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Bibliography of South Dakota Climate and Annotations

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BIBLIOGRAPHY OF SOUTH DAKOTA CLIMATE

With Annotations

South Dakota State College
Agricultural Experiment Station
in cooperation with
U. S. Department of Commerce,
Weather Bureau
Brookings, South Dakota

CONTENTS

BIBLIOGRAPHY OF SOUTH DAKOTA CLIMATE

With Annotations

By WALTER SPUHLER, RAY F. PENGRA, and D. L. MOE[1]

Introduction

This bibliography is designed to aid scientists, agriculturalists, and others find what research work has been accomplished in Climatology in South Dakota and what data are available for further study and analysis.

The list of publications by the Weather Bureau, the tables under "Card Library" of Weather Data on punch cards, and the Climatological Summaries of Weather Bureau Substations in South Dakota are sources of climatological data for the state. The various other publications listed are results of research work that pertains, at least in part, to Climatology in South Dakota.

Although considerable effort was made to list all material available on this subject, some publications may have been inadvertently omitted.

BULLETINS AND PAMPHLETS PUBLISHED BY SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION[2]

Pengra, Ray F., and Magnuson, M. D., Likelihood of Damaging Low Temperatures During the Growing Season. Bulletin 441 (1954).

Statistical probability of damaging temperatures during spring and fall seasons of temperatures of 34°, 32°, 28°, and 24° F. of 40%, 30%, 20%, 10% and 5% of the years. Data in both tabular and graphic form.

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[1]U. S. Department of Commerce, Weather Bureau State Climatologist; Emeritus Professor in Economics, South Dakota State College; and Professor and Head, Agricultural Engineering Department, South Dakota State College, respectively.

[2]Copies on file in South Dakota State College Library.

Pengra, Ray F., Using Climatic Water Balance to Determine Irrigation Needs in South Dakota. Bulletin 496 (1961).

Thornthwaite Method used to estimate yearly soil moisture at Brookings, Redfield, and Newell for 1930-46 inclusive. When the soil moisture fell to 50% of soil capacity a drought was assumed to exist and hypothetical irrigations calculated to prevent such droughts. Thus an estimate was made of amount of irrigation water needed for each of three crop seasons at each station. Also reported is soil moisture deficit, surplus, and moisture remaining at end of each seasonal period.

MIMEOGRAPHED PAMPHLETS OF SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION

The following were published by the South Dakota Agricultural Experiment Station as mimeographed Agricultural Economics Pamphlets.

Basile, Robert M., Climatic Variations in South Dakota 1900-1950. Pamphlet 96 (September 1958).

"Dry" and "wet" areas of South Dakota by precipitation maps for each of 50 years. Thornthwaite Method used in making analysis.

*Pengra, Ray F., Weekly Summary Climatological Data, Huron, South Dakota, 1881-1953. Pamphlet 59 (January 1955).

Includes: mean maximum temperatures; mean minimum tempreatures; mean temperatures; total precipitation; total snowfall; daily frequency of maximum temperatures 90° or higher and 32° or lower; daily frequency of minimum temperatures 32° or lower and 0° or lower; daily frequency of precipitation received in these class intervals: 0.10-0.39 inch, 0.40-0.99 inch and 1 inch or more.

———. Average Frequencies of Daily Occurrence of Maximum Temperatures for Five Areas in Eastern South Dakota by Five Week Intervals Throughout the Year. Pamphlet 66 (September 1955).

The five areas are indicated by the two stations for which temperatures were combined to minimize variations: Clark-Watertown, Brookings-Wentworth, Sioux Falls-Centerville, and Yankton-Vermillion. Temperatures are from earliest records up through 1953.

———. Average Weekly Precipitation, Temperatures and New Snow Received at 60 Weather Bureau Stations Through 1954. Pamphlet 68 (March 1956).

Data varies depending upon earliest date after which reasonably continuous data were available from each station.

Included are total frequencies of precipitation of 0.10 to 0.39 inch, 0.40 to 0.99 inch, and 1 inch and over.

*Out of print.

*———. Weekly Summary of Climatological Data, Faulkton, South Dakota, 1900-1953. Pamphlet 71 (June 1956).

Included are: mean maximum temperatures, mean minimum temperatures, mean temperatures, and total precipitation; and daily frequencies of maximum temperatures of 90° or higher, minimum temperatures of 32° or lower and 0° or lower, and precipitation for 0.10-0.39 inch, 0.40-0.99 inch, and 1 inch or over.

———. Temperature Summary of Data for 66 South Dakota Weather Stations from the Start of Continuous Records for Each Station Through 1954. Pamphlet 77 (January 1957).

Included are: mean maximum temperatures, mean minimum temperatures, total frequencies of daily occurrence of maximum temperatures of 90° F. or higher, and of 32° F. or lower, and total frequencies of minimum temperatures of 32° F. or lower and 0° F. or lower.

———. Yearly Dates of Last Spring and First Fall Occurrence of Minimum Temperature of 24° F. or Lower for 58 Weather Bureau Stations of South Dakota. Pamphlet 78 (January 1957).

Included are dates of last spring and first fall temperature of 24° F. and number of days between for each year and each station. (Similar summaries using 28° F. and 32° F. are in Pamphlets 79 and 80, below). Average dates and average season length are shown for each station and also on a map.

———. Yearly Dates of Last Spring and First Fall Occurrence of Minimum Temperature of 28° F. or Lower for 58 Weather Bureau Stations of South Dakota. Pamphlet 79 (January 1957).

See Pamphlet 78, above.

———. Yearly Dates of Last Spring and First Fall Occurrence of Minimum Temperature of 32° F. or Lower for 58 Weather Bureau Stations of South Dakota. Pamphlet 80 (January 1957).

See Pamphlet 78, above.

———. Frequencies of Daily Occurrence of Maximum and Minimum Temperatures at Huron, South Dakota, Each Week of the Year by 5° Intervals Together with Highest and Lowest Temperatures Recorded and Standard Deviation of Temperature Each Week of the Year. Pamphlet 83 (March 1957).

Includes data for 1881-1955.

———. Graphic Presentation of Weekly Mean Maximum and Mean Minimum Temperatures for 58 South Dakota Weather Stations for Each Week of the Year. Pamphlet 84 (March 1957).

Maximum and minimum temperatures on maps for years for which continuous data available through 1955.

———. Frequencies of Daily Occurrence of Maximum and Minimum Temperature at Sioux Falls, South Dakota Each Week of the Year by 5° Intervals Together with Highest and Lowest Temperature Recorded and Standard Deviation of Temperature Each Week of the Year Covering the Years 1896 Through 1955. Pamphlet 87 (July 1957).

