

DEPARTMENT OF THE INTERIOR WEATHER PROGRAMS

The Interior Department (DOI), is the Nation's principal conservation agency, charged with the mission "to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian tribes and our commitments to island communities. The following operational and research program narratives describe the full range of meteorological activity in the Interior Department that contribute to the overall Federal Meteorological Plan.



Bureau of Land Management



BLM is one of five Federal Land Management agencies which have centralized Wildland fire weather operations at the National Interagency Fire Center (NIFC), Boise, Idaho. BLM's Initial Attack Management System (IAMS) was designed in the mid-1980's to provide real-time data access and modeling for the fire management organization. The IAMS required a considerable dedicated telecommunications network for data distribution. In an effort to reduce these inherent telecommunications costs, the BLM has moved into a "web server" environment. Many of the capabilities that were centrally located in the old IAMS have been moved to other web sites.

Fire Weather Websites. The principal Wildland Fire Management Information System (WFMIS) inputs remain the same with Remote Automatic Weather Station (RAWS) and National Lightning Detection Network (NLDN) information (Figure 3-DOI-1). BLM's new server system is called the BLM Wildland Fire Management Information Site (www.nifc.blm.gov). Additional fire management information is summa-

rized and made available at the Desert Research Institute (wrcc.dri.edu and cefa.dri.edu) and the United States Forest Service Wildland Fire Assessment System ([//svinet2.fs.fed.us/land/wfas/](http://svinet2.fs.fed.us/land/wfas/)). Additionally, the BLM has utilized the Desert Research Institute's capabilities to respond quickly for website support.

Automated Weather Stations. The BLM's RAWS Program primarily collects meteorological data for fire weather forecasting. However, use of BLM's RAWS data set by other non-fire users has generated sufficient funding to permit year-round operation of the entire network. The BLM's Resource Management and Oregon O&C (West-Side) also operate RAWS networks which are much smaller and have specific program requirements that differ from fire management.

Lightning Detection. In 1997, the BLM began contracting with a private vendor via the National Weather Service for lightning location data. Data are received at the NIFC in Boise, Idaho, and placed on the BLM WFMIS for qualified user access. Current plans are to continue the operation of the Alaska Automatic Lightning Detection System as an independent government-owned and operated system.

Fire Weather Support. The BLM's Remote Sensing Fire Weather Support Unit at NIFC provides a full range of specialized management, maintenance, data, and support services for the BLM and numerous other government agencies. This interagency staffed and funded facility performs work under long-term interagency agreements with those agencies within the govern-

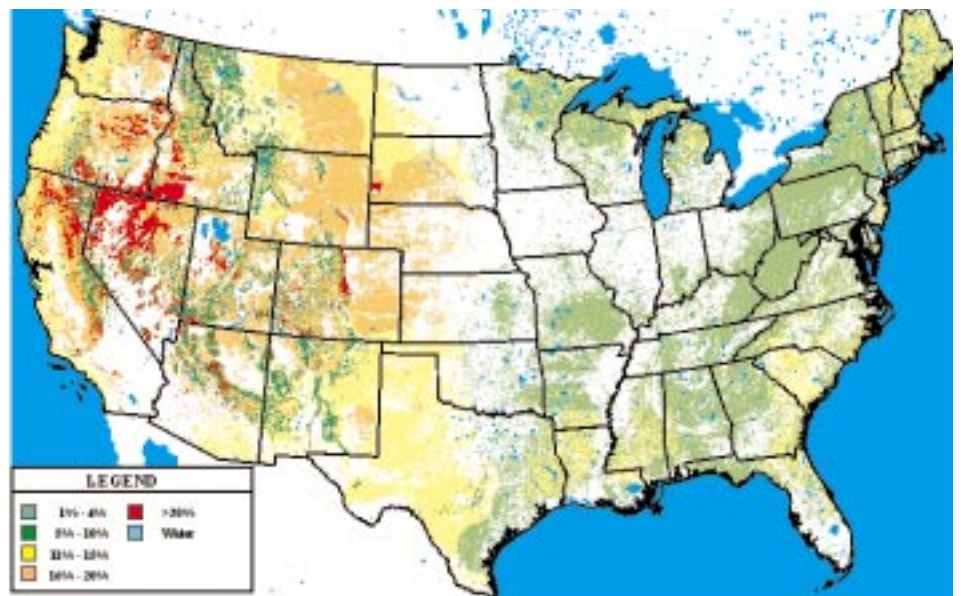


Figure 3-DOI-1. A National Interagency Fire Center graphic of Lightning Ignition Efficiency for the lower 48 states.

ment having similar equipment and requirements. Staffing levels within this group are adjusted to meet the overall interagency requirements.

