Appendix B. NOAA Line Offices

The National Oceanic and Atmospheric Administration (NOAA) is a multi-varied, environmental, scientific agency composed of five major organizations:

- National Weather Service (NWS)
- Office of Oceanic and Atmospheric Research (OAR)
- National Ocean Service (NOS)
- National Marine Fisheries Service (NMFS)
- National Environmental Satellite, Data, and Information Service (NESDIS)

NOAA's mission is to describe and predict changes in Earth's environment and to conserve and wisely manage the Nation's coastal and marine resources.

NOAA and its predecessor agencies have been collecting, analyzing, and distributing environmental information to the Nation since the early 1800s, when the Survey of the Coast was formed by President Thomas Jefferson through the Organic Act of 1807. The creation of NOAA in 1970 was the result of a series of decisions made by various Presidents and Congress (over more than 150 years) that recognized the importance of the oceans and atmosphere to our Nation's welfare and economy.

Appendix B provides a sampling of environmental data management activities within NOAA's Line Offices.

Contents

B.1 National Weather Service (NWS)

The National Weather Service (NWS) provides weather, water, and climate forecasts and warnings for the United States, its territories, adjacent waters, and ocean areas, for the protection of life and property and the enhancement of the national economy. NWS data and products form a national information database and infrastructure that can be used by other governmental agencies, the private sector, the public, and the global community. The NWS is the sole United States *official* voice for issuing warnings during life-threatening weather situations.

The origins of the NWS can be traced back to the first national weather warning service, which was created in the Department of the Army in 1870. Today's NWS organization is composed of a headquarters, six regional offices, five National Centers, and 121 Weather Forecast Offices that provide meteorological services, as well as 13 River Forecast Centers that provide specialized hydrological services. The NWS mission is supported through the activities of this organization on a 24 hours per day, seven days per week basis at the field offices. Products are provided in the form of alphanumeric observations, forecasts, warnings, advisories, outlooks (covering their geographical areas of responsibility), and graphical products of various types.

NOAA WP-3D Orion hurricane hunter collecting storm observations.

B.1.1 Upper-Air Observations Program

The NWS has conducted radiosonde observations for more than 60 years. The radiosonde is a small, expendable instrument package carried aloft by a large balloon. As the radiosonde ascends, it radio transmits to a ground receiver continuous pressure, temperature, and relative humidity data to altitudes approaching 35 km and distances of up to 250 km from tracking stations. By tracking the position of the radiosonde in flight, information on wind speed and direction aloft is also obtained. Observations are made by the NWS at 92 stations—69 in the conterminous United States, 13 in Alaska, nine in the Pacific, and one in Puerto Rico. The NWS also supports the operation of 10 stations in the Caribbean. Observations are taken twice daily.

Radiosonde observations are the primary source of upper-air data required to understand and accurately predict changes in the atmosphere. Radiosonde observations are applied to a spectrum of efforts including:

- Input to national and international computer-based weather prediction models
- Local severe storm, aviation, and marine forecasts
- Weather and climate change research
- Ground truth for satellite-based measurements

Radiosonde ascent.

The NWS systems in use today have obsolete components and are increasingly difficult to maintain. The ground tracking system is more than 45 years old and the computer systems used to process and transmit the upper-air data are outdated IBM PC/XTs. Efforts are underway by the NWS to develop and deploy advanced ground tracking systems that will be interfaced with modern data processing computers. The new Radiosonde Replacement System network will utilize Global Positioning System radiosondes to provide winds aloft. The upper-air data provided with the new system will provide a high resolution four-dimensional data set in the horizontal and vertical by time, be more reliable, and have higher quality. Initial implementation of the Radiosonde Replacement System is scheduled to begin in late 2001 and to be completed by 2005.

B.1.2 National Weather Service Modernized Operations

Advanced Weather Information Processing System (AWIPS)

AWIPS serves as the linchpin of the NWS modernization. NWS offices use AWIPS for data acquisition and distribution, for analysis, and for forecast preparation and dissemination. AWIPS provides direct links to observing systems such as the Automated Surface Observing System (ASOS), the Radiosonde MicroArt data collection system, and the Weather Surveillance Radar-88 Doppler (WSR-88D).

Data collected by the local site are centrally collected at the AWIPS Network Control Facility (NCF) using a Wide Area Network and are broadcast on the AWIPS Satellite Broadcast Network, also called NOAAPORT. In addition, NOAA's National Environmental Satellite, Data, and Information Service delivers five channels of GOES satellite data to the NCF from satellites positioned over the Eastern and Western U.S for distribution on NOAAPORT.

NOAA's National Climatic Data Center (NCDC) has a NOAAPORT Receive Site antenna which was installed in 1998.