———. Frequencies of Daily Occurrence of Maximum and Minimum Temperatures at Rapid City, South Dakota Each Week of the Year by 5° Intervals Together with Highest and Lowest Temperature Recorded and Standard Deviation of Temperature Each Week of the Year. Pamphlet 88 (July 1957).

Data for 1881-1955 inclusive.

———. Weather in the Making. Pamphlet 89 (August 1957).

Popular treatment of weather using illustrations from Pilot's Weather Handbook and 1955 Yearbook of Agriculture. Basic atmospheric phenomena providing an appreciation and interest in application of weather factors to agriculture and its problems.

———. Frequencies of Daily Occurrence of Maximum and Minimum Temperatures at Pierre, South Dakota Each Week of the Year by 5° Intervals Together with Highest and Lowest Temperature Recorded and Standard Deviation of Temperature Each Week of the Year. Pamphlet 90 (July 1957).

Data for 1892-1955, inclusive.

———. Agricultural Drought in South Dakota, How Many Droughty Days Per Season? Pamphlet 94 (July 1958).

Likelihood of different numbers of days of drought per season at 10 selected weather stations in South Dakota. (Drought defined as period when soil moisture falls below 50% of soil capacity in crop root zone.) Adaptation of Thornthwaite Method used in estimating soil moisture. Likelihood of drought days for "full season," small grain, and corn presented for three soil capacities (2, 4, and 6 inches) as probability charts for the 10 stations of Brookings, Cottonwood, Eureka, Highmore, Huron, Pierre, Rapid City, Redfield, Sioux Falls, and Watertown.

———. Seasonal Variations in Soil Moisture in South Dakota. Pamphlet 99 (February 1959).

Estimates of average daily soil moisture at 25 South Dakota weather stations in tabular and graphic form. Adaptation of Thornthwaite Method used in estimating soil moisture. Graphs show average seasonal march of soil moisture at each station. Number of years varies but includes at least 35 years of data ending with 1956. Soil moisture capacity in crop root zone assumed at 4 inches and drought existed when moisture fell below 50% of capacity.

Pengra, Ray F., and Lytle, W. F., Yearly Maximum Mean, Minimum Mean and Yearly Mean Temperatures for 58 South Dakota Weather Stations Together With Daily Frequencies for Each Year. Pamphlet 113 (March 1962).

Also includes maximum temperatures of 90° F. or higher and 32° F. or lower and daily frequencies of minimum temperatures of 32° F. or lower and 0° F. or lower.

OTHER PROFESSIONAL AND POPULAR WORKS ON CLIMATOLOGY

Pengra, Ray F., Precipitation as a Basis of Estimating Crop Yields in Central South Dakota. Master of Science Thesis, South Dakota State College, April 1946.

Object was to investigate possibility forecasting crop yields on basis of preseasonal precipitation. Report covers weather and crop yields data for 1919-1943 for 3 East Central South Dakota areas. Annual crop yields used as reported by South Dakota Crop and Livestock Reporting Service. Crop year from August 1 of previous year through July 31 of current year. Preseasonal precipitation amount received from August 1 through March 31 of following year. Seasonal precipitation that from April 1 through July 31. Correlation analysis used to show relationship between crop yields and amount of precipitation received during each precipitation period for corn, wheat, oats, and barley. Correlations then used to estimate yields and estimates then compared with reported yields. Results indicated preseasonal precipitation is highly significant as a factor in determining crop yields especially for small grains. Applies particularly to North Central region of South Dakota where average amount of precipitation is barely sufficient to produce profitable yields of farm crops.

———. "Correlation Analysis of Precipitation and Crop Yields Data for the Sub-humid Areas of the Northern Great Plains." Journal of the American Society of Agronomy, Vol. 38, No. 9, Sept. 1946, pp. 848-850.

Compares preseasonal (Aug. 1-Mar. 30) and seasonal (Apr. 1-July 31) precipitation with yields of oats, plus correlation and regression coefficients for yield and precipitation for corn, wheat, oats, and barley.

———. "Crop Production in the Semi-arid Regions and Insurable Risk." The Journal of Farm Economics, Vol. 39, No. 2, May 1947.

Yields of spring wheat by various amounts of preseasonal precipitation for three areas in Central South Dakota for 1919-1943. Illustrated are estimated costs of Central South Dakota spring wheat production suitable as basis of crop production insurance.

———. "Estimating Crop Yields at Seeding Time in the Great Plains." Agronomy Journal, Vol. 44, No. 5, May 1952.

Contribution of preseasonal precipitation to crop yields shown by correlation and regression coefficients between yields of spring wheat, oats, and barley and both preseasonal and seasonal precipitation for 1923-47 for 13 South Dakota areas.

———. "A Job for Rain Makers." The Farmer, Feb. 7, 1948.

An inch of moisture during eight months before seeding contributes as much to crop yields as an inch during the growing season.

———. "Will the Plains Grow Wheat Next Year?" Successful Farming, Sept. 1948.

In central South Dakota only 5 years out of 31 having preseasonal precipitation below 8 inches produced yields above 10 bushels, indicating only 1 chance in 6 the farmer can profitably raise wheat under these conditions.

———. "Do Preseasonal Rain and Snow Increase Crop Yields?" South Dakota Farm and Home Research, Vol. 3, No. 1, Fall 1951, pp. 8-11.

Preseasonal rain and snow make significant contribution to grain production where average precipitation is barely enough to make crops profitable.

———. "Instructions for Use of the IBM 602, A Calculator for Daily Soil Moisture Accounting." Publications in Climatology, Vol. XIV, No. 3, published by C. W. Thornthwaite Associates Laboratory of Climatology, Centertown, N. J., 1961.

Application of Thornthwaite Method in use of the 602 A IBM calculator to obtain daily soil moisture estimates.

Nelson, Aaron G., and Wintrode, Virgil. Climate and Crop Yields, South Dakota Agricultural Experiment Station, Department of Agricultural Economics, Agricultural Pamphlet 1 (1941-42).

Pamphlets for each South Dakota county on the climate and crop yield phase of agricultural planning project through cooperation of the Work Projects Administration, (Official Project Number 265-1-74-57). Each pamphlet contains charts and tables on climate and crop production.

Grafius, J. E., and Dirks, V. A. An Analysis of Small Grain Performance in South Dakota 1942-51, South Dakota Agricultural Experiment Station, Agronomy Department, Bulletin 422 (May 1952).

Weather associated with small grain yields.

U. S. WEATHER BUREAU PUBLICATIONS*

Bulletin W (Climatic Summary of the United States)

Eastern and western sections for South Dakota containing detailed

*Weather Bureau publications may be purchased from Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. or through Weather Bureau State Climatologist, South Dakota State College, Brookings, South Dakota.

data by stations from the beginning of observations through 1930, (1930 edition.)

Climatic Summary of the United States—Supplement 1931-52. Climatography of the U. S., No. 11-34.

