SUMMER/FALL
1996

Volume 20
Issues 2 and 3

the STATE CLIMATOLOGIST

CONTENTS

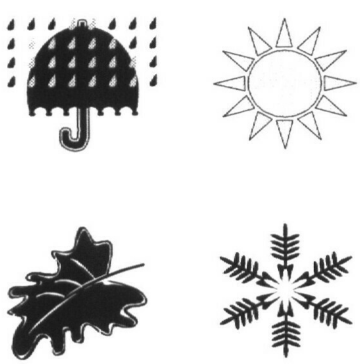
Note from the Editor 2

Pennsylvania State Climatologist 2

Rules for Numerical Diagrams 3

A Cool Way to Visualize NOAA's Climate Data 6

Published by the National Climatic Data Center in cooperation with the American Association of State Climatologists



Pennsylvania State Climatologist Office

While Pennsylvania set the standard in 1838 by appropriating the first money by any state in the Union for the gathering of weather information, it was last to reinstate the position of the state climatologist.

In August 1994, Paul Knight was appointed the Pennsylvania State Climatologist by the Dean, College of Earth and Mineral Sciences, Pennsylvania State University. The Dean's office supplied a generous grant for equipment, the Northeast Regional Climate Center (NRCC) helped point the newly established office in the right direction, and the National Climatic Data Center (NCDC) assisted in many ways, especially through their annual State Climatologist Exchange Program.

The Pennsylvania state climatologist office is co-located with the National Weather Service Central Pennsylvania Forecast Office (CTP) and the Middle Atlantic River Forecast Office (MARF). This position allows close cooperation with the Data Acquisition Program Manager and the Cooperative Program Manager/Hydro-Meteorological Technicians.

Currently, the Pennsylvania State Climatologist office receives approximately 100 requests a month, and the number is increasing steadily.

(Continued on page 3)

A Note from the Editor

As you may have noticed, this is a combined issue, Volume 20 issues 2 and 3, Summer and Fall 1996. Since the 1996 AASC annual meeting in Laramie, I have received only two articles from current and past State Climatologists. This newsletter is your chance to let others know the important work you are doing. After hearing the reports given at the annual meetings, I know all of you are involved in projects that everyone would like to hear about. NCDC continues to support this quarterly publication, but we need your help.

John Hughes, Editor

(Continued from page 2)

The inquiries vary from forensic data for county coroners, to recent temperature and humidity trends for mushroom growers, to rainfall runoff for mining reclamation, and doctoral thesis work on Pennsylvania river flows. Most of the requests come by NWS referrals or through the State Climatologist Home Page(http://www.ems.psu.edu/PA_Climatologist/PA_Climatologist.html. Thankfully, student support along with technological short-cuts have allowed the office to keep up with most of these important requests.

The Pennsylvania State Climatologist Office is just beginning to spread the word to state agencies and businesses about the climatic services they offer. Their goal for the coming year is to work with the CTP office to produce a series of videos on how to take a cooperative weather observation. The intent of the project is to provide the videos to other DAPMs/CPMs and state climatologists. The office is also working on a system to allow some of the Pennsylvania cooperative observers to transfer their B-91 forms electronically. In addition, their search for regular funding continues.

Paul Knight
Pennsylvania State Climatologist

Ten Proposed Rules for Numerical Diagrams

Diagrams have been used for centuries to present numerical information succinctly. Yet no complete, specific rules are available for their preparation, similar to the rules of grammar, syntax, and spelling of language. Some guidance is offered in the dozen of books on graphics published in the United States in the past 40 years, as well as fragments appearing in textbooks and manuals. But none of these references are complete or consistent and each offers at least one glaring contravention of the basic tenets of mathematics and logic.

Ten proposed rules for numerical diagrams are offered here, in exactly the same form as presented and distributed at the Winter Conference on Statistics in the Information Age of the American Statistical Association in Orlando, Florida, January 8, 1987. Earlier versions were presented at other conferences and in lectures in the preceding two years. They are intended to provide discussion and objection, leading to possible further revision.

Most fundamental, and hence perhaps controversial, is the contention that continuous line must permit interpolation at any point and that the average of such interpolations over an interval must equal the original average for that interval. Another contention is that consecutive time intervals must be shown as contiguous, without intervening gaps.

