

# Evolution of the National Weather Service

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The National Weather Service has its beginning in the early history of the United States. Weather always has been important to the citizenry of this country, and this was especially true during the 17<sup>th</sup> and 18<sup>th</sup> centuries. Weather also was important to many of the Founding Fathers. Colonial leaders who formed the path to independence of our country also were avid weather observers. Thomas Jefferson bought his first thermometer while writing the Declaration of Independence, and purchased his first barometer a few days following the signing of the document. Incidentally, he noted that the high temperature in Philadelphia, PA on July 4, 1776 was 76 degrees. Jefferson made regular observations at Monticello from 1772-78, and participated in taking the first known simultaneous weather observations in America. George Washington also took regular observations; the last weather entry in his diary was made the day before he died.

During the early and mid 1800's, weather observation networks began to grow and expand across the United States. Although most basic meteorological instruments had existed for over 100 years, it was the telegraph that was largely responsible for the advancement of operational meteorology during the 19<sup>th</sup> century. With the advent of the telegraph, weather observations from distant points could be "rapidly" collected, plotted and analyzed at one location.

- **1849:** Smithsonian Institution supplies weather instruments to telegraph companies and establishes extensive observation network. Observations submitted by telegraph to the Smithsonian, where weather maps are created.

By the end of 1849, 150 volunteers throughout the United States were reporting weather observations to the Smithsonian regularly. By 1860, 500 stations were furnishing daily telegraphic weather reports to the Washington Evening Star, and as the network grew, other existing systems were gradually absorbed, including several state weather services.

- **1860:** 500 stations are making regular observations, but work is interrupted by the Civil War.
- **1869:** Telegraph service, instituted in Cincinnati, began collecting weather data and producing weather charts.

The ability to observe and display simultaneously observed weather data, through the use of the telegraph, quickly led to initial efforts toward the next logical advancement, the forecasting of weather. However, the ability to observe and forecast weather over much of the country, required considerable structure and organization -- a government agency.

- **1870:** A Joint Congressional Resolution requiring the Secretary of War "to provide for taking meteorological observations at the military stations in the interior of the continent and at other points in the States and Territories...and for giving notice on the northern (Great) Lakes and on the seacoast by magnetic telegraph and marine signals, of the approach and force of storms" was introduced. The Resolution was passed by Congress and signed into law on February 9, 1870, by President Ulysses S. Grant. An agency had been born which would affect the daily lives of most of the citizens of the United States through its forecasts and warnings.

- **1870-1880:** Gen. Albert J. Meyer serves as the first director of the Weather Bureau. Gen. William Babcock serves as the director of the Weather Bureau.
- **1887-1891:** Maj. Gen. Adolphus Greely takes over as director of the Weather Bureau.
- **May 30, 1889:** An earthen dam breaks near Johnstown, Pennsylvania. The flood kills 2,209 people and wrecks 1,880 homes and businesses.
- **October 1, 1890:** Weather Service is first identified as a civilian enterprise when Congress, at the request of President Benjamin Harrison, passes an act creating a Weather Bureau in the Department of Agriculture.

A weather sensitive sports event of this first year: 15<sup>th</sup> running of the Kentucky Derby.

- **1891:** The Secretary of Agriculture directs R.G. Dyrenforth to carry out rain-making experiments by setting off explosions from balloons in the air; Weather Bureau becomes responsible for issuing flood warnings to the public; Telegraphic reports of stages of rivers were made at 26 places on the Mississippi and its tributaries, the Savannah and Potomac Rivers.
- **1891-1895:** Professor Mark W. Harrington replaces Maj. Gen. Greely as director of the Weather Bureau.
- **1894:** William Eddy, using five kites to loft a self-recording thermometer, makes first observations of temperatures aloft.
- **September 30, 1895:** The first Washington daily weather map is published by the Weather Bureau. An expanded version, covering the entire nation, is still published in 1997.
- **1895-1913:** Secretary of Agriculture J. Sterling Morton appoints Professor Willis Luther Moore chief of the Weather Bureau.
- **1898:** President William McKinley orders the Weather Bureau to establish a hurricane warning network in the West Indies.