Supplement to Bulletin W (above) for South Dakota and other states containing monthly precipitation for each year and summary of other climatological data for 1931-52.

Climates of the States—South Dakota. Climatography of the U. S. No. 60-39.

Mean monthly temperature and precipitation for South Dakota stations for 1931-55. Also freeze data and normal, mean and extreme tables for Huron, Rapid City, and Sioux Falls, and narrative climatological summary covering other elements.

Climatic Summary of the United States, 1951-1960. Climatography of the U. S. No. 86-39.

Separate issue for South Dakota with some similarity of tables in "Climatic Summary of the United States—Supplement for 1931-1952." In addition, tables show number of days with precipitation equal to or greater than 0.10 and 0.50 inch, respectively; maximum temperature equal to or greater than 90°, minimum equal to or less than 32°, and monthly mean evaporation.

Climate and Man—1941 Yearbook of Agriculture. U. S. Department of Agriculture.

South Dakota (and other states) climatic summaries plus discussions of crops and climate. (Superceded by Climates of the States.)

Climatological Data (South Dakota).

Bulletin published since 1898 issued monthly and annually.

Monthly issue contains tables of daily temperatures and precipitation, and for limited number of stations, evaporation and wind movement. Included also are monthly heating degree day values and an index for locating and identifying each station. Narrative summary was included in all monthly and annual bulletins until 1958 and since then upon occasions of unusual or outstanding weather. Tables listing snowfall and snow on ground for selected stations published in monthly bulletins during the snow season and table of monthly and seasonal snowfall is published in each July issue.

Annual issue presents monthly and annual temperature means and precipitation and evaporation data as well as temperature extremes, freeze data, and since 1961, a table of soil moisture measurements.

Climatological Data, National Summary (Monthly and Annual).

Abstracts on national scale climatological and hydrologic data from South Dakota and other state Climatological Data Bulletins. Also pre-

sents summaries of river and flood conditions and average values of upper air data at standard pressure surfaces. Serves as basic publication source for all solar radiation data: daily, weekly, and monthly, and ozone data. Prior to 1959, "Storm Data and Unusual Weather Phenomena" were presented in this publication. Since then severe storm information is in Storm Data. (Prior to 1950, storm data were published in the Monthly Weather Review.) The annual issue also includes a table of excessive short duration rainfall.

Storm Data.

Issued monthly and contains a table similar to "Storm Data and Unusual Weather Phenomena" published prior to 1959 in monthly issues of "Climatological Data, National Summary."

Local Climatological Data. (Monthly, annual, and supplement.)

First order station summaries for Huron, Rapid City, and Sioux Falls.

Monthly issue contains daily values of temperature, degree days, precipitation, wind, sunshine, sky cover, and related data, with summaries. Usually available about 7th to 10th after close of data month.

Monthly supplement contains frequency tables of wind, ceiling, relative humidity, visibility, precipitation, etc., plus a table of hourly observational data. Available about 15th of following month.

Annual issue contains a table of meteorological data for the current year; a normals, means, and extremes table; sequential tables of monthly temperature, precipitation, snowfall and heating degree days since 1930, and station history and location table.

Hourly Precipitation Data.

Monthly issue contains daily and hourly precipitation data from recording precipitation stations in South Dakota.

Annual issue contains monthly precipitation totals for recorder stations, an index of stations, and station location map. These issues began Oct. 1, 1951. Between 1948 and October 1951, hourly precipitation data were published as Table 4 in monthly Climatological Data. The basic network of recording precipitation gauges was established in 1936 and data published in "Hydrologic Bulletin" by river basins until 1948.

National Weekly Weather and Crop Bulletin.

Published and distributed by the U. S. Weather Bureau in Washington D. C. in cooperation with the Department of Agriculture. Included are weather summaries of the week past in narrative, tabular, and chart form, and the weather's effect on crops and farm activities for South Dakota (and other states). Also contains special articles on weather and crops. Time of release is 12:00 noon, E.S.T., each Tuesday, except when Monday or Tuesday is a holiday when the release time is 12:00 noon, E.S.T., Wednesday.

South Dakota Weekly Weather, Crop and Livestock Report.

More detailed for South Dakota than National Weekly Weather and Crop Bulletin. The Weather Bureau State Climatologist prepares weather material for this report published and distributed by the Statistical Reporting Service of the U. S. Department of Agriculture in cooperation with South Dakota State College Cooperative Extension Service.

Summary of Hourly Observations, Climatography of the United States, No. 30-39. Published separately for Sioux Falls, Rapid City, and Huron, S. D.

Tables of percentage frequencies of sky cover, wind and relative humidity as well as ceiling and visibility based on 10 years of hourly record. Includes also frequencies of precipitation amounts and temperature and wind–relative humidity occurrences.

Substation History for South Dakota. Key to Meteorological Records Documentation No. 1.1, 1956.

Listing of Weather Bureau substations giving: the name, location, elevation, period of record, name of observers, instruments used, and where data is published up to 1955. Current extension can be obtained from Weather Bureau, Regional Substation Management Unit, Kansas City, Mo.

Decadal Census of Weather Stations in South Dakota. Key to Meteorological Records Documentation No. 6.11, 1963.

Map series showing name and location of weather stations for the years: 1890, 1900, 1910, 1920, 1930, 1940, and 1950.

Monthly Weather Review.

First published in 1872, serves as medium of publication for contributions to the science of meteorology. Prior to 1950, also included some climatological data for South Dakota and other states.

Mean Number of Thunderstorm Days in the United States. U. S. Department of Commerce, Weather Bureau Technical Paper No. 19, December 1952. Climatological Services Division.

Tables and charts giving mean number of thunderstorm days for each month and annually for South Dakota (and other states).

Baker, D. R., Hershfield, David M., Kohler, M. A., and Nordenson, T. J. Rainfall Frequency Atlas of the United States for Durations of 30 Minutes to 24 Hours and Return Period of from 1 to 100 Years, May 1961. U.S. Department of Commerce, Weather Bureau Technical Paper No. 40.

Maps plus text explaining how maps were made and how to obtain values for return periods of longer than 100 years. A table gives relationships between 30-minute durations and shorter periods.

Evaporation Maps for the United States, U. S. Department of Commerce, Weather Bureau Technical Paper No. 37 (1959).

Series of U. S. maps (except Alaska and Hawaii) including:

Plate 1 Average Annual Class A Pan Evaporation,

Plate 2 Average Annual Lake Evaporation,

Plate 3 Average Annual Class A Pan Coefficient,

Plate 4 Average May-October Evaporation in Percent of Normal,

Plate 5 Standard Deviation of Annual Class A Pan Evaporation.

Wolford, Laura V. Tornado Occurrences in the United States. U. S. Department of Commerce, Weather Bureau Technical Paper No. 20. Revised 1960.