It will use this downlink and original AWIPS prototype hardware and software to ingest and archive the data. NCDC is working with the NWS on an improved design to capture the data in the most usable formats and to allow monitoring, quality control, and display of the archived data. This could include the development of complete case study data sets to allow NWS to enhance scientific understanding of extreme events and improve forecasting skills through training.

Weather Surveillance Radar-88 Doppler (WSR-88D) Program

The Weather Surveillance Radar-88 Doppler (WSR-88D) Program, also known as NEXRAD, was put into operation during the early 1990s. These radars have proven to be a significant asset to the Nation. They provide critical weather information during weather events such as flash flood and tornado episodes. With the ability to record and archive the radar data, research and climatic studies have been greatly enhanced.

NEXRAD radar tower.

There are 164 operational sites, each providing between 0.75 and 1.0 terabytes (TB) of radar data each year to NCDC's archive (approximately 120 TB from the entire system). Data are provided on 8 mm tapes, and products are provided on non-standard optical disks—both of which require an enormous amount of data management. The nearly 10-year-old network of WSR-88Ds is undergoing an evolution to an open architecture to allow for a more rapid upgrade to the system. As part of the upgrade, NWS is exploring new technologies to archive the base radar data so that the antiquated equipment and tapes can be replaced. The NWS is going to centrally collect a set of radar products via AWIPS. This will allow for a more efficient distribution of the products to NWS field sites and other users. The products will also be delivered to NCDC for archival to fulfill legal and other requirements. Products are being migrated to the NCDC mass storage system to improve accessibility.

Automated Surface Observing System (ASOS)

NCDC captures data through direct-dial access to the Automated Surface Observing System (ASOS) sites located throughout the United States. As of July 2000, there were more than 760 commissioned ASOS sites recording official observations. NCDC ingest and processing systems retrieve data continuously. Both systems ingest, process, archive, and make accessible hourly and special observations, as well as the high-resolution 1-minute data.

B.1.3 Cooperative Observer Program (COOP)

The Cooperative Observer Program (COOP) is a nationwide weather and climate monitoring network of about 11,700 volunteer citizens and institutions that observe and report weather information on a daily basis. COOP is a critical component of the NWS's data collection system and is a vital component of the national observing capability for monitoring temperature, precipitation, snowfall, and other weather events across the country.

COOP is the Nation's largest and oldest climate/weather network. The observations provide the bulk of historical climate data for the United States. Officially established in 1890, observers submit monthly summaries of their 24-hour manual observations to the National Climatic Data Center (NCDC) for quality control, archiving, and publication. Data are made available by NCDC via published hard copy and the Web. Several thousand observers also transmit 24-hour observations daily to NWS forecast offices, where the data are utilized in support of local forecast and warning services. These data are made available daily by the NWS via the Web and other dissemination products. These high quality data are used by the Climate Prediction Center and climate change researchers.

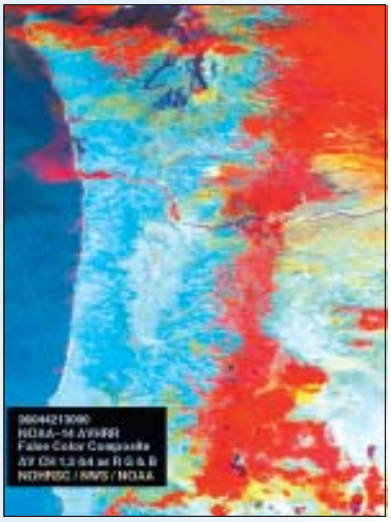
The COOP database is one of NOAA's most requested data sets. Applications of the data are far ranging, and include basic socioeconomic activities such as management of water resources, design and maintenance of infrastructure, predicting crop yields, litigation, energy consumption studies, etc. Thus, dissemination, archiving, and customer service related to the network's data requires strong crosscutting data management coordination with other NOAA line offices, Federal and State governments, and other groups such as the Regional Climate Centers and State Climatologists.

B.1.4 Climate Prediction Center (CPC)

The Climate Prediction Center (CPC) provides climate products and services relating to operational prediction of climate variations, monitoring of the climate system, and development of databases for determining current global and regional climate anomalies and trends. These services cover climate time-scales ranging from weeks to seasons, as well as the domains of land, ocean, and atmosphere, including the stratosphere.

Services and products are distributed to users in the Federal government, the research community, private industry, the general

public, and foreign countries. CPC supports and stimulates the use of climate data for applications in agriculture, energy, transportation, water resources, and health. To support these services, CPC engages in diagnostic studies of observations and forecast model output to improve the prediction, monitoring, and analysis of the physical climate system.