**1900:** Cable exchange of weather warnings and other weather information begins with Europe.

- **September, 1900:** Hurricane strikes Galveston, Texas, killing over 6,000 people. The wife of the Galveston Official-in-Charge and one Weather Bureau employee and his wife are killed in the associated flooding. Weather Bureau forecasts the storm 4 days earlier, but not the high tide.
- **1901:** Official three day forecasts begin for the North Atlantic. At the Weather Bureau Conference in Milwaukee, Wisconsin, Willis Moore observed the Post Office Department was delivering slips of paper on which were daily forecasts, frost and cold-wave warnings, to everyone's door with the mail. The one disadvantage to the system was the mail carriers started their routes about 7 a.m. and that day's forecast was not issued until 10 a.m., so the previous night's forecasts were used.

- **1902:** The Marconi Company begins broadcasting Weather Bureau forecasts by wireless telegraphy to Cunard Line steamers; the Bureau begins collecting flood damage statistics nationally.
- **1903:** Weather sensitive historic events: United States and Panama sign the Canal Treaty; the first automobile trip across the United States is completed from San Francisco to New York City; Orville Wright makes first powered airplane flight at Kill Devil Hill, N.C., after consultation with the Weather Bureau.
- **1904:** Government begins using airplanes to conduct upper air atmospheric research.
- **1905:** The SS New York transmits the first wireless weather report received on ship at sea.
- **1907:** Weather sensitive historic event: Round-the-world cruise of U.S. "Great White Fleet" including 16 battleships and 12,000 men.
- **1909:** The Weather Bureau begins its program of free-rising balloon observations.
- **1910:** Weather Bureau begins issuing generalized weekly forecasts for agricultural planning; its River and Flood Division begins assessment of water available each season for irrigating the Far West.
- **1911:** The first transcontinental airplane flight, from New York City to Pasadena, California, by C.P. Rogers, in 87 hours and 4 minutes, air time, over a period of 18 days.
- **1912:** As a result of the Titanic disaster, an international ice patrol is established, conducted by the Coast Guard; first fire weather forecast issued; Dr. Charles F. Marvin appointed chief of the Weather Bureau.
- **1913-1934:** Professor Charles F. Marvin serves as the new chief of the Weather Bureau, replacing Professor Moore.
- **1914:** An aerological section is established within the Weather Bureau to meet growing needs of aviation; first daily radiotelegraphy broadcast of agricultural forecasts by the University of North Dakota.
- **1916:** Fire Weather Service established, with all district forecast centers authorized to issue fire weather forecasts; the Bureau's fire district forecast center started at Medford, Oregon.
- **1917:** Norwegian meteorologists begin experimenting with air mass analysis techniques which will revolutionize the practice of meteorology.
- **1918:** The Weather Bureau begins issuing bulletins and forecasts for domestic military flights and for new air mail routes.
- **1919:** Navy Aerological Service established on a permanent basis; First Transatlantic flight by U.S. Navy sea plane, with stops in Newfoundland, Azores and Lisbon.
- **1920:** Meteorologists form a professional organization, the American Meteorological Society.