Statistics on tornadoes relative to aerial distribution, hours of occurrence, loss of life, property damage, and frequency of occurrence in South Dakota (and other states) for 1916-58.

Annual Progress Reports of Cooperative Project in Climatology by South Dakota State College and U. S. Weather Bureau*

Beginning Feb. 1, 1952 the South Dakota Agricultural Experiment Station entered into a cooperative agreement with the United States Weather Bureau and the Bureau of Reclamation to analyze weather data collected at the various weather stations in the state. Annual reports in mimeograph form by the Economics Department of the Experiment Station are:

Magnuson, M. D. and Pengra, Ray F., First Annual Progress Report South Dakota Cooperative Project in Climatology, July 1, 1952.

Editing and punching instructions with summary of work completed during first five months of project ending June 30, 1952.

———. Second Annual Progress Report South Dakota Cooperative Project in Climatology, July 1, 1953.

Summary of 1953 fiscal year and inventory of data on IBM cards.

———. Third Annual Progress Report South Dakota Cooperative Project in Climatology, July 1, 1954.

Summary of 1954 fiscal year and details of weekly summary card. Also lists cards duplicated for the Weather Records Center at Asheville, N. C.

———. Fourth Annual Progress Report South Dakota Cooperative Project in Climatology, July 1, 1955.

Summary of 1955 fiscal year and details of area summary card plus lists of cards reproduced for the Records Center at Asheville, N. C.

*Copies on file in South Dakota State College Library.

Hodge, William T., and Pengra, Ray F. Fifth Annual Progress Report of the South Dakota Cooperative Project in Climatology, July 1, 1956.

Summary of card library together with cards prepared for the Records Center at Asheville, N. C.

———. Sixth Progress Report South Dakota Cooperative Project in Climatology, July 1, 1959.

Describes temperature and evaporation studies and brings card inventory up-to-date.

Pack, Boyd A., and Pengra, Ray F. Seventh Progress Report South Dakota Project in Climatology, Nov. 1961.

Summary of 1961 fiscal year.

Lytle, W. F., Pengra, Ray F., and Spuhler, Walter. Eighth Progress Report South Dakota Cooperative Project in Climatology.

Summary of period July 1, 1961 through June 30, 1963. Included are lists of climatological punch cards at South Dakota State College and projects in progress.

WEATHER MODIFICATION IN SOUTH DAKOTA*

Berndt, Gerald D. An Evaluation of Commercial Cloud Seeding Operations During the Summer Months in South Dakota, Technical Report No. 5 (June 1957). Advisory Committee on Weather Control, Washington, D. C.

The following publications on cloud seeding in South Dakota were under direction of A. M. Eberle, Dean Emeritus of Agriculture, South Dakota State College:

Analysis of Climatological Data for Survey of Cloud Seeding Period in South Dakota June Through September 1951.

Rain Increasing Report 1952, Analysis of the Three Rain Increasing Projects in South Dakota.

Cloud Seeding Results in South Dakota During the Seeded Years 1951-54.

Annual Report 1954 South Dakota Weather Control Commission. Submitted to the Governor and members of the State Legislature.

Economic Implications of Weather Modification. Report by Consultants to National Advisory Committee on Weather Control, Agricultural Economics Pamphlet 60. (December 1954.)

A Summary and Observations of the Cloud Seeding Done in the Black Hills of South Dakota. Summer 1961. Memorandum of Chairman to members of the Committee on Public Works, U. S. Senate, 87th Congress 2nd Session. Committee Print.

*On file in South Dakota State College Library.

SOUTH DAKOTA COUNTY SOIL SURVEY REPORTS

Soil Survey of ..... County, South Dakota. U. S. Department of Agriculture, Soil Conservation Service in Cooperation with South Dakota Agricultural Experiment Station.

Soil survey reports for South Dakota are for: Beadle County 1924, Brookings County 1959, Brown County 1930, Clay County 1953, Day County 1952, Douglas County 1927, Grant County 1927, Hand County 1963, Hyde County 1930, Jerauld County 1951, McCook County 1924, Moody County 1929, Potter County 1955, Spink County 1954, Union County 1924, and Walworth County 1926. Each publication contains a summary of climate for the individual county in table form and discussion, as part of the report.

SUBSTATION SUMMARIES*

Pack, Boyd A. Climatological Summary for Armour, South Dakota. U. S. Department of Commerce, Weather Bureau in cooperation with Armour Commercial Club. (November 1961.)

Tables of means and extremes of temperature and precipitation, of normal monthly temperature, and of normal monthly precipitation for 1931-60 plus discussion of climate of the locality.

Similar South Dakota substation climatological summaries prepared by Boyd A. Pack are:

Substation	Cooperator	Published	Period of tables
Brookings	Brookings Chamber of Comerce	June 1961	1931-60
Madison	Radio Station KJAM	Feb. 1961	1941-59
Pierre	Pierre Chamber of Commerce	June 1961	1931-60
Redfield	First National Bank of Redfield	Feb. 1961	1930-59

PUBLICATIONS FROM MISCELLANEOUS SOURCES

Barger, Gerald L., Dale, Robert F., and Shaw, Robert H. Chances of Receiving Selected Amounts of Precipitation in the North Central Region of the United States. First report to North Central Regional Technical Committee on Weather Information for Agriculture, Iowa State University. (July 1959.)

Tables show chances of receiving selected amounts of precipitation for 1-, 2-, and 3-week periods for some stations in South Dakota and other North Central states.

Barger, Gerald L., Dale, Robert F., and Shaw, Robert H. Gamma Distribution Parameters From Two and Three Week Precipitation Totals in the North Central Region of the United States. Second report to North

*Available from Weather Bureau State Climatologist, South Dakota State College.

Central Regional Technical Committee on Weather Information for Agriculture including Statistical Parameters used in computing probabilities in first report. Agricultural and Home Economics Experiment Station, Iowa State University. (December 1959.)

Chances of receiving given amounts of total precipitation during 1-, 2-, and 3-week periods at 125 selected stations in 12 North Central states (South Dakota included) computed by fitting the incomplete gamma distribution to the precipitation totals derived from the records. This publication makes the 2- and 3-week parameters available. Parameters for 1 week not published since estimates are less reliable than those for 2 or 3 weeks and are not required in generating distributions for 4 weeks or longer.

Shaw, Robert H., Barger, Gerald L., and Dale, Robert F. Precipitation in the North Central States. North Central Regional Publication No. 115, Bulletin 753, University of Missouri, Agricultural Experiment Station. (June 1960.)

Material similar to first report by same authors but precipitation probabilities summaries in form of graphs and charts instead of tables.

