

# FOREIGN WEATHER DATA SERVICING AT NCDC

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## ABSTRACT

*Part of the mission of the National Oceanic and Atmospheric Administration (NOAA) is to develop and maintain environmental data bases and to disseminate this information to users. The NOAA's National Climatic Data Center (NCDC) is responsible for the archiving and dissemination of climatological information on both national and global scales. The NCDC works with the World Meteorological Organization (WMO), the International Council of Scientific Unions, and other world data centers to obtain and exchange information and data. The primary digital data source for foreign surface weather data is the U.S. Air Force's DATSAV2 surface data base. Several publications and CD-ROM products are available that contain global data. This paper describes these sources and products and provides information on how to obtain them.*

## INTRODUCTION

The National Climatic Data Center (NCDC) is part of the National Oceanic and Atmospheric Administration (NOAA), which is within the Department of Commerce (DOC). The Federal Records Act of 1950 established the National Weather Records Center, now known as the NCDC, as the official archive for U.S. weather records. Asheville, North Carolina, became the permanent home of the Center in 1952. Over the years, the NCDC assumed new responsibilities as additional legislative mandates were enacted by Congress and the NCDC became involved in more international activities. In 1957, the International Council of Scientific Unions (ICSU) established world data centers (WDC) to archive and disseminate scientific data. WDC-A was established in Asheville, North Carolina, as a repository for global meteorological data. Today, the NCDC's mission is to receive, archive, manage, and disseminate national and global environmental data.

The NCDC has taken the lead in developing baseline long-term global climatic data sets that are used in global-warming and climate-change research. Global data must be acquired, quality-controlled, and archived to achieve this goal. The NCDC works with international institutions such as the ICSU, the world data Centers, and the World Meteorological

Organization (WMO) to develop standards for exchanging data and making data more accessible.

In 1990 the Federal Climate Complex (FCC) was established at the Federal Building in Asheville. The FCC is composed of the U.S. Air Force's Environmental Technical Applications Center Operating Location A (USAFETAC/OL-A), the U.S. Navy's Fleet Numerical Meteorology and Oceanography Detachment, and the NCDC. The FCC has enabled these agencies to more easily share resources, computers, and expertise.

The NCDC's digital data base currently contains 180 terabytes of data (not including back-up copies). New data streams will add an average of 70 terabytes per year for the remainder of the 1990s. The USAFETAC/OL-A archives more than 40 million global surface observations per year in its DATSAV2 data base. The NCDC routinely accesses this data base to respond to requests for hourly surface data for foreign locations. It also archives nearly 2.5 million original manuscript forms each year. These records are indexed, placed on microfiche, and added to the more than 200 million pages already archived.

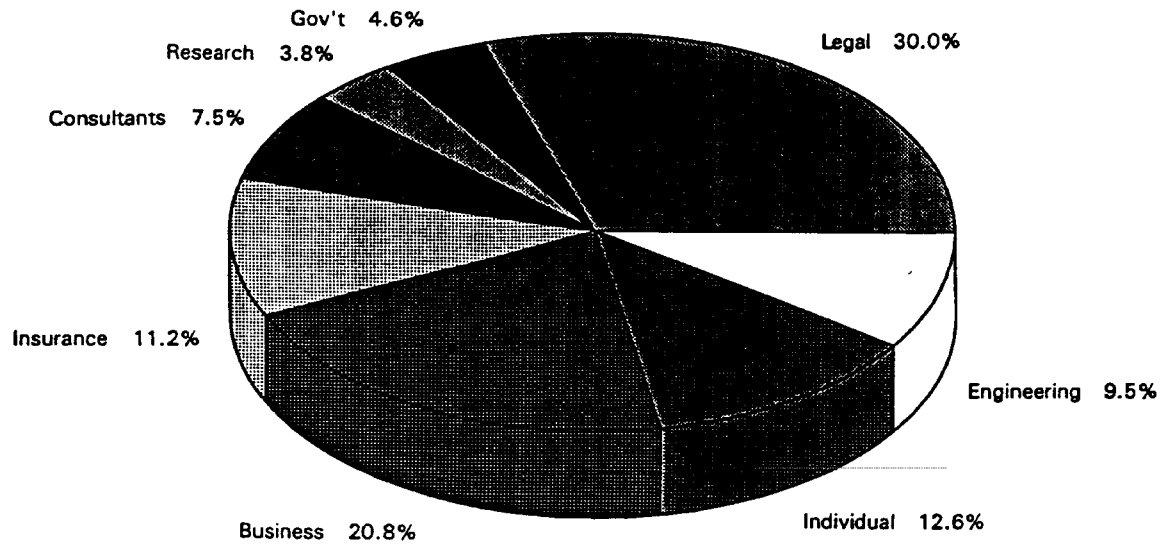
Archiving the data is only the initial step in providing quality service to the climate community. For these data to be a truly valuable resource, they must be easily accessible and available to the public in a timely manner. Monthly and annual publications are prepared and distributed for some of the more requested data. The NCDC has a subscription list of more than 40,000 users, and thousands of additional publications are available to satisfy a large number of the nearly 100,000 requests that the Center services each year. User contacts are through the mail and by phone, fax, and visits; an increasing proportion are via electronic mail.

