# WEATHER TO FLY

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# The National Weather Service Modernization and Associated Restructuring

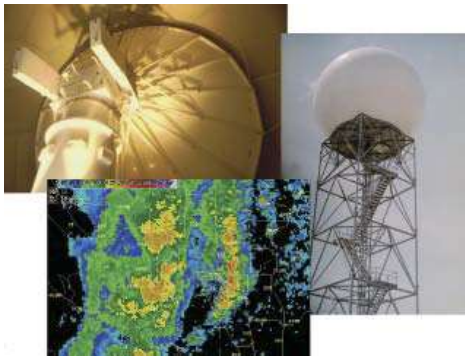
Continuing the story of the U.S. Department of Commerce National Weather Service (NWS) from the last installment of *Weather-To-Fly*, the NWS prior to 1980 used the communications technology of the time, i.e., teletypes, telephones, and rotating-band facsimile machines, to deliver meteorological text information, charts, and images to its field office structure. In the time period around 1980, the NWS began to distribute to its field offices a cutting-edge, computer-based technology, the Automation of Field Offices and Services (AFOS), built by Ford Aerospace in California's Silicon Valley. Very primitive in comparison to today's desktop personal computers, AFOS initially had only one megabyte (MB) of random access memory (RAM) but quickly was bumped to "an amazing" 2MB of RAM within a year of its implementation. The NWS utilization of the emerging computer technology for a nationwide information distribution system was ground-breaking. By 1984, teletype systems and facsimile machines disappeared from the NWS field offices. Augmenting AFOS, the decade of the 1980s saw constantly changing desktop computer configurations that delivered satellite images rather than the rotating-band facsimile machines, provided auxiliary text information, and allowed displays and processing of rudimentary, remote surface observation automation. Over the decade of the 1980s research and development in communication technology coupled with the exponential growth in computer capabilities lead the NWS toward what would eventually be called the *"Modernization and Associated Restructuring" (MAR)*, a whole-scale change in NWS field office structure coupled with bringing the newest weather observation, communication, observation, and processing technologies to field offices by the mid-1990s.

To fully understand what the NWS restructuring was to accomplish it is necessary to note that the NWS field offices prior to the MAR had a two-tiered hierarchy structure. There were 52 Weather Service Forecast Offices (WSFO) that were well-equipped and staffed with several levels of forecaster experience and highest rank. The personnel in each WSFO analyzed, evaluated, and provided weather guidance and forecast information for its typically state-sized forecast area-of-responsibility. Some of the larger states had more than one WSFO and some of the smaller states having none. The forecast output and guidance from the WSFOs were then provided to 204 local Weather Service Offices (WSO) operating on a hierarchy level below those WSFOs. The WSOs provided localized, adapted forecasts (within *the guidance* issued by the WSFO) and held county inclement weather warning responsibilities. The area-of-responsibility for WSOs was typically several counties (although WSOs in the West often had fewer area counties due to the large geographical size of their counties). [For example: *WSFO San Francisco provided weather guidance for Northern California WSOs located at Redding, Sacramento, Eureka, Stockton, Fresno, Bakersfield, and Santa Maria].* Along with adaptive local weather forecasts and warnings, the WSOs generally took weather observations for their location, typically airports, and possessed pilot weather briefing services. Most WSOs provided 24-hour-per-day/7-day-per-week (24/7) services but there were a few limited-hour stations, especially in the Western Region where night coverage for warnings was often assumed by a supervising WSFO. Even at those limited-hour offices, the NWS WSOs were particularly effective at providing close decision-support services for state and county emergency managers as well as the aviation, marine, air pollution, agricultural, and fire suppression communities. The NWS personnel at WSOs were well-known by the communities and counties they served and likewise, the adaptive forecasts issued by "local" NWS Offices were highly regarded.