Plane diagrams may be rectangular (Cartesian), with two perpendicular axes, or circular (polar), with angular and radial scales. After slow development, each type was brought to almost present form by the late 1600s, by Descartes, Bernoulli, and Newton. To be numerical, diagrams must have at least one dimension in interval or ratio form (not nominal or ordinal) so that value at any point may be interpolated readily. Three-axis diagrams, while interesting and even informative, are not numerical.

Rule 1. Coverage

Data symbols should span the entire interval (space, time, or measurement) represented, no more nor less. Point or instantaneous measurements should appear at the appropriate time or place; areal or spatial totals or averages should be shown over the entire summing interval. Days, months, and years are adjacent divisions of continuous time, without intervening gaps; contiguous counties, states, and countries

(Continued on page 4)

(Continued from page 3)

should likewise be shown correctly. A common violation of these precepts is contrasted with a recommended version in Figure 1 below.

Rule 2. Dimensions

Numerical values of observations are shown by symbols placed along one of two scales, perpendicular in rectangular coordinates, radial and circumferential in circular diagrams. One-dimensional diagrams have only one numerical scale, the other being nominal or perhaps ordinal. Two-dimensional diagrams have interval or ratio scales on each axis; a third dimension may be shown by isopleths among data symbols. A fourth dimension may be indicated, but for only a few classes, by sizes (areas or apparent volumes) of data symbols, the shapes of which (circles, squares, triangles, etc., or spheres, cubes, cylinders, tetrahedra, etc.) may indicate a fifth dimension; their colors can suggest a sixth, each to no more than five or maybe six classes.

Rule 3. Plotting

Separate events (observations) with identical values can be indicated by clustering two, three, or more identical symbols around the proper position, within the limits of observational precision, rather than as another dimension indicated by differing symbols. A larger symbol having 10 times the area (or apparent volume) of one for a single observation can indicate 10 identical readings, while one of 100 times the area (or volume) can replace 100 singles (if symbol size is not used otherwise).

Rule 4. Connection

Lines should not connect data symbols unless interpolation along them is proper. Annual averages may be smoothed into a continuous line, along which interpolation indicates averages for successive 12-month periods, but connecting annual or seasonal maxima or minima, or episodic events (wheat yields, drowning deaths), could suggest false

(Continued on page 5)