Requests for NCDC information come from all areas of the globe and cover a wide spectrum of users (see Figure 1). Major user groups include consultants; businesses; legal, insurance, and engineering firms; government; researchers; and individuals. The legal community makes up nearly one-third of the total customer profile for earth-platform data. The engineering community makes up nearly 10% of the customer base. Climatic data are used by engineers in many decision-making settings, including design, construction, marketing, and sales. Space-platform observations (i.e., satellite data) are more widely used by government (40.5%)

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**Figure 1** NCDC customer profile based on orders for 1993.

and, to a lesser degree, by engineers and the legal field. Since these remotely sensed data are global in scope, foreign customers make up a large sector of the user base.

In a typical month the NCDC averages more than 8,000 contacts for climate information. Of this total, requests for foreign digital data now exceed 100 per month. The recent growth in the number of foreign data requests is shown in Figure 2.

### INTERNATIONAL DIGITAL DATA SOURCES

The NCDC receives foreign data through a variety of sources. As the World Data Center-A for meteorology, the NCDC exchanges foreign data with the other world data centers (Russia and China) and with individual foreign countries. The WMO has also established mechanisms for the free and open exchange of data among participating countries. The NCDC has sponsored visiting scientists from throughout the world and has worked with them on data exchange. The NCDC also actively pursues cooperative agreements with individual countries for data exchange to supplement those sources already mentioned.

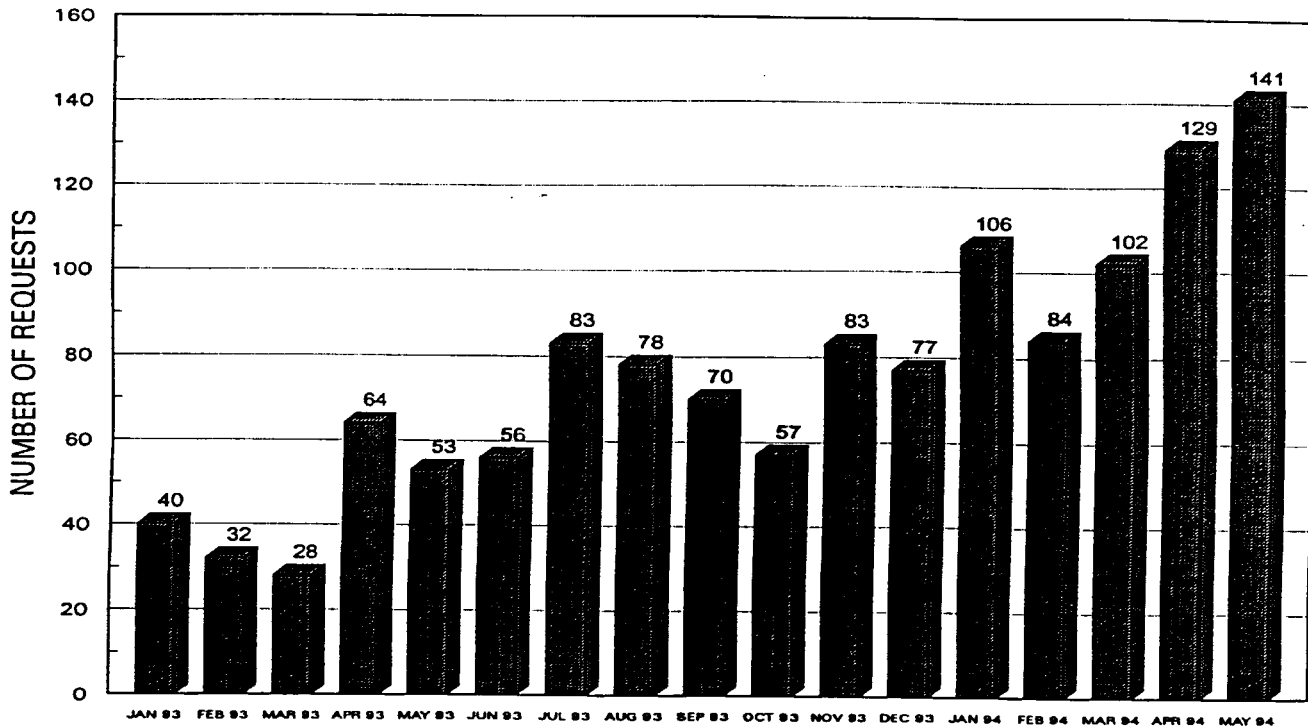
The WMO, under its World Weather Watch program established a communications network called the Global Telecommunications System (GTS) to transmit observations around the world. This network supplies data to the NCDC through the National Weather Service's National Meteorological Center (NMC), the Air Force's Global Weather Central (AFGWC), and the Navy's Fleet Numerical Meteorology and Oceanography Center. Antarctic data from U.S. reporting sites are also received via the NASA SPAN network.

