# THE STATE CLIMATOLOGIST

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IN COOPERATION WITH THE AMERICAN ASSOCIATION OF STATE CLIMATOLOGISTS

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL ENVIRONMENTAL SATELLITE, DATA, AND INFORMATION SERVICE
NATIONAL CLIMATIC DATA CENTER

*ON THE COVER. Rain Shower Over The French Broad River Valley, N. C. Photo By G.W. Goodge*

A-76 IMPLEMENTATION. RCA, Inc., has been awarded the contract to perform data conversion, computer operations, and archival services at the National Climatic Data Center (NCDC). This contract is a result of an A-76 study conducted at the Center. Official contract award date was October 1, 1986; transition period began October 22, 1986; and full contractor performance will begin December 7, 1986.

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UNITED STATES HISTORICAL CLIMATOLOGY NETWORK. The Oak Ridge National Laboratory's Carbon Dioxide Information Center is planning to release the 1,219-station historical temperature and precipitation data set prepared by the National Climatic Data Center (NCDC) for the Department of Energy (ORNL/CDIC-19). The data set will be made available to researchers working on detection of climatic change and the influence of the increased concentrations of greenhouse gases on climate. The documentation of the data set has been prepared from contributions made by Frank Quinlan, Tom Karl, and Claude Williams of the NCDC.

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ARCTIC ICE ATLAS. The NCDC has published EASTERN-WESTERN SEA ICE ANALYSIS - 1985 for the Naval Oceanography Command. Using data obtained from satellite imagery and supplemented by conventional observations, weekly hemispheric sea ice analyses are prepared by the Joint Ice Center, Naval Polar Oceanography Center. The weekly charts, depicting ice conditions in the Arctic, North Atlantic, and North Pacific Oceans and Great Lakes, are the twelfth in a continuing yearly series of ice atlases. A limited number are available at NCDC for distribution.

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NATIONAL WATER SUMMARY 1985: Thomas R. Karl of the NCDC co-authored the report "Seasonal Summaries of Hydrologic Conditions, Water Year 1985" published in USGS Water Supply Paper 2300, National Water Summary 1985 - Hydrologic Events and Surface-Water Resources. The publication also contains a map of the 1951-80 average annual precipitation which was prepared through cooperative NCDC/CAC/NMC efforts.

# EARL KUEHNAST

## Minnesota State Climatologist Retires

Mr. Earl Kuehnast retired on October 10, 1986, thus ending a long career in meteorology and climatology. However, we doubt that Earl will forget about the weather or climate now that he has retired.

For those who do not know Earl, we submit the folloiwng brief biography of his background and accomplishments. He was raised on a farm in Humboldt County, Iowa, later receiving his B.S. Degree in Chemistry from Iowa State University. Earl served the Nation as an Air Force pilot and meteorologist for 23 years, during which he lived in many localities around the world, such as Newfoundland, Germany, and the Philippines. In 1968 Earl became the State Climatologist of Minnesota, and during the last 18 years has made significant contributions to a wide array of state services and programs. Following are just a few of those contributions: developed methods to assess flood potential, soil moisture conditions, crop maturation and drying prospects, "ice out" dates for area lakes, and fire weather hazards. Earl also worked closely with the National Weather Service and state agencies in post-disaster assessment.

Even with all the above activities, Earl still made time to prepare agricultural materials for the University of Minnesota Extension Service to help educate farmers about such subjects as drought and prospects for alleviation. Last but not least, the general public also benefitted from Earl's work in preparing meaningful weather stories for broadcast through the local news media.

From all of us in the AASC, best wishes for a long and fulfilling retirement.

# WESTERN REGIONAL CLIMATE CENTER ESTABLISHED

Richard L. Reinhardt, PhD
Assistant Executive Director
Atmospheric Sciences Center
Desert Research Institute

The Western Regional Climate Center was officially begun August 1, 1986, at the Atmospheric Sciences Center of the Desert Reserach Institute in Reno, Nevada. The intended initial service area for the Western Region includes the states of Arizona, California, Idaho, Nevada, New Mexico, Oregon and Utah, with possible later inclusion of Washington. Funding for this effort was provided by Congress through the National Climate Program Office in order to continue the regional center concept, which was successfully demonstrated by the Northeast Regional Climate Center at Cornell and the North Central Regional Climate Center at the Illinois State Water Survey.

The main purpose of the regional center is to augment the capabilities of the NCDC and CAC in making regional data more accessible to decision makers whose use of climate information affects the economy. The first interface to the user of climate information is the State climatologist, the local climate expert. Therefore, the first step in achieving the main goal of the regional center is to facilitate the work of the State Climatologist. To find out how this might be accomplished most effectively, a meeting was held in Reno on September 3, 1986, with the State Climatologists of the Region.

The meeting was attended by State Climatologists Dr. Anthony J. Brazel, Arizona; Mr. Maurice Roos, California; Dr. Myron Molnau, Idaho; Professor John W. James, Nevada; Dr. Kenneth E. Kunkel, New Mexico; Dr. Kelly T. Redmond, Oregon; and Dr. Gail Bingham, Utah. Also in attendance were Dr. Howard Hill, National Climate Program Office; Dr. Joseph Warburton, Executive Director of ASC/DRI; Dr. Richard Reinhardt, Mr. Larry Young and Mr. Sam Keck, ASC/DRI; and special invited speakers Dr. Wayne Wendland, Illinois State Climatologist and Professor Stanley Changnon, Illinois State Water Survey, who discussed "Rationale and Role of Regional Climate Centers in the United States," a report which they co-authored. The meeting provided the opportunity to establish the guidelines for the interaction of the State Climatologists and the Regional Center. The two primary results of this inaugural meeting were the specification of the computer network that will link the State Climatologists to the main computer at the Regional Center and the types of data deemed necessary to have available at the Center.

Some of the future activities in which the Western Regional Climate Center will be involved are: helping to expand the user base of the State Climatologists by developing computer software "products" to improve the utility of the climate data; identifying additional public and private sector users with interstate needs that can be more effectively met directly by the Regional Center; working with NCDC and CAC to implement national products, such as CLICOM, on a regional and state level.

## The National Environmental Data Referral Service

NOAA's National Environmental Referral Service (NEDRES) has a publicly available data base (NEDS) accessed on BRS Information Technologies. The NEDRES data base is a computer-searchable catalog and index of environmental data held by various governmental and private sources throughout the United States and Canada. NEDRES does not contain the data, but refers users to the holder of the information.

Subjects covered include meteorology, oceanography, geophysics, geography, pollution, fisheries, ecology, and remote sensing satellite data. Types of information described include unpublished data files, data serial publications, atlases, manuals, catalogs, and data centers. The data base has the standard bibliographic fields as well as additional fields which describe environmental data.

## New NEDRES Publications

**North American Climatic Data Catalog, Part 2 (1985).** The majority of data descriptions in this 658-page climatic data catalog cover the Southern states, including North and South Carolina, Alabama, Georgia, Tennessee, Florida, Louisiana, Kentucky, Virginia, West Virginia, Mississippi, Arkansas, Oklahoma and Texas.

**Satellite Remote Sensing of the Marine Environment: Literature and Data Sources (1986).** The NEDRES Office and the Library Information Services Division (LISD) of NOAA jointly compiled this 250pg. publication. Listings of publications and other data sources relating to the use of satellites in the marine environment were prepared by searching the NEDRES data base and four bibliographic data bases.

The bibliographic data bases searched were the LISD NOAA Automated Library Information System (NALIS), the Meteorological and Geoastrophysical Abstracts (MGA), the National Technical Information Service (NTIS), and the Aquatic Sciences and Fisheries Abstracts (ASFA).

Copies of these publications are available prepaid at $10 each from the NEDRES Office, E/AIx3, NESDIS/NOAA, Rm 522, 1825 Connecticut Avenue N.W., Washington, D.C. 20235, (202)673-5404.

Further information and free literature may be obtained by contacting NEDRES at the above address.


**The National Environmental Data Referral Service**

Information Sheet
Contact: Elaine Riccio
(202)673-5405

American Association of State Climatologists

Minutes of Annual Meeting

Asheville, North Carolina

August 8, 1986

The business meeting was called to order by President Ken Hubbard (NE) at 1400 hours. He reviewed activities of the AASC for the past year. He reminded everyone that we did pass both Education and Data Standards reports during the past year. One very valuable activity of his was to travel to Washington, DC, and meet with various NOAA and USDA people.

The minutes of last year's meeting were approved as printed in the October 1985 State Climatologist.