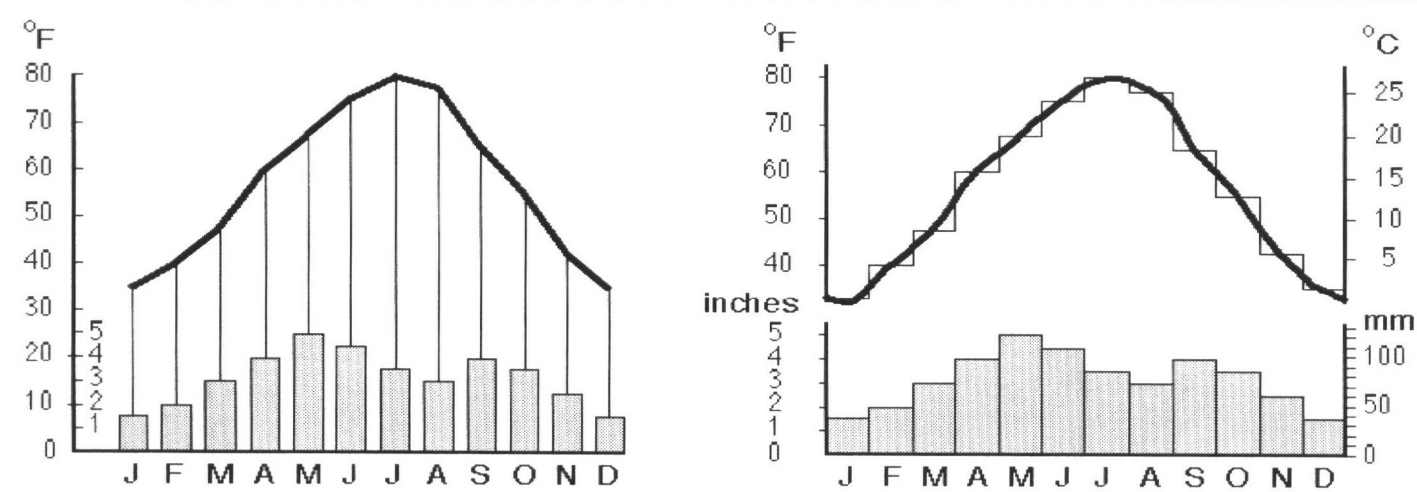


Figure 1. Mean monthly temperature and precipitation (1941-1970 normals) at Tulsa, Oklahoma. The left diagram separates monthly rainfall amounts that are actually contiguous and represents months as lines rather than as parts of a continuum. The temperature line extends only from mid-January to mid-December and cannot be interpolated for New Year's Day; interpolation elsewhere will yield values that do not average to those used in the initial construction of the diagram. The version on the right has none of these deficiencies; in it, mean monthly temperature is represented by a histogram, which is then smoothed by preserving areas, so that interpolated daily values will recover the monthly mean.

(Continued from page 4)

readings for intervening points. Where connecting such points seems desirable to guide the eye, the points themselves should be much more prominent than the line, which can be dashed or dotted to negate interpolation. Points representing time or space averages usually are connected by curved lines, to preserve area, but this may be improper on some bivariate diagrams (e.g., climagram, thermodynamic diagrams) because the two variables may vary differently.

Rule 5. Area

Area, not length, of a bar or column or other representation should be proportional to the quantity it represents. This applies directly to data collected over intervals of varying widths and to polar diagrams where sector areas increase with the square of the radius.

Rule 6. Orientation

Axis choice should correspond to physical reality: on rectangular diagrams, upward for height or accumulation (of rain, crops, etc.) or downward for geologic strata, or time on vertical axis, recent and future time on horizontal. Any otherwise dependent or consequent variable goes on the vertical axis (ordinate). On circular diagrams, direction or time corresponds to the compass or the clock, with north or midnight or New Year's at the top and values increasing clockwise; any other starting point, chosen for clarity, must be emphasized on the diagram and in the legend.

Rule 7. Bounds

On each rectangular axis, and at least on the radius of circular diagrams, both bounds (0 and 100 for percentages) of fully bounded variables and the single bound (usually 0) of semibounded variables should terminate the scales, perhaps with an axis break if observations are far from the bound(s). Unbounded variables ($-\infty$ x ∞) are best referred to some value near the mean, or to the mean or median.

Rule 8. Scales

On rectangular diagrams, primary scales at bottom and left should increase consistently upward and toward the right, away from the axis intersection; secondary scales at top and right may give equivalent units (metric on primary and English on secondary, or frequency at left and wavelength at right) or may apply to a second set of data. On circular diagrams, used only for lower-bounded variables on radius and repetitive variables (direction or time) as angles, values increase outward from center (or central circle) and clockwise from top. Deficits, temperatures below threshold, years B.C. or B.P., south latitudes and west longitudes, etc., are essentially negative and hence increase numerically, in absolute value, downward and to the left in rectangular diagrams. On chronoisopleth diagrams, hours should increase upward, days and months to the right, to show hourly variation throughout the year. Often, however, time increases downward. or if scales are reversed, dates may increase downward, contrary to accepted mathematical practice. Scale intervals usually are arithmetic but may be logarithmic (to show growth relations) or square root (to relate diameter to area) or cube root (to show diameter versus volume or mass) or trigonometric (cosine of latitude to preserve area), etc. Such nonlinear scales must be identified on the diagram and in the legend.

Rule 9. Labels

Labels on scales should be large and well spaced, without superfluous decimals. No more than five to eight are needed on each rectangular axis or on radius and around perimeter. Usually,

(Continued on page 6)

(Continued from page 5)

they are in multiples of two, four, five, 10, 50, or 100, etc. Interpolation between large digits is easier than discriminating among small ones. Each number label should refer unambiguously to a tick or line extension; intervening unlabeled ticks should be smaller than those labeled.

Rule 10. Legends

Each diagram should be identified and explained fully in its own legend, not "in text." Labels adjacent to data symbols within diagrams or on each of two or more lines of the same diagram are easier to grasp than identification by different line symbols (solid, dashed, dot-dash, etc.) in legend; judicious abbreviations can help preserve clarity.