- **1921:** The University of Wisconsin makes a radiotelephone broadcast of weather forecasts, the first successful use of the new medium for weather advisories.
- **1922:** Histories of 500 river stations completed.
- **1926:** The Air Commerce Act directs the Weather Bureau to provide for weather services to civilian aviation; fire weather service formally inaugurated when Congress provides funds for seven fire weather districts.
- **1927:** The Weather Bureau establishes a West Coast prototype for an Airways Meteorological Service; Charles A. Lindbergh flies alone from Long Island, non-stop, to Paris. The 3610 mile trip is completed in 33.5 hours. As on his earlier transcontinental flight, he consulted the Bureau in planning this flight. However, Lindbergh didn't wait for the final confirmation of good weather over the Atlantic. When Weather Bureau officials in New York heard that Lindbergh had left, they expressed surprise because the forecasts indicated that the flight should have been delayed by at least 12 hours. Indeed, Lindbergh ran into problems with fog and rain--as the Weather Bureau had predicted.
- **1928:** The teletype replaces telegraph and telephone service as the primary method for communicating weather information.
- **1931:** The Weather Bureau begins regular 5 a.m. EST aircraft observations at Chicago, Cleveland, Dallas and Omaha, at altitudes reaching 16,000 feet. This program spells the demise of "kite stations."
- **1933:** A science advisory group apprizes President Franklin D. Roosevelt that the work of the volunteer Cooperative Weather observer network is one of the most extraordinary services ever developed, netting the public more per dollar expended than any other government service in the world. By 1990 the 25 mile radius network encompasses nearly 10,000 stations.
- **1934-1938:** Dr. Willis L. Gregg is named Bureau Chief, replacing Professor Marvin.
- **1934:** Bureau establishes an Air Mass Analysis Section; 1934-37 "Dust Bowl" drought in southern plains causes severe economic damage.
- **1935:** A hurricane warning service is established; The Smithsonian Institution begins making long-range weather forecasts based on solar cycles; floating automatic weather instruments mounted on buoys begin collecting marine weather data.
- **1936:** Hoover Dam is completed, a weather sensitive engineering feat.
- **1937:** First official Weather Bureau radio meteorograph, or radiosonde sounding made at East Boston, Mass. This program spells the end for aircraft soundings since balloons average only 50,000 feet altitude. Twelve pilots die flying weather missions. January flood on the Ohio River is the greatest ever experienced, with Ohio River levels exceeding all previous. Cincinnati's 80 foot crest and Louisville's 81.4 foot crest have never been exceeded. Seventy percent of Louisville under water, 175,000 of its residents flee their homes; the entire city of Paducah, Kentucky, (population 40,000) is evacuated.
- **1938-1963:** President Franklin D. Roosevelt appoints Dr. Francis W. Reichelderfer Chief of the Weather Bureau.

- **1939:** Bureau initiates automatic telephone weather service in New York City; radio meteorographs, or radiosondes, replace all military and Weather Bureau aircraft observations.
  - **1940:** Weather Bureau transferred to Department of Commerce; Army and Navy establish weather centers; President Roosevelt orders Coast Guard to man ocean weather stations.
- 1941:** Dr. Helmut Landsberg, "the Father of Climatology," writes the first edition of his elementary textbook entitled, "Physical Climatology." Two women are listed as observer and forecaster in the Weather Bureau.
- **1942:** A Central Analysis Center, forerunner of the National Meteorological Center, is created to prepare and distribute master analyses of upper atmosphere; Joint Chiefs of Staff establish a Joint Meteorological Committee to coordinate wartime civilian and military weather activities; Navy gives the Weather Bureau 25 surplus aircraft radars to be modified for ground meteorological use, marking the start of a weather radar system in the U.S. Navy aerologists play key role as U.S. carrier-based Navy planes decimate Japanese fleet in mid-Pacific Battle of Midway Island in early June 1942, turning point in World War II. A cooperative thunderstorm research effort is undertaken by the Bureau, military services, and the University of Chicago.
  - **1944:** The decision to invade Normandy on June 6<sup>th</sup> was based on weather forecasts, which indicated the correct combination of tides and winds.
  - **1945:** Over 900 women are employed by the Weather Bureau as observers and forecasters, as a result of filling positions of men during World War II.
  - **1946:** The U.S. Weather Bureau selects Cincinnati, Ohio and Kansas City, Missouri, as locations for the nation's first hydrologist staffed River Forecast Centers. Eventually, 13 RFC's would be established to serve the United States.
  - **1948:** USAF Air Weather Service meteorologists issue first tornado warnings from a military installation. Princeton's Institute for Advanced Studies begins research into use of a computer for weather forecasting; Chicago Weather Bureau office demonstrates use of facsimile for map transmission; truck mounted campers first used as mobile forecast stations in major forest fires.
  - **1950:** The Weather Bureau begins issuing 30-day weather outlooks; authorizes release of "tornado alerts" to the public.
  - **1951:** Severe Weather Warning Center begins operation at Tinker Air Force Base, Oklahoma, forerunner of the National Severe Storms Center; World Meteorological Organization established by the U.N. Bureau Chief Riechelderfer elected its first head; Bureau's New Orleans data tabulation unit moves to Asheville, N.C., to become the National Weather Records Center and later the National Climatic Data Center.
  - **1952:** Bureau organizes Severe Local Storms forecasting Unit in Washington, D.C. and begins issuing tornado forecasts.
  - **1954:** The Weather Bureau, Navy, Air Force, MIT's Institute for Advanced Study, and the University of Chicago form a Joint Numerical Weather Prediction Unit at Suitland,

