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WINTERTIME TEMPERATURE FLUCTUATIONS

AT JACKSON, MISSISSIPPI (1896-1991)

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INTRODUCTION

Historical climatic fluctuations, such as the ones defined by Diaz and Quayle (1978) and Lettenmaier, Wood, and Wallis (1994), are often used to show long-term changes in meteorological parameters (i.e., temperature or moisture) and the tendency for certain types of weather (i.e., cold, warm, wet or dry) to be more prevalent during certain periods of time. This is important to meteorologists, since the way in which weather normals and extremes are defined (at any given time) inevitably determines the degree of significance ascribed to daily or monthly weather events (both past and present). As this study will show, long-term changes in the frequency of unusually cold and unusually warm winter temperatures helped to create a drop of 4 deg in the January and February 30-year averages between 1950 and 1990. Long-term temperature fluctuations were charted by using polynomial approximations and running means.

An investigation into the source(s) of these changes revealed that periods of warmer and cooler temperature averages were closely linked to the number and duration of cold air outbreaks as well as the degree of warmth experienced during the milder interludes. Certain types of monthly temperature profiles, which will be defined, were found to be common during certain periods of time and uncommon during others. The increased frequency of the warmest or coldest profiles were largely responsible for creating the defined fluctuations. Thus, there is reason to believe that when monthly (wintertime) temperature profiles start to become significantly different from those which occurred during the preceding 30 years, a transition may be taking place into a long-term period when very warm or very cold winter weather will become more frequent. At such times, the 30-year temperature averages are likely to become least effective at providing a gauge for normalcy.

DEFINING LONG-TERM TEMPERATURE TRENDS

Long-term temperature trends were isolated by using a third degree polynomial approximation (Diaz and Quayle, 1978). A trigonometric approximation was used, rather than the least squares method, because of the cyclic (periodic) nature of trigonometric best-fits (Matthews, 1987). Due to the great deal of interannual variance in the temperature records, the correlation ratios for the third degree polynomial best-fits were only 0.14 (for January) and 0.12 (for February). The graphed data and the approximating curves are shown in Figs. 1(a) and 3(a). The fluctuations for January and February consisted of generally "cool" temperatures, separated by a period of generally warmer weather. The coolest periods, during which either January or February averages were frequently quite cold, were between 1896 and 1905 and between 1961 and 1991. An intervening warm period occurred between 1906 and 1960.

The percentage of colder-than-normal and warmer-than-normal months for each of the three periods is given in Table I (based on the record average for each month). The average temperature for each period is also provided.

These calculations indicate that a majority of the data support the trend shown by the third degree polynomial best-fit curves.

An F-test was conducted on the temperatures using the same groupings as shown in Table 1 and resulted in F-ratios significant at the 1% level. Furthermore, the first harmonic revealed virtually identical long-term fluctuations as those indicated by the third degree polynomial approximations and suggests the possible presence of a regular cyclic oscillation (Fig. 1(b) and 3(b)) (Panofsky, 1958). The maximum temperature average along the polynomial curve was 50 F for January and occurred during the period 1912-1921. The same maximum (of 50 deg) was indicated by the first harmonic between 1923 and 1935. The February data showed a maximum of 53 F, which occurred between 1928 and 1934. A maximum of 52 F also showed up with the first harmonic between 1930 and 1935. As will be shown later, all these maxima occurred during a 31-year period when cold air outbreaks were at a minimum at Jackson (1907-1937). The degree of cooling observed between the 1920s and 1930s and the middle 1980s for January and February is very similar to the regional findings of Lettenmaier, Wood, and Wallis (1994) and Diaz and Quayle (1978).

LONG-TERM CHANGES IN 30-YEAR AVERAGES

Up to this point, there seems to be a reasonably strong case to be made that the average winter temperatures in Jackson, Mississippi, have undergone significant fluctuations over the past 100 years. The third degree polynomial best-fit curves were used to isolate distinct periods which appear to have been generally "warm" or "cool." Table II shows each period average versus the polynomial approximation.

To further investigate these long-term trends, a calculation was made of 30-year averages over the past 90 years. Calculations began with the period 1901-1930 and ended with the period 1961-1990. The results are listed in Table III.