Myron Molnau (ID), Treasurer, reported a bank balance of $5,461.05 as of 30 June. Interest income for the first six months of 1986 was $171.08. All funds are now kept at the Arcade Credit Union in the Federal Building, Asheville, NC. The account at First Union Bank has been closed. A total of 19 members, 17 associate members, 7 visitors, and one honorary member were in attendance at the meeting.

Committee reports were then given. Copies of reports that are available are printed elsewhere in this edition. A synopsis follows:

Computer Committee: Gaylen Ashcroft (UT) reported that the committee thought the CLICOM system from NCDC was a good start towards minimal standardization among State Climatologists. It was also recommended that NCDC actively support any CLICOM users group.

Education: Wayne Wendland (IL) reported that the committee report has been published in the State Climatologist and has also been sent to the AMS Bulletin as a letter to the editor. This being done, no report is published in this newsletter and President Hubbard dissolved the committee.

Goals: Glen Conner (KY) gave the committee's report. After some discussion and amendment, the report was approved. Conner will remain chairman for the coming year. Any recommended changes should be sent to him.

Instrument: Ken Kunkel (NM) gave the committee's report. Discussion followed on the apparent high failure rate of the MMTS and testing of NWS instruments.

Publications: John Purvis (SC) gave the report and said he would provide a summary of their questionnaire to the State Climatologists. He stressed that State Climatologists should receive all NWS publications, especially educational. The committee also wants NCDC to look into ways whereby all data for a station is on one page.

Regional Programs: Bob Muller (LA) reported that a new regional center was established at the University of Nevada.

Climate Programs: Fred Nurnberger (MI) and Kelly Redmond (OR) reworked the climate program questionnaire and will send it out this coming year.

The new committees were instituted. There are the committee on Climate Division and Normals, chaired by Gaylen Ashcroft (UT) with Nolan Doesken (CO), Gayther Plummer (GA) and Fred Nurnberger (MI). They are to report on any problems and possible solutions with regard to current divisions and also computation of normals. The other new committee is $CO_2$ and Trace Gases chaired by Pat Michaels (VA) with members Gail Bingham (UT), Gayther Plummer (GA), Jim Newman (IN) and Tony Brazel (AZ). This group is to bring a policy statement for discussion at the 1987 meeting.

New Business:

Pat Michaels (VA) suggested a constitutional amendment to the effect that a State Climatologist can send a designated proxy to vote at a meeting. It was moved, seconded and carried that the now dormant Constitution Committee be empowered to suggest an amendment to be submitted to the 1987 meeting.

It was reported that Bill Bartlett was recovering from surgery. The Executive Committee was empowered to send Bill the Association's best wishes for a speedy recovery.

New Associate Members were elected after being proposed by two members. These are:

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| Janine Bryan, TX | (Griffith and Hubbard) |
| Michael Folkoff, CT | (Miller and Hubbard) |
| Tom Schmidlin, OH | (Dethier and Miller) |
| Keith Eggleston, NY | (Dethier and Miller) |
| Steven Williams, AL | (McNider and Muller) |
| David Smith, SC | (Purvis and Dale) |
| Paul Knappenberger, VA | (Michaels and Nurnberger) |

Ken Hubbard made a plea for articles for The State Climatologist. Items such as theses or paper abstracts or synopses would be very appropriate.

Discussion followed on the format of the 1987 meeting and whether or not AASC should sponsor another conference on Human Consequences of Climate. The discussion narrowed down to a preference for a fall two day meeting with either longer reports or papers for a half day and 1 1/2 days for the business meeting. The exact format was left up to the President-elect in consultation with the full Executive Committee.

The 1987 meeting will be held in St. Paul, Minnesota,with help from Paul Waite (IA) if necessary.

Several announcements were then made. Bob Dale (IN) gave a short statement on the USDA regional committees.

Grant Goodge handed out sheets to each State Climatologist. This sheet showed error rate, etc., for each month's arrays.

The new Observers Handbook 2 will go to the printer this fall.

Election:

The Nomination Committee of Purvis (SC), Hamberger (TN), and Redmond (OR) presented the following slate:

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|---|---|
| President-elect | Pat Michaels (VA) |
| Secretary-Treasurer | Kelly Redmond (OR) |

These were elected by acclamation.

The Nomination Committee for 1987 is to consist of Fred Nurnberger (MI), Bob Muller (LA), and Myron Molnau (ID).

As his last act as President, Ken Hubbard figuratively passed the gavel to Dave Miller (CT), who thanked him for a job well done.

A resolution passed thanking NCDC for the fine hospitality and particularly Grant Goodge and Steve Doty for all their help.

There being no further business, the meeting adjourned at 1645 hours.

Respectfully submitted,

Myron Molnau
Secretary - Treasurer

American Association of State Climatologists

Report of the Computer Committee

Committee Members: Gail Bingham, Chairman
Rolland Houser
Myron Molnau
Ernie Atkins

Members who met: Gaylen Ashcroft, Acting Chairman
Myron Molnau

1. In light of the current availability of CLICOM, we recommend that State Climatologists purchase a system that will handle this program. The recommended configuration is:

PC AT Compatible
1 Megabyte (MB) memory
40 MB hard disk
1.2 MB diskette drive
Enhanced Graphics Adaptor (EGA) card
Medium resolution color monitor
Backup device such as optical disk or streamer tape drive
Dot matrix printer

With the addition of 2 MB of additional memory, this system will handle the MCIDAS program that is being developed by Wisconsin for UNIDATA at UCAR.

2. Considering the great interest of State Climatologists in obtaining and using the CLICOM system, we strongly recommend that NCDC act as the "clearing house" for the CLICOM User Group. We further recommend that NCDC furnish programming personnel to assure that the CLICOM programs are upgraded as software packages are developed by State Climatologists as they use CLICOM to facilaitate efficient operation of their office.

American Association of State Climatologists

Report of Goals Committee

GOAL 1:

Promote cooperation between State Climatologists and those Federal, state, and private agencies whose functions include the collection, analysis, use and dissemination of climate and weather information.

OBJECTIVE 1:

Act as the primary source for Federal agencies to determine State Climatologists' opinions, public service needs,and problems.

OBJECTIVE 2:

Maintain close cooperation with NOAA, CAC, NWS, NCPO, and NCDC in matters concerning state climatology programs.

OBJECTIVE 3:

Include appropriate Federal, state, and private agencies in the agenda of annual AASC meetings for presentations.

OBJECTIVE 4:

Assure a good visibility of the AASC within each state.

OBJECTIVE 5:

Assure that a current list of State Climatologists is distributed to appropriate Federal, state, and private agencies.

GOAL 2:

Facilitate exchange of information among State Climatologists.

OBJECTIVE 1:

Compile a list of publications by members and State Climatologists' offices and provide the list to the NCDC.

OBJECTIVE 2:

Conduct a survey of climatic work done by State Climatologists and maintain an inventory of this work.

OBJECTIVE 3:

Encourage members to provide articles to the State Climatologist journal and to exchange information about innovative uses of data to enhance service in each state.

GOAL 3:

Provide mutual assistance in the development of effective State Climatologist programs.

OBJECTIVE 1:

Institute committees to address problems and items of current interest.

OBJECTIVE 2:

Develop a model "Governor's Briefing Book" for use by State Climatologists in presenting their products and services.

American Association of State Climatologists

Instrumentation and Data Standards

Committee Report

Committee Members: Gail Bingham (UT)
Douglas Clark (WI)
Richard Davis (NCDC)
Kenneth Hubbard (NE)
Kenneth Kunkel (NM)-Chairman
Myron Molnau (ID)
Fred Nurnberger (MI)
John Vogel (IL)

The committee reviewed documents concerning the National Weather Service's Automation of Surface Observations Program (ASOP). A summary of this review was prepared and sent to Steve Short, ASOP Program Manager. The major concern of the committee, as expressed in our review, was that every precaution be taken to insure that data obtained from any future automated station be fully compatible with present and past measurements. It is not clear whether this is possible with current technology.

Steps were taken to arrange for participation by committee members in the testing of new National Weather Service instrumentation. The National Weather Service agreed in principle to loan prototypes of new instruments for testing by committee members. It is hoped that this program will allow new instrumentation to be tested under various climatic regimes before deploying around the country. Unfortunately, recent budget cuts have temporarily postponed new instrument development.

In recent communications, we have explored the possibility of coordinating our work on instrumentation and data standards with the work of the Task Group on Surface Instrumentation Standards, which is part of the committee structure of the Federal Coordinator for Meteorological Services and Supporting Research. We are working out the mechanism for such coordination with Jon Parein, Chairman of the Task Group.

