Chapter 3
System Description

Our vision is that by 2025 the military could influence the weather on a mesoscale (<200 km2) or microscale (immediate local area) to achieve operational capabilities such as those listed in Table 1. The capability would be the synergistic result of a system consisting of (1) highly trained weather force specialists (WFS) who are members of the CINC's weather force support element (WFSE); (2) access ports to the global weather network (GWN), where worldwide weather observations and forecasts are obtained near-real-time from civilian and military sources; (3) a dense, highly accurate local area weather sensing and communication system; (4) an advanced computer local area weather-modification modeling and prediction capability within the area of responsibility (AOR); (5) proven weather-modification intervention technologies; and (6) a feedback capability.

The Global Weather Network

The GWN is envisioned to be an evolutionary expansion of the current military and civilian worldwide weather data network. By 2025, it will be a super high-speed, expanded bandwidth, communication network filled with near-real-time weather observations taken from a denser and more accurate worldwide observation network resulting from highly improved ground, air, maritime, and space sensors. The network will also provide access to forecast centers around the world where sophisticated, tailored forecast and data products, generated from weather prediction models (global, regional, local, specialized, etc.) based on the latest nonlinear mathematical techniques are made available to GWN customers for near-real-time use.

By 2025, we envision that weather prediction models, in general, and mesoscale weather-modification models, in particular, will be able to emulate all-weather producing variables, along with their interrelated dynamics, and prove to be highly accurate in stringent measurement trials against empirical data. The brains of these models will be advanced software and hardware capabilities which can rapidly ingest trillions of environmental data points, merge them into usable data bases, process the data through the weather prediction models, and disseminate the weather information over the GWN in near-real-time.[15] This network is depicted schematically in figure 3-1.

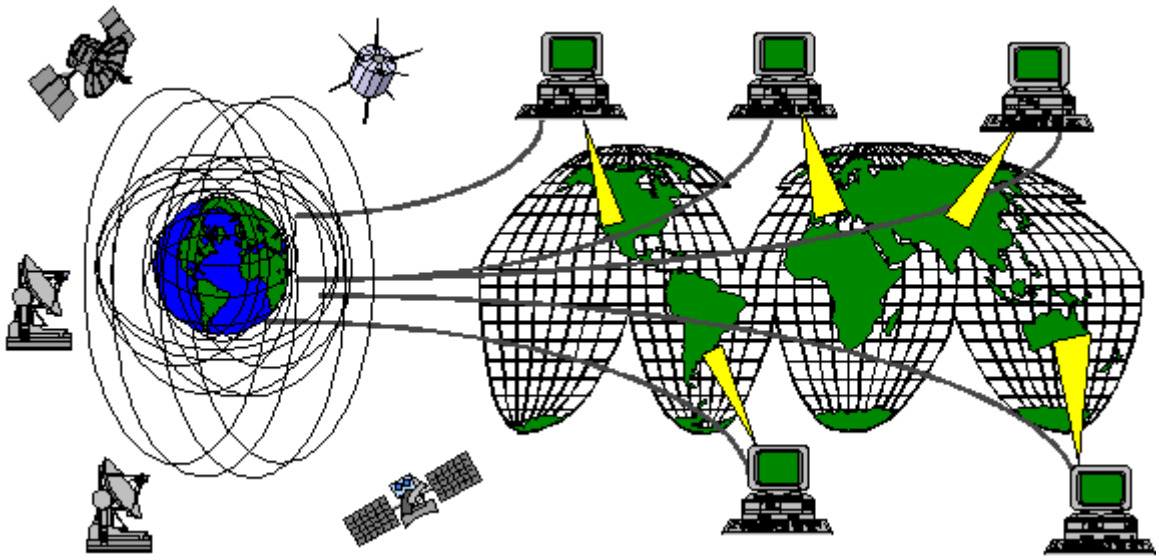

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Figure 3-1. Global Weather Network

Evidence of the evolving future weather modeling and prediction capability as well as the GWN can be seen in the national oceanic and atmospheric administration's (NOAA) 1995-2005 strategic plan. It includes program elements to "advance short-term warning and forecast services, implement seasonal to inter-annual climate forecasts, and predict and assess decadal to centennial change;"[16] it does not, however, include plans for weather-modification modeling or modification technology development. NOAA's plans include extensive data gathering programs such as Next Generation Radar (NEXRAD) and Doppler weather surveillance systems deployed throughout the US. Data from these sensing systems feed into over 100 forecast centers for processing by the Advanced Weather Interactive Processing System (AWIPS), which will provide data communication, processing, and display capabilities for extensive forecasting. In addition, NOAA has leased a Cray C90 supercomputer capable of performing over 1.5x1010 operations per second that has already been used to run a Hurricane Prediction System.[17]

Applying Weather-modification to Military Operations

How will the military, in general, and the USAF, in particular, manage and employ a weather-modification capability? We envision this will be done by the weather force support element (WFSE), whose primary mission would be to support the war-fighting CINCs with weather-modification options, in addition to current forecasting support. Although the WFSE could operate anywhere as long as it has access to the GWN and the system components already discussed, it will more than likely be a component within the AOC or its 2025-equivalent. With the CINC's intent as guidance, the WFSE formulates weather-modification options using information provided by the GWN, local weather data network, and weather-modification forecast model. The options include range of effect, probability of success, resources to be expended, the enemy's vulnerability, and risks involved. The CINC chooses an effect based on these inputs, and the WFSE then implements the chosen course, selecting the right modification tools and employing them to achieve the desired effect. Sensors detect the change and feed data on the new weather pattern to the modeling system which updates its forecast accordingly. The WFSE checks the effectiveness of its efforts by pulling down the updated current conditions and new forecast(s) from the GWN and local weather data network, and plans follow-on missions as needed. This concept is illustrated in figure 3-2.