Perhaps not surprisingly, the results are highly supportive of the pre-established trend. In fact, one would probably consider the change in the 30-year average (of 4 F), between 1921-1950 and 1961-1990, to indicate a significant cooling. Further support for this cooling shows up when using these 30-year averages to determine consecutive decade departures from normal. After doing so, a general increase in the number of colder-than-normal months was found between 1941 and 1970 (Fig. 5).

Regarding fluctuation of 30-year averages, there are several implications which should be addressed. Most importantly, it is apparent that prevailing climate during any given 30-year period is not necessarily representative of succeeding decades. For instance, it must be considered that all of the 30-year averages up until 1961 were calculated using many of the monthly averages produced during the warmer period of 1906 to 1960. This undoubtedly helped to create the dramatic increased frequency of colder-than-normal temperatures between 1941 and 1970, as shown in the histograms in Fig. 5. Furthermore, the departures from normal for any given month can be increased simply because the monthly temperature profile is different from the one(s) that prevailed during the preceding 30 years.

There is little doubt that knowledge of historical climatic patterns can give valuable insight into the subjective meaning of "normals," "averages," and "extremes." The fact that monthly temperature averages can fluctuate so significantly, even over successive 30-year periods, is a feature that cannot be ignored. Truly, what can be considered "normal" for one period in time may or may not be "normal" for another period.

Using ideas set forth in this section, it is possible to see how the 30-year averages for the next several decades could end up being non-representative of the average January and February temperatures experienced between now and 2010. For instance, based on the polynomial curve in Fig. 1(a), there is reason to believe that average January temperatures may have recently begun a swing back toward a warmer regime. If this is the case, and if this trend takes us back to temperatures similar to the those experienced in the 1920s and 1930s, one might also expect to see another period similar to 1961-1970 when some rather large departures from normal became more frequent. However, in this case a majority of departures would be positive rather than negative. Indeed, to keep things in perspective, it is always advantageous to look back into past climate records to see if similar warm-ups or cool-downs have occurred, before jumping to any rash conclusions concerning climatic fluctuations. Furthermore, existence of periodic changes in the temperature average, similar to those documented here, could very well mask or amplify man-made climate impacts.

DEFINING SHORT-TERM TEMPERATURE TRENDS

Since an entire cycle does not show up in the long-term fluctuations, indicated by the third degree polynomials, it is impossible to know if they are truly cyclic in nature. However, it can be concluded that it has taken almost 100 years for average winter temperatures to undergo the fluctuations indicated. Yet, after further investigation, existence of different shorter-term cycles can also be found. These cycles represent significant temperature fluctuations and have occurred repeatedly over the last 100 years.

The cycles begin to show up well after simply performing a calculation of "running means" (using five-year intervals). The first calculation (of the five-year average) was centered on the year 1898, and the last calculation was centered on 1989. Results appear in Figs. 2(b) and 4(b) and indicate a great deal of short-term temperature fluctuation. Notice, for instance, the large rise in average temperatures between those years close to the turn of the century and the succeeding several decades. Also, note the sizeable drop in temperatures during the late 1950s and late 1970s.

These short-term temperature changes are quite significant, fluctuating as much as 10 deg or more. Thus, based on the apparent amplitude of these fluctuations, it is reasonable to assume that there is a particular polynomial that can be fit to the data which will also isolate these trends. Starting from a cubic curve (third degree), the polynomial degree was gradually increased (one degree at a time) until a curve was produced which appeared to closely approximate the graph of running means. The 12th degree polynomial produced the desired results, and the similarity between the two separate plots can be seen in Figs. 2 and 4. The correlation ratios for the 12th degree best-fits were determined to be 0.38 (for January) and 0.39

(for February). An F-test was conducted on the temperatures using the 13 groups listed in Table IV. The average temperature and polynomial approximation for each period are also listed in the table.

Aside from the significance indicated by the 12th degree polynomial approximations, there is another more subtle feature that shows up. If successive maxima and minima are charted, a general fluctuation shows up that agrees closely with the pre-established long-term trend. For instance, notice how maxima and minima became generally "warmer" during the first three or four decades of the century but trended back toward "colder" conditions from the 1940s into the 1970s and early 1980s.