Climate Monitoring. In addition to the meteorological monitoring BLM conducts primarily to support Wildland fire management activities, the BLM also conducts site-specific climate monitoring at over 200 manual weather station locations on the public lands in the 11 western states and Alaska. The operation of these sites ranges from seasonal to annual, taking measurements of precipitation, temperature, soil moisture, and other meteorological parameters necessary to assess local climactic influences. These data are primarily used for natural resources management and planning at the local level.

Portable Weather Stations. During the 1999 fire season, the Remote Sensing/Fire Weather Support Unit began a 2-year "proof of concept" effort with a portable weather station referred to as the Fire RAWS (FRWS). FRWS are intended for use on or near a fire line and can be rapidly relocated to points desired by Fire Behavior Analysts (FBAs) for real-time weather data. Due to the extreme fire season in both 1999 and 2000, the FRWS was used extensively and was found to be a valuable asset for firefighter safety and fire weather forecasting.

Currently, 30 FRWS systems are cached at NIFC for use during the 2003 season. Prescribed fire managers have increased the usage of FRWS for prescribed burns for information pertaining to fire weather window prescriptions. FRWS collect, store, and forward data by interrogated voice radio with new data available every fifteen minutes. Satellite data can be retrieved from the BLM/NIFC website. Hourly satellite data is available to Fire Weather Forecasting Staff for spot forecasts and fire support from all central locations (Geographic Area Coordination Centers (GACCs), NIFC, etc.).

All Risks Support. After the terrorist attack on September 11th, 2001, the Remote Sensing/Fire Weather Support Unit was tasked to provide near-real-time meteorological data collection at the World Trade Center (Figure 3-DOI-2). This effort was in direct support of the Environmental Protection Agency's task of monitoring air quality in the vicinity of the collapsed towers. Most recently, the unit also provided remote meteorological support for the Columbia Shuttle recovery effort. RAWS data from BLM's network has generated additional interest from the new Department of Homeland Security (DHS). As DHS assesses its needs for remote and urban environmental monitoring, BLM could potentially see additional requests for support required for the DHS mission.

UNITED STATES GEOLOGICAL SURVEY (USGS)

Water Data. The USGS's Water Resources Division (WRD) collects streamflow, precipitation, water quality, ground-water level, and other water resources and climatological data as

part of a national network and for a number of projects concerning rainfall/runoff, water quality and hydrologic processes. Currently, the USGS collects hydrologic and meteorological data from more than 11,000 surface-water sites, precipitation data from more than 1,100 sites, ground-water level data from more than 21,000 sites, and water quality data from more than 8,500 surface-water, ground-water, and precipitation sites.

Data collected at USGS sites are transmitted from approximately 7,100 remote Data Collection Platforms (DCPs). The data are transmitted to Wallops, Virginia, via GOES and rebroadcast to a domestic communication satellite (DOMSAT). Data are received from the DOMSAT by local readout ground stations (LRGS) procured by USGS under a 1992 contract. The USGS currently operates 15 LRGS which provide near-real-time data to the USGS's computerized National Water Information System (NWIS). Data from an additional 1,300 sites are transmitted via other telemetry (mostly telephone). Near-



Figure 3-DOI-2. Remote Sensing/Fire Weather Support Unit providing near-real-time meteorological data collection at the World Trade Center.

