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CLIMATOGRAPHY OF THE UNITED STATES NO. 81-15

DECENNIAL CENSUS OF UNITED STATES CLIMATE—

MONTHLY NORMALS OF TEMPERATURE, PRECIPITATION, AND HEATING DEGREE DAYS

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PREFACE

The climatological standard normals presented in this publication are based on records for the 30-year period 1931-1960 inclusive. For the first time, normals have been computed for substations and divisions using a base period identical to that used for first-order stations.

Previous normals were published in Weather Bureau Technical Paper No. 31, "Monthly Normal Temperatures, Precipitation, and Degree Days," and were based on records for the period 1921-1950. Earlier sets of normals are described in [1].

This is the first series of publications resulting from the project "The Decennial Census of United States Climate, 1960." The project is a continuation of earlier censuses of the climate of the United States that date back to the early 19th Century and are described in [2]. Future publications of this project will be listings of daily normals of temperature, and degree days; summaries of hourly observations; and listings of monthly divisional averages of temperature and precipitation.

Units used in this publication are degrees F. for temperatures, and inches for precipitation. The heating degree day normals are derived from the monthly normal temperatures, and are computed on the standard base of 65°F. Monthly normals of less than 5 degree days are shown as zero.

Standard Normals for Weather Bureau First Order Stations

A normal of a climatological element is an arithmetic mean for a specific period of record which estimates the true mean of the element at the current exposure of the meteorological instrument measuring the element. The true mean is the mean of all possible observations (population) at the current exposure. It is from this population that future observations will come, not from values in the past record. This is what makes it important to obtain an estimate of this mean. The true mean can never be known exactly but must be estimated from a sample of the past record ([3] p. 53 section 4. 3). The normals presented here are estimates of the true mean obtained from the 30-year sample record 1931-1960. They are called standard normals because they conform to the World Meteorological Organization standard for climatological normals.

If no exposure changes have occurred at a station the normal is estimated by simply averaging the 30 values from the 1931-1960 record. Since it is next to impossible to maintain a multiple purpose network of meteorological stations without having exposure changes, it is first necessary to find and evaluate these changes and then make adjustments for them if necessary.

Heterogeneities in record due to exposure changes are found in two ways: by determining them from the station histories and by use of statistical tests. The statistical test when standardized for the purpose is easy to apply and will often find heterogeneities which are not defined by the station histories as well as those which have been so determined. Two statistical tests were employed: one for temperature and the other for precipitation. These are described in [4].

After the periods of heterogeneity have been determined, adjustments are applied to remove the heterogeneities introduced into the mean. This is done by comparing the record at the base station, for which the normal is desired, to the record at a supplementary station with a homogeneous period which covers the heterogeneous period at the base station. The difference method is applied to the monthly average maximum and minimum temperatures and the ratio method to the monthly total precipitation. A weighted average of the various partial means of the adjusted and unadjusted record is then prepared to give the normal. Brief discussions of the methods of adjustment are found in [3] (p. 49, section 4. 24).

Normal heating degree days are derived by the method described in [5].

Normals for Substations and Divisions

Normals for substations were computed somewhat differently than those for first-order stations. Monthly substation normals are the simple arithmetic averages of the monthly values of temperature and precipitation for the period 1931-1960. These were computed for only those substations that were active during the entire period and no attempt was made to adjust for minor changes in location of the observing site, or for changes in the time of observation. Normals were not computed for substations that were moved a significant distance during the 1931-1960 period. Missing values in the data series were estimated by methods described in [6]. Substations whose locations were essentially unchanged during the 1931-1960 period are identified in the tables.

Monthly divisional normals are the means of the monthly divisional averages of temperature and precipitation for the period 1931-1960. In calculating the monthly divisional averages, all of the stations in the division that furnished both temperature and precipitation data during the particular month were used. The averages therefore were obtained from a variable station sample. As a result, the divisional normals often differ from the averages of the normals for stations in the division.

Annual substation and divisional normals are the averages of the 12 monthly temperature normals and the sums of the 12 monthly precipitation normals.