DETERMINING THE SOURCE(S) OF THE TEMPERATURE FLUCTUATIONS

As already shown by the polynomial approximations and running means, winter temperature averages have undergone significant fluctuations since the late nineteenth century. Further investigation was done to determine the source(s) of these changes. An attempt was made to develop temperature profiles for each January and February between 1896 and 1991 using the daily means. The number of cold air outbreaks and the duration of each were determined, as was the degree of warming during the milder interludes.

The standard deviation for each month's record was found to be 5 F. Hence, only daily departures greater than 5 deg were determined to represent unusual or extreme departures. Positive departures between 6 and 14 deg were chosen to represent unusual warmth. Positive departures of 15 deg or more were chosen to represent extreme warmth. Negative departures were similarly chosen to represent unusual or extreme cold. Calculations were made for each month to determine the percentage of daily means within one standard deviation, as well as the percentage of unusual or extreme departures. Thus, a general temperature profile was produced for each month.

To determine the number of significant coolings each month, as well as the characteristics of each, a more complex set of conditions was developed. A significant cooling was determined to occur when there was a drop in the daily mean of 6 deg or more from one day to the next. The lowest mean was isolated from each event, and those which resulted in dropping the mean below 40 deg (for January) or 43 deg (for February) were determined to represent cold air outbreaks and were subdivided into four levels. January's Level 1 included daily means in the 30s. The upper limit for February's Level 1 was 42 deg. Levels 2, 3, and 4 represent coolings that resulted in dropping daily means into the 20s, teens, and single digits, respectively (for both months). A cold air outbreak was also determined if Level 1 temperatures (or below) occurred during the first day(s) of the month but was not proceeded by a significant temperature drop (i.e., cold air outbreak began late in the previous month).

The duration of each cooling was determined by counting the total number of days cooling and the number of days with Level 1 temperatures or below. The duration of an outbreak only consisted of days with Level 1 temperatures or below. Additional characteristics of monthly coolings which were analyzed included average daily mean one day prior to cooling and the magnitude of the initial temperature drop. An attempt was also made to isolate times when there was a lack of significant warming between outbreaks. In such cases, the second outbreak is also referred to as a "cold air reinforcement" and indicates times when the daily mean, just prior to the onset of another outbreak, was unable to warm any higher than 45 deg (for January) or 48 deg (for February).

Table VI indicates that winters between 1907 and 1938 frequently contained a high percentage of unusually warm or extremely warm conditions, often accounting for between 45 and 75 percent of the daily means. Such a large degree of warmth only showed up briefly elsewhere in the January record, most notably between 1949 and 1954 and in the early to mid 1970s. However, very warm February temperatures were also prevalent for an extended period between the late 1940s and early 1960s, as well as after 1982. It was during these warmest periods that daily means of 70 deg or more were most common, sometimes occurring on as many as seven or eight days during February.

After charting the number of cold air outbreaks for each winter, the periods 1907-1937 and 1949-1954 showed the lowest number. During these periods, the number of outbreaks typically was between one and three (per month) and produced up to six days of Level 1 temperatures or below. Between 1896 and 1906 and from 1963 to 1982, the number of outbreaks was larger, and the duration of cold temperatures increased (See Table V). This period also included some of the most frequent occurrences of cold air reinforcements (See Table V). Prior to 1960, January outbreaks lasting seven days or more only occurred during six years (9 percent of the time). After 1959, 32 percent of the Januaries included such an outbreak, and 71 percent had at least one outbreak that lasted four days or more. Prior to 1960, even the strongest cold air outbreak in January typically lasted less than four days and was usually preceded and followed by unusual or extreme warmth.

All of the monthly temperature profiles can be classified as one of the following three types, and are listed in Table VII:

WARM SKEW: Typically includes between 13 and 21 days of unusually warm or extremely warm weather. May involve a complete lack of Level 1 temperatures or below, but more often includes one to three brief cold air outbreaks (each lasting three days or less). Total number of days with Level 1 temperatures or below does not exceed six days, although a single outbreak may last up to four or five days in rare cases (i.e., January 1917, February 1911, and February 1951). One brief cold air reinforcement is possible, although unusual, and typically lasts three days or less.