### DATSAV2 Surface Data Base

The AFGWC surface data are archived and quality-controlled by the USAFETAC/OL-A as the DATSAV2 surface data base. Due to its superior quality and quantity compared to other worldwide surface data sources, the NCDC uses DATSAV2 as its primary source for foreign digital surface weather data. This data base contains hourly and/or synoptic data for about 20,000 worldwide stations, with nearly 10,000 of these stations currently active. The DATSAV2 data base includes data from such codes as synoptic, airways, METAR (Meteorological Aviation Routine Weather Report), AERO (Aviation Routine Weather Report), SMARS (Supplementary Marine Reporting Station), and drifting buoys, as well as observations from automatic weather stations.

Data are collected from the Automated Weather Network (AWN) and the Global Telecommunications System (GTS). Transmitted observations are decoded at the AFGWC at Offutt Air Force Base (AFB), Nebraska, then sent to the USAFETAC's OL-A in Asheville for additional decoding, quality control, and archival. More than 40 million observations are added to the data base each year. The reported elements vary considerably by station, although most report the basic elements such as temperature, dew point, wind speed/direction, and pressure. Some stations also report precipitation, snow depth, sea surface temperature, wave height, and a variety of other elements. The most current data are normally available from this data base three weeks after the data month.

The period of record varies by station. Many stations have data from 1973 to the present, while some stations go



*Figure 2 Foreign data requests.*

as far back as the 1930s. The DATSAV2 surface data base became available to the public in 1992. From January 1, 1973, until the inception of DATSAV2, observations were stored in a different format called "DATSAV." All observations that were in the original DATSAV format have been converted to the DATSAV2 format. Figure 3 shows the breakdown of the number of surface observations in the DATSAV2 data base for selected periods. Data for the period 1930 to 1972 were keyed from manuscript forms. Data since 1972 were obtained from the telecommunications network.

The DATSAV2 data base offers several major improvements over the original DATSAV. First, the DATSAV2 format is an ANSI-standard ASCII format that conforms to federal information processing standards (FIPS). Second, it can accommodate meteorological data fields that could not be handled in the older format. Third, the DATSAV2 data base has been processed through much more extensive quality control.