Northwestern United States, February 1996. NWS/NOHRSC image from NOAA-14 AVHRR data. The red color represents cold temperatures such as snow packs. The red plume coming out of the mouth of the Columbia River represents snowmelt.

B.1.5 National Operational Hydrologic Remote Sensing Center (NOHRSC)

The National Operational Hydrologic Remote Sensing Center (NOHRSC), operating under the Office of Hydrology of the NWS, creates and distributes a variety of products that use remotely sensed data in support of the hydrological services mission of the NWS. The NWS issues river and flood forecasts for the Nation, and it provides hydrometeorological data and products to support the Nation's water resource managers.

The NOHRSC uses airborne and satellite remotely-sensed data to derive the snow water equivalent and areal extent of the snow cover (in near-real-time) throughout North America each winter. Snow water equivalent is determined from data collected by gamma radiation detection systems operating onboard low-flying aircraft. The NOHRSC maintains an active network of more than 1,800 flight lines covering portions of 25 States and seven Canadian Provinces. Airborne snow water equivalent data are collected over various flight lines each winter according to regional snow cover conditions. Additionally, the areal extent of snow cover is measured using data from the NOAA polar-orbiting (POES) and geostationary satellites (GOES). The satellite snow cover data sets are integrated with other spatial data to generate products that indicate the areal extent of snow by hydrologic basin and ground elevation.

On-line products cover major portions of the continental United States and Canada and include:

- Airborne snow water equivalent data and the digitized flight-line network
- Areal extent of snow cover products derived from satellite data
- National and regional snow cover image products
- Ancillary data sets, including digital elevation data, digitized NWS basin boundaries, and the alphanumeric results of the satellite snow cover mapping by basin and elevation zone.

B.1.6 National Data Buoy Center (NDBC)

The National Data Buoy Center (NDBC) maintains a network of 123 automated reporting stations in the coastal and offshore area of the Atlantic and Pacific Oceans, the Gulf of Mexico, and in the Great Lakes. The network is comprised of 68 moored buoys and 55 Coastal-Marine Automated Network (C-MAN) stations that are attached to permanent structures, such as light towers or piers. These stations obtain measurements of meteorological and oceanographic parameters for operations and research.

C-MAN station, Ambrose Light, New York.

Moored buoy and C-MAN stations acquire, store, and transmit meteorological and oceanographic data every hour; a few selected stations report every half hour. Measurements include sea-level pressure, wind speed and direction, peak wind, and air temperature. In addition, sea-surface temperature and wave spectra data are measured by all moored buoys and a limited number of C-MAN stations. Relative humidity is measured at many buoy and C-MAN stations where most beneficial to forecast operations.

Since the observations are critical for operational decisions, such as issuance of warnings and advisories, NDBC operates a sophisticated, real-time data quality control program that prevents incorrect, misleading measurements from distribution to the field. Subsequent data quality control procedures are applied to prevent more subtle errors in environmental data and station metadata from entering the national data archives.

In addition to its automated network, NDBC manages the NWS Voluntary Observing Ship (VOS) program. VOS provides approximately 30,000 meteorological and oceanographic observations per month. It is anticipated that system improvements, such as more user-friendly data entry processes, more automation, and more focused use of telecommunications options, will lead to higher quality data in support of operations and research.

The 6-meter NOMAD buoy provides excellent long-term survivability in severe seas.

B.1.7 Dissemination Program

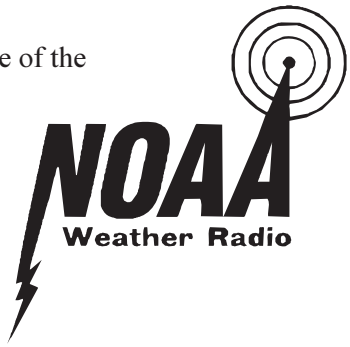
Emergency Managers Weather Information Network (EMWIN)

Emergency Managers Weather Information Network (EMWIN) is a wireless computer data broadcast system that provides live warnings, forecasts, graphics, satellite imagery and other data to the emergency management community, television stations, various government and private institutions, as well as the general public. Data are broadcast via three methods: GOES satellites, VHF radio, and the Internet. The satellite broadcast now cover two thirds of the planet. The data stream is prioritized and continuous.

EMWIN's main strength is its affordability. Many similar services are expensive, difficult to maintain and have reoccurring fees. EMWIN systems and display software are user friendly and very inexpensive. The data are provided by the NWS for free. This is extremely important to many local managers that are on limited budgets. EMWIN is now used in many small island nations in the Pacific as their primary advanced warning system for tsunamis and hurricanes. EMWIN is also very adaptable. Emergency managers can locally retransmit EMWIN data using one of the several NWS VHF frequencies that are now available. Local areas have the ability to customize the data stream for their own needs.