BALANCED PROFILE: Typically includes six to 11 days of Level 1 temperatures or below in January; five to ten days in February. Usually between two and four cold air outbreaks, including cold air reinforcements (especially in January). In rare cases, a single outbreak may last up to ten days in January (i.e., 1942, 1982); seven days in

February (i.e, 1983, 1989). Interludes usually consist of temperatures close to the normal (within 5 deg of the average) or unusually warm. Extreme warmth is generally limited to five days or less, although in rare cases there may be as many as eight or nine such days (January 1930, January 1982, February 1917).

COLD SKEW: Total duration of Level 1 temperatures between 11 and 25 days in January; seven to 19 days in February. Particularly long-lasting periods of very cold weather, almost always resulting from the onslaught of four to seven January outbreaks or three to five February outbreaks, and often involving cold air reinforcements. Interlude temperatures are typically close to the normal or unusually warm, with no more than a few days of extreme warmth. In rare cases, however, extreme warmth may exist for up to four days (i.e., February 1980).

During warmer times, the duration of unusual or extreme warmth, coupled with a relatively low number of cold air outbreaks, resulted in some of the largest positive departures. Conversely, during the colder periods, the increased frequency of particularly severe outbreaks (i.e., long duration) were most effective at creating the coldest monthly averages (especially during January).

Furthermore, the coldest months were almost always devoid of extreme warmth. Some of the lowest daily means, however, were recorded during months with less deviant monthly averages, either because the cold air was short-lived and/or the interludes were quite warm.

The warm skew profile accounted for all Januaries with monthly averages greater than 50 deg and all February averages greater than 54 deg. The cold skew profile accounted for all January averages less than 43 deg and 20 percent of the months with averages of 43 or 44 deg. Cold skew profiles accounted for all February averages less than 47 deg. The remaining monthly averages were associated with a balanced profile.

The balanced temperature profiles produced monthly temperature averages that were usually within a few degrees of the record normal. Months that had temperature averages slightly above the normal often exhibited a profile that was only slightly skewed toward unusually warm temperatures. Monthly averages slightly below normal were often produced by just a slight skew toward unusually cold weather. Although days of extreme cold and warmth were often present, they were quite limited. Yet the more balanced the profile, the easier it was for just a few extra days of extreme cold or warmth to determine whether the monthly average would fall slightly above or below the normal.

COLDEST WINTERS AND EXTREME MINIMA

Years during which both January and February exhibited cold skew profiles were 1905, 1940, 1958, 1963, 1966, 1968, 1970, 1978, 1979, and 1985. Notice that 80 percent of these cold winters occurred during the cooler times as defined by the third degree polynomials (1896-1906 and 1960-1991). Also, absolute minimum temperatures below 20 deg were much more common for January and February after 1959. The long-term changes in the absolute minima, however, were not as dramatic as those indicated for the monthly averages. This is due mostly to the fact that absolute minimum temperatures reflect only the magnitude of cooling for the coldest episode each month. Furthermore, since 96 percent of all of the months on record had at least one cold air outbreak, it is not surprising that long-term changes are fairly small. Conversely, the range in absolute minima is large (ranging from -5 to 32 deg for January) due to the fact that the severity of cold air experienced from one year to the next can vary greatly. For example, the absolute January minimum in 1939 was 29 deg, while in 1940 it dropped to -5 deg.

CONCLUSIONS

- Significant long-term fluctuations of average January and February temperatures occurred at Jackson, Mississippi, between 1896 and 1991.

- Monthly wintertime temperature profiles can be divided into three different types, based on duration of cold weather, number and duration of cold air outbreaks, and degree of warmth between cold episodes.

- The defined polynomial fluctuations were created largely by an increased frequency of either warm skew or cold skew temperature profiles.

- Warm skew profiles occurred exclusively during the following periods: 1898, 1907-1962, 1971-1976, and 1989-1990.

- Cold skew profiles occurred exclusively during the following periods: 1900-1905, 1918, 1940-1948 and 1956-1988.

- There are indications (based on the first harmonic) that the long-term fluctuations of January and February temperatures may be a regular cyclic oscillation.

- Most winter (monthly) temperature averages were associated with a distinct temperature profile (warm skew, balanced or cold skew).