Arnold Court, Department of Geography, California State University, Northridge, California

CLIMVIS - A Cool Way to Visualize NOAA's Climate Data

How cold is it in Antarctica? How hot is it in the Sahara Desert? Visually "see" climate data graphically using the National Climatic Data Center's (NCDC) Climate Visualization (CLIMVIS) system. CLIMVIS is an interactive visualization program that permits users to view climate information via the World Wide Web. CLIMVIS has won several World Wide Web awards including the highest Magellan rating, the top five percent of all Science and Technology-Meteorology web sites, USA Today Hot Site for the Day, and the educational "Too Cool School Site of the Week."

The NCDC is part of the National Oceanic and Atmospheric Administration (NOAA), which is under the

(Continued on page 7)

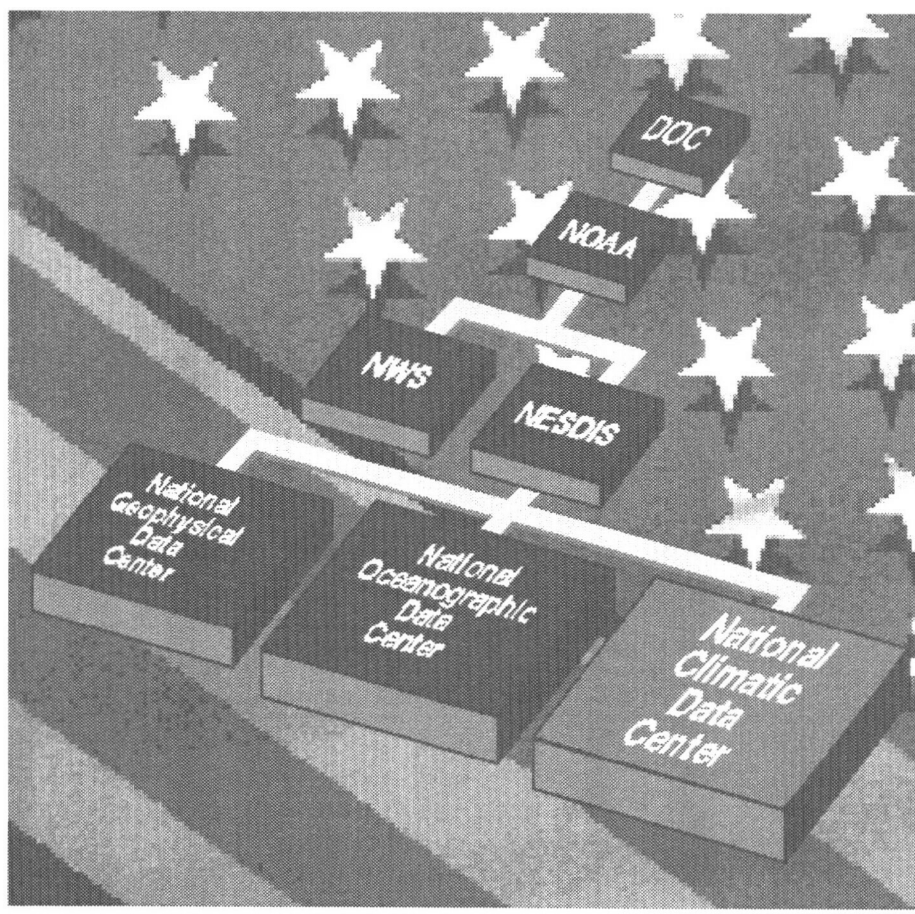


Figure 2. NCDC within the Department of Commerce.

(Continued from page 6)

umbrella of the Department of Commerce (Figure 2). NCDC's mission is to manage and disseminate national and global environmental data. NCDC collects data from around the globe and archives nearly a half-million magnetic tapes/cartridges, 1.2 million microfiche records, and 130 million paper records. NCDC has more than 150 years of data on hand and adds 55 gigabytes of information each day.

NCDC averages nearly 50,000 off-line user contacts per quarter concerning data availability. Requests from educators and university researchers make up two to five percent of that total. The Climate Services Branch handles contacts by telephone, electronic mail, letter, or fax. NCDC also maintains a World Wide Web (WWW) home page (http://www.ncdc.noaa. gov). This site handles approximately 240,000 users per quarter and continues to grow. NCDC contacts include a wide spectrum of business, academic, and government users.