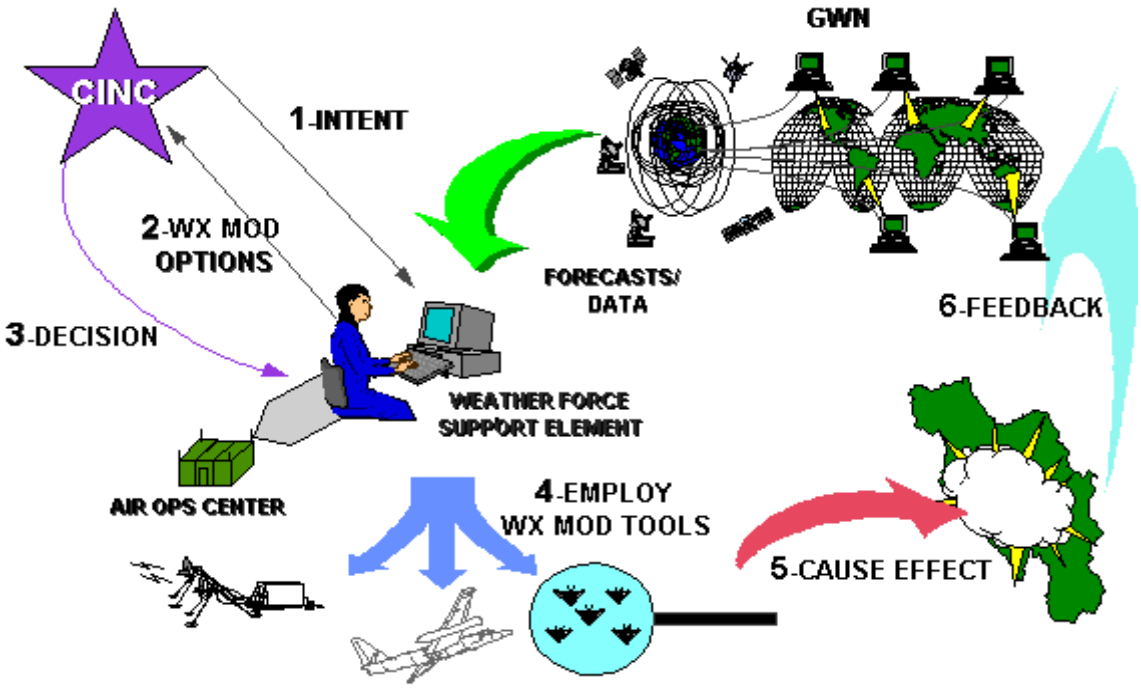

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Figure 3-2. The Military System for Weather-Modification Operations.

WFSE personnel will need to be experts in information systems and well schooled in the arts of both offensive and defensive information warfare. They would also have an in-depth understanding of the GWN and an appreciation for how weather-modification could be employed to meet a CINC's needs.

Because of the nodal web nature of the GWN, this concept would be very flexible. For instance, a WFSE could be assigned to each theater to provide direct support to the CINC. The system would also be survivable, with multiple nodes connected to the GWN.

A product of the information age, this system would be most vulnerable to information warfare. Each WFSE would need the most current defensive and offensive information capabilities available. Defensive abilities would be necessary for survival. Offensive abilities could provide spoofing options to create virtual weather in the enemy's sensory and information systems, making it more likely for them to make decisions producing results of our choosing rather than theirs. It would also allow for the capability to mask or disguise our weather-modification activities.

Two key technologies are necessary to meld an integrated, comprehensive, responsive, precise, and effective weather-modification system. Advances in the science of chaos are critical to this endeavor. Also key to the feasibility of such a system is the ability to model the extremely complex nonlinear system of global weather in ways that can accurately predict the outcome of changes in the influencing variables. Researchers have already successfully controlled single variable nonlinear systems in the lab and hypothesize that current mathematical techniques and computer capacity could handle systems with up to five variables. Advances in these two areas would make it feasible to affect regional weather patterns by making small, continuous nudges to one or more influencing factors. Conceivably, with enough lead time and the right conditions, you could get "made-to-order" weather.[18]

Developing a true weather-modification capability will require various intervention tools to adjust the appropriate meteorological parameters in predictable ways. It is this area that must be developed by the military based on specific required capabilities such as those listed in table 1, table 1 is located in the Executive Summary. Such a system would contain a sensor array and localized battle area data net to provide the fine level of resolution required to detect intervention effects and provide feedback. This net would include ground, air, maritime, and space sensors as well as human observations in order to ensure the reliability and responsiveness of the system, even in the event of enemy countermeasures. It would also include specific intervention tools and technologies, some of which already exist and others which must be developed. Some of these proposed tools are described in the following chapter titled Concept of Operations. The total weather-modification process would be a real-time loop of continuous, appropriate, measured interventions, and feedback capable of producing desired weather behavior.

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Last updated: 11 December 1996


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