American Association of State Climatologists

Publications Committee Report

Committee Members: John Purvis (SC) - Chairman
Grant Goodge (NCDC)
John Griffiths (TX)
Harold Crutcher
Earl Kuehnast (MN)
Joseph Moyer (MD)
Paul Waite (IA)

The committee was tasked to study and evaluate those climatological publications which are used (or needed) by State Climatologists and other Applied Climatologists for providing climatological services and useful information to climatologists.

Each committee member has reviewed the various climatological publications that are available. Criteria included an evaluation of the effectiveness of the publication in conveying climatological information to the user as well as to any possible changes that might improve the publication usefulness. A questionnaire was prepared and circulated to all State Climatologists.

From the information received, it is obvious that many useful climatological publications have been produced by the various State Climatologists and that many more could have been published if funds had been available. A central point for collecting, reviewing, and informing climatologists about publications produced by various State Climatologists would be valuable.

The committee commends NCDC for the excellent publications printed during this year. Also, we recognize the very useful articles in professional publications. Too, we would be amiss not to mention the excellent quarterly medium, The State Climatologist, now in its 10th year. This fine publication serves as a focal point for the State Climatologist program.

Following is the committee evaluation and recommendations regarding the continuing NCDC publications:

CLIMATOLOGICAL DATA (CD). This is perhaps the most widely used publication in the State Climatology program and invoked the most comment from the various State Climatologists. The CD format in use since July 1981 is preferred by some users because of the larger print, but many find the split precipitation arrays on two pages difficult to use. There was also considerable comment about grouping by division, and about

missing data. The Committee recommends that NCDC review the presentation of precipitation data to see if the split precipitation arrays can be avoided. Also, the time of the observations should be included with the temperature/rainfall data if possible so as to avoid misuse of these data.

We also feel that all State Climatologists should give consideration to the need for historical documentation of unusual and/or notable weather and climate events in the form of a narrative in the monthly CD. If a satisfactory and uniform program could be adopted in this regard, then we would urge that NCDC find a way to include CD narratives in the archived CD microfiche. We believe this to be a valuable public service, both to the casual user and to researchers and historians. We recommend that NCDC establish desired standards for the narrative and, if these standards are met, that the narrative be archived.

Missing data is an obvious problem without an easy solution. While the Committee is not able to provide an answer, we would like to avoid losing data because a small amount is missing.

It would also be helpful if the annual CD had more vital statistics for various stations such as the average maximum and minimum temperature in addition to the mean temperature. A precipitation summary of the number of days with measurable precipitation 0.10, 0.50, 1.00 inches etc. would be useful.

The Committee commends NCDC for the prompt publication of corrections in the 1985 annual CD's. These corrections were in the form of a corrected sheet to be added to the published annual. However, if the corrected page had been numbered and printed on both sides in the same manner as the page bearing the error, then the offending sheet could have been completely removed from the annual.

HOURLY PRECIPITATION DATA (HPD). The Committee recognizes the extensive work required to prepare this publication. Several State Climatolgoists are concerned with the readability and suggest lines or a better way for the eye to follow the data across the sheet.

STORM DATA. The Committee commends the present format but strongly encourages all State Climatologists to become more involved in assisting in the collection of data for this important publication. All State Climatologists should be aware of the mission and value of this publication. It is expected that this publication officially document the more damaging storms and all human deaths and injuries associated therewith. It does not provide a good data base for crop-hail, heavy rains, and local wind storms although it has expanded in these areas.

There is an existing need for all State Climatologists to receive the NOAA climatological, hydrological and weather technical publications - particularly those which will improve the public service and research programs of the State Climatology program. For example, this summer the National Weather Service adopated a new policy of distributing heat index information on a routine basis. State Climatologists were not in any way informed of this new issuance, but, of course, began to receive requests about this new approach.

The Committee recognizes the need for an updating of the Climatological Atlas and offers its support in such an undertaking. Dr. John Griffiths (TX) has offered to assist in this task.

In conclusion, this Committee believes that all State Climatologists are pleased with the excellent NCDC publications and published studies available. The committee continues to recommend increased involvement of all State Climatologists with the NCDC publications by contributing narratives, reviewing publications, and individually informing NCDC of both those areas that should be preserved, as well as those areas in which improvement is needed. It is not enough to say a publication is good or bad unless the conditions dictating that assessment are given.

Attachments:
Recommendations
Result of Survey

## RECOMMENDATIONS OF PUBLICATION COMMITTEE

1. Recommend that a list of each year's publications by the various State Climatologists be published in the publication, "The State Climatologist."

2. Recommend that NCDC review the presentation of daily precipitation data as published in the CD to see if split precipitation arrays can be avoided while at the same time preserving legibility.

3. Recommend that a monthly documentation of unusual or notable weather events be prepared where possible by the various State Climatologists. We urge also that NCDC find a way to archive these data as a regular part of the CD's.

4. Recommend that NCDC include, if possible, the time of observation on the same page with the temperature and precipitaton data as recorded in the CD.

5. Recommend, if a suitable format can be devised, that the annual CD include additional statistics such as the average high, low temperature for each station as well as the number of days with specific rainfall amounts as 0.10 inch.

6. Recommend that hourly precipitation data include some type of visual reference so that the user would be able to better distinguish between each line of data.

7. Recommend that the CAC, NWS, and NCPO coordinate arrangements so that each State Climatologist receives a copy of NOAA's climatological, hydrological weather technical and severe weather preparedness publications issued by their office.

State Climatologist Questionnaire

Summarized below are the questions asked and the response:

1. List helpful publications/pages produced in the past year in your State/Region.

IOWA - Iowa Horticulture (Quarterly publication)
Iowa Secular Precipitation Characteristics. Climate of Iowa Series No. 7; "Precipitation Variations: Past, Present, and Future." Planting to Harvest, Iowa, 1985.

ALASKA - "Extreme Wind Predictions for First Order Weather Stations in Alaska."

OREGON - "An Inventory of Climate Data for the State of Oregon."

NEW MEXICO - Temperature and Precipitation Summaries for Selected New Mexico Locations. Temperature and Precipitation Probabilities, Growing Season Data, Degree Data Data Design Temperatures.

MINNESOTA - Climate of Minnesota, Part XV, "Normal Temperatures and their Application." Isohyet Maps and Descriptions, "Flash Floods and Heavy Rain Events."

IDAHO - The U.S. Forest Service is putting out a series on climate of various forest areas in the Northern Rockies that is very good.

VERMONT - Northeast Regional Climate Center monthly - Vermont Edition.

ILLINOIS

Head, D.E., 1985: Mean temperature biases as a function of the observation. NCRCC Paper #6. North Central Regional Climate Center, Illinois State Water Survey, Champaign, 105p

Wendland, W.M., and N.S. McDonald, 1985: Mean Airstreams of Australia. Austral. Geogr. Studies. 23: 2837

___, J.L. Vogel and S.A. Changon Jr., 1985: Mean 1951 - 1980 temperature and precipitation for the North Central Region. Paper No. 7, North Central Regional Climate Center, Ill. State Water Survey, Champaign. 30 p.

___, S.A. Changnon, Jr.,& J. L. Vogel, 1985: Rationale and role of regional climate centers in the United States. Paper No. 8, North Central Regional Climate Center, Ill. State Water Survey, Champaign. 22p.

Wendland, W.M. and N.W. McDonald, 1986: Mean Monthly Streamlines of the Southern Hemisphere. Mon. Wea. Rev. 114: 88-94.

Karl, T. R., C. N. Williams Jr., P. J. Young and W. M. Wendland, 1986: A model to estimate the time of observation bias associated with monthly mean maximum, minimum and mean temperatures for United States locations. J. Clim. Appl. Meteo. 25:145-160.

Wendland, W. M., 1986: Hydroclimatology. Encyclopedia of Climatology. J.E. Oliver (ed) Hutchinson Ross Publ. Co. In press.

___ & J. L. Vogel: Assessment of need for real-time climate data and information in the Upper Midwest. North Central Regional Climate Center, Illinois State Water Survey, Champaign. 28p.

___J. L. Vogel & S. A. Changon Jr., 1986: The North Central Regional Climate Center. Annual Report of Contract COMMNA81AADOO112. Illinois State Water Survey, Champaign. 35p.

___ & S. A. Changnon Jr., 1986: Assessment of usage of real-time climatic data and information to the public and private sector. Annual report Control COMMNA85AA-D-MC-056. Illinois State Water Survey, Champaign. 18p.

SOUTH CAROLINA

MONTHLY RAINFALL PROBABILITIES IN SOUTH CAROLINA; Purvis, John C., S.C. Water Resources Commission, May 1983; $1.50.