Using the CLIMVIS system, data can be viewed as time series graphs for individual sites around the world or as contoured products for various regions of the United States. Users pick the site, time and weather elements, and the charts are dynamically produced.

Go to the NCDC Home Page and choose the "Interactive Visualization of Climate Data" option via our WWW site. Once you have chosen the "Interactive" button, select CLIMVIS from the

(Continued on page 8)

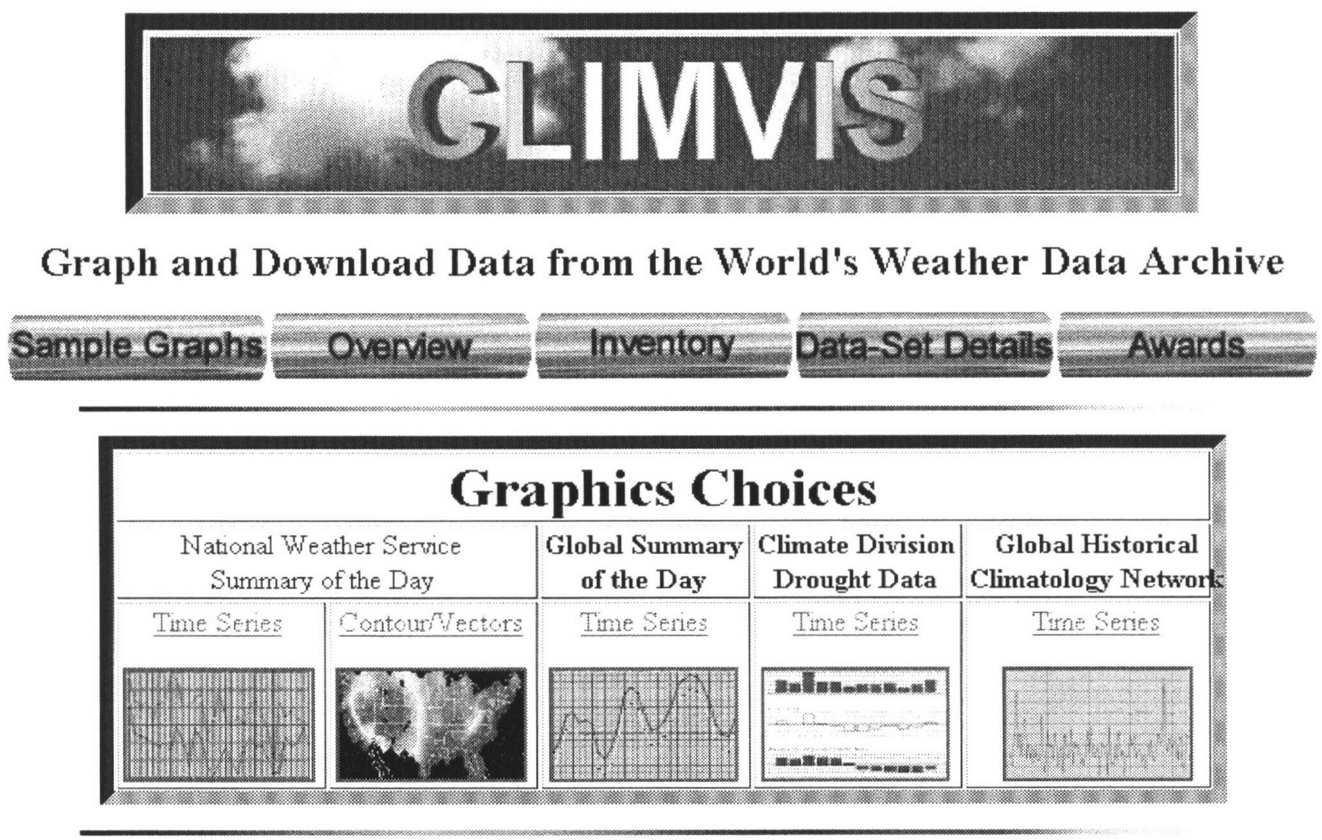


Figure 3. The NCDC's CLIMVIS World Wide Web Home Page.