References

1. U. S. Weather Bureau, "History of Climatological Publications," Key to Meteorological Records Documentation No. 4. 1, Washington, D. C., 1958.
2. H. E. Landsberg, "The Decennial United States Census of Climate 1960 and Its Antecedents," Key to Meteorological Records Documentation No. 6. 2, U. S. Weather Bureau, Washington, D. C., 1960.
3. U. S. Weather Bureau, Climatology at Work, Gerald L. Barger, ed., Washington, D. C., 1960.
4. H. C. S. Thom, "Tests of Significance for Temperature and Precipitation Normals," U. S. Weather Bureau Manuscript, 1961.
5. H. C. S. Thom, "The Rational Relationship Between Heating Degree Days and Temperature," Monthly Weather Review, Vol. 82, No. 1, January 1954.
6. U. S. Weather Bureau, Administrative Manual, Vol. III, Chap. C-05, paras. C-0509 and C-0510.

NOTES

1. Station Names

In Table I, "AP" after the city name indicates "airport station" "CO" indicates "city office station." Figures and letters following the station name indicate a rural location, and refer to the distance and direction of the station from the nearest post office.

# indicates a station whose location has been essentially unchanged during the period 1931-1960.

H indicates the ground elevation of the station in feet above sea level, as of December 31, 1960.

G indicates the elevation at hygrothermometer site (where different from "H").

T indicates the height of the thermometer in feet above the ground as of December 31, 1960.

/NO TEST/ indicates that significant difference tests were not made.

2. Table Content

* indicates that the departure of the 1951-60 record from the 1921-50 normal is statistically significant, but through the adjustments for changes in location and exposure the absolute difference between old and new normals may even in these cases be very small.

T in the data tables indicates a monthly precipitation amount of only a trace.

February monthly normals are for a 28-day month.

TABLE I - NORMALS FOR FIRST ORDER STATIONS

STATION		JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	ANNUAL
COLUMBIA AP	H 778 T 5													
MAX TEMP		39.3	43.2	51.9	65.2	74.9*	84.3*	89.7	88.1*	80.8*	70.0	53.3	42.5	65.3
MIN TEMP		21.3	24.3	31.9	43.9	53.9	63.7	67.6	66.2	57.7	47.3	33.3	25.1	44.7
AVG TEMP		30.3	33.8	41.9	54.6	64.4*	74.0*	78.7	77.2*	69.3*	58.7	43.3	33.8	55.0
DEG DAYS		1076	874	716	324	121*	12*	0	0	5*	251	651	967	5046
PRECIP		1.71	1.81	2.65	3.30	4.70	4.34*	3.41*	3.81	3.88*	3.12	2.27*	1.96	36.96
KANSAS CITY AP	H 741 T 5													
MAX TEMP		38.9	43.8	52.6	65.6	75.1	85.2	90.9	89.3	81.7	70.6	53.5	42.7	65.8
MIN TEMP		22.4	25.7	33.0	44.8	55.0	65.5	71.0*	69.2*	59.9	48.7	34.6	26.9	46.4
AVG TEMP		30.7	34.8	42.8	55.2	65.1	75.4	81.0*	79.3*	70.8	59.7	44.1	34.8	56.1
DEG DAYS		1063	846	688	306	118	9	0	0	39	236	627	936	4868
PRECIP		1.41	1.24*	2.49	3.56	4.40	4.57	3.19*	3.77	3.25	2.86	1.80*	1.53	34.07
ST JOSEPH AP	H 809 T 5													
MAX TEMP		37.2	41.4	51.0*	64.9	75.1	85.0	91.0	89.0	81.0	70.1	52.2	41.2	64.9
MIN TEMP		17.1	20.7	29.4	42.3	53.0	63.0	67.8	66.0	56.2	44.7	30.5*	21.7	42.7
AVG TEMP		27.2	31.1	40.2*	53.6	64.1	74.0	79.4	77.5	68.6	57.4	41.4*	31.5	53.8
DEG DAYS		1172	949	769*	348	133	15	0	6	60	285	708*	1039	5484
PRECIP		1.20	1.09*	2.33	3.15	4.39	5.93	3.22	4.21	3.44	2.18	1.68*	1.36*	34.18
ST LOUIS AP	H 552 T 6													
MAX TEMP		40.2	44.0	52.8	65.9	76.1*	86.1	90.2	88.3	81.3	70.1	53.7	43.0	66.0
MIN TEMP		23.5	26.3	33.4	44.8	55.3	65.1	68.9	67.3	58.6	47.6	34.5	26.5	46.0
AVG TEMP		31.9	35.2	43.1	55.4	65.7*	75.6	79.6	77.8	70.0	58.9	44.1	34.8	56.0
DEG DAYS		1026	834	688	297	102*	6	0	0	51	242	627	936	4809
PRECIP		1.98	2.04*	3.08	3.71*	3.73	4.29	3.30	3.02*	2.76*	2.86	2.57	1.97	35.31
ST LOUIS CO	H 465 T179													
MAX TEMP		41.1	44.5	53.0	65.6	75.6	85.5	89.7	88.0	81.0	70.1	53.9	43.7	66.0
MIN TEMP		25.8	28.3	35.5	47.4	57.6	67.6	71.6	70.3	62.3	51.5	37.6	29.3	48.7
AVG TEMP		33.5	36.4	44.3	56.5	66.6	76.6	80.7	79.2	71.7	60.8	45.8	36.5	57.4
DEG DAYS		977	801	651	270	87	0	0	0	36	202	576	884	4484
PRECIP		2.16	2.21*	3.19	3.58	3.85	3.92	3.31	3.62	2.99	2.77	2.69	2.17	36.46
SPRINGFIELD AP	H1265 T 5													
MAX TEMP		43.4	47.4	54.7	66.4	74.9*	84.9*	90.3	90.0*	83.1*	72.2	56.3	46.4	67.5
MIN TEMP		23.8*	26.7	33.3	44.8	54.0	63.5	67.2	66.0	57.7	47.1	33.7*	27.0	45.4
AVG TEMP		33.6*	37.1	44.0	55.6	64.5*	74.2*	78.8	78.0*	70.4*	59.7	45.0*	36.7	56.5
DEG DAYS		973*	781	660	291	105*	6*	0	0	45*	223	600*	877	4561
PRECIP		1.96*	2.12*	2.84	4.09	5.28	5.02*	3.89*	3.32*	3.85	3.76	2.76	2.19	41.08