S.C. TORNADO STATISTICS 1950 - 1982; Purvis, John C.,September 1983; $1.00.

CLIMATOLOGY OF SOUTH CAROLINA MONTHLY AND ANNUAL NORMALS OF TEMPERATURES, PRECIPITATION AND HEATING AND COOLING DEGREE DAYS, 1951-80; Purvis, John C., September 1983; $1.00.

MAXIMUM ENVELOPE OF WATER AND TIME HISTORY FOR HURRICANES AFFECTING THE SOUTH CAROLINA COAST; Purvis, John C., February 1984; $18.50.

GENERAL CHARACTERISTICS OF SOUTH CAROLINA'S CLIMATE; Purvis, John C., and Ann Nolte, July 1984; $1.00.

FROZEN PRECIPITATION IN SOUTH CAROLINA, December 1962 - April 1983; Caughnan, Roddy, July 1984; $2.50.

DEATHS CAUSED BY LIGHTNING IN SOUTH CAROLINA; Purvis, John C., August 1984; $1.00.

TIME HISTORIES OF STORM SURGE ELEVATIONS FOR HURRICANES AFFECTING THE SOUTH CAROLINA COAST; Purvis, John C.,January 1985; $18.50.

AUGUST 11TH, 1940 HURRICANE; Purvis, John C., Brian R. Jarvinen, December 1984; $1.50.

HURRICANE DIANA (1984); Purvis, John C., February 1985; $1.00.

HURRICANE DAVID (1979); Purvis, John C., Brian R. Jarvinen. January 1985; $1.00.

TIME HISTORY INFORMATION FOR HURRICANES AFFECTING THE SOUTH CAROLINA COAST; Purvis, John C., Mark Perry, M. Holland, April 1985; $9.00.

HURRICANE VULNERABILITY FOR 6 SOUTH CAROLINA COASTAL COUNTIES: HORRY, CHARLESTON, COLLETON, DORCHESTER, GEORGETOWN, AND BEAUFORT; Purvis, John C., Albert McNab, Jr., May 1985; $1.00 each.

HURRICANE STORM SURGE TIDAL CORRECTION, Purvis, John C.,May 1985; $1.00.

HURRICANE BOB (1985); Purvis, John C., Lariri Estaba, Greg Yarbrough, November 1985; $1.00.

2. List cases where climate statistics have been completed but publications disapproved or delayed due to funding:

Minnesota, Vermont, Connecticut, Oregon, North Carolina, New Mexico, Nebraska, Florida, Missouri, and Illinois said, none. Iowa has a file full of such delays but contract money has made some publications available in print.

ALASKA - trouble with "Alaska Climate Center News and Review, Winter 1986."

IDAHO - no problems except for the time to complete the publication.

NORTH DAKOTA - may have funding problems with the almanacs they're working on.

INDIANA - having problems with Class "A" networks 20-12.

WASHINGTON - funding limitations inhibit preparation and publication.

GEORGIA - History of Extremes Temperature in Georgia ($75,000 for 1500 copies).

SOUTH CAROLINA - several publications awaiting funding.

3. List your experience with overcoming publication funding problems.

ILLINOIS - Shop around for estimates and publish using microfilm or fiche.

IOWA - Large requests are explored to see if requester wishes to fund basic development and printing.

CONNECTICUT - Publishing as a part of a related publication.

NEBRASKA - Attract research funds by writing to local foundations, boards, etc.

4. List publications produced nationally that are helpful.

Minnesota and New Mexico like all publications. Idaho uses the Forest Service and SCS publications. The other states mentioned the following: Climatology of the U.S. No. 20, 81, 85. LCD's, CD's, HPD's, Storm Data, HCS 6-1 (according to Georgia, superb!). HCS 3-5, 3-6, 3-7, 3-10 and 3-11. There are many others.

5. Comments on Climatography of U.S. No. 20.

Connecticut hasn't received it. New Mexico has another publication with similar information. North Dakota, South Carolina, Idaho, Washington, Florida, Missouri, and Iowa feel it is useful, but also think it should include First Order Stations, wind summaries, and humidity as available. Minnesota and Vermont think it is good while Illinois thinks it is excellent. The selection distribution could be improved according to Indiana. Oregon, Alaska, and Nebraska agree that more stations are needed. It was also suggested that it include a time series, standard deviation and other statistical information.

6. Comments on other existing or planned climatography series.

Georgia says graph all "graphs." Nebraska - update 82 series. Alaska - update Technical Paper 47 (Probable Maximum Precipitation and Rain Frequency Data for Alaska, 1963) Oregon needs summary of all stations, time series, and variability. Washington says add stations including FAA, military and Coast Guard. Minnesota wants more wind data.

7. Comments on "Electronic publishing." (Computer communication system):

Missouri, Minnesota, North Dakota, Vermont, Idaho, Indiana, Connecticut, Iowa, Oregon, North Carolina, New Mexico, Alabama, and Georgia don't use or had no comments. Washington feels it could be useful but funds are a problem. Florida hopes to use it in the future. Nebraska uses it to make 7-day temperature forecasts and 5-10 day outlooks. Illinois uses the 1-5, 6-10, 30 and 90 day outlook. There are many other uses.

8. Do we need a climatic atlas?

Everyone said yes except Indiana, New Mexico and Alaska who didn't comment. Georgia says you need a pattern history of data sets, but no mean values. Missouri wants single station summaries. Illinois needs mean and extreme data probabilities.

9. Weekly Weather and Crop Bulletin Comments.

Most find the publication useful but agree that faster distribution would be helpful. North Dakota thinks it is a great publication. Indiana likes the weekly summary but not the 2, 4, 6, 8, 12, 16 weeks and 6 month deviation in precipitation. It is generally agreed that the drought information and the heating/cooling degree days are good. It is also useful because it shows the big picture. Oregon feels it needs more numbers less writing. Alaska doesn't receive.

10. Comments on Severe Weather Documentation.

Comments already given.

11. Are you satisfied with HPD and CD maps?

North Dakota would like the names to be larger. Idaho wants to change the scale. Alaska would like the holes filled.

12. Should there be a uniform scale for network maps?

Minnesota feels that periphery data of other states would greatly aid in analysis. North Dakota would like a uniform scale. Indiana and Washington want 8 1/2 x 11, while Idaho wants 11 x 17 inches. Missouri would like regional map of 4-6 states, of 16 x 22 inches. The rest don't think it is necessary. Iowa feels it would put an unnecessary burden on NCDC.

13. New graph from NCDC and the idea of clusters.

Illinois suggests changes. Idaho and Indiana feel it would be useless, especially in the mountains - Hawaii feels the cluster concept is interesting. Minnesota feels it would be helpful. Washington sees a use for it in research but little value in day-to-day services. Georgia feels that cluster is a nonsense word. Missouri doesn't use the cluster concept. Iowa dislikes the idea if it will do away with districts. Oregon likes the idea of proportional circles, but Nebraska thinks they are hard to see. North Carolina thinks it is good to see statewide trends.

14. Other

Indiana suggests crop reporting should be uniform. Georgia says the NCDC needs to be careful about the accuracy of languauge. (Data are, data sets, graph, etc.) as they are about accuracy of numbers. Missouri - "Don't fix what is not broken."

American Association of State Climatologists

Regional Climate Committee Report

Committee Members: Tony Brazel (AZ)
Nolan Doesken (CO)
Robert Muller (LA) - Chairman
John Purvis (SC)
Peter Robinson (UNC)
Norton Strommen (USDA)

There has probably been little interest on the part of most State Climatologists in attempting to form regional organizations and centers during the last several years because of the commonly held view that significant federal support funds would not be available through NOAA or NCPO. Indeed, there were ongoing rumors that the two centers partially supported by NCPO were in danger of losing the limited federal funding in future budget years.

Within the last six months, most of the SCs learned about the (one-time?) congressional initiative for funding of a Western Regional Center at the Desert Research Institute (DRI) where there has been little to no tradition for climatology research. Therefore, at least some of us were especially surprised at the Asheville meetings to learn that the DRI is likely to be funded again, and that other current regional centers and projects are also likely to receive additional funding. In fact, the "climate" may be ripe for the establishment of new regional centers to fill in the gaps on the map.