NOAA Weather Radio (NWR)

NOAA Weather Radio (NWR) is the "Voice of the National Weather Service." It provides continuous broadcasts of the latest weather information, and warnings of severe weather and other life-threatening hazards from 121 local NWS Weather Forecast Offices. Broadcasts are specifically tailored to needs of people within the service area of the NWR station.



During severe weather or other life threatening situations, including those due to both natural and man made disasters, the regular broadcast is interrupted by special warning messages describing the threat and actions that should be taken. These messages are accompanied by Specific Area Message Encoding (SAME) digital coding that activates special receivers programmed by the user to alarm only for specific events and for specific areas. These receivers have a loud siren, LEDs to indicate the immediacy of the threat (advisory, watch, or warning), and an LCD display that identifies the

specific threat (tornado, flash flood, civil emergency, etc.). Some can also drive external devices (bed shakers, strobe lamps, etc.) to alert those who are deaf and hard of hearing.

NWR broadcasts from more than 550 NWR stations in the fifty States, Puerto Rico, the U.S. Virgin Islands, Guam and Saipan on seven frequencies (162.4 to 162.55 megahertz). The NWR network currently provides coverage to 80 to 85% of the population. The NWS is working increase coverage to 95% of the population.

NOAA Weather Wire Service (NWWS)

The NOAA Weather Wire Service (NWWS) is a C-Band satellite-based telecommunications network designed to disseminate weather watches, warnings and other products—more than 6000 in all—in the shortest possible time and with the highest possible reliability**.** The NWWS is comprised of 20 transmitting sites known as uplinks. The uplinks consist of 13 Weather Forecast Office/River Forecast Centers, the AWIPS Network Control Center, and special centers such as the Storm Prediction Center, Tropical Prediction Center, Pacific and Alaska Tsunami Warning Centers, and the USGS Earthquake Center.

By utilizing the AWIPS WAN, NWWS data from all WFOs are uplinked by the 13 WFO/RFC AWIPS hub locations. The data are broadcast at 64 Kbps to "end users." End users consist mainly of mass news disseminators such as newspapers, radio, paging systems, and TV stations as well as emergency managers (law enforcement and civil defense) and commercial/industry users. It is the most timely method used by the NWS to disseminate important data such as watches and warnings to the public.

The primary data are textual, with headers identifying the type of product, origination, and applicable time period. The NWWS uses both Product Inventory List (PIL) headers and World Meteorological Organization (WMO) headers. The enhanced capabilities of the new NWWS will allow transmission of limited graphics products.

In addition, the NWWS has automatic dial backup at all transmission sites in case of failure of any part of the system, whether it is satellite or terrestrial. This also provides a means of continuous operations even during sun outages. The specified availability for the data link is 99.9%. The products are transmitted/uplinked at a data rate of 9.6 Kbps and a broadcast rate of 64 Kbps. The Message Processing Center (MPC) is located in Chantilly, Virginia. Master Ground Station (MGS) hubs are located at the Washington International Teleport (WIT) and Ft. Meade, Maryland.

B.1.8 NOAA Model Data Distribution and Archive

Numerical weather model data sets that are more timely and of high spatial and temporal resolution are increasingly being required by university research and education programs. These data sets, produced by the NWS National Centers for Environmental Prediction (NCEP), are now being distributed to these institutions and laboratories through the cooperation of the U.S. Weather Research Program (USWRP), NWS, NASA's Goddard Space Flight Center (GSFC) and the University Corporation for Atmospheric Research (UCAR) Unidata Program Center.

The system, called Cooperative Opportunity for NCEP Data Using Internet Data Distribution (IDD) Technology (CONDUIT), uses Unidata's IDD architecture and the associated Local Data Manager (LDM) software to distribute NCEP model data to universities throughout the country (through the Unidata network). Statistics indicate that the LDM and associated "push" of data improves the data transfer rate to universities approximately 10-fold over the previous File Protocol Transfer method. Plans to migrate the system to the Next Generation Internet (high-speed network) should improve performance and reliability even further.

A new collaborative effort, between the NWS, NCDC, the National Center for Atmospheric Research (NCAR), and the Geophysical Fluid Dynamic Laboratory (GFDL) is planned to archive and provide access to real-time and retrospective Global Climate and Numerical Weather Prediction (NWP) model data. The total volume for this archive will approach 100 terabytes per year. Once implemented, this advanced research-quality archive will provide data for a variety of model applications and be a resource for government agencies and the private sector.