- The fluctuation of the 30-year average shows a strong correlation to the long-term fluctuation indicated by the third degree polynomial approximations.

- The 30-year average is not necessarily representative of monthly temperature averages for a succeeding decade.

- Short-term significant warmings have occurred in the midst of a long-term cooling trend and show up as distinct maxima in the running means and 12th degree polynomial approximations. These maxima are closely linked to an increased prevalence of warm skew monthly temperature profiles (i.e., 1949-1962 and 1971-1976).

- Wintertime extreme minima show less long-term fluctuation than the monthly averages but can show significant variation from year to year.

- The signal that a long-term cooling or warming may have started is the frequent appearance of extreme temperature profiles (i.e., warm skew or cold skew) that are significantly different from those which typically occurred during the previous 30 years.

- Due to the large interannual variation in monthly wintertime averages, it would not be useful to extrapolate polynomial approximations for forecast purposes. However, temperature fluctuations such as the ones described in this paper should be considered when investigating climatic change.

ADDITIONAL NOTES ABOUT DATA BIAS

Due partly to the degree of statistical testing required, the issue of climatic fluctuation is inherently complex and oftentimes controversial. In a statistical and mathematical sense it is complicated by the great amount of yearly variance which is often found in climate data and which can serve to mask underlying trends. Also, existence of various long-term and short-term trends occurring in tandem with one another can further complicate isolating real and significant oscillations from an already "noisy" data set.

Finally, an attempt must be made to gauge data record credibility and to judge its merits and shortcomings. For instance, it is virtually impossible to fully account for changes in thermometer location over the years and corresponding effects on biasing the data. It is also difficult to gauge the bias from many other variables. Furthermore, there will always be some who will argue that conclusions should never be drawn from a set of data that could possibly be biased. Yet, confidence in conclusions can be improved by testing a large number of individual data sets. This is why all three sets of temperature averages for each month were used in this study.

Although curve-fitting results for average monthly maxima and minima are not presented, results were virtually identical to those found for January and February means. Another shortcoming in many data sets used in this study was the lack of complete monthly statistics for several of the years early in the record. For instance, in the set of average February temperatures, data for 1899, 1904, and 1921 are missing. Similarly, data for January 1899 are also missing. Yet, remaining years have been treated as continuous, based largely on the assumption that data from missing years probably would have created little overall change in calculated averages and polynomials.

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REFERENCES

Diaz, Henry F. and Robert G. Quayle, 1978: The 1976-77 winter in the contiguous United States in comparison with past records. *Monthly Weather Review*, **106**, 1393-1421.

Matthews, John H., 1978: *Numerical Methods for Computer Science, Engineering and Mathematics*, Prentice-Hall, Inc., p. 258.

Panofsky, Hans A. and Glenn W. Brier, 1958: *Some Applications of Statistics to Meteorology*, The Pennsylvania State University.

Lettenmaier, Dennis P., Eric F. Wood, and James R. Wallis, 1994: Hydro-climatological trends in the continental United States, 1948-1988. *J. of Climate*, **7**, 586-607.

TABLE I

Period	Percent of temperatures above or below the normal		Period Average *	
	January	February	Jan	/ Feb
1896-1905	78% (below)	88% (below)	45	46
1906-1960	64% (above)	65% (above)	49	51
1961-1991	65% (below)	65% (below)	45	49

* Temperatures in degrees Fahrenheit

TABLE II

Period	Average Temp *		Polynomial Approximation *	
	Jan	Feb	Jan	Feb
1896-1905	45	46	45 (min),1896	48 (min),1898
1906-1960	49	51	50 (max),1911-23	53 (max),1928-34
1991	45	49	44 (min),1974-89	48 (min), 1970-91

* Temperatures in degrees Fahrenheit

TABLE III

30-year period	Avg Jan Temp	Avg Feb Temp
1901-1930	49 deg F	51 deg F
1911-1940	49 "	52 "
1921-1950	49 "	52 "
1931-1960	48 "	51 "
1941-1970	47 "	50 "
1951-1980	46 "	49 "
1961-1990	45 "	48 "

Note: These averages were calculated using integer values, and may not agree precisely with NCDC averages. Also, due to missing data, the 30 year average for February temperatures for 1901-1930 is actually a 28-year average.