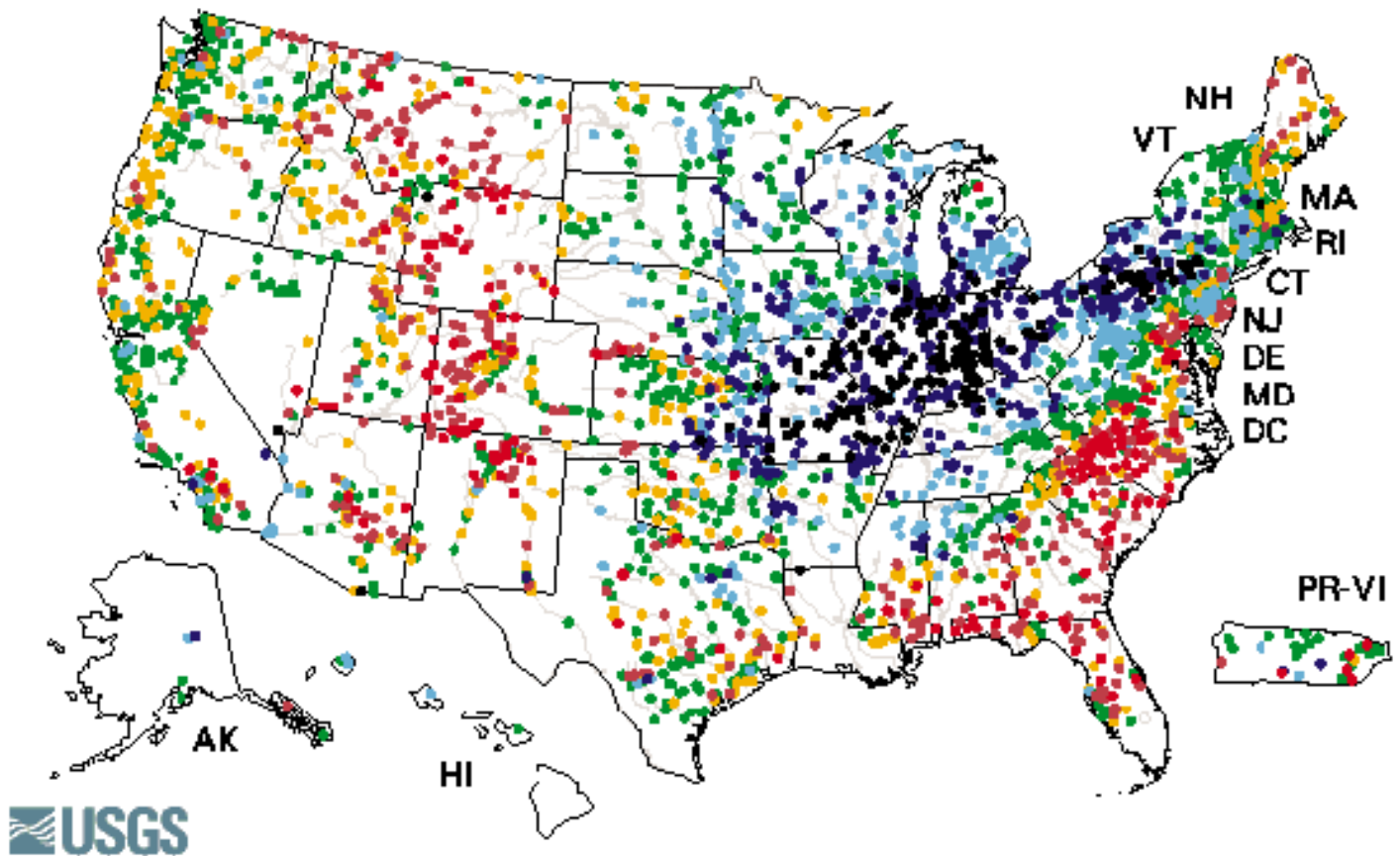


Figure 3-DOI-3. Sample USGS Water Watch map of real-time streamflow compared to historical streamflow for the day of the year. Source: USGS Website

real-time streamflow data and ancillary information are provided to National Weather Service River Forecast Centers for over 2000 river forecast points (Figure 3-DOI-3).

The USGS also collects precipitation samples in a number of studies for the determination of atmospheric contribution to the chemical constituent loads to runoff, and for defining the effect of atmospheric deposition on water quality and the aquatic environment. The USGS serves historical and real-time water resources data on its NWIS Web Internet site (<http://water-data.usgs.gov/nwis/>).