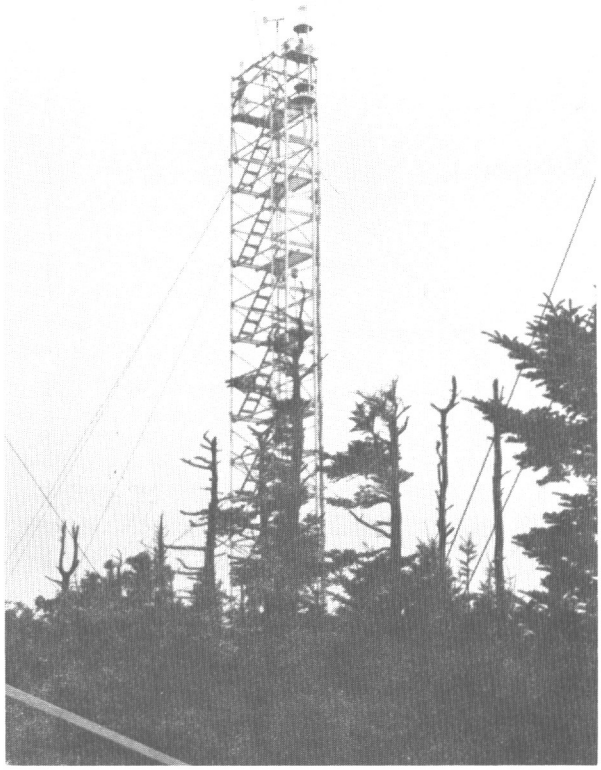
It was stressed, however, that establishment of new centers and any federal funding should be based on regional resource commitments, especially long-term stability, and successful congressional initiatives from the regions. Now that the Intergovernmental Program section of the National Climate Act has been deleted from the Act, there is no requirement of individual state climate programs; therefore, regional centers could be developed for very different operations and objectives. It could be a very busy time for movers and shakers.

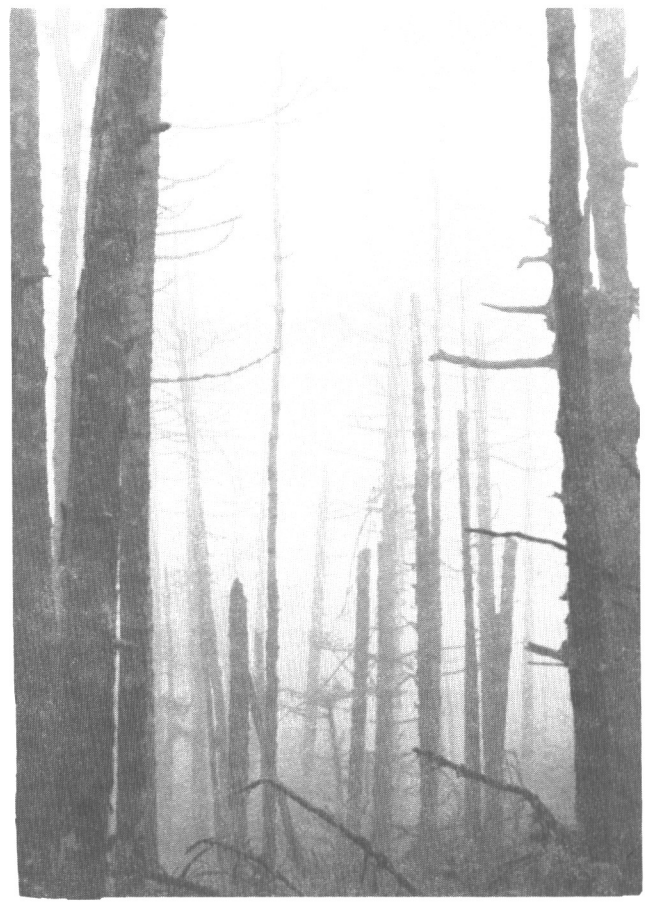
Attendees at the 1986 Annual Meeting of the AASC.

More attendees at the August meeting in Asheville, NC.

One of the field trips took us to the newly established Biltmore Vineyards. Mr. Steve Sorensen (extreme left) discusses the micro-climatic variations in the vineyards.

One of our other field trips took us to one of the NC State University's research sites atop Mt. Mitchell, NC where Red Spruce and Frazier Fir trees are showing a high mortality rate.



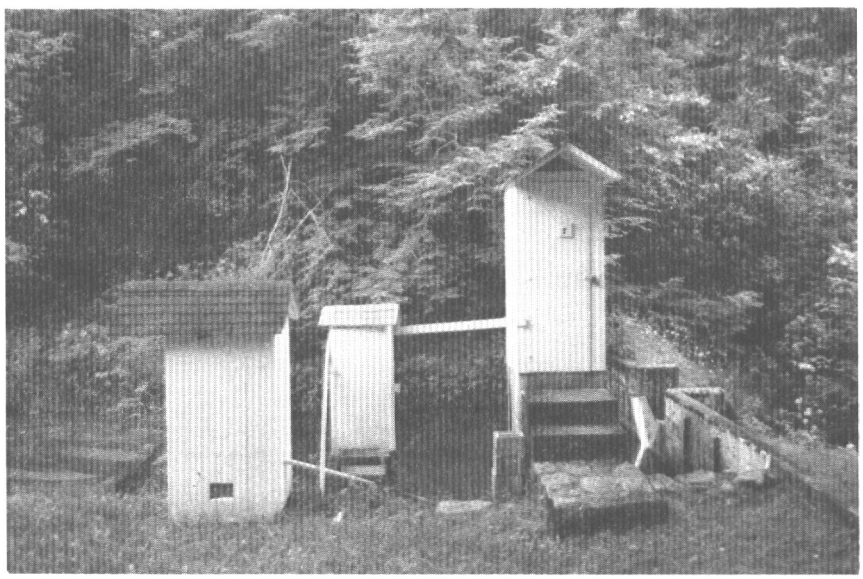


NC State University Research Tower (above) near Mt. Mitchell. At right dead evergreen trees on Mt. Mitchell.

A NCSU researcher describes some of the evidence and impacts of acid deposition on the boreal forest.

Left, one of several cloud droplet collectors used by NCSU to determine the PH acidity, and conductivity of the cloud moisture that comes in contact with the trees on the mountain tops.

The last field trip took some of the SCs to the U.S. Forest Service's Coweeta Hydrologic Laboratory 10 miles SSW of Franklin, NC. It is at the headwaters of this test facility that an average of 92 inches of precipitation falls per year.



Right: one of the weirs and stream gauges used to measure stream flow and runoff.

Left: Some of the collection equipment used by the USFS in their study of the effects of "acid precipitation."

# SOME THOUGHTS ON IMPROVEMENTS IN COOPERATIVE DATA

Kelly Redmond
Oregon State Climatologist

This past summer, I had the opportunity to spend three weeks in Asheville, NC, participating in the State Climatologist Exchange Program at NCDC. Among the numerous reasons for wanting to visit was the opportunity to follow the progress of an issue of Climatological Data. Of particular interest were the issues relating to quality control of the daily temperature data. I would like to share some of my observations and recommendations resulting from a close look at this process.

One of the reasons for the existence of the cooperative network is to learn about the small-scale and meso-scale variations of climate that are present in the United States. Because it is impractical to have a dense network of trained and salaried observers, the present, largely voluntary, system has evolved. As we are all well aware, there are ample opportunities for errors to occur throughout the process of bringing the data from the field to the user. Some of these are avoidable, while others are very hard to eliminate.

The quality of the observations from the cooperative network covers a wide spectrum. Some of the observers are extremely conscientious and provide high quality data, in some cases surpassing those of the National Weather Service. A small number are not highly motivated, and provide data of limited usefulness. In between, one can find stations with errors and omissions resulting from occasional mental lapses or forgetfulness, weekend and longer vacations, untrained substitutes, illegible handwriting, instrumental problems, and so forth. Further errors can be introduced through the conversion to digital format. Obviously, we would like to end up with data sets that are both accurate and complete. For some applications, a complete time series of data is essential. Clearly, reliable methods of checking the errors and for estimating missing data are greatly desirable.

Because of the expense involved, it is also desirable that the screening and editing process be automated to some degree, if the method(s) can be shown to be trustworthy. Regretably, the pool of validators at NCDC has continued to dwindle, down to the present six. Therefore, each validator must deal with about eight states, spending an average of one day or less on each state. Help from interactive screening techniques will be welcomed by these individuals. It is always better to identify potential errors as early as possible in the archival process. For all intents and purposes, once these data have passed through the NCDC quality control procedures, it is quite unlikely that they will ever be examined this closely again, except under special circumstances, and even less likely that they will be modified in the historical data base. It is therefore very important that quality control procedures at NCDC be as good as possible.