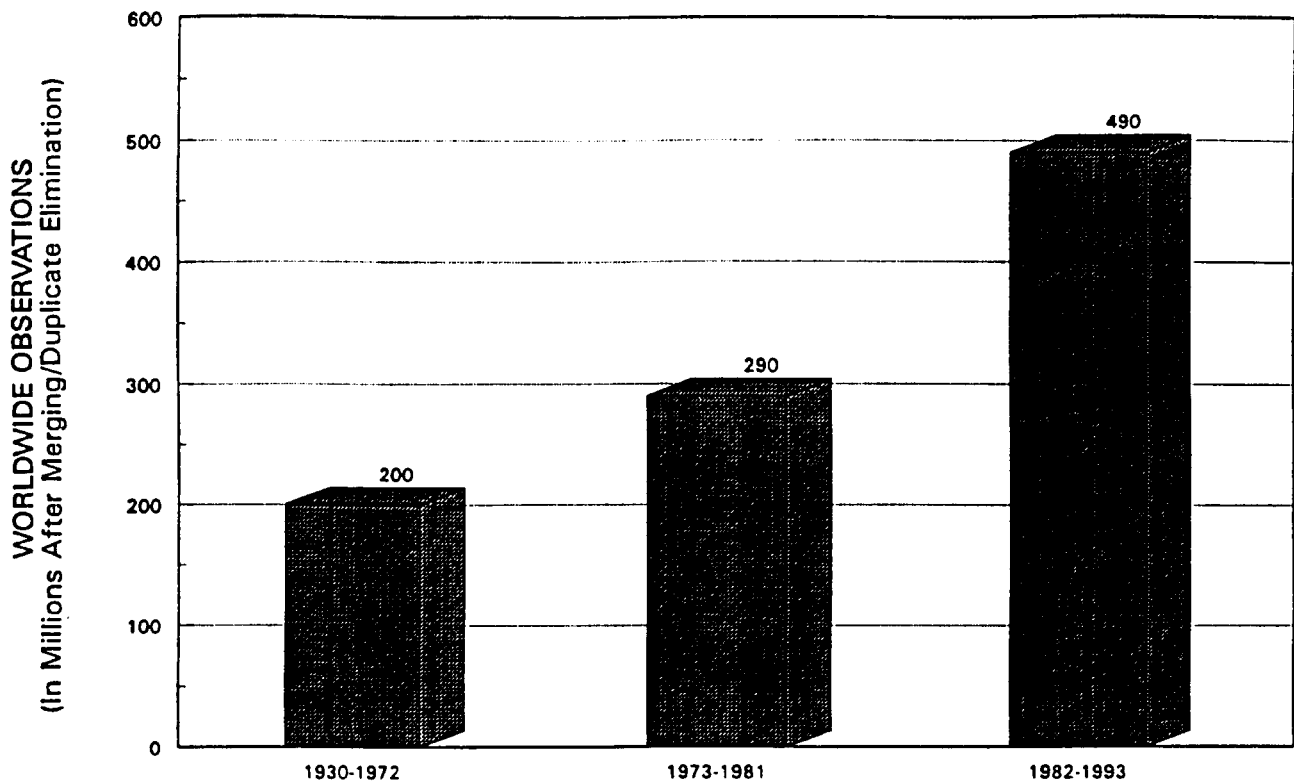
**Quality Control (QC) of DATSAV2 Surface Data Base**

The DATSAV2 surface data base, although of much better quality than previous data bases, still contains some erroneous data. Errors were introduced into the original transmission mainly through observer errors, communication problems "garbling" the data, and countries/stations not

following WMO standard encoding practices. The latter problem is the most difficult to identify and correct. Many countries follow their own set of reporting practices, and some individual stations will even have local variations. Although WMO manuals are helpful, they often do not accurately reflect the current reporting practices of certain countries (e.g., a change in encoding methods or the addition of a synoptic group not previously used by the country). Careful monitoring of incoming data is required to ensure proper decoding and validation of the data.

In the late 1970s, the USAFETAC/OL-A coined the term version to assign a number to each succeeding level of data base quality control (OC). The Version 1 through 6 programs were developed from 1977 through 1983. These programs were designed to correct specifically known and identified errors. Then, in 1984, the USAFETAC/OL-A undertook a project to create a new, improved quality data base through the use of a more systematic approach to OC. This effort cumulated with the completion of Versions 7 and 8 in 1992. The current OC is an entirely automated "expert system" consisting of more than 400 algorithms.

Specifically, Version 7 focuses on random errors, while Version 8 focuses on systematic errors (e.g., incorrectly decoded synoptic data). Version 7 uses a series of extreme



*Figure 3* Volume of surface observations in DATSAV2 data base.

value checks, internal consistency (within observation) checks, and external continuity (between observations) checks to QC the data. All historical DATSAV2 data were processed through Version 7. Version 8 was applied to all data going back to 1982. All current, incoming data are processed through both programs. An average of more than 40 million corrections and/or enhancements have been applied to each year's data. See Figure 4 for an illustration of version enhancements since 1973.