Snow and Ice Studies. The USGS is carrying out a joint research program with NASA and the University of Washington-Seattle's Electrical and Civil Engineering Departments to measure snowpack water equivalent or snow depth using satellite passive microwave observations from the Defense Meteorological Satellite

Program's (DMSP's) Special Sensor Microwave/Imager (SSM/I) sensor. Unlike observations in the visible bands, passive microwave observations are independent of cloud cover and solar illumination and respond to both snow depth and snowpack grain size. The satellite observations are being compared to snowpack data from a variety of sources: USDA/NRCS automatic SNOTEL sites; NOAA/NWS sites; and observations by USGS field teams which include grain size, density and stratigraphy. The object of the program is to develop algorithms to extract snow depth or water equivalent information from the satellite observations to be used in near-real-time water resource assessments and in climatological studies based on snowpack distributions determined from the two-decade-long DMSP satellite record. The investigation is developing techniques to utilize algorithms that include the

effects of grain size metamorphoses and to incorporate these algorithms into hydrologic models.

Climatological Research. USGS also carries out research in climate change, regional hydrology, the carbon cycle, coastal erosion, volcanic activity, and glaciology. As part of its glaciology program, the USGS maintains an observation program on three benchmark glaciers representative of different climatic zones of the western United States, one in Washington, one on the south coast of Alaska and one in the interior of Alaska. At each glacier, the program measures the winter snow accumulation, summer snow and ice ablation, air temperature, and runoff in the glacier basin. The length of the glacier record is now 43 years; this is the longest such record in North America. Analysis of this record is providing a greater understanding of the climate variability and its effects on water resources of the western

United States. The record clearly shows the effects of changing winter precipitation patterns associated with El Niño and La Niña events. In addition, the record from South Cascade Glacier, in Washington State, indicates that we are returning to the cool-phase of the Pacific Decadal Oscillation. Both the snowpack and glaciology program now incorporate data supplied by the U.S. intelligence community through the coordination of the Civil Applications Committee (CAC).

Geomagnetic Data. The Geomagnetism Group of the USGS Central Region Geohazards Team provides real-time, ground-based measurements of the Earth's magnetic field, which are an important contribution to the diagnosis of conditions in the near-Earth space environment of the sun, the solar wind, the magnetosphere, the ionosphere, and the thermosphere. During geomagnetic storms, brought about by the complex interaction of the Earth's magnetic field with that of the Sun's, both high- and low-frequency radio communications can be difficult or impossible, global positioning systems (GPS) can be degraded, satellite electronics can be damaged, satellite drag can be enhanced, and astronaut and high-altitude pilots can be subjected to enhanced levels of radiation.

Ground-based geomagnetic observatory data are complementary to those collected by space-based satellites, indeed, most of the hazardous effects on technological systems brought about by magnetic storms, occur at or near the Earth's surface; therefore, to monitor the magnetic field, the Geomagnetism Group operates 14 magnetic observatories in the United States and its Territories. The data from these observatories, plus 15 foreign observatories, are transmitted to the Group's headquarters in

Golden, Colorado, where they are processed and analyzed. Data are then transmitted to the Space Environment Center (SEC) of the National Oceanic and Atmospheric Administration (NOAA) and to the U.S. Air Force's (USAF) Air Force Weather Agency at Offutt AFB, Nebraska.

USGS observatories are operated in cooperation with Intermagnet, an international consortium overseeing the operation of nearly 80 geomagnetic observatories distributed around the globe. The roles and responsibilities of agencies participating in the National Space Environment and Warning Program are detailed in the *The National Space Weather Program Strategic Plan* (FCM-P30-1995).

Until the 1980s, the Alaskan volcanoes had been largely unstudied. Despite Alaska's low population density over much of the state, Alaska's volcanoes underlie the heavily traveled air routes of the North Pacific region.

During recent years, the USGS's Alaskan Volcano Observatory (AVO) has expanded its network of real-time seismic monitoring stations to bring 24 of the Alaska's volcanoes under continuous, real-time surveillance. Data and information from the AVO monitoring activities are integrated directly into the regional operational activities of the FAA, DOD, and NOAA/NWS to provide warnings for pilots and aircraft operators in the Alaskan region.