In 1982, NCDC began to publish both the original observed value and the edited value if an edit occurred. It was my impression from looking at data from Oregon and my home state of Montana that 5-10 or more good data values were being rejected per month. Such data rejection occurs more often in the western states where large and real horizontal and vertical gradients in temperature can persist for periods of a day or more. By their nature, procedures for screening and rejecting/replacing observed values will identify as suspicious those values that differ greatly from "surrounding" values.

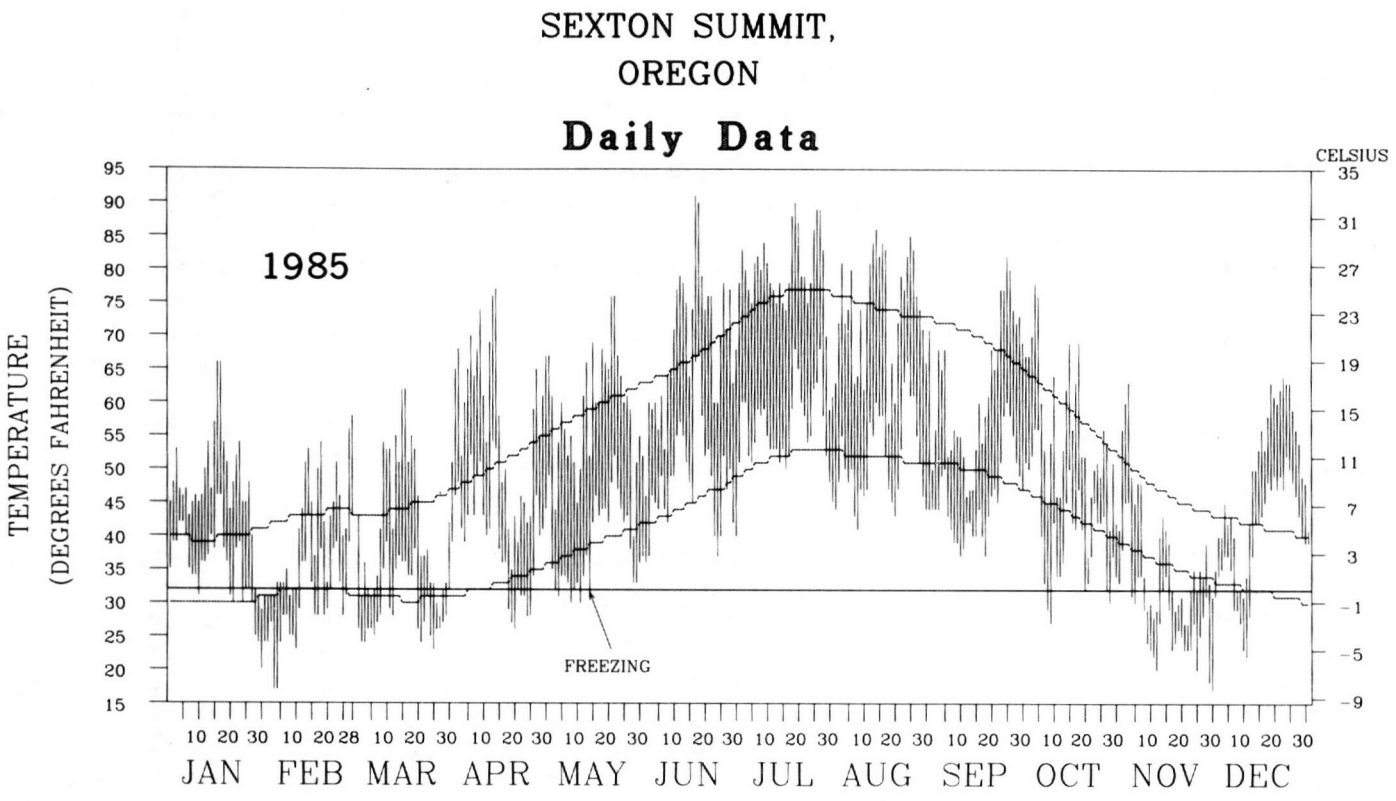
Unfortunately, it is in those very cases that we are the most interested, and that we most wish to retain in the digital archived records.* If we make the assumption that all significant departures from nearby stations are erroneous, part of the rationale for maintaining a dense climatological network disappears. We know, however, from past cooperative observations and from other independent input, that such an assumption is false. Another effect of uncritical replacement of unusual values is that if one begins to remove unusual values because they do not fit in, the statistics of extremes will begin to change, most likely in the direction of moderation.

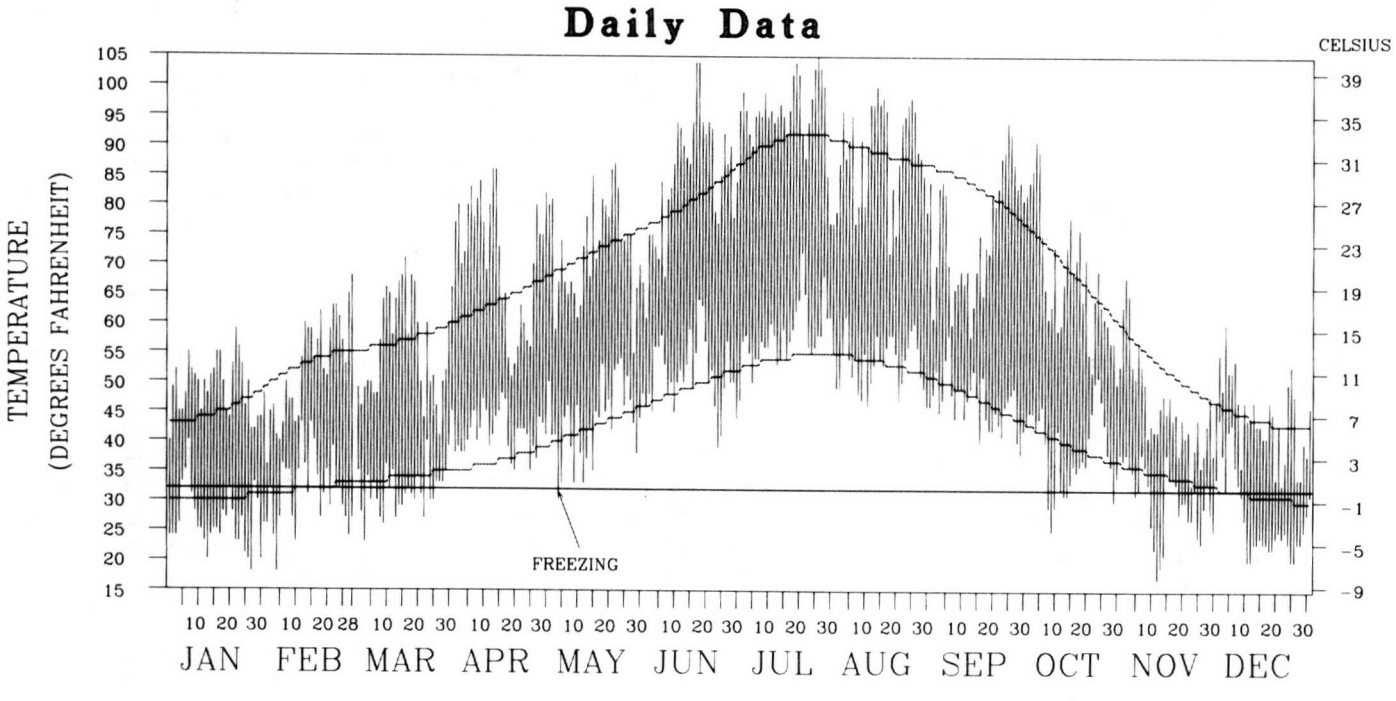
On the other hand, a close examination of the values flagged as suspicious reveals that many of the values do indeed seem wrong, as a result of the above-mentioned and other errors. Furthermore, there are many cases where the actual original value of an observation is known, and has simply been omitted or miskeyed. In those cases, the procedure used by NCDC will many times make an excellent estimate of the (known) value. After reviewing the temperature arrays for Oregon for the last year or two, I feel that approximately half of the edits improved the data base, and the other half diminished the quality of the data base. The challenge, therefore, becomes to devise a method that (a) rejects bad unusual values; but (b) retains good unusual values. An example of the importance of small scale variations was illustrated in Oregon a couple years ago by an investigation of an airplane crash. Daytime maximum temperatures recorded by the co-op network were used to establish the height of the top of the fog layer in the small valley where the accident occurred. A second example involved the weather of December 1985 in western Oregon where it was the coldest on record near sea level, while at the same time one of the warmest on record at mountain sites less than 10-20 miles away. This anomaly was the result of a three-week-long temperature inversion (See Figure 1). It is difficult for automated screening methods to properly deal with these situations.