The field offices, WSFOs and WSOs, were administered by Regional Headquarter Offices for the Western, Southern, Central, and Eastern Regions for the contiguous United States, with additional Regional Offices in Alaska (Alaska Region) and Hawaii (Pacific Region). Also in the field structure with Regional Office administrative support were two other types of field offices; multi-state Agricultural Offices and River Forecast Centers. These offices were fewer in number, but specialized in function. Along with the field offices, the NWS was also composed of specialized weather centers focusing on aviation weather, severe weather, hurricanes, tropical weather, communications, and numerical forecasting. The NWS National Headquarters overseeing all administrative functions within the agency has resided in the Washington, D.C., area since the turn of the last century with its current location at the National Oceanic and Atmospheric Administration (NOAA) Silver Spring, MD, Metro Complex.

With the rapid technological advancement in computer capabilities and associated equipment in the early-to-mid 1980s, the NWS began planning for a major modernization effort. This modernization was targeted to be in place by the mid-1990s and involved three aspects: implementation of a nationwide network of Weather Surveillance Doppler Radars (WSR-88D); replacing the labor-intensive, staffed weather observation functions with the automation of surface weather observations (ASOS);

and, updating AFOS with the next-generation of weather information processing workstations known as the Advanced Interactive Weather Processing System (AWIPS). Before the implementation of the new Weather Surveillance Doppler Radar System, the NWS operated three



different types of old, tube-technology radars around the country. In fact, and despite the "Cold War" with Russia, the weather radars before the modernization had to rely on Russian production and stocks of electronic tubes! All but four of the dedicated weather radars were east of the Rocky Mountains, and weather radar coverage was unevenly spaced and not comprehensive. The WSR-88D Radar Network was designed to provide complete radar coverage at the 10,000-foot level for the contiguous U.S. (the intermountain West still has some radar coverage holes that is unavoidable due to terrain blocking of the radar beam). The

AWIPS workstation was scheduled for implementation to the field offices by the mid-1990s, but the envisioned version of the system did not get fully implemented into the restructured offices until the late 1990s. Perhaps the most controversial aspect of the modernization, however, was the replacement of the NWS and Federal Aviation Administration (FAA) staffed weather observing sites with the aviation-quality ASOS. The ability of a weather

observer to completely observe, document by encoding, and transmit a representative description of the weather for the entire sky dome at a station for aviation purposes was replaced in the NWS MAR by a "point" observation from ASOS. Notably, the weather observation went from being one describing all the sky's cloud layers, corresponding cloud base altitudes, and limits to visibility and weather by sky quadrants as furnished by a weather observer to that of measured cloud layers immediately overhead, sky coverage estimated by the timed passing of those layers, and the weather and visibility observed over a one-meter portion of the atmosphere by the ASOS unit. The most-missed observer capability was the ability to report restrictions to visibility and weather in proximity but not actually at the actual observing site. In its place, the capability to get a "complete" weather picture at a given observing site was replaced by the *"Total Observation Concept"* that attempts to describe a site's weather picture by combining information from upgraded satellite data (visible, infrared, and water vapor imagery), WSR-88D Radar imagery, and the ASOS weather report. However, there were only about 350 staffed, aviation-quality, observing sites in the contiguous U.S. (NWS, FAA, and Department of Defense sites) prior to the MAR. With ASOS automation, over 801 aviation-quality stations came on-line with the initial equipment placement surge in the NWS MAR…and the number and types of automated stations has continued to increase. Argument can be made that the aviation weather reporting system is not as good as it once was in comparing staffed weather reporting quality against ASOS. However, the sheer number of sites providing point weather information along with other technology augmentation to ASOS at a fraction of the cost of a smaller network of staffed weather stations provides some degree of counter argument in justifying ASOS implementation.

