

# DEPARTMENT OF THE INTERIOR WEATHER PROGRAMS

The Department of the Interior's (DOI) Atmospheric Science activities are primarily research and, historically, have been reported through the Subcommittee for Atmospheric Research. However, budgetary information for the Bureau of Land Management's operational wildfire weather data collection system is reported in this Federal Plan. The narrative below describes the full-range of meteorological activity in the Interior Department.



## 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 (Figure 3-DOI-1). 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. This new system is called the BLM Wildland Fire Management Information Site (WFMIS) ([www.nifc.blm.gov](http://www.nifc.blm.gov)). Many of the capabilities that were centrally located in the old IAMS have been moved to other web sites.

The principal WFMIS inputs remain the same with Remote Automatic Weather Station (RAWS) and National Lightning Detection Network (NLDN) information. Additional fire management information is summarized and made available at the Western Regional Climate Center ([www.wrcc.sage.dri.edu](http://www.wrcc.sage.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/)).

The BLM's RAWS Program primarily collects meteorological data for fire weather forecasting. In past years, the network also provided considerable support to nonfire entities and was

operated year around. However, with increased pressure on operational dollars, the BLM Office of Fire and Aviation Management has decided to restructure its network. Plans were to reduce the fire network by about one fourth in the western states. However, after considerable study, and optimization, actual reductions have been about 15 percent. With continued funding pressures, the requirement to replace aging equipment, and the considerable costs associated with maintaining such a large network, BLM Fire Management's strategy was to reduce the total number of RAWS, move to a single station classification (all stations configured the same), operate only during the traditional western fire season (RAWS no longer maintained in winter months), and to use any savings

in operating funds to replace aging equipment and upgrade the remaining network. However, once again, the expanded use of Fire Managements RAWS data set by other non-fire users has generated funding to permit year around operation of the entire network. The BLM's Resource Management and Oregon O&C (West-Side) RAWS networks will continue to operate and to be supported as in the past. These networks are much smaller and have specific program requirements that differ from fire management.

In 1997, the BLM began contracting with a private vendor via the National Weather Service for lightning location data. Data is received at the NIFC in Boise, Idaho and placed on the BLM WFMIS for qualified user access. Current plans are to continue the oper-

## Geographic Areas and Coordination Centers



Figure 3-DOI-1. National Interagency Coordination Center coordinates with the GACCs for wildland fire supplies and resources.

ation of the Alaska Automatic Lightning Detection System as an independent government-owned and operated system.

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 government having similar equipment and requirements. Staffing levels within this Group are being adjusted to meet the overall interagency requirements.

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 eleven western states and Alaska. The operation of these sites ranges from seasonal to annual measurements of precipitation, temperature, soil moisture and other meteorological parameters necessary to assess local climatic influences. These data are primarily used for natural resources management and planning at the local level.

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 the fireline and are rapidly relocated to points desired by Fire Behavior Analysts (FBA's) 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, seventeen FRWS systems are cached at NIFC for use during the 2001 season. Prescribed Fire managers are encouraged to call for infor-

mation pertaining to 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 (GACC's, NIFC, etc.).

#### National Park Service

The Park Service monitors air quality and visibility in several national parks and monuments (Figure 3-DOI-2). 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 parti-



Figure 3-DOI-2. Visibility impairment from air pollution at Acadia National Park, Maine. Top: Clear; middle: moderate; bottom: hazy

cle 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.

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.

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 (Figure 3-DOI-3).

#### United States Geological Survey

The Survey's Water Resources Division (WRD) collects streamflow, precipitation, and other climatological data for a number of projects concerning rainfall/runoff, water quality and hydrologic processes. Currently, the Geological Survey collects hydrometeorological data from approximately 5130 remote Data Collection Platforms. 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 the Geological Survey under a 1992 contract. The USGS currently operates 15 LRGS' which provide near-real-time data to the Survey's computerized National Water Information System. 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 atmos-

pheric deposition on water quality and the aquatic environment.

The USGS is carrying out a joint research program with NASA and the University of Washington, Seattle, WA, Electrical and Civil Engineering Departments to measure snowpack water equivalent or snow depth using satellite passive microwave observations from the Defense Meteorological Satellite Program 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 snow pack distributions determined from the two decade long 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.