Chilcott, E. C. The Relations Between Crop Yields and Precipitation in the Great Plains Area. U. S. Department of Agriculture, Bureau of Plant Industry, Miscellaneous Circular No. 81 February 1927.

Data from 23 stations in 10 Great Plains states including Ardmore and Belle Fourche in South Dakota. Weather equipment and crops were in the same location at each station and under supervision of a qualified scientist. Crop yields and precipitation presented in tabular and graphic form. Precipitation is one of the greatest factors in determining crop yield although other factors with about equal importance may also exercise controls.

Crop and Livestock Reporting Service, South Dakota Agriculture, U. S. Department of Agriculture, Statistical Reporting Service, Agriculture Estimates and South Dakota Department of Agriculture, Division of Agricultural Statistics.

Published each year from 1941 through 1962. Each issue has short weather summary giving precipitation and mean monthly temperature for the year in comparison with previous years.

Finley, John P., 1st Lt. 9th U. S. Infantry. Certain Climatic Features of the Two Dakotas, 204 pages illustrated with 163 tables, charts and diagrams. Government Printing Office. 1893.

Detailed summary of Dakotas' climate from middle 1850's through 1891.

Articles by E. M. Frisby, professor of weather engineering, South Dakota State College 1957-60; meteorologist, Raven Industries, Sioux Falls, S. D., 1960 to present. Six of these articles are:

Review of Climatological Observations Taken at the Pathfinder Atomic Power Plant Site Near Sioux Falls, South Dakota, May 1, 1958 to April 30, 1959.

Analysis of first year meteorological records of Pathfinder Atomic Power Plant Site along Big Sioux River near Sioux Falls, S. D. Statistical study of temperature lapse rate and wind conditions for the plant site and vicinity. An attempt made to determine effect these weather elements and the valley had on local diffusion.

Hail Storms of the Upper Great Plains of the United States of America with Special Reference to South Dakota.

Report prepared for National Science Foundation in completion of Contract C-196 with Raven Industries, Sioux Falls, S. D.

The Part Played by the Polar Front Jet Stream in the Geographical Positioning of Damaging Hailswaths in the Upper Midwest of the U. S.

Paper presented at annual meeting of American Meteorological Society, New York, January 1963. Mimeographed copy, South Dakota State College Library.

Ground hail damage patterns for South Dakota, Minnesota, Iowa, and Nebraska. Jet stream winds associated with the Polar Front provide the shear and gives direction and geographical positioning to hailswaths occasioned by severe traveling storms of Upper Great Plains of the United States in summertime.

Report on a Second Year of Hourly Climatological Observations Taken at the Pathfinder Atomic Power Plant Site Near Sioux Falls, South Dakota May 1, 1959 to April 30, 1960. Prepared for Northern States Power Company, Minneapolis, Minn. Copy available, South Dakota State College Library.

Analysis of hourly meterological records and further statistical studies on effect of weather elements and valley on local diffusion.

A South Dakota Hail Study—1954-59. Proceedings of American Meteorological Society Eighth Weather Radar Conference, San Francisco, Calif. 1960. Co-author K. R. Clark, U. S. Weather Bureau, Sioux Falls, S. D. Copy in South Dakota State College Library.

Six summer seasons climatological study of frequency and incidence of hail occurrence across South Dakota as presented by Record of Insurance claims. Radar photographs from Ellsworth and Sioux Falls supplemented hail claims in 1959. Synoptic data is combined to provide evidence of storm movement, origin and behavior within the state.

Relationship of Ground Hail Damage Patterns to Features of the Synoptic Map in the Upper Plains of the United States. Journal of Applied Meteorology. Vol. 1, No. 3. Sept. 1962.

Ground hail damage, plotted from insurance records for 10 years of

crop season hail storms, falls into recognizable pattern groups with specific features of the synoptic map. Speed of movement of synoptic systems appears to exert considerable influence on extent and degree of ground hail damage.

Glenn, Sam W. Tornado of August 28, 1884, Near Huron, South Dakota, U. S. Army Signal Service Notes No. XIX. 1885.

Early detailed account of an observed tornado along with theory as to what causes a tornado to form.

Hamann, Roland R. "The Remarkable Temperature Fluctuations in the Black Hills Region, January 1943," Monthly Weather Review, Vol. 71, March 1943, pp. 29-32.

Frequent changes of temperature of as much as 40° F. or more in 15 minutes occurred in Black Hills January 22, 1943. A discussion of topography and weather conditions are given in an attempt to explain the large and sudden temperature fluctuations.

Johnson, Harly N. "A Climatological Review of the Black Hills," The Black Hills Engineer, Vol. XXI, No. 4. November 1933.

Black Hills climate, history, and geographical features.

Judy, S. S. Central South Dakota Weather from 1873-1960, mimeographed by Economics Department, South Dakota State College. February 1962. (Judy is cooperative Weather Observer at Forestburg, S. D.)

Collection of weather information pertaining mostly to Forestburg, S. D. and vicinity from weather observers, newspaper accounts, and other sources.

Laskowski, B. R. "Soil Moisture Reporting by a Weather Bureau State Service," AMS Bulletin, Vol. 32, No. 6. June 1951, p. 216.

Description of soil moisture reporting service organized by the author in South Dakota. Measurements of moist soil depth at close of each month are used to forecast soil moisture conditions. Relationship between soil moisture and rainfall and snow, and between soil moisture and growth of grasses and grains is discussed.

Magnuson, M. D. Analysis of Crop Season Precipitation in South Dakota. U. S. Weather Bureau in cooperation with South Dakota Natural Resources Commission, March 1953.

Includes precipitation data with normals and extremes for each month of growing season (April-September) and probability of growing season precipitation for South Dakota.

Myrick, Delbert, Climate: The Limiting Factor in Hand County Agriculture, U. S. Department of Agriculture, Bureau of Agricultural Economics in cooperation with South Dakota Agricultural Experiment Station. FM 25, June 1941.

Variations of Hand County crop yields and climate from 1860's through 1939.

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THE LIBRARY OF WEATHER DATA ON PUNCHCARDS

This section presents an index to the library of weather data placed on IBM cards available for climatological studies at South Dakota State College.

This library of weather data was made possible by a cooperative project in climatology of South Dakota initiated by the U. S. Weather Bureau and the Agricultural Experiment Station in 1952[1]. One objective of this project was to place historical weather data of South Dakota on IBM punch cards. This objective has been largely accomplished and most studies by Pengra have been made possible by this library of weather data.

Work on the project began Feb. 1, 1952. Cards were punched locally through 1947. The U. S. Weather Bureau started punching data for the cooperative stations in 1948 and cards have been furnished from those files since.

Daily weather records for cooperative stations were punched on the standard Weather Bureau card number 1009. Data were punched from observation records rather than from published reports.