TABLE I - NORMALS FOR FIRST ORDER STATIONS

STATION	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	ANNUAL
WILMINGTON AP H 78 T 5													
MAX TEMP	41.3	42.4	50.5*	62.5	73.4*	81.8*	86.2	84.2	77.9	67.3	55.1*	43.5	63.8
MIN TEMP	25.5	25.2*	32.0	41.6*	52.0	61.0	65.8*	64.3*	57.5	45.9	35.7	26.7*	44.4
AVG TEMP	33.4	33.8*	41.3*	52.1*	62.7*	71.4*	76.0*	74.3*	67.6	56.6	45.4*	35.1	54.1
DEG DAYS	980	874*	735*	387*	112*	6	0	0	51	270	588*	927	4930
PRECIP	3.40	2.95	4.02	3.33	3.53	4.07	4.25	5.59	3.95	2.91	3.53	3.03	44.56

TABLE II - NORMALS BY CLIMATOLOGICAL DIVISIONS

STATIONS (By Divisions)	TEMPERATURE (°F)													PRECIPITATION (In.)												
	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	ANNUAL	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	ANNUAL
NORTHERN																										
WILMINGTON AP	33.4	33.8	41.3	52.1	62.7	71.4	76.0	74.3	67.6	56.6	45.4	35.1	54.1	3.40	2.95	4.02	3.33	3.53	4.07	4.25	5.59	3.95	2.91	3.53	3.03	44.56
#WILMINGTON PORTER RESVR	*	*	*	*	*	*	*	*	*	*	*	*	*	3.47	2.79	4.01	3.74	4.10	3.91	4.47	5.32	3.43	3.10	3.67	3.13	45.14
DIVISION	33.9	34.3	41.7	52.3	62.9	71.5	76.0	74.3	68.0	57.2	46.0	35.6	54.5	3.48	2.85	3.95	3.56	4.00	3.83	4.37	5.24	3.48	3.14	3.48	3.10	44.48
SOUTHERN																										
#BRIDGEVILLE 1 NW	36.5	37.1	43.6	53.6	63.7	72.2	76.2	74.5	68.4	58.0	47.5	37.8	55.8	3.54	2.89	3.98	3.43	3.78	3.60	5.06	5.55	4.02	3.19	3.21	3.03	45.28
#DOVER	36.4	36.8	43.7	54.1	64.4	72.9	77.1	75.4	69.4	58.7	47.9	37.9	56.2	3.70	3.03	4.12	3.42	4.15	3.46	4.67	5.73	3.81	3.27	3.67	3.11	46.14
DIVISION	36.8	37.2	43.8	53.7	63.9	72.4	76.6	74.9	68.9	58.4	47.9	38.1	56.1	3.76	3.08	4.19	3.50	3.89	3.61	4.84	5.62	4.09	3.40	3.57	3.20	46.75

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