In addition to the QC described above, most Air Weather Service (Air Force) stations are made "serially complete" to ensure that all hourly observations are present in the data base. This is accomplished by key-entering the missing observations. Also, these same stations undergo manual QC in addition to the automated procedures described.

The DATSAV2 surface data base is currently the best source of digital global surface observational data, both in terms of quality and quantity. Also, with higher levels of QC planned for the future, its quality should continue to improve.

### Other Foreign Digital Data Bases

Other frequently used and requested digital data bases include the following:

- Comprehensive Aerological Reference Data Set (CARDS-Global upper-air data from 1946 to the

present. This includes global sounding data from nearly 1,500 locations that are quality-controlled by the NCDC and placed in one common format. Further QC enhancements are planned for the future.

- Global Historical Climate Network (GHCN-Global monthly averages for approximately 7,000 worldwide stations with data from the beginning of record (the 1700s in a few cases) to 1990. Elements included are temperature, station pressure, sea-level pressure, and precipitation.
- Summary of Day (Surface) Data--Data from selected foreign sites (mostly military bases) from the beginning of record (the late 1800s in a few cases) to the present. The data include elements such as maximum/minimum temperature, precipitation, snowfall, and peak wind gust.
- USAFETAC/OL-A Real-Time Nephanalysis (RTN-EPH-Global gridded cloud analysis from 1984 to the present on a 25 nautical-mile resolution grid.
- USAFETAC/OL-A High-Resolution Analysis System (HIRAS-Global upper-air analysis on a 2.5° by 2.5° grid from 1985 to the present.
- USAFETAC/OL-A Worldwide Gridded Snow Depth Climatology--Climatic averages of snow depth by month on a 25-nautical-mile resolution grid.
- Worldwide satellite data for polar-orbiter and geostationary satellites.