Seven weather stations had more weather data for at least most of the years than could be placed on the 1009 card. Hence, data for these stations of Aberdeen, Huron, Pierre, Rapid City, Sioux Falls, Watertown, and Yankton were punched on number 3 cards. (See table 1.)

Hourly data were punched for the Huron station from 1940 through 1947. Additional hourly cards were secured through 1956 from the National Weather Records Center, Asheville, N. C. Hourly cards were also secured for Pierre and Rapid City for a few years for a special study that required relative humidity data. (See table 2.)

Weekly summary cards have been prepared for 69 South Dakota Weather Stations giving data shown in table 4.

[1]The Bureau of Reclamation, U S Department of Interior furnished funds for first year of operation.

CARD LIBRARY

Following are tables of punch cards with climatological data at South Dakota State College.

Table 1

Station	WBAN No.3 Punched By the College	WBAN No.3 Reproduced by Weather Bureau
Aberdeen	1/96-12/47	5/48-12/62
Huron	*1/81-12/47	5/48-12/62
Pierre	1/92-12/47	5/48-12/62
Sioux Falls	1/96-12/47	5/48-12/62
	*1/32-12/47	
Watertown	1/96-12/47	5/48-12/62
	*1/32-12/47	
Yankton	*1/81-12/47	5/48-12/62
	*1/32-12/47	
Rapid City	1/89- 4/48	5/48-12/62

Table 2

Station	WBAN No.1 Punched By the College	WBAN No.1 Reproduced by Weather Bureau
Huron	*1/40-12/47	1/48-12/55
Pierre		1/48-12/55
Rapid City		1/48-12/55

*Duplicate cards furnished Weather Bureau.

147,924 Punched by College WBAN No. 3; 37,513 Reproduced by Weather Bureau WBAN No. 3; 70,082 Punched by the College WBAN No. 1; 210,246 Reproduced by Weather Bureau WBAN No. 1.

Table 3

Station	1009 Cards Punched by College	1009 Cards Reproduced by Weather Bureau
Academy	*1/98- 4/48	5/48-12/62
Alcester 9SE		8/56-12/57
Alcester 8SE		8/56-10/57
Alcester 7ESE		8/56-12/57
Alcester 4ESE		8/56-12/57
Alcester		8/48- 9/51
Alcester 4SE		9/56-12/57
Alcester 6SE		8/56-10/57
Alexandria	1/96-12/47	1/48-12/62
Andover 7N	1/13-12/47	1/48-12/57
Angostura Dam†		10/47-12/62
Antelope Range Station		3/51-12/57
Ardmore	1/08-12/47	1/48-12/62
Arlington		2/48-12/57
Armour	*1/96- 4/48	5/48-12/57
Ashton		6/51-12/57
Belle Fourche 2NE		1/48-12/57
Belle Fourche 27WNW		7/51-12/57
Bison	1/16-12/21	
Bison	1/31-12/47	1/48-12/62
Blunt		7/50- 2/57
Bonesteel		5/56-12/62
Bonilla 3SSW		1/48- 9/57
Bowdle		1/48- 9/57
Bridgewater		3/48-12/57
Britton	*1/12- 4/48	5/48-12/62
Brookings 1NE†	*1/93- 4/48	5/48-12/62
Bryant 1NE		7/51-12/57
Buffalo Gap		9/51-12/57
Buskala Ranch		1/48- 9/57
Camp Crook	*1/96- 6/48	7/48-12/62
Canistota 2N		1/48-12/57
Canton	1/96- 4/48	5/48-12/62
Carthage		6/51-12/57
Castlewood	1/06-12/47	1/48-12/62
Cedar Butte		5/53-12/57
Centerville	*1/97-12/47	1/48-12/62
Chamberlain		6/48-12/57
Cheyenne Agency		1/48-12/57
Clark	*1/96- 4/48	5/48-12/62
Clear Lake	1/38-12/47	1/48-12/62
Columbia 8N		9/49-12/57
Conde 3ESE		6/51-12/57
Cottonwood	*1/09- 4/48	5/48-12/62
Cresbard 8NW		7/51- 9/57
Custer	*1/26- 4/48	5/48-12/62
Custer 7SW		11/48-12/56
Deadwood		1/48-12/57
Deerfield 5NW		1/48-12/57
Deerfield Dam		6/48-11/55
DeSmet		1/48-12/57
Dewey		1/48- 9/57
Dewey 9NW		1/48- 9/57
Dewey 15 NNE		12/48-12/57
Dumont 2ENE		1/48-12/57
Dupree	*1/22- 4/48	5/48-12/62
Dupree 16S		1/48-12/57
Eagle Butte		7/51-12/57
Edgemont 10N		11/48- 9/57
Ellingson 1NW		8/49-12/57
Elm Springs 3E		7/50-12/57
Eureka	*1/08- 4/48	5/48-12/62
Fairfax	9/92- 4/48	5/48- 4/56
	*1/02-12/47	

Table 3 (continued)