(Continued from page 7)

list of NCDC visualization tools, then you receive the CLIMVIS Home page (Figure 3). Under "Graphics Choices" you have four different options.

- ***National Weather Service Summary of the Day***

Approximately 300 currently active National Weather Service stations are included, with a lag time (after end of data month) of about 8-10 weeks. This is our best quality and most complete data for these stations. Sixteen parameters for as early as 1869 to present are available. Data can be viewed as a time series for individual sites or as a contoured chart for a state, a region, or the entire contiguous United States.

- ***Global Summary of the Day***

Approximately 8,000 active global stations, including over 1,200 active U.S. stations are included, with a lag time (aft end of data month) of about 4-5 weeks. Twelve parameters beginning with 1994 are available. These data undergo considerable quality control, but the U.S. Summary of the Day is the best choice for National Weather Service sites. Data from individual sites can be viewed or data from two sites in the same region or different regions can be viewed as time series charts. (See Figure 4.)

(Continued on page 9)

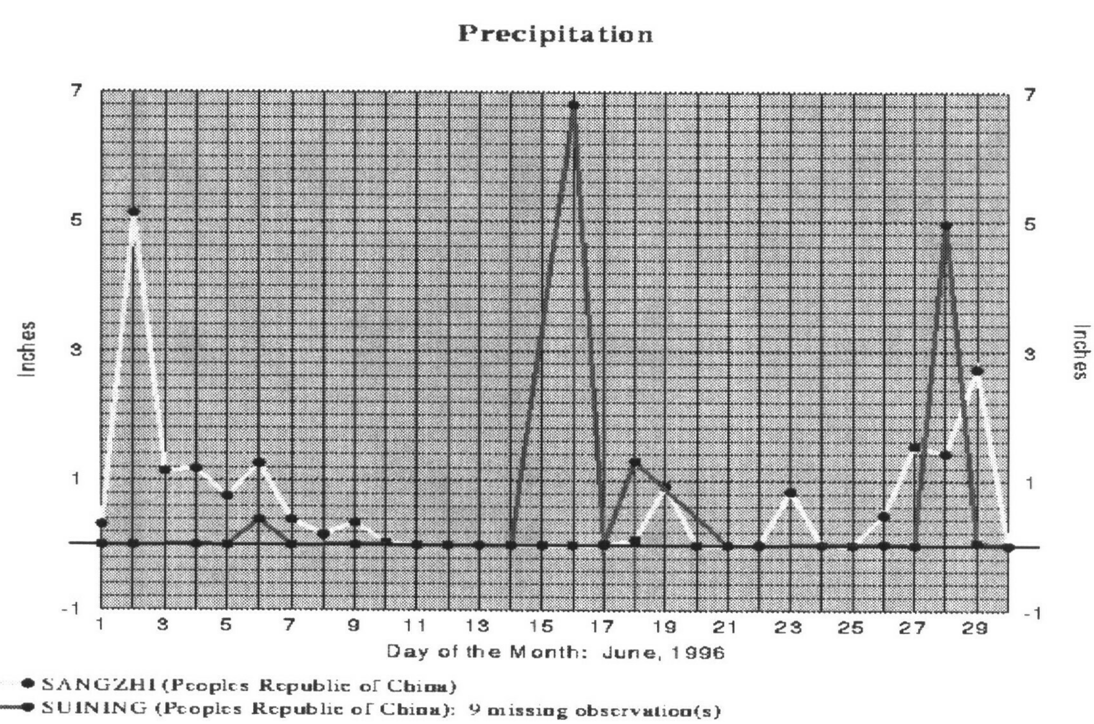


Figure 4. Global Summary of the Day daily precipitation data comparing two sites in the People Republic of China.

(Continued from page 8)

♦ *Climate Division Data*

Monthly drought indices, precipitation, and temperature data for U.S. climate divisions are available. Divisions are homogeneous climate regions, data presented are estimated monthly averages for each division. Period available is from 1895 to present. The data are viewed in time series charts. Divisional state maps are also available.

♦ *Data Download Option*

After the user creates a specific graph using CLIMVIS, the user has the option to download the data values plotted in the graph. Users just click on the "To Download the Data File Click Here!" option.