The Survey also carries out research in past climate change, regional hydrology, the carbon cycle, coastal erosion, volcanic activity, and glaciology. As part of its glaciology program, the Survey maintains a benchmark 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 iceablation, air temperature, and runoff in the glacier

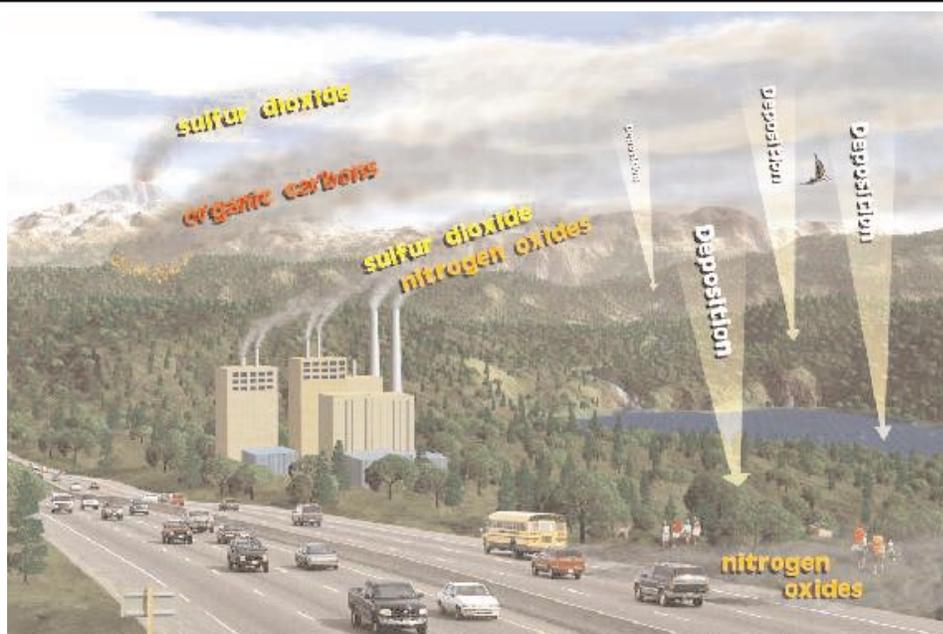


Figure 3-DOI-3. Air pollutants emitted by human-made sources affect natural resources of FWS lands.

basin. Analysis of this 39 year long 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 Nina 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 intelligence community through the coordination of the Civil Applications Committee (CAC).

The Survey's Geologic Division, through the USGS Geomagnetism Group in Golden, Colorado, collects data on temporal variations of the Earth's magnetic field from a global network of over 70 geomagnetic observatories. These observatories (which include 14 operated directly by USGS) all belong to the INTERMAGNET program. Under INTERMAGNET, data from a global network of geomagnetic observatories are transmitted in near-real-time via satellites and computer links (E-mail) to collection and dissemination points called

Geomagnetic Information Nodes (GIN's). Five GIN's are now located in Europe, North America, and Asia.

Magnetic field data are key inputs to the National Space Environment Forecast and Warning Program, which is coordinated by the OFCM, and to the new inter-agency National Space Weather Program. These data are used for nowcasting, forecasting, and modeling of "space weather" -- particularly the effects of geomagnetic disturbances. These effects range from: satellite computer upsets and early re-entry, to disruption of radio communications, to degradation of navigation systems [such as Global Positioning System (GPS)], and to outages of power distribution grids. The roles and responsibilities of agencies participating in the National Space Environment and Warning Program are detailed in the "*National Plan for Space Environment Services and Supporting Research, 1993-1997*" (FCMP10-1993) which was prepared by the OFCM Committee for Space Environment Forecasting.

The Survey 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 Survey is responsible for monitoring volcanoes in the United States; of the approximately 56 historically active volcanoes in the United States, 44 are in Alaska. Until the 1980s, the Alaskan volcanoes had been largely unstudied. Despite the low population density of much of the State, Alaska's volcanoes underlie the heavily traveled air routes of the North Pacific region.

During recent years, the Survey's Alaskan Volcano Observatory (AVO) has expanded its network of real-time seismic monitoring stations to bring 21 of the State'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 NWS to provide

warnings for pilots and aircraft operators in the Alaskan region (Figure 3-DOI-4).

Internationally, the OFCM's WG/VA supported expansion of Survey 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 assessment, 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. This program provides a data-centered framework for science-based water resources decision making. Major components are:

- Hydrologic Data Base (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



Figure 3-DOI-4. Composite image shows the relative movement of the February 19, 2001 eruption cloud from Mt. Cleveland as observed by the GOES 10 satellite. The first image at 1615 UTC on 2/19/01 is approximately 2 hours after the initial eruption start time. Over time, this first plume became bifurcated, or split, and sent ash to the southeast up to FL200 (20,000 ft.) and to the northwest up to FL300 (30,000 ft.). After this time, the plume rose to FL350 (35,000 ft.). Times are listed in UTC (or Z).