The edit procedure used at NCDC compares the departures of max or min temperatures at nearby stations from their monthly means, in

*Both the original observed and edited values are retained in the digital data base; however, the edited values are the ones used to compute the monthly summary statistics. It should be noted that whenever additional information is received that substantiates an unusual observed value or values, then those values are used to compute the monthly summary statistics.

Figure 1: Daily maximum/minimum temperature plots for two Oregon NWS stations located only 29 miles apart. Sexton Summit is a mountain exposure while Medford is a valley exposure. Note the large differences during the last three weeks of December.



terms of absolute units. Then, if they are greater than a certain number of degrees during a second screening, in terms of standard deviations. If sufficiently different after the second screening, they are flagged as suspicious. Means are recalculated leaving these values out and the process is repeated. To this point, the screening process compares only stations within that climate division. These comparisons are stratified by time of observation (AM, PM or Midnight). After being flagged as suspicious during the second screening, six nearby sites are selected to generate potential replacement values. These six sites must observe at the same time of day, and must be within 1000 feet in elevation and within three degrees of latitude. The sites may thus not really be physically "nearby" but are presumed to be "nearby" in behavior. Comparisons are made for the entire U.S. in one pass through the data, irrespective of state or division boundaries. The normalized departures of all permutations of the six nearby sites are used to produce estimates for the station and element in question for all days that are not flagged. The combination of stations that best reproduces (as measured by the lowest error variance) the unflagged observations at the station in question is selected to generate the replacement for the flagged value. Up to eight missing or suspicious days are allowed to be filled in this way.

A listing of the comparison stations used for each site is kept in the Cooperative Data Branch. Examination of this list was exceedingly interesting. Many of the comparison stations are quite logical choices. Others are less so. For example, the nearest station compared for Crater Lake, the highest station in Oregon, is in California (none in Oregon are within 1000 feet in elevation). Some coastal cities are compared exclusively with inland locations with radically different climates. An isolated mountaintop near the coast is compared with an elevated plateau in eastern Oregon. Often, nearby stations are available, but observe at a different time of day. The restriction that comparison sites have a similar time of observation is both understandable and severe. Upper air profiles are not used at all; however, first order station data has recently been incorporated into the comparison process. The nearby stations that are finally chosen as the basis for replacement values depend on the availability of data for that month. The station mix need not be the same from month to month. In order to meet the monthly production schedule, current policy at NCDC is that data received after the 15th working day of the next month will not be edited or published in the monthly Climatological Data. Data received after this point, but within an additional month or two, will be keyed and entered into the historical digital archive with minimal editing. Still later data will be microfiched and filed as paper copy, but will NEVER be digitized. A recently retired NCDC employee, Lew Blodgett, undertook the laborious task of examining all the edit changes made for a one-year period for all U.S. stations, to obtain an estimate of the reliability of the NCDC edit procedure. The results of this unpublished study can be found in the office of Alan McNab, Chief

of the Cooperative Data Branch. For each edit, Blodgett made a subjective assessment of whether the value was correctly or incorrectly edited. The results were tabulated by state and by month, and in addition were mapped for each state. Table 1 shows the number of subjectively determined mis-edits for each month and each state from July 1984 through June 1985. The largest number of mis-edits are in winter. On the west coast the number is largest in summer, as expected. All states with at least 100 probable mis-edits, according to this study, are in the west, where topographic effects are dominant. Conversely, relatively homogeneous states, such as Kansas and Nebraska, have relatively few mis-edits, even though they have a large number of stations. Many of the mis-edits in the central U.S. arise from timing problems associated with moving fronts. Key entry errors were specifically excluded from this analysis. (The key entry error rate at NCDC is about 1-5 errors per 1000 entries.) Validators are instructed to check all flagged values for key entry errors. It should be noted that unflagged keypunch errors (that is, "reasonable" miskeyed numbers) will be caught only by accident.

This fascinating study reinforced my prior opinion that both good and bad edits are taking place. Overall, Blodgett concluded that about 60 percent of the edits were good edits of bad data, and about 40 percent were bad edits of good data. While one may debate this study, my subjective feeling is that these conclusions are in the right ball park. The trick for the future will be to improve the screening/editing technique so that it can simultaneously raise the number of good edits and lower the number of bad edits.

The FORTRAN program which performs this quality control was written by several individuals over the years, and the listing is about one and one-half feet thick. The stratification by time of day is engrained into the logic and cannot be easily changed. Major modifications to this routine are not a trivial matter.

Based on conversations and observations while at NCDC, I will boldly charge ahead and make the following recommendations for improving the NCDC daily cooperative data base.

1. IMPROVE THE OBSERVATIONS

The observers need feedback when mistakes are identified. The Cooperative Program Manager (CPM) is the most important link in this process. When validators at NCDC identify problems with time of observation, shifting by one day, consistency errors, failure to record observation temperature, failure to properly record precipitation or snow, and others, this knowledge should be promptly passed on to the CPM. The CPM should then promptly transmit this to the observer.

The current time lag between identification of an observer problem and its possible resolution should be shortened.

A clear, simple, non-intimidating, and weatherproof handbook should be available to all observers, with examples of common

Table 1: Number of mis-edited stations by state subjectively estimated by Mr. Lew Blodgett of NCDC for the period July 1984 through June 1985. The right-hand column indicates the percent of temperature stations with "mis-edits" during an average month from this study sample. M = missing month; * - New England states except for Maine. Alaska and Hawaii were not included in this study.

NOTE: The number or percent of temperature stations with "mis-edits" does not indicate the true number or percent of mis-edited data. For example, Alabama had 83 temperature stations during the study period. This would equal 996 station months, (83 x 12) of which 22 station-months had "mis-edits" (2.2%). It is likely that a station might have only one "mis-edited" value out of the 60 reported during an average month, thus giving a 0.037% edit error rate for Alabama.