Figure 5 is a sample contour plot available using the CLIMVIS system. Users have the options of defining the geographic region, any of 16 weather elements, and time. Up to four plots can be done on a single screen and users again have the option to download the data points that made up the graph. Try it out, it's easy!

(Continued on page 10)

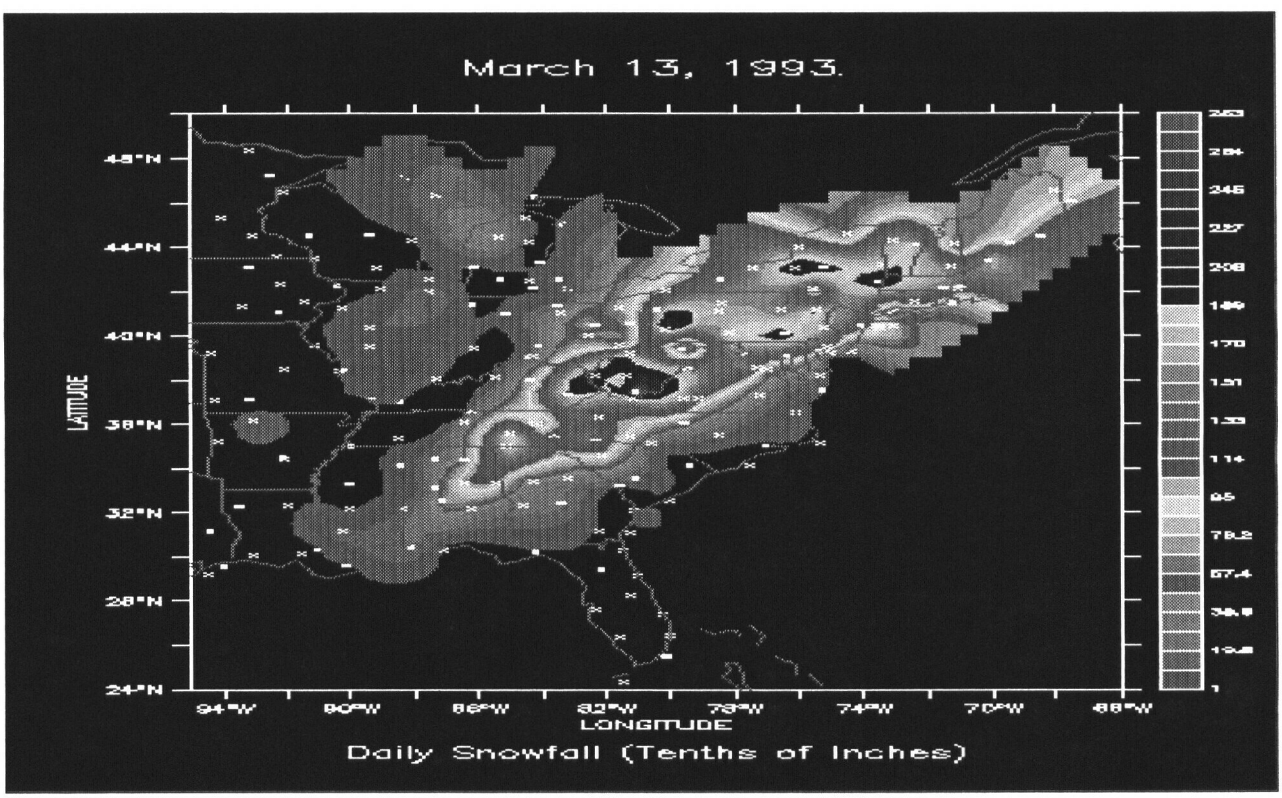


Figure 5. U.S. Summary of the Day - Contour Plot of the daily snowfall amounts during the Blizzard of 1993.

(Continued from page 9)

Global Historical Climatology Network (GHCN) is a new CLIMVIS system feature. The GHCN is a research quality archive data base comprised of nearly 10,000 global stations. Users can plot, contour, and download monthly variables of temperature, precipitation, and pressure data.