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". ([www.lc.usbr.gov/~g4000/surplus/SURPLUS\\_FEIS.HTML](http://www.lc.usbr.gov/~g4000/surplus/SURPLUS_FEIS.HTML))

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-hr 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 ([www.usbr.gov/hmi](http://www.usbr.gov/hmi)).

**Decision Support Systems:** The AWARDS/ET Toolbox for the Middle Rio Grande is a good example of decision support tool development to enhance river system management. An AWARDS system was implemented to meet a critical need for improvement in calculating and forecasting daily agricultural and riparian water use demands along the Middle Rio Grande. This Internet-based automated information system assists water managers and users by providing easy access to daily rainfall and crop water use estimates. These estimates are based on real-time data obtained from NEXRAD radar systems and automated weather stations. The NEXRAD

precipitation products use the NWS's Hydrologic Rainfall Analysis Project (HRAP) grid, which has a resolution of about 4km<sup>2</sup>.

The ET Toolbox builds on the AWARDS system, adding GIS land use to specify crop, riparian, and open water acreage within each grid cell. The primary purpose of the ET Toolbox is to accumulate the grid cells' daily rainfall and water use estimates within specified river reaches. These estimates are presented on the Internet ([www.usbr.gov/rsmg/nexrad](http://www.usbr.gov/rsmg/nexrad)) and imported into RiverWare, which is the river modeling and water accounting system used by the Upper Rio Grande Water Operations Model. Figure 3-DOI-5 (below) is an example

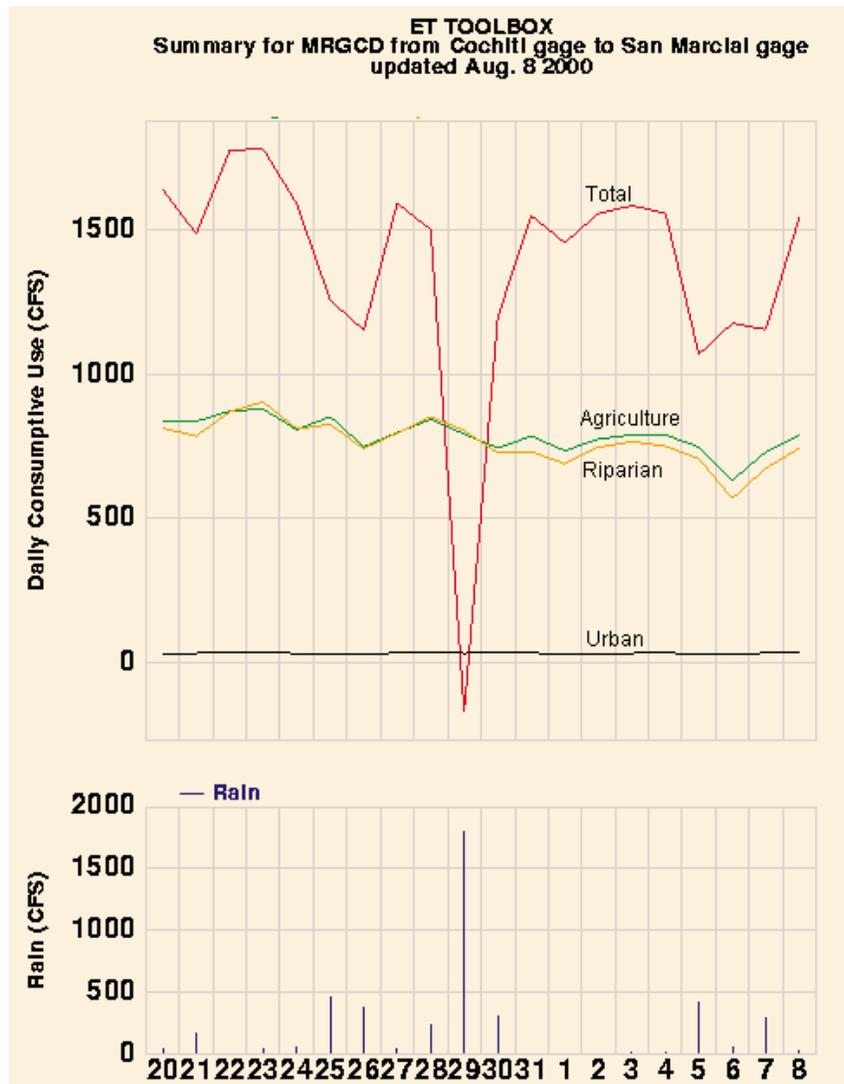


Figure 3-DOI-5. Example of a Middle Rio Grande Evapotranspiration Toolbox pop-up graph for daily water consumption use.

of an ET Toolbox pop-up graph summary of daily water consumptive use for the area from Cochiti Dam to San Marcial, New Mexico, for a time period in July-August 2000. The figure shows the effect of a heavy rainfall event on 29 July; the effects of lighter rainfall events can also be noted.