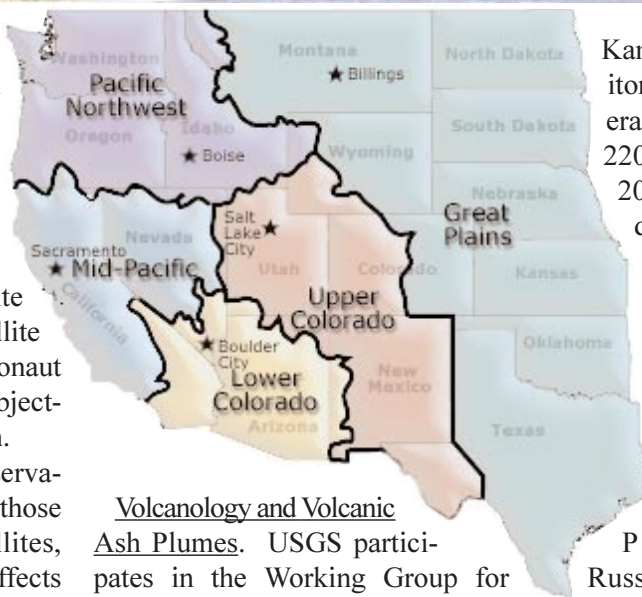
Internationally, the OFCM's WG/VA supported expansion of USGS monitoring activities in the remote Pacific Rim of explosive volcanoes. The 100 historically active volcanoes in Alaska,

Kamchatka, and the Kuriles are monitored through satellite imagery several times a day. Currently, about 220 aircraft per day - carrying about 20,000 passengers and millions of dollars of cargo value - fly international Northern Pacific Routes near these historically active volcanoes. About half these flights are United States carriers.

AVO, through its working agreement with the Kamchatka Volcanic Eruption Response Team (KVERT) in Petropavlovsk-Kamchatsky, Russia, also supplies information about eruptive activity in Kamchatka and the Kuriles to the FAA, the NWS, and numerous domestic and foreign air carriers.

BUREAU OF RECLAMATION

The Bureau of Reclamation (Reclamation) activities requiring the collection and use of meteorological data include water supply forecasting, snowpack water equivalent assess-



Volcanology and Volcanic Ash Plumes. USGS participates in the Working Group for Volcanic Ash (WG/VA) of the OFCM. This working group is preparing *A National Framework for Volcanic Ash Hazards to Aviation*. Through its Volcanic Hazards Program, the USGS is responsible for monitoring volcanoes in the United States; of the approximately 56 historically active volcanoes in the United States, more than 40 are in Alaska.



Figure 3-DOI-4. The Watershed and River Systems Management Program focuses on integrating multi-disciplinary science into decision support systems that enable water managers to make the best deliveries of water to stakeholders.

ment, river system management, reservoir operations, irrigation scheduling, drought status assessment, flood hydrology, and projects related to hydroelectric energy resources. One example of such an ongoing activity within the Science and Technology Program is the Watershed and River System Management Program (WaRSMP), which is being developed in partnership with the USGS (Figure 3-DOI-4). This program provides a data-centered framework for science-based water resources decision making. Major components are:

- Hydrologic DataBase (HDB),
- Modular Modeling System (MMS),
- RiverWare river system modeling framework,
- Stochastic Analysis, Modeling and Simulation (SAMS) system, and
- Agricultural Water Resources Decision Support (AWARDS) and Evapotranspiration Toolbox (ET Toolbox) system.

Hydrologic Modeling. SAMS is being used in WaRSMP to assist water resource managers in developing likely hydrologic scenarios for water supplies. It allows users to test various

water resources management strategies, including extreme drought and high-flow scenarios which haven't been encountered in the historical period of record.

The RiverWare and HDB data-centered decision support system enables water managers to examine a variety of observed and forecast hydrologic scenarios using hourly, daily, or monthly data within the legal and physical constraints on operations of the river system. This model provides a holistic management tool for watershed and river systems, in order to meet a variety of competing demands for water. Each new river system requires considerable development work (2-3 years) for RiverWare and HDB implementation. However, such a system can provide for efficient water operations management, and is especially useful during periods of drought and surplus - as demonstrated by the recent "Colorado River Interim Surplus Criteria: Final Environmental Impact Statement".