| State | Jul84 | Aug84 | Sep84 | Oct84 | Nov84 | Dec84 | Jan85 | Feb85 | Mar85 | Apr85 | May85 | Jun85 | Total | % of Temperature Stations with Mis-edits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alabama | 0 | 0 | 2 | 0 | 3 | 2 | 4 | 5 | 3 | 3 | 0 | 0 | 22 | 2.2 |
| Arizona | 4 | 4 | 7 | 9 | 15 | 12 | 14 | 21 | 15 | 9 | 11 | 11 | 132 | 7.3 |
| Arkansas | 0 | 0 | 0 | 0 | 0 | 2 | 6 | 2 | 2 | 0 | 1 | 0 | 13 | 1.1 |
| California | 18 | 27 | 36 | 27 | 20 | 34 | 39 | 34 | 21 | 41 | 26 | 29 | 352 | 9.4 |
| Colorado | 4 | 6 | 20 | 18 | 24 | 48 | 29 | M | 28 | 19 | 13 | 10 | 219M | 11.6 |
| New England* | 1 | 1 | 2 | 1 | 1 | 6 | 4 | 5 | 2 | 2 | 3 | 0 | 28 | 1.9 |
| Maine | 0 | 0 | 2 | 1 | 2 | 1 | 3 | 5 | 3 | 1 | 5 | 1 | 24 | 4.2 |
| Florida | 0 | 1 | 0 | 0 | 0 | 1 | 4 | 2 | 2 | 0 | 3 | 0 | 13 | 1.1 |
| Georgia | 3 | 0 | 3 | 0 | 4 | 3 | 3 | 1 | 4 | 0 | 1 | 0 | 22 | 1.9 |
| Idaho | 2 | 13 | 11 | 10 | 8 | 19 | 27 | 25 | 15 | 12 | 7 | 9 | 158 | 9.5 |
| Illinois | 0 | 0 | 2 | 2 | 1 | 1 | 4 | 4 | 3 | 1 | 1 | 1 | 20 | 1.5 |
| Indiana | 0 | 0 | 1 | 2 | 1 | 1 | 4 | 2 | 3 | 0 | 0 | 0 | 14 | 1.3 |
| Iowa | 0 | 4 | 4 | 1 | 2 | 3 | 0 | 3 | 0 | 1 | 1 | 1 | 20 | 1.3 |
| Kansas | 0 | 1 | 5 | 3 | 0 | 3 | 5 | 3 | 6 | 1 | 0 | 4 | 31 | 2.0 |
| Kentucky | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 3 | 1 | 1 | 0 | 9 | 1.0 |
| Louisiana | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 3 | 0.3 |
| Md and Del | 0 | 0 | 1 | 0 | 0 | 3 | 2 | 2 | 2 | 0 | 1 | 1 | 12 | 1.7 |
| Michigan | 3 | 5 | 1 | 3 | 1 | 2 | 5 | 9 | 5 | 14 | 3 | 3 | 54 | 3.5 |
| Minnesota | 8 | 3 | 6 | 4 | 1 | 9 | 10 | 11 | 4 | 9 | 7 | 4 | 76 | 4.7 |
| Mississippi | 0 | 0 | 0 | 1 | 1 | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 7 | 0.7 |
| Missouri | 1 | 4 | 6 | 2 | 5 | 3 | 2 | 2 | 2 | 1 | 2 | 1 | 31 | 1.9 |
| Montana | 4 | 12 | 8 | 11 | 31 | 53 | M | 31 | 25 | 14 | 14 | 15 | 218M | 8.8 |
| Nebraska | 0 | 2 | 6 | 4 | 1 | 7 | 4 | 1 | 4 | 3 | 2 | 7 | 41 | 2.5 |
| Nevada | 2 | 2 | 4 | 13 | 3 | 12 | 12 | 13 | 5 | 6 | 9 | 13 | 94 | 7.8 |
| New Jersey | 0 | 0 | 1 | 0 | 1 | 2 | 0 | 0 | 2 | 0 | 1 | 0 | 7 | 1.4 |
| New Mexico | 2 | 2 | 22 | 7 | 15 | 22 | 35 | 29 | 21 | 15 | 14 | 10 | 194 | 10.7 |
| New York | 3 | 1 | 1 | 2 | 5 | 10 | 5 | 8 | 3 | 3 | 2 | 3 | 46 | 2.8 |
| N Carolina | 1 | 1 | 2 | 1 | M | 6 | 1 | 9 | 4 | M | 1 | 0 | 26M | 2.0 |
| N Dakota | 1 | 2 | 4 | 4 | 4 | 10 | 9 | 1 | 0 | 8 | 2 | 4 | 49 | 3.6 |
| Ohio | 1 | 0 | 5 | 4 | 0 | 3 | 2 | 3 | 2 | 1 | 2 | 1 | 24 | 1.9 |
| Oklahoma | 0 | 1 | 3 | 2 | 2 | 12 | 4 | 5 | 10 | 1 | 0 | 1 | 41 | 2.8 |
| Oregon | 8 | 12 | 10 | 6 | 7 | 17 | 20 | 24 | 8 | 8 | 13 | 11 | 144 | 6.6 |
| Pennsylvania | 2 | 3 | 5 | 2 | 2 | 7 | 7 | 7 | 5 | 6 | 3 | 0 | 49 | 3.5 |
| S Carolina | 0 | 0 | 0 | 0 | 3 | 3 | 4 | 4 | 3 | 1 | 5 | 1 | 24 | 2.8 |
| S Dakota | 2 | 3 | 10 | 3 | 8 | 14 | 10 | 2 | 6 | 4 | 9 | 8 | 79 | 5.7 |
| Tennessee | 0 | 0 | 1 | 4 | 5 | 9 | 2 | 4 | 3 | 2 | 0 | 1 | 31 | 3.0 |
| Texas | 6 | 6 | 25 | 14 | 25 | 37 | 34 | 21 | 15 | 10 | 10 | 4 | 207 | 4.8 |
| Utah | 4 | 10 | 4 | 8 | 13 | 41 | 30 | 22 | 22 | 15 | 11 | 14 | 194 | 9.5 |
| Virginia | 1 | 2 | 2 | 2 | 3 | 6 | 7 | 4 | 4 | 3 | 4 | 2 | 40 | 3.9 |
| Washington | 5 | 7 | 4 | 4 | 7 | 14 | 6 | 9 | 2 | 3 | 11 | 5 | 77 | 4.6 |
| W Virginia | 0 | 0 | 0 | 0 | 5 | 9 | 5 | 3 | 4 | 3 | 0 | 0 | 29 | 3.1 |
| Wisconsin | 3 | 3 | 6 | 3 | 4 | 5 | 9 | 9 | 7 | 8 | 9 | 4 | 70 | 4.1 |
| Wyoming | 2 | 9 | 10 | 9 | 13 | 33 | 31 | 19 | 14 | 10 | 5 | 9 | 164 | 10.8 |
| Total | 91 | 147 | 244 | 187 | 247M | 489 | 404M | 367 | 292 | 239M | 213 | 188 | 3108M | 4.1 |

mistakes, and should be stored with the instruments (not the observer, for the benefit of substitutes.)

The CPM's should be sent to NCDC to obtain a clearer understanding of their important role, and to observe firsthand what happens to the data collected under their supervision.

The observers should be informed of the need for timely submission of data. Otherwise their data may NEVER become part of the digital archive.

Since most observers are volunteers, they should be made aware that their observations are very useful, and frequently of great importance, and are appreciated. This task of tact and diplomacy should be carried on by both the CPM's and the State Climatologists, who should take the time to aid in this process.

A simple and cheap device to encode the observations in digital form and to check for, and inform, the observer of consistency errors would improve the observations at their source and eliminate the need for key entry, with its own potential for error.

2. IMPROVE KEY ENTRY

No obvious way is available to do this easily. Marked improvements may prove expensive (such as double punching).

Pre-editing by validators to clarify potentially confusing values should help.

3. IMPROVE THE EDITING ALGORITHM.

Approach the problem as one of 4-dimensional data assimilation. Use first order, FAA, AMOS, RAMOS, and upper air observations. First order and FAA stations can be used as AM, PM, and Midnight stations, simply by changing the starting times, with a small allowance for maximums and minimums between hours. Non-quality-controlled airways data are usually at least as good as the better cooperative station data.

Include an indicator for "editability." For example, a mountain, seacoast, remote or otherwise unusual location should have a higher threshold for suspicion.

Make the process more interactive. Presently, the core of the flagging/replacement process is a once-through batch job (a several-hour run on the UNIVAC). The offline editing done by the validators, as opposed to screen editing, is inefficient and cumbersome.

It would be highly desirable for NCDC to permanently maintain the nation's cooperative data from the most recent two or three years on disk. After initial hardware costs are met, a much greater efficiency of operation would result. This would readily allow the entry of even very late data into the permanent

archives with little fuss, and greatly facilitate the processing of requests for data.

Try to remove the dependence of the algorithm on the character of the particular month and the nature of the missing day.

Keep the last day of the previous month, for consistency checks.

Make use of edited values to re-edit, or use other iterative techniques. Care is needed here to avoid reinforcing mistakes, however.

Perform an automatic check for PM observers who improperly adjust maximum temperatures to the calendar days on which they occurred. When this occurs, it is interesting to note the number of data values that are NOT flagged as suspicious, even when it is known that all values are off by one day.

Improve the array display. This should help validators and S'ate Climatologists alike. Perhaps coded information regarding "editability" or station idiosyncracies could be displayed in the array for the validators' benefit. The recent addition of first order and FAA stations to the array listing is greatly appreciated.

Have a list of preferred (default) comparison stations for each site, which would be used by the computer. Distribute copies of these lists to the State Climatologists for comment or guidance.

Extreme temperatures may occur during an observer vacation, and be recorded on the first day back at the site. The extreme since last reading is available for monthly summary purposes, but a method is needed to estimate the date of occurrence. (This is related to the "accumulation" problem of precipitation.)

More than eight days can be estimated, in some cases.

4. IMPROVE THE VALIDATORS

A better knowledge of meteorology is always useful. A knowledge of the surprisingly large range of atmospheric extremes which may occur is also helpful. Additionally, better knowledge of geography can benefit considerably. Raised relief maps of each state would be of help.

It is easy to see how the validators can come to look upon the values as merely numbers, and not as physical quantities. Anything which relieves the tedium and helps the mind focus on the important cases is useful.

State Climatologists should provide guidance regarding special station circumstances.

The cooperative network provides extremely valuable observations that will continue to serve as the principal source of climate data for the nation for the foreseeable future. It is essential that as high quality observations as possible be archived. Regardless of whether the present unfortunate trend of personnel reductions at NCDC continues, it is likely that intelligent computer routines will increasingly be required to bear the burden of providing quality control. However, no computer can anticipate the entire range of phenomena which the climate system exhibits. Ideally, a human should remain the final arbiter of data reliability. In my opinion, the philosophy adopted at NCDC regarding the quality assurance of cooperative data (involving a blend of computers and human input) is the most sound and practical approach to this problem.

Overall, I felt that employees at NCDC remain dedicated to maintaining a high quality data base, even while working under the present adverse circumstances. Asheville is a pleasant place to visit, and I would thoroughly recommend that State Climatologists make an effort to participate in the Exchange Program if it remains available.

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