Station	1009 Cards Punched by College	1009 Cards Reproduced by Weather Bureau
Faith	1/13-12/47	1/48-12/62
Faith	*1/26- 4/48	
Farmingdale 2N		9/50-12/57
Faulkton	*1/96-12/47	1/48-12/62
Flandreau	1/96-12/47	1/48-12/62
Forestburg	*1/96- 4/48	5/48-12/62
Fort Meade		12/53-12/57
Fort Thompson 3E		8/51-12/57
Frederick		8/50-12/57
Gann Valley	1/03- 4/48	5/48-12/62
Gann Valley	*1/20- 4/48	
Gelhaus Farm		1/48- 9/52
Gettysburg	1/31- 4/48	5/48-12/62
Glad Valley		8/49-12/57
Gregory	*1/26-12/47	1/48-12/62
Harding 3SE		12/51-12/57
Hayes 5ESE		8/51-12/57
Hermosa 1ENE		1/48-12/57
Highmore 25N		5/52-12/57
Highmore	*1/96- 4/48	5/48-12/62
Hilland	1/09- 4/48	5/48-12/62
Hill City 1E		7/55-12/57
Hopewell	1/09-12/49	1/50-12/62
Hot Springs	*1/08- 4/48	5/48-12/62
Hot Springs 7W		12/48-12/57
Hot Springs 9SW		11/48- 9/57
Howard	1/96-12/47	1/48-12/62
Interior 3NE		7/55-12/57
Ipswich		4/48-12/57
Iroquois		6/51-12/57
Kadoka		6/52-12/57
Keldron 11S		8/51-12/57
Kennebec	1/06-12/47	1/48-12/62
Kyle		9/51-12/56
LaDelle 7NE	1/96-12/47	1/48-12/57
Lead	1/09-12/47	1/48-12/62
Lemmon	1/09-12/47	1/48-12/62
Leola		2/53-12/57
Little Falls		7/51-12/57
Long Valley	1/27-12/47	1/49-12/62
Ludlow 2NW	1/24-12/47	1/48-12/62
Madison 1WNW†		1/48-12/57
Manderson		7/49-12/57
Marion	1/01-12/47	1/48-12/62
Martin	1/34-12/47	1/48-12/62
McIntosh	1/15-12/47	1/48-12/62
McLaughlin		1/48-12/57
Mellette	*1/96-12/47	1/48-12/62
Menno	1/96-12/47	1/48-12/62
Midland		1/48-12/57
Milbank	1/93-12/47	1/48-12/62
Milesville 5NE		8/48-12/57
Miller	1/02-12/47	1/48-12/62
Mitchell	*1/96-12/47	1/48-12/62
Mission 14SSE		8/51-12/57
Mobridge	1/27-12/47	1/48-12/62
Moenville 6E		1/48-12/57
Mount Coolidge		10/52-12/57
Murdo	1/07-12/47	1/48-12/62
Mystic		8/50-12/57
Newell†	1/09-12/47	1/48-12/62
Oelrichs	1/96-12/47	1/48-12/62
Oelrichs 8W		11/48-12/57
Onaka		1/48-12/57
Onida	1/13-12/47	1/48-12/62
Orman Dam	1/08-12/47	1/48-12/62
Pactola Dam†		8/51-12/62
Parkston 5E		1/48-12/57
Philip	1/41-12/47	1/48-12/62
Pickstown†		1/48-12/62
Pine Ridge	1/28-12/47	1/48-12/62
Platte		11/51-12/56
Pollock	1/20-12/47	1/48-12/62
Provo		11/48-12/57
Pukwana 3W		1/48-12/57
Ralph 1N		1/48-12/57
Rapid City		6/49-12/57
Raymond		1/48-12/57
Redfield	1/97-12/47	1/48-12/62
Redfield 6E†		8/50-12/57
Redig	1/20-12/47	1/48-12/62
Red Owl		8/51-12/57
Ree Heights 5NNW		6/51- 9/57
Rockham 2NNE		3/53- 9/57
Roscoe	1/35-12/47	1/48-12/62
Roslyn		9/48- 4/52
Rumford		11/48-12/57
Salem		1/48-12/57
Scenic		7/50-12/57
Selby		1/53-12/57
Shadehill Dam†		1/50-12/62
Sisseton	1/31-12/47	1/48-12/62
Smithwick 6SW		11/48- 9/57
Spearfish 9WNW		1/48-12/57
Spearfish	1/96-12/47	1/48-12/62
Stratford		6/51-12/57
Sulphur 2W		8/49- 9/57
Summit		9/56-12/57
Thunder Hawk		8/49-12/57
Timber Lake	1/26-12/47	1/48-12/57
Tulare		7/51-12/57
Tyndall	1/11-12/47	1/48-12/57
Union Center		8/51-12/57
Usta		7/51-12/57
Usta 9WNW		6/57-12/57
Vale	1/20-12/47	1/48-12/62
Vermillion	1/97-12/47	1/48-12/62
Victor 5NE		1/32-12/57
Vivian	1/14-12/47	1/48-12/62
Wagner		1/48-12/62
Wasta		7/49-12/57
Waubay National Wild Life		5/52-12/57
Webster		7/54-12/62

Table 3 (continued)

Station	1009 Cards Punched by College	1009 Cards Reproduced by Weather Bureau
Wendte		5/54-12/57
Wentworth	1/96-12/47	1/48-12/62
Wessington		6/51-12/57
Wessington Springs 9SW		1/48-12/57
Westport 1ESE		6/51-12/57
Wetonka		6/51-12/57
Wewela		8/51-12/57
White Lake	1/09-12/47	1/48-12/62
Willett		8/50- 8/52
Willett 1ENE		1/48-12/57
Wind Cave		8/48- 9/51
Winner	1/24-12/47	1/48-12/62
Wolsey		7/51-12/57
Wood	1/13-12/47	1/48-12/62
Woonsocket		1/48-12/57
Yankton 3NNW		1/48-12/57
Zeona		8/49-12/57

958,219, No. 1009 Cards punched by College; 708,640, No. 1009 Cards reproduced by Weather Bureau; 1,176,225 total number cards punched by College; 449,584 total number duplicate cards furnished Weather Bureau; 956,399 total number of cards reproduced and furnished College.

*Duplicated cards furnished Weather Bureau.

†Stations that include 24-hour evaporation and wind movement.

Table 4. South Dakota Weekly Weather Summary Cards

Station number	Station name	Starting and final date	Years of record
0043	Academy	1896-12/62	67
0128	Alexandria	1896-12/62	67
0217	Angostura	1948-12/62	15
0236	Ardmore	1908-12/62	55
0296	Armour	1896-12/62	67
0701	Bison	1916-12/62	47
0778	Bonesteel	5/1/1956-12/62	7
1049	Britton	1913-12/62	50
1076	Brookings	1893-12/62	70
1294	Camp Crook	1896-12/62	67
1362	Canton	1896-12/62	67
1519	Castlewood	1906-12/62	57
1579	Centerville	1897-12/62	66
1739	Clark	1896-12/62	67
1777	Clear Lake	1948-12/62	15
1972	Cottonwood	1909-12/62	54
2087	Custer	1926-12/62	37
2429	Dupree	1922-12/62	41
2797	Eureka	1908-12/62	55
2820	Fairfax	9/1/1902- 4/56	53
2852	Faith	1913-12/62	50
2927	Faulkton	1896-12/62	67
2984	Flandreau	1896-12/62	67
3029	Forestburg	1896-12/62	67
3217	Gann Valley	1903-12/62	60
3294	Gettysburg	1931-12/62	32
3452	Gregory	1926-12/62	37
3852	Highmore	1896-12/62	67
3857	Hilland	1909-12/62	54
3987	Hopewell	1909-12/62	54
4007	Hot Springs	1908-12/62	55
4037	Howard	1896-12/62	67
4516	Kennebec	1906-12/62	57
4834	Lead	1909-12/62	54
4864	Lemmon	1909-12/62	54
4983	Long Valley	1927-12/62	36
5048	Ludlow	1924-12/62	39
5228	Marion	1901-12/62	62
5281	Martin	1934-12/62	29
5381	McIntosh	1915-12/62	48
5456	Mellette	1896-12/62	67
5481	Menno	1896-12/62	67
5536	Milbank	1893-12/62	70
5561	Miller	1902-12/62	61
5671	Mitchell	1896-12/62	67
5691	Mobridge	1927-12/62	36
5891	Murdo	1907-12/62	56
6054	Newell	1909-12/62	54
6212	Oelrichs	1896-12/62	67
6292	Onida	1913-12/62	50
6357	Orman Dam	1908-12/62	55
6552	Philip	1941-12/62	22
6612	Pine Ridge	1928-12/62	35
6712	Pollock	1920-12/62	43
7047	Redfield	1897-12/62	66
7062	Redig	1920-12/62	43
7277	Roscoe	1935-12/62	28
7742	Sisseton	1931-12/62	32
7882	Spearfish	1896-12/62	67
8307	Timber Lake	1926-12/62	37
8472	Tyndall	1911-12/62	52
8552	Vale	1920-12/62	43
8622	Vermillion	1897-12/62	66
8727	Vivian	1914-12/62	49
8767	Wagner	1948-12/62	15
9042	Wentworth	1896-12/62	67
9232	White Lake	1909-12/62	54
9367	Winner	1924-12/62	39
9442	Wood	1913-12/62	50