Current Reclamation Science and Technology Program projects under WaRSMP include:

- Planning and developing HDB, MMS and RiverWare systems for the Gunnison, San Juan, Rio Grande, Yakima, and Truckee river systems;
- SAMS integration and testing for the Colorado River Basin;
- Implementing AWARDS systems to improve the efficiency of water management and irrigation scheduling for the Tualatin Project, Upper Columbia project areas, and Lower Colorado area;
- Developing the AWARDS/ET Toolbox system in the Middle Rio Grande and providing 24-hour water use estimates for input, via the Corps of Engineers' Hydrologic Engineering Center Decision Support System or a new HDB, to the Rio Grande RiverWare; and
- Implementing similar AWARDS/ET Toolbox systems with input to local HDBs and RiverWare systems in the Upper Columbia, Lower Colorado, and possibly the Truckee-Carson areas.

An additional product of the WaRSMP is the Hydrologic Modeling Inventory (HMI) which provides general technical information and contacts for a wide variety of water resources models presently in use. The HMI is being expanded and can be accessed on the Web at www.usbr.gov/hmi.

Decision Support Systems. An example of the real-time support to Reclamation's water managers is shown for the Upper Columbia Basin (Figure 3-DOI-5). Here NEXRAD estimates of precipitation are used for water supply and water delivery decision-making. Water managers can view the distribution of precipitation over watersheds that supply water to storage facilities, and examine the detailed spatial distributions of precipitation over the irrigated areas along with estimates of soil moisture, and evapotranspiration from crops and riparian vegetation.