Along with modernizing equipment within its offices in the MAR, the NWS also restructured its field office configuration, including personnel responsibilities and functions. While the NWS MAR infused new technology into field offices, it also eliminated the cumbersome and sometimes conflicting two-tier weather office authority for a given forecast area. Every office of the restructured NWS with modernized equipment and staffing to provide solid 24/7 weather forecasts and warnings is autonomous in regard to its authority over its forecast and warning area-of-responsibility. The conflict often caused by a "distant" WSFO dictating the type, intensity, and timing of weather events over a WSO's local county warning area was eliminated with a single tier office hierarchy. With the removal of state-level WSFOs, sole authority for area-of-responsibility weather forecasts and warnings are held by the new "local" Weather Service Forecast Offices (WFO). The establishment of a single tier of hierarchy for forecast responsibility also meant that the total number of NWS Offices could be reduced. This reduction in the number of offices in the MAR was controversial as "local" WSOs were replaced by better equipped WFOs. However, WFOs have larger areas-of-responsibility formed from the combination of previous WSOs' county warning areas. In many instances around the country, the "pride" of having a NWS WSO in a smaller community was lost. The number of offices under the MAR dropped from the 52 WSFOs and 204 WSOs (along with the loss of dedicated Agricultural Offices), down to 123 WFOs.

With the MAR and implementation of newer technologies, the number and type of personnel at the WFOs are similar from office-to-office. Besides data collection specialists and weather forecasters in the WFOs, two new positions are dedicated in function, the Warning Coordination Meteorologist and the Science and Operations Officer. Both positions are considered part of the office management team in overseeing operational forecast functions and quality. These positions also provide for dedicated community outreach and decision-support coordination, and the ongoing training of the WFO personnel.

Rounding out the general public NWS service configuration for the nation's weather forecast and warning needs is the upgrading of National Centers for Environmental Prediction (NCEP). Many but not all of these centers are located in the NOAA Center for Weather and Climate Prediction (NCWCP) building in College Park, MD. These continuously staffed centers have specified functions that provide national products as well as information support for NWS field offices, headquarters, other national agencies, and research communities *[See Text Box #1: National Centers for Environmental Prediction]*. Of particular interest within the aviation community is the NCEP Aviation Weather Center (AWC) that focuses on aviation weather information *[See Text Box #2: Aviation Weather Center]*. The AWC, cooperatively funding the Aviation Digital Data Service with the FAA, envisions itself "to be the trusted authority and leading innovator for aviation weather information. *[See Reference List]*.


Lastly, it behooves me to mention one other little-known but important aviation-serving NWS entity, the Center Weather Service Unit (CWSU) that is positioned within each of the FAA's 21 Air Route Traffic Control Centers (ARTCC). "The FAA-funded CWSU provides NWS aviation support products for ARTCC personnel, interprets and clarifies other NWS aviation weather products for personnel, and gives routine weather briefings for ARTCC operations planning purposes. Already in place through the NWS MAR, CWSUs were begun in the late 1970s as a means of keeping ARTCC controllers briefed on hazardous weather affecting the National Air Space system. The establishment of the CWSUs arose from recommendations from the National Transportation Safety Board in review of air carrier, weather-related accidents that were interpreted to have been avoidable with in-center weather advisories.

Unlike much of the world's weather services, the U.S. NWS provides its information over the Internet with no direct fee. While some complaints are presented by other nations that the U.S. Government provides weather data "free," that data is fiscally supported through the tax system! The NWS, in a post-MAR evaluation by the U.S. General Accounting Office, was deemed to have given a high return-of-investment for services provided. Since the implementation and staffing of the new MAR offices in the mid-1990s, the WSR-88D Network Radar System has been upgraded to dual-polarization, WFO weather processing systems continually are updated, and the information flowing over the Internet available for all to access provides much more weather information than that available only to NWS personnel within dedicated WSOs and WSFOs just fifteen years ago. Internet search engines or going to the NWS national web site can provide more specific information regarding the components and capabilities of AWIPS, ASOS, and WSR-88D Radar Systems *[See Reference List]*.