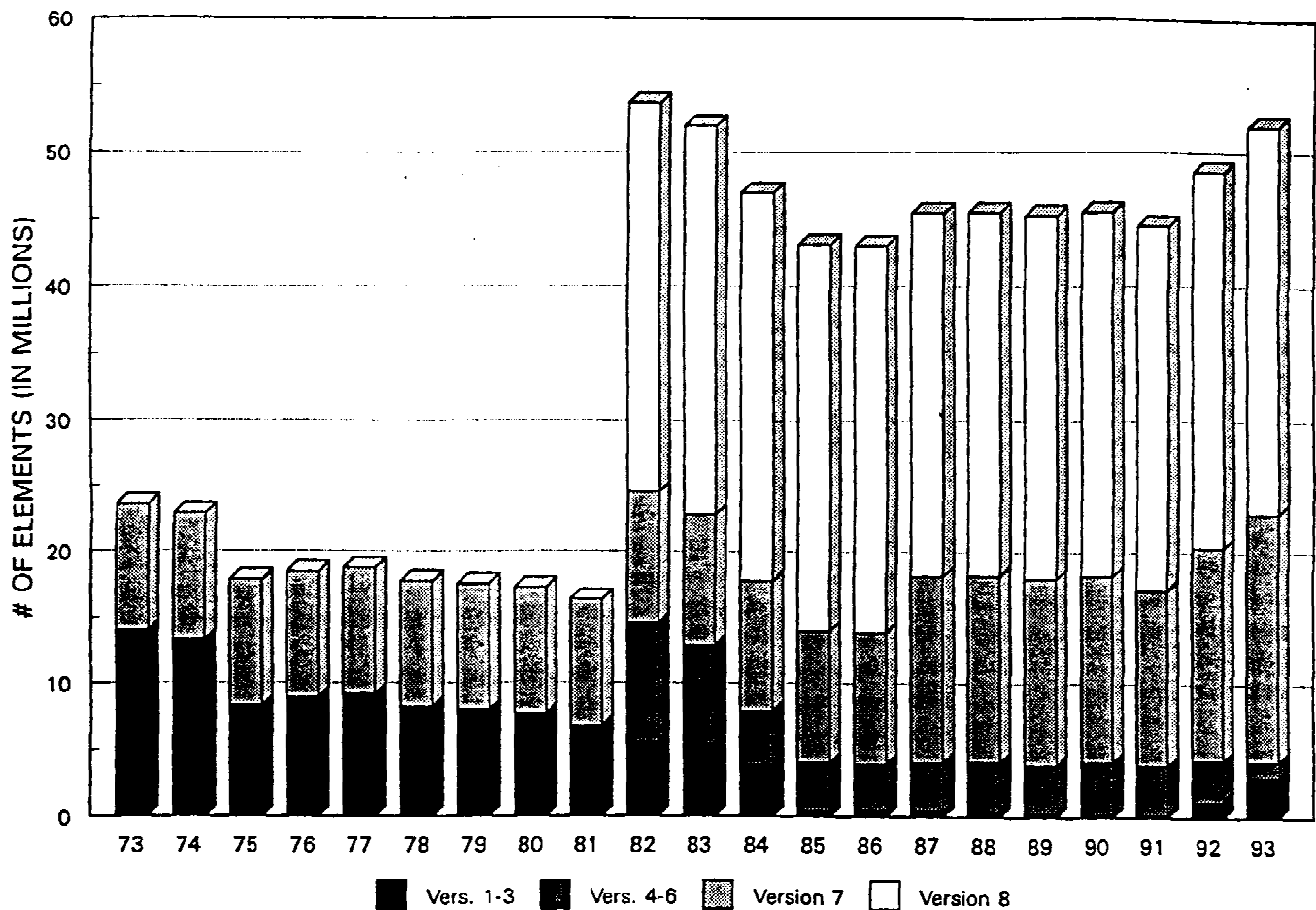


Figure 4 Version enhancements for DATSAV2 surface data base.

## FOREIGN DATA PRODUCTS AND PUBLICATIONS

### CD-ROM Products

In recent years the NCDC has developed several CD-ROM products that provide users with a large volume of data at a reasonable cost. Some of the CD-ROM products that contain foreign data include the following.

- International Station Meteorological Climate Summary (ISMCS) Version 2.0. This CD was released in June 1992 and gives detailed climatological summaries for about 980 locations worldwide. These locations include National Weather Service locations, domestic and overseas Navy and Air Force sites, and selected foreign stations. Limited summaries are also given for almost 5,000 additional worldwide sites. Tabular or statistical data can be exported to a printer or spreadsheet. Version 3.0 was due for release in late 1994. This update will add nearly another 1100 global stations, bringing the total number of detailed summaries to more than 2,000 locations.

- Global Daily Summary (GDS). This CD-ROM became available in early 1994 and provides access to global daily data for about 10,000 stations. The data set includes daily maximum/minimum temperature, daily precipitation, and three-hourly present weather for the period of record from 1977 to 1991. Data can be selected for screen viewing or output to file for geographic areas or by a predefined user-selected list of stations. A data inventory contains station name, latitude/longitude, elevation, period of record, and the number of observations of available data.
- U.S. Navy Marine Climatic Atlas of the World--Version 1.0. This CD-ROM includes analysis and display software for climatological averages of atmospheric and oceanographic data. The data are summarized with user-defined 1° and 5° grid areas covering the global marine environment. The summaries are produced using predominantly ship data collected between 1854 and 1969. The major elements include air and sea temperature, dew-point temperature, scalar wind speed, sea-level pressure, wave height, wind, and ocean-current roses. This CD also allows the user to define element intervals

(e.g., 5 to 10 knots, 2° temperature intervals). Contouring for explicitly user-defined regions and exporting data to a printer or diskette are supported.

· **Global Upper-Air Climatic Atlas (GUACA).** The Global Upper-Air Climatic Atlas is a two volume CD-ROM set of 2.5° gridded upper-air climatic summaries obtained from the model output of the European Centre for Medium Range Weather Forecasts (ECMWF). This CD presents monthly upper-air statistics for 15 different vertical levels in the Northern and Southern Hemispheres for dry-bulb and dew-point temperature, geopotential height, air density, and vector and scalar wind speed. The disc provides access/display software for gridpoint data, contouring capability for user-defined areas, and vertical profiles. The climatology covers the 12-year period from 1980 to 1991 as well as individual year-months (e.g., January 1991).

· **Radiosonde Data of North America 1946-1992.** This four-disc CD-ROM set contains all available radiosonde data for North America (U.S., Canada, Mexico, and the Caribbean Islands) through the 10-mb level for the periods 1946-1965, 1966-1979, 1980-1989, and 1990-1992. Data include significant, mandatory, and special wind levels for all observation times and geopotential height, temperature, dew point, wind direction, and scalar speed. The user can select output for a single station or multiple stations for a defined Time period, or all stations within a specified geographic region in either synoptic or station sort. The CD-ROM also contains available station metadata.