The CLIMVIS system allows users to choose a city from over 10,000 locations worldwide and visually "***see***" the climate for the time selected. Users can ***compare*** the climate at various cities around the globe or can ***observe and study*** how the climate varies at any city for a long period of time. Various weather parameters can be viewed as time series graphs: temperature, precipitation, winds, pressure, hours of sunshine, degree days, etc. Two cities from separate regions around the world can be viewed at the same time. Another CLIMVIS feature allows the user to view winds in vector form to study wind flow and wind patterns. Users can also plot U.S. Climate Divisional data over an area to see how a particular weather system affect a state or region.

You can access the CLIMVIS page through the NCDC home page by clicking on the "Interactive Visualization of Climate Data" button. Another option is to connect to the page directly at the following WWW page: (http://www.ncdc.noaa.gov/onlinprod/drought/xmgr.html).

For more details on CLIMVIS, see the Daniel J. Manns paper "Climate Visualization of NOAA's Environmental Data" presented at the 1997 AMS 13th International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography, and Hydrology.

NCDC has developed the CLIMVIS system to allow users to easily graph and retrieve climate data from a variety of national and international data bases. The system will continue to grow and evolve as NCDC continues to archive and disseminate climatic data and information to our various users. NCDC's commitment to the educational community involves more than just the CLIMVIS system. Please visit the NCDC Home page. NCDC offers additional climatological and satellite data not only from domestic sites but from areas and locations around the globe.

NCDC's Climate Services Branch is responsible for distribution of climate information. They can be contacted via the following phone number, Internet, electronic mailbox, or facsimile. Please call for latest availability and pricing of any of these products and services.

Telephone Number:
704-271-4800
Fax Number:
704-271-4876
WWW Home Page:
http://www.ncdc.noaa.gov
Internet Access:
orders@ncdc.noaa.gov

Thomas Ross, Daniel Manns, and Wayne Faas, National Climatic Data Center, Asheville, North Carolina

These and other publications are available from the National Climatic Data Center

Hourly Precipitation Data
This publication contains hourly precipitation amounts obtained from recording rain gages located at National Weather Service, Federal Aviation Administration, and cooperative observer stations. Published data are displayed in inches and tenths or inches and hundreths at local standard time. **HPD** includes maximum precipitation for nine (9) time periods from 15 minutes to 24 hours, for selected stations.

Climatological Data
Monthly editions contain station daily maximum and minimum temperatures and precipitation. Some stations provide daily snowfall, snow depth, evaporation, and soil temperature data. Each edition also contains monthly summaries for heating and cooling degree days (65 degree F base). The July issue contains a recap of monthly heating degree days and snow data for the preceding July though June.

The Annual issue contains monthly and annual averages of temperature, precipitation, temperature extremes, freeze data, soil temperatures, evaporation, and a recap of monthly cooling degree days.

Storm Data
Monthly issues contain a chronological listing, by states, of occurrences of storms and unusual weather phenomena. Reports contain information on storm paths, deaths, injuries, and property damage. An "Outstanding storms of the month" section highlights severe weather events with photographs, illustrations, and narratives. The December issue includes annual tornado, lightning, flash flood, and tropical cyclone summaries.

Monthly Climatic Data for the World
This publication contains monthly means for temperature, pressure, precipitation, vapor pressure, and sunshine for approximately 2,000 surface data collection stations worldwide and monthly mean upper air temperatures, dew point depressions, and wind velocities for approximately 500 observing sites.

Local Climatological Data
LCD summarizes temperature, relative humidity, precipitation, cloudiness, wind speed and direction observations for several hundred cities in the U.S. and its territories. Each monthly publication also contains the 3 hourly weather observations for that month and an hourly summary of precipitation. Annual **LCD** publications contain a summary of the past calendar year as well as historical averages and extremes.

For Information Call:

(704) 271–4800 (Voice)
(704) 271–4010 (TDD)
(704) 271–4876 (Fax)

National Climatic Data Center
Room 120
151 Patton Avenue
Asheville, NC 28801–5001

U.S. DEPARTMENT OF COMMERCE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL ENVIRONMENTAL SATELLITE, DATA, AND
INFORMATION SERVICE
NATIONAL CLIMATIC DATA CENTER
FEDERAL BUILDING
151 PATTON AVENUE, ROOM 120
ASHEVILLE, NORTH CAROLINA 28801-5001