Hopefully, these two installments of the "history" and configuration of the NWS provide some insight into how government weather services operate and provide information for aviation applications. Future articles will continue to focus on meteorological products and applications for the benefit of the soaring pilot as we look for "weather-to-fly."

## REFERENCE LIST

1) National Weather Service National Web Site
On-line: ***http://www.weather.gov***

2) Weather Surveillance Radar – 88D (WSR-88D)
On-line: ***http://www.roc.noaa.gov/WSR88D/***

3) Advanced Weather Interactive Processing System (AWIPS)
On-line: ***http://www.crh.noaa.gov/lmk/?n=awipsoverview***

4) Automated Surface Observation System (ASOS)
On-line: ***http://www.nws.noaa.gov/asos/aum-toc.pdf***

5) NOAA's National Centers for Environmental Prediction
On-line: ***http://www.ncep.noaa.gov/*** ; and,
***http://www.weather.gov/organization***

6) NOAA's Aviation Weather Center Vision Statement: "*To be the trusted authority and leading innovator for aviation weather information.*"
On-line: ***http://www.aviationweather.gov***

7) Aviation Weather Center Aviation Digital Data Service
On-line: ***http://www.aviationweather.gov/adds/***

*Pilot Weather Briefing Board, Reno, NV, 1974. Author Dan Gudgel, Meteorologist Intern, shown with Teletype Text Info and Facsimile Weather Charts.*

Text Box #1

## National Centers for Environmental Prediction (NCEP)

• ***NCEP Central Operations*** within the NOAA Weather and Climate Prediction Building in College Park, MD, which sustains and executes the operational suite of numerical analyses and forecast models and prepares NCEP products for dissemination;

• ***Climate Prediction Center*** in College Park, MD, is a unit that monitors and forecasts short-term climate fluctuations and provides information on the effects climate patterns can have on the nation;

• ***Environmental Modeling Center*** in College Park, MD, is another NCEP unit that develops and improves numerical weather, climate, hydrological and ocean prediction through a broad program in partnership with the research community;

• ***Hydro-meteorological Prediction Center*** within NCEP at College Park, MD, that develops nationwide analysis and forecast guidance products out through seven days;

• ***Ocean Prediction Center*** at College Park, MD, issues weather warnings and forecasts out to five days for the Atlantic and Pacific Ocean north of 30 degrees North Latitude;

• ***Space Weather Prediction Center*** in Boulder, CO, provides space and weather alerts and warnings for disturbances that can affect people and equipment working in space and on earth;

• ***National Hurricane Center / Tropical Prediction Center*** in Miami, FL, provides forecasts of the movement and strength of tropical weather systems, and issues watches and warnings for the North Atlantic and the Eastern Pacific ocean;

• ***Storm Prediction Center*** in Norman, OK, provides tornado and severe weather watches for the contiguous United States along with a suite of hazardous weather products; and, of particular interest to the soaring and aviation community,

• ***Aviation Weather Center*** in Kansas City, MO, provides aviation warnings and forecasts of hazardous flight conditions at all levels within domestic and international air space.

Text Box #2

## NWS Aviation Weather Center (AWC)

The Aviation Weather Center Mission Statement:

"*The Aviation Weather Center (AWC) delivers consistent, timely and accurate weather information for the world airspace system. We are a team of highly skilled people dedicated to working with customers and partners to enhance safe and efficient flight.*"

The **Aviation Digital Data Service (ADDS)** makes available to the aviation community text, digital and graphical forecasts, analyses, and observations of aviation-related weather variables. ADDS is a joint effort of the National Centers for Atmospheric Research Applications Program, Global Systems Division of NOAA's Earth System Research Laboratory, and the National Centers for Environmental Prediction Aviation Weather Center (AWC). **The** Federal Aviation Administration **funds and directs the continuing development of ADDS as well as other experimental products being developed by the** FAA Aviation Weather Research Program**.**