Maryland. This will become a twice daily routine in 1955, using an IBM 701. First radar specifically designed for meteorological use, the AN/CPS-9, is unveiled by the Air Weather Service, USAF.

- **1955:** Hurricane Diane floods the Northeast and 187 people die. Regularly scheduled operational computer forecasts begun by the Joint Numerical Forecast Unit. Weather Bureau becomes a pioneer civilian user of computers along with the Census Bureau in Commerce; Bureau begins development of Barotropic model, a first for numerical predictions.
- **1956:** The Bureau initiates a National Hurricane Research Project.
- **1957-58:** International Geophysical year provides first concerted world wide sharing of meteorological research data. Dr. Reichelderfer accepts proposal by Dr. James Brantly of Cornell Aeronautical Laboratories to modify surplus Navy Doppler radars for severe storms observation--the first endeavor to measure motion of precipitation particles by radar.
- **1958:** Weather related scientific event: Explorer I is launched into space by an Army Redstone Rocket from Cape Canaveral. This satellite discovers the Van Allen Radiation Belts; the National Meteorological Center is established; the first commercial jet passenger flight from New York to Miami by National Airlines.
- **1959:** Major weather scientific event: The Army launches Vanguard II from Cape Canaveral, carrying two photocell units to measure sunlight reflected from clouds, demonstrating feasibility of a weather satellite. The Bureau's first WSR-57 weather surveillance radar is commissioned at Miami Hurricane Forecast Center. Same model, now obsolete, is still in service in New York City, although replacement parts must be machined by hand; The Naval Aerological Service becomes the Naval Weather Service.

The Thomas Jefferson and John Campanius Holm awards are created by the Weather Bureau to honor volunteer observers for unusual and outstanding accomplishments in the field of meteorological observations.

- **1960:** World's first weather satellite, solar orbiting TIROS I, successfully launches from the Air Force Missile Test Center at Cape Canaveral, FL; the Bureau and NASA invite scientists from 21 nations to participate in the analysis of weather data gathered by TIROS II. In cooperation with the Department of Health, Education and Welfare, Weather Bureau meteorologists issue first advisories on air pollution potential over the Eastern United States.
- **1961:** President Kennedy, in his State of the Union address, invites all nations to join the United States in developing an International Weather Prediction Program. The Bureau assumes full responsibility for severe weather forecasting, establishing the National Severe Storms Center in Kansas City; special training begins for Federal Aviation Authority employees to equip them to brief pilots as part of a joint FAA-Bureau program; to USAF Air Weather Service issues first official forecast of clear air turbulence; scientists from 27 countries attend NASA Weather Bureau sponsored international workshop on technique to interpret weather satellite data.
- **1963-1965:** Dr. Robert M. White succeeds Dr. Reichelderfer as Chief of the Bureau.