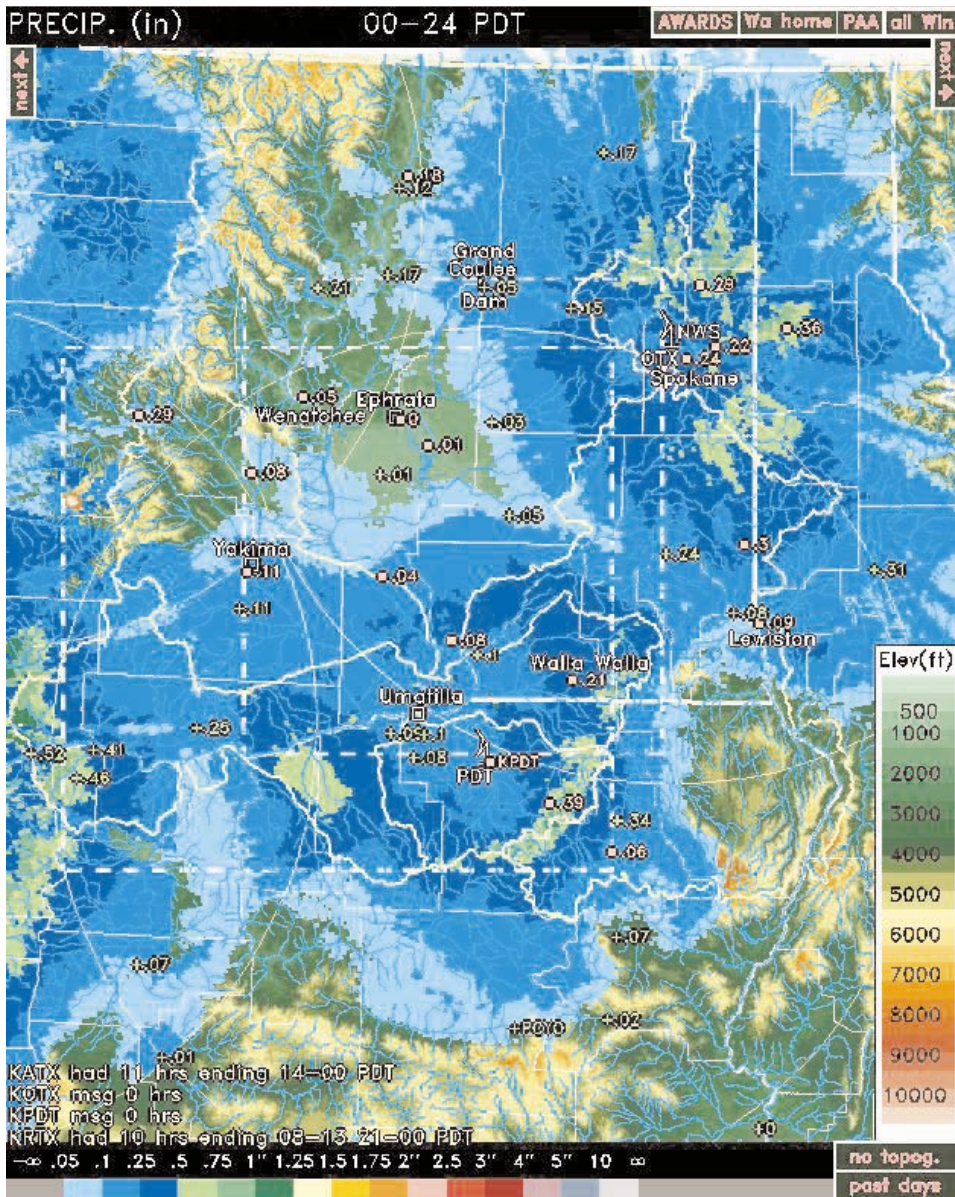


Figure 3-DOI-5. Agricultural Water Resources Decision-Support (AWARDS)/ET Toolbox example from the Columbia Basin from Grand Coulee Dam, Washington to Pendleton, Oregon, showing the precipitation accumulation algorithm (PAA) estimates from the Spokane, Washington, and Pendleton, Oregon, WSR-88D radars.

Instrumentation and Data Acquisition.

Currently, Reclamation's HYDROMET system collects data from approximately 400 hydrometeorological data collection platforms (DCPs) which transmit data in real-time through GOES to Reclamation's DRGS in Boise, Idaho. AGRIMET is another network of 60 DCPs dedicated to analysis of crop water use and water conservation in the Pacific Northwest. Data collected and products created in Boise are electronically transferred to

other BLM, Federal and state offices.

Reclamation's primary real-time hydrometeorological information from the National Weather Service, USGS, NASA, and other agencies is displayed on the AWARDS / NEXRAD / ET Toolbox web site: <http://www.usbr.gov/rsmg/awards/>. Water supply information from cumulative precipitation estimates from radar is also provided in areas where snow fall is an important source of water. Links directly to NRCS and NOAA/NCEP analysis and

forecasting web sites are provided to further document the latest information.

Technical Information. Reclamation is a partner with several large western municipal water providers in the study of benefits from the implementation of water conserving landscaping. The study known as the National Xeriscape Demonstration Program includes the development of a numerical evapotranspiration-based model that will use municipal logistical and climatological data as inputs to develop benefit estimates for municipalities of the West. Some early suggestions from the study point to inefficient irrigation by homeowners caused by inefficient systems and operation, in addition to using high water-consuming landscape plants. More study is needed on development of "smart" irrigation scheduling systems and centralized control by water providers.

During abnormal regional climate conditions, Reclamation meteorologists assist water managers by evaluating environmental information and providing guidance based on the NOAA Climate Prediction Center's (CPC) Weekly Hazards Briefing updates and CPC's seasonal and annual climate forecasts. Special related studies are done upon the request of Reclamation water operations managers, policy team leaders, and cooperating agencies.

MINERALS MANAGEMENT SERVICE

The Minerals Management Service's (MMS's) Environmental Studies Program gathers offshore environmental data for use in the management of offshore oil and gas resources. Currently, MMS is funding the continued operation of five offshore meteorological buoys. Two buoys are located in the Gulf of Mexico and three in the Pacific Ocean off California. The MMS also utilizes data from other buoys funded by NOAA. The buoys collect air temperature, sea surface temperature, wind direction, wind

speed, wave height, and wave spectrum data. Many of the buoys measure relative humidity as well.

In FY 2002, the MMS completed data collection from two 915-MHz radar profilers with Radio Acoustic Sounding System (RASS) in the Gulf of Mexico. One profiler was located about 6 miles off the central Louisiana coast, while the other was placed in deeper water about 130 km from shore. Data collection started in June 1998, and ended in October 2001. Each profiler site also collected surface wind, temperature, relative humidity, atmospheric pressure, and sea surface temperature. The profiler data will be synthesized with data from other sources, such as buoys, as well as with output from a prognostic model to construct a database on marine boundary layer and atmospheric dispersion characteristics in the Gulf of Mexico.

