the air [operations]. Some soldier once said, "The weather is always neutral." Nothing could be more untrue. Bad weather is obviously the enemy of the side that seeks to launch projects requiring good weather, or of the side possessing great assets, such as strong air forces, which depend upon good weather for effective operations. If really bad weather should endure permanently, the Nazi would need nothing else to defend the Normandy coast![8]

The impact of weather has also been important in more recent military operations. A significant number of the air sorties into Tuzla during the initial deployment supporting the Bosnian peace operation aborted due to weather. During Operation Desert Storm, Gen Buster C. Glosson asked his weather officer to tell him which targets would be clear in 48 hours for inclusion in the air tasking order (ATO).[9] But current forecasting capability is only 85 percent accurate for no more than 24 hours, which doesn't adequately meet the needs of the ATO planning cycle. Over 50 percent of the F-117 sorties weather aborted over their targets and A-10s only flew 75 of 200 scheduled close air support (CAS) missions due to low cloud cover during the first two days of the campaign.[10] The application of weather-modification technology to clear a hole over the targets long enough for F-117s to attack and place bombs on target or clear the fog from the runway at Tuzla would have been a very effective force multiplier. Weather-modification clearly has potential for military use at the

operational level to reduce the elements of fog and friction for friendly operations and to significantly increase them for the enemy.

What Do We Mean by "Weather-modification"?

Today, weather-modification is the alteration of weather phenomena over a limited area for a limited period of time.[11] Within the next three decades, the concept of weather-modification could expand to include the ability to shape weather patterns by influencing their determining factors.[12] Achieving such a highly accurate and reasonably precise weather-modification capability in the next 30 years will require overcoming some challenging but not insurmountable technological and legal hurdles.

Technologically, we must have a solid understanding of the variables that affect weather. We must be able to model the dynamics of their relationships, map the possible results of their interactions, measure their actual real-time values, and influence their values to achieve a desired outcome. Society will have to provide the resources and legal basis for a mature capability to develop. How could all of this happen? The following notional scenario postulates how weather-modification might become both technically feasible and socially desirable by 2025.

Between now and 2005, technological advances in meteorology and the demand for more precise weather information by global businesses will lead to the successful identification and parameterization of the major variables that affect weather. By 2015, advances in computational capability, modeling techniques, and atmospheric information tracking will produce a highly accurate and reliable weather prediction capability, validated against real-world weather. In the following decade, population densities put pressure on the worldwide availability and cost of food and usable water. Massive life and property losses associated with natural weather disasters become increasingly unacceptable. These pressures prompt governments and/or other organizations who are able to capitalize on the technological advances of the previous 20 years to pursue a highly accurate and reasonably precise weather-modification capability. The increasing urgency to realize the benefits of this capability stimulates laws and treaties, and some unilateral actions, making the risks required to validate and refine it acceptable. By 2025, the world, or parts of it, are able to shape local weather patterns by influencing the factors that affect climate, precipitation, storms and their effects, fog, and near space. These highly accurate and reasonably precise civil applications of weather-modification technology have obvious military implications. This is particularly true for aerospace forces, for while weather may affect all mediums of operation, it operates in ours.

The term weather-modification may have negative connotations for many people, civilians and military members alike. It is thus important to define the scope to be considered in this paper so that potential critics or proponents of further research have a common basis for discussion.

In the broadest sense, weather-modification can be divided into two major categories: suppression and intensification of weather patterns. In extreme cases, it might involve the creation of completely new weather patterns, attenuation or control of severe storms, or even alteration of global climate on a far-reaching and/or long-lasting scale. In the mildest and least controversial cases it may consist of inducing or suppressing precipitation, clouds, or fog for short times over a small-scale region. Other low-intensity applications might include the alteration and/or use of near space as a medium to enhance communications, disrupt active or passive sensing, or other purposes. In conducting the research for this study, the broadest possible interpretation of weather-modification was initially embraced, so that the widest range of opportunities available for our military in 2025 were thoughtfully considered. However, for several reasons described below, *this paper focuses primarily on localized and short-term forms of weather-modification and how these could be incorporated into war-fighting capability. The primary areas discussed include generation and dissipation of precipitation, clouds, and fog; modification of localized storm systems; and the use of the ionosphere and near space for space control and communications dominance. These applications are*

consistent with CJCSI 3810.01, "Meteorological and Oceanographic Operations."[13]

Extreme and controversial examples of weather modification-creation of made-to-order weather, large-scale climate modification, creation and/or control (or "steering") of severe storms, etc.-were researched as part of this study but receive only brief mention here because, in the authors' judgment, the technical obstacles preventing their application appear insurmountable within 30 years.[14] If this were not the case, such applications would have been included in this report as potential military options, despite their controversial and potentially malevolent nature and their inconsistency with standing UN agreements to which the US is a signatory.

On the other hand, the weather-modification applications proposed in this report range from technically proven to potentially feasible. They are similar, however, in that none are currently employed or envisioned for employment by our operational forces. They are also similar in their potential value for the war fighter of the future, as we hope to convey in the following chapters. A notional integrated system that incorporates weather-modification tools will be described in the next chapter; how those tools might be applied are then discussed within the framework of the Concept of Operations in chapter 4.

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