- **1963:** Commerce Department polar orbiting weather satellite TIROS III is launched with automatic picture transmission (APT) capability, eventually to provide continuous cloud images to over 100 nations.
  - **1964:** Secretary of Commerce establishes the office for the Federal Coordinator for meteorology; the National Severe Storms Laboratory is established in Norman, Oklahoma; the American Meteorological Society writes to the Taiwanese Ambassador to the U.S. deploring treatment accorded Mr. Kenneth T.C. Cheng, Head of the Taiwan Weather Service, who had been indicted for an incorrect typhoon forecast. The AMS points out that if forecasters were indicted for an incorrect forecast there could soon be a total lack of forecasters. (Minutes of the AMS Council, October 3, 4, 1964).
  - **1965:** Environmental Science Services Administration is created in the Department of Commerce, incorporating the Weather Bureau and several other agencies; Dr. White is appointed Administrator.
  - **1965-1979:** Dr. George Cressman is named Bureau Director.
  - **1966:** Weather officials from 25 nations meet in London for the First International Clean Air Congress; National Meteorological Center introduces a computer numerical model capable of making sea level predictions as accurate as those made manually.
  - **1967:** Responsibility for issuing air pollution advisories is assigned to the Weather Bureau, National Meteorological Center; fire weather forecasts extended to cover contiguous U.S.
  - **1969:** Weather related historic event: Neil Armstrong, Commander of spacecraft Apollo 11, becomes first man to set foot on the moon.
  - **1970:** Environmental Science Services Administration (ESSA) becomes NOAA-- National Oceanic and Atmospheric Administration, with Dr. White as Administration. US Weather Bureau becomes National Weather Service.
  - **1972:** Rainfall from Hurricane Agnes floods the east coast, killing 105 people; a flash flood in the Black Hills of South Dakota kills 237 people.
  - **1973:** National Weather Service purchases its second generation radar (WSR-74).
  - **1975:** The first "hurricane hunter" Geostationary Operational Environmental Satellite (GOES) is launched into orbit; these satellites with their early and close tracking of hurricanes, will greatly reduce the loss of life from such storms.
  - **1976:** Real-time operational forecasts and warnings using Doppler radar are evaluated by the Joint Doppler Operational Project, spawning a third Generation Weather Radar (WSR 88). The Big Thompson Canyon, Colorado flood kills 139 people.
- 1977:** Success of weather satellites causes elimination of last U.S. weather observation ship; real time access to satellite data by national centers advances hurricane, marine and coastal storm forecasts.
- **1979-1988:** Dr. Richard Hallgren appointed NOAA Assistant Administrator for the Weather Services.

- **1979:** A Nested Grid Model (NGM) becomes operational; a Global Data Assimilation System (GDAS) developed; AFOS Computer system is deployed, connecting all Weather Service forecast offices. AFOS is the most ambitious computer network yet created, setting records for volume of data and number of entry points while supporting full range of word processing and other capabilities.
- **1980:** Mt. St. Helens, a dormant volcano in Washington state, erupts; weather satellites spot eruption and alert FAA.
- **1980:** "Dean of the Cooperative Weather Observers," Mr. Edward H. Stoll of Elwood, Nebraska, is honored at the Nation's Capitol and meets President Jimmy Carter in the White House. Mr. Stoll had faithfully served as a Cooperative Observer since October 10, 1905.

Various "hot weather topics" become of general public concern, such as the El Niño/Southern Oscillation as a factor in U.S. weather, and global warming.

- **1981:** Weather related science event: World's first reusable space shuttle, Columbia, launched, completing its mission three days later.
- **1982:** El Chicon erupts in Mexico; NOAA polar weather satellites track movement of its cloud around the earth as a possible global climate impact.
- **1984:** The National Weather Service provides special forecast for the Olympic Games in Los Angeles; Weather related event: First successful solo balloon crossing of the Atlantic by pilot Joe Kittinger, 83 hours and 45 minutes.
- **1984:** September 11-13--first official Air Transportable Mobile Unit (ATMU) dispatches to the Shasta-Trinity National Forest wildfire. The ATMU is dispatched by plane from Redding, California while the forecaster is flying from Sacramento, California. These mobile fire units are deployed nationwide in 1987. ATMUs permit NWS forecasters to set up remote observing and forecasting offices anywhere in the world within hours of a request for on-site fire weather support.
- **1985:** Harvard's Blue Hill Observatory celebrates 100 years of continuous monitoring of the atmosphere.