Table 5. Inventory of South Dakota IBM Cards Used in Irrigation Study Bulletin No. 496

Station number	Station	Years	Total years
1076	Brookings	1930-1946	17
6054	Newell	1930-1946	17
7047	Redfield	1930-1946	17
		Total years	51
245 cards per year			
Irrigation at 50% of capacity			12,495
Irrigation at 62.5% of capacity			12,495
		Total cards	24,990

Table 6. Daily Soil Moisture—Agricultural Engineering Department File

Station number	Station name	Starting and final date
0043	Academy	3/ 1/00-12/31/57
1049	Britton	3/ 1/13-10/31/56
1076	Brookings	3/ 1/00-10/31/56
1579	Centerville	5/ 1/10- 4/ 7/20
1972	Cottonwood	4/ 8/20-10/31/56
2429	Dupree	3/ 1/22-10/31/56
2797	Eureka	8/ 1/08-10/31/56
2927	Faulkton	3/ 1/00-10/31/50
3217	Gann Valley	10/16/27-10/31/56
3832	Highmore	3/ 1/04-10/31/56
4127	Huron	3/ 1/00-10/31/56
4864	Lemmon	3/ 1/00-10/31/56
5228	Marion	3/ 1/08-10/31/56
5536	Milbank	3/ 1/00-10/31/56
5671	Mitchell	3/ 1/00-10/31/56
6054	Newell	3/ 1/23-10/31/56
6212	Oelrichs	3/ 1/11-10/31/53
6597	Pierre	3/ 1/00-10/31/56
6937	Rapid City Airport	3/ 1/00-10/31/56
7047	Redfield	3/ 1/00-10/31/56
7062	Redig	3/ 1/20-10/31/56
7667	Sioux Falls	3/ 1/00-10/31/56
8622	Vermillion	3/ 1/08- 3/14/51
8932	Watertown	4/ 1/02-10/31/56
9442	Wood	3/ 1/20-10/31/56

Cards will be added to the weather punch card library each year as data becomes available.

*This is generalized information as to what data is on the cards. In some cases WBAN No. 3, WBAN No. 1, and WB No. 1009 are not punched the same by South Dakota State College as by the Weather Bureau. Details of the State College card punching are given in these references: For WBAN No. 1, WBAN No. 3, and WB No. 1009 see **First Annual Progress Report of South Dakota Cooperative Project in Climatology** by South Dakota State College and U. S. Weather Bureau, July 1952. For Weekly Weather Summary Card see **Third Annual Progress Report on South Dakota Cooperative Project in Climatology** by South Dakota State College and U. S. Weather Bureau, July 1954. For IBM cards used in South Dakota Irrigation Study Bulletin No. 496 and Daily Soil Moisture Cards see **Instructions for Use of the IBM 602 A Calculator for Daily Soil Moisture Accounting,** by Ray F. Pengra, **Publications in Climatology,** Vol. XIV, No. 3, Thornthwaite Laboratory of Climatology, Centerton, N. J., 1961.

Details of data on WBAN No. 1 and No. 3 punched by the Weather Bureau are given in various editions of **Manual of Card Punching** (WBAN), U. S. Department of Commerce, Weather Bureau.

CLIMATOLOGICAL DATA PUNCHED ON IBM CARDS*

TABLE 1—WBAN NO. 3

Daily cards: maximum temperature, minimum temperature, precipitation, snowfall, snow on ground at midnight, peak gust (wind speed, direction and time), maximum relative humidity, minimum relative humidity (only for few years by South Dakota State College), day with fog, thunder, sleet, hail, rain, snow, glaze, dust storm, smoke or haze and blowing snow, mean temperature, departure of mean temperature from normal and degree days.

TABLE 2—WBAN NO. 1

Hourly cards: ceiling height, sky condition, visibility, thunder or tornado, liquid precipitation (not on cards by College), frozen precipitation, obstructions to vision, sea-level pressure, dew point, wind speed and direction, station pressure, dry bulb temperature, wet bulb temperature, relative humidity, total amount sky cover, type of clouds with height and amount up to 4 layers (not punched by College).

TABLE 3—WB NO. 1009

Daily cards: maximum temperature, minimum temperature, temperature at observation time, precipitation, snowfall, snow on ground at observation time, day with (not uniformly reported) rain (not punched by College), snow, smoke or haze, fog, drizzle, sleet, glaze, thunder, hail, dust or sandstorm, blowing snow, high wind and tornado, mean temperature and degree days. The 24 hour wind movement and amount of evaporation are included for stations with evaporation equipment.

TABLE 4—SOUTH DAKOTA WEEKLY WEATHER SUMMARY CARD

Weekly cards: mean maximum temperature, mean minimum temperature, weekly mean temperature, frequency count of maximum temperature 90° or higher and 32° or lower, frequency count of minimum temperature 32° or lower and 0° or lower, total precipitation, total snowfall, frequency count of precipitation T to 0.09 inch, 0.10 to 0.39 inch, 0.40 to 0.99 inch, and 1 inch and over.

TABLE 5—IBM CARDS USED IN SOUTH DAKOTA IRRIGATION STUDY BULLETIN NO. 496

Daily cards: precipitation (P); potential evapotranspiration (PE); P-PE; under irrigation to maintain soil moisture at or above 2 inches—soil moisture, actual storage change, deficiency and surplus; under no irrigation-soil moisture, actual storage change, deficiency, moisture surplus, available gravity water, gravity water storage and soil water balances; and intermediate factor $\frac{\text{P-PE}}{4}$.

TABLE 6—DAILY SOIL MOISTURE CARDS

Daily cards: mean temperature; precipitation (P); potential evapotranspiration (PE); P-PE; under soil capacity for 2 inches, 4 inches, and 6 inches—soil moisture, actual storage change, moisture deficiency and moisture surplus; and under intermediate factors $\frac{\text{P-PE}}{2}$, $\frac{\text{P-PE}}{4}$, and $\frac{\text{P-PE}}{6}$.

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