### **Foreign Data Publications and Other Miscellaneous Summaries Available from the NCDC**

*Monthly Climatic Data for the World (MCDW)* - This publication contains monthly mean values of surface and/or upper-air measurements from more than 3,000 stations worldwide. Surface elements include pressure, temperature, vapor pressure, precipitation, total sunshine, and percent of long-term averaged sunshine. Upper-air data consist of height, temperature, dew-point depression, and mean vector wind at standard constant pressure levels. This publication will be available beginning in 1996.

*Climates of the World* - A 28-page brochure produced in 1969 that presents average temperature and precipitation data for approximately 800 stations throughout the world. Included are brief narrative descriptions of the climate of each continent and maps depicting the annual average worldwide distribution of temperature and precipitation.

*World Weather Records* - This six-volume set contains monthly and annual tables of mean temperature, mean pressure, and total precipitation for those stations throughout the world for which complete data were available for the 10-year

periods 1961-1970 and 1971-1980. Prior issues back to 1920 are available on microfiche.

The NCDC also disseminates several additional products and summaries produced by the U.S. Air Force and Navy. These include a variety of regional climate summaries and atlases. Weather data recorded by the U.S. Defense Department are archived on paper and microfiche at the NCDC. Hourly surface data, autographic charts, and radiosonde records also are available. Other summaries include the following:

*Worldwide Airfield Summaries* - These summaries present monthly and annual climatological information for approximately 4,000 airfields throughout the world. The period of record varies by station and element but only includes data prior to 1974. Copies of summaries for individual stations are available on paper or on microfiche. These data are included in the ISMCS CD-ROM described in the previous section.

*Surface Observational Climatic Summaries (SOCS)* - Contains detailed climatological summaries for selected Air Force bases worldwide that have a minimum period of record of 30 years (approximately 130 stations). These data are also included on the ISMCS CD-ROM.

Numerous other publications are available, such as a worldwide upper-air climatology series and a marine climatology series for selected regions. The WDC-A Foreign Library is also located at the NCDC. This library has a collection of more than 100,000 volumes that contain meteorological data for individual foreign countries.

### **ORDER INFORMATION FOR FOREIGN WEATHER DATA AND PRODUCTS**

Inquiries and orders for the NCDC's CD-ROM products, publications, and digital data sets can be made by phone, letter, Internet, electronic mailbox, or facsimile. Most digital data sets are available on magnetic tape, cartridge tape, exabyte tape (8 mm), diskette, or paper copy. Call or write for the latest availability and pricing.

Telephone Number:	704-271-4800
Fax Number:	704-271-4876
OMNET Mailbox:	NCDC.SERVICE
Internet Access:	orders@ncdc.noaa.gov
Address:	Climate Services Branch National Climatic Data Center Federal Building Asheville, NC 28801

### **NCDC'S FOREIGN DATA SERVICING POLICY**

The NCDC's policy for servicing foreign data requests is based on Department of State guidance and the guidance

of the ICSU Panel on World Data Centers. Most data and products held by the FCC are available to anyone without restriction, including foreign countries with which the U.S. has diplomatic relations. Requests from foreign countries with no diplomatic relations with the U.S. are referred to the Department of State through the NESDIS International Office for guidance, since situations may change. Requests coming directly to the WDC-A for data or products in the WDC-A holdings are serviced without restrictions since the WDC system operates under a policy of free and open exchange in support of research.

## **CONCLUSION**

A variety of sources are available from the NCDC for foreign weather data. Data used in publications, summaries, and CD-ROM products are obtained from the best available

sources. These data have undergone various degrees of quality control. The new DATSAV2 surface data base is the best digital data source currently available for global surface observations. It must be remembered, however, that no data base is perfect and error free. Countries have different observation practices, coding procedures, instrumentation, and various degrees of quality control performed on-site. These practices and procedures are subject to change at any time without prior notification. This may result in decoder problems or other systematic errors. Random errors also occur routinely, and a small percentage of these are not identified and eliminated by current quality-control procedures. Data to be used in engineering design should be reviewed by a certified consulting meteorologist. A knowledgeable user can determine whether the data used for a particular application are reliable or if some "filtering" of the data is necessary.