Rio Grande water operations managers at Reclamation's Albuquerque Area Office used the ET Toolbox website several times a day to direct critical water releases for the threatened Silvery Minnow and to meet other irrigation demands during the severe 2000 drought. They found that the ET Toolbox information was "invaluable" for their decision making. System enhancements were made in near real time to provide specialized support.

**Radar meteorology:** A new version of Reclamation's Snow Accumulation Algorithm (SAA) was developed under the auspices of the GEWEX Continental-Scale International Program (GCIP) and Reclamation's Science and Technology Program. This model uses real-time NEXRAD Level III radar data and was deployed in the north-central United States as a demonstration project during cool seasons from 1998-2001. It provides graphical distributions of snow water equivalent (SWE) and snow depth (SD) estimates on the Internet. The end goal is to improve snowpack water equivalent assessments and input SWE into the river model at the NWS Missouri Basin River Forecast Center, which will lead to more accurate streamflow forecasts.

Recently the SAA was improved by several major modifications, which primarily identify different precipitation types (snow, melting snow, rain). The inclusion of different precipitation types, led to renaming the SAA as the Precipitation Accumulation Algorithm (PAA). The former SAA range correction employed a mean Vertical Profile of Reflectivity (VPR) recast as a function of range. The PAA restores the

adjustment with a true VPR based on clearance between the radar beam center and the terrain surface.

In the PAA, precipitation phase in the radar beam and at the surface is classified into three types: dry snow, melting snow (slush), and rain, based on hourly model sounding altitudes of the highest 0°C and lowest +4°C levels. If any part of the radar beam is between those altitudes, it is considered contaminated by bright band effects. If the surface temperature is warmer than +4°C, snow depth SD is not accumulated because rain is assumed. The relationship between equivalent radar reflectivity  $Z_e$  and rainfall rate  $R$  is approximated by the power law  $Z_e = \alpha R^\beta$ . The three precipitation type classes in the PAA have different  $\alpha$  but  $\beta$  remains constant (2.0). Tests are also being implemented in the PAA to identify virga, or precipitation that is not reaching the ground.

Improved quantitative precipitation estimates are expected from PAA - which will lead to better watershed precipitation water volume and runoff estimates for the AWARDS system. This will provide water managers with near real-time estimates of possible sidewash inflows into the mainstem of river systems (via a hydrologic runoff model).

**Water conservation efforts:** 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-consum-

ing 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 Threats 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.

**Instrumentation:** Currently, Reclamation's HYDROMET system collects data from approximately 400 hydrometeorological data collection platforms (DCPs) which transmit data in the "real-time" through the GOES to the Bureau'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 Bureau, Federal and state offices.

#### Minerals Management Service

The Minerals Management Service's Environmental Studies Program gathers offshore environmental data for use in the management of offshore oil and



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gas resources. Currently, MMS is funding the continued operation of five meteorological buoys which transmit data via NOAA satellites. 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.

In FY 1998, the MMS started data collection from two 915-MHz profilers with RASS to study the atmospheric boundary layer over the Gulf of Mexico. One profiler is located on a platform about 6 miles off the central Louisiana coast; the other is placed in deeper waters about 130 km from shore. Hourly observations are transmitted to the NWS via GOES satellite

on a real-time basis for use in prognostic models. Data collection started in June 1998 and will end in late 2001. Each site also collects surface data on wind, temperature, relative humidity, atmospheric pressure, and sea surface temperature. The MMS initiated a 3-year study to synthesize the data from the two profilers along with data from various other sources in the Gulf of Mexico and adjacent onshore area. The goal of this effort is to establish a data base on marine boundary layer and atmospheric dispersion characteristics in the Gulf.

Upon request by MMS, the oil and gas industry has undertaken an aerometric monitoring program for the offshore area within 100 km of the Breton National Wilderness Area. Six monitoring stations were established, five of them located on offshore platforms.

All of them collect surface meteorological data. Four of the sites have radar profilers with RASS. Three of the sites also collect air quality data. Data collection started in September 2000 and will continue through August 2001. The purpose of the program is to obtain a data set for air quality modeling in the area.

#### 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 fire weather data with other Federal agencies while participating in fire weather forecasting at NIFC.