Upon request by MMS, the oil and gas industry operators with facilities located within 100 km of the Breton National Wilderness Area (NWA) in Louisiana undertook an aerometric monitoring program. Six monitoring stations were established. One was based on shore; the others were placed on offshore platforms or buoys. All of them collected surface meteorological data. Four of the sites had radar profilers with RASS. Three of the sites also collected air quality data. Data collection started in October 2000 and ended in September 2001. The data will be used to study the effect of air emissions in the area on air quality in the Breton NWA.

BUREAU OF INDIAN AFFAIRS

The Bureau of Indian Affairs collects atmospheric data to evaluate potentially irrigable Indian Trust lands in the Southwest. The Bureau also shares

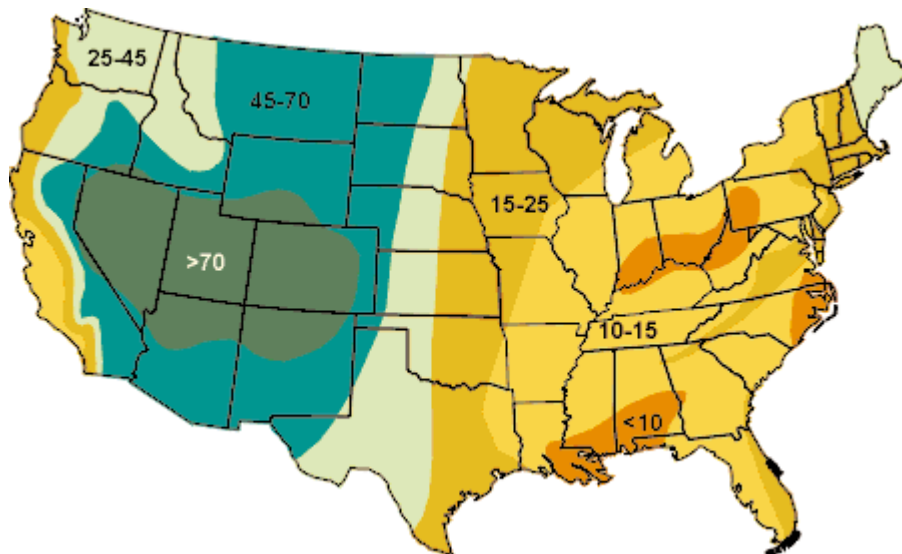


Figure 3-DOI-6. Visibility impairment causes landscape features and colors to fade, diminishing the experience of park visitors. Poorest visibility occurs east of the Mississippi River and in the urban areas of California. NPS monitors visibility conditions and conducts studies to determine the causes of visibility impairment in many park areas nationwide. Sulfates are usually the largest single contributor to visibility impairment; however, nitrates and organic compounds also contribute significantly in some regions of the country.

fire weather data with other Federal agencies while participating in fire weather forecasting at the National Interagency Fire Center.

National Park Service and Fish and Wildlife Service

The National Park Service (NPS) monitors air quality and visibility in several national parks and monuments. Gaseous pollutants data are collected on continuous and integrated (24-hour) bases. Surface meteorological data are collected and analyzed for hourly averages. Precipitation chemistry is determined on week-long integrated rainfall samples. Twenty-four hour, average particle concentrations (mass, elemental analyses, some chemical constituent analyses) are measured twice weekly. Atmospheric light extinction is measured continuously and relayed to a central location for analyses (Figure 3-DOI-6).

The NPS also conducts and contracts research to develop and test air quality models to assess long-range transport, chemical transformation, and deposition of air pollutants. These models are used to estimate source contributions to, and to identify source regions responsible for, observed pollutant loadings.

Joint Monitoring and Research. The Fish and Wildlife Service Air Quality Branch and the NPS Air Resources Division operate under an interagency agreement and are collocated in Lakewood, Colorado. Expertise from both agencies is pooled to address the air quality issues that are the responsibility of the Assistant Secretary of the Interior for Fish and Wildlife and Parks.