President Ronald Reagan awards Dr. Helmet Landsberg the National Medal of Science, the most prestigious service award a civilian can receive.

- **1986:** Eight day non-stop Voyager around-the-world balloon flight completed with assistance of continuous weather support from retired, volunteer and current Weather Service employees.
- **1988:** Weather Service operates several remote forecast operations in Yellowstone Park to assist in fighting week-long wildfire; National Hurricane Center provides continuous advisories and early forecast on movement of giant hurricane Gilbert to assist Caribbean and U.S. coastal areas with evacuation plans; 1987-88 major drought experienced by nation's midsection, with some of lowest river levels in 50 years observed on the Mississippi; Dr. Hallgren retires to become President of the AMS.

- **1988:** Dr. Elbert W. Friday, Jr. appointed NOAA Assistant Administrator for Weather Service.
- **1989:** U.S. assists clean-up efforts in San Francisco Earthquake area with mobile forecast unit; Miami Hurricane Center plays central role in limiting loss of life from gigantic storm Hugo which causes \$7 billion damage.

Eight year national plan for the modernization and restructuring of the National Weather Service is announced.

- **1990:** Procured and installed a supercomputer - the Cray Y-MP8 at the National Meteorological Center to run higher resolution and more sophisticated numerical weather production models.

The National Weather Service exercised the contract option for full scale production with the Unisys Corporation for production of 165 Next General Radar (NEXRAD) units and over 300 display subsystems. The explosive growth of technology has led to NEXRAD, a joint project of the Departments of Commerce, Transportation and Defense to meet their common radar needs.

Continued development and planning for the Automated Surface Observing System (ASOS). Today, routine surface observations are collected manually each hour at 260 Weather Service facilities with 1,200 people giving at least part time to the task. By freeing them of manual observations, the Automated Surface Observing System (ASOS) will help provide this vital time.

A joint effort of NOAA and the Federal Aviation Administration, the ASOS program will produce as many as 1,700 units--scheduled for installation at U.S. airports by the mid 1990s. Operating automatically 24 hours a day, they will alert forecasters to significant weather changes.

- **1991:** Automated Surface Observing System contract, a key element in NOAA's modernization of its NWS, awarded to AAI Corporation of Hunt Valley, Maryland on February 19<sup>th</sup>.
- **1992:** Twenty-two of the planned 115 modernized Weather Forecast Offices (WFO) were built or remodeled during the year, with 12 NWS radars installed. Of a programmed 1,700 ASOS units, 151 were installed and 13 commissioned. Hurricane Inki struck the Hawaiian island of Kauai killing seven and Hurricane Andrew devastates Florida and Louisiana.
- **1993:** "Year of Water" -- record floods inundate the Midwest; the National Weather Service earns the U.S. Commerce Department's highest award, a gold medal, for performance during the flooding. Advanced Weather Interactive Processing System (AWIPS) contract awarded to PRC, Inc., of McLean, VA. AWIPS will rapidly analyze weather data and distribute it nationwide; the 100<sup>th</sup> new Doppler weather radar was installed; the blizzard of '93 deposited enough precipitation in one weekend to drastically change the Spring hydroponic outlook; an international training facility was dedicated at the National Meteorological Center.

Two scientists develop a new method of processing atmospheric data needed for global forecasting and five meteorologists from Alaska design a state-of-the-art computer network used to improve forecasting capabilities in Alaska.

- **1994:** Dr. Elbert W. Friday, Jr. was honored as Federal Executive of the Year; tornadoes plow through Southeast United States killing 40; Vice President Al Gore launches NOAA Weather Radio initiative to increase transmitter coverage to 95 percent of the population; the new Gray C90 supercomputer was dedicated providing for faster and more accurate forecasts; NOAA and the EPA launched an experimental Ultraviolet Exposure Index.