TABLE IV

PERIOD AVERAGES VS. POLYNOMIAL APPROXIMATIONS

JANUARY

PERIOD	AVG TEMP	12th DEGREE POLYNOMIAL APPROXIMATION
1896-1901	46 deg F	49 deg (max), 1896
1902-1905	43 "	43 " (min), 1902
1906-1916	51 "	53 " (max), 1912-13
1917-1920	47 "	48 " (min), 1918-19
1921-1939	50 "	51 " (max), 1935-36
1940-1948	45 "	45 " (min), 1941-42
1949-1957	51 "	54 " (max), 1954
1958-1970	44 "	43 " (min), 1959
1971-1976	49 "	50 " (max), 1973
1977-1979	37 "	40 " (min), 1978-1979
1980-1983	45 "	45 " (max), 1983
1984-1988	42 "	42 " (min), 1986
1989-1991	50 "	50 " (max), 1991

FEBRUARY

PERIOD	AVG TEMP	12th DEGREE POLYNOMIAL APPROXIMATION
1896-1898	50 deg F	51 deg (max), 1896
1900-1906	44 "	43 " (min), 1902-03
1907-1911	51 "	52 " (max), 1910
1912-1914	48 "	50 " (min), 1912-14
1915-1919	53 "	53 " (max), 1917-19
1920-1923	50 "	52 " (min), 1920-23
1924-1932	55 "	57 " (max), 1928
1933-1942	49 "	49 " (min), 1940-41
1943-1957	53 "	55 " (max), 1952-53
1958-1970	46 "	44 " (min), 1967-68
1971-1977	51 "	52 " (max), 1974
1978-1985	47 "	44 " (min), 1979-80
1986-1991	51 "	51 " (max), 1990-91

TABLE V

CHANGES IN FREQUENCY AND DURATION OF COLD AIR OUTBREAKS

JANUARY

PERIOD	TYPICAL NO. OF OUTBREAKS	TYPICAL NO. OF DAYS W/ LVL 1 TEMPS OR BELOW
1896-1906	2-4	6-14
1907-1937	1-3	3-8
1938-1948	2-4	3-8
1949-1954	1-3	2-6
1955-1966	2-4*	8-16
1967-1988	3-6*	8-16
1989-1991	1	1-2

FEBRUARY

PERIOD	TYPICAL NO. OF OUTBREAKS	TYPICAL NO. OF DAYS W/ LVL 1 TEMPS OR BELOW
1896-1924	2-4*	5-14
1925-1933	1-3	2-8
1934-1948	2-5*	4-12
1949-1962	0-2	2-6
1963-1982	3-6*	7-16
1983-1989	1-3	5-13
1990-1991	0-1	0-2

* PERIODS DURING WHICH COLD AIR REINFORCEMENTS WERE MOST COMMON.

TABLE VI

WARMEST WINTER MONTHS

	YEAR	%UW *	%EW **	NO. OF DAYS WITH TEMPS >= 70 DEG / MAX
JANUARY:	1898	29.0	16.1	2/ 72
	1907	12.9	45.2	6/ 72
	1909	32.3	22.6	2/ 71
	1911	25.8	45.2	5/ 70
	1913	29.0	32.3	1/ 70
	1914	22.6	25.8	1/ 70
	1916	22.6	45.2	3/ 71
	1917	19.4	32.3	5/ 72
	1921	35.5	29.0	1/ 70
	1923	32.3	19.4	0
	1927	29.0	32.3	2/ 72
	1929	29.0	19.4	1/ 71
	1932	16.1	25.8	3/ 74
	1933	32.3	22.6	1/ 70
	1934	45.2	6.5	0
	1937	22.6	41.9	3/ 74
	1939	22.6	9.7	1/ 71
	1949	22.6	35.5	2/ 72
	1950	25.8	48.4	6/ 74
	1952	32.3	32.3	2/ 73
	1953	32.3	12.9	0
	1972	19.4	29.0	2/ 71
	1974	41.9	25.8	2/ 71
	1975	22.6	19.4	2/ 73
	1989	25.8	16.1	0
	1990	32.3	6.5	0
FEBRUARY:	1911	14.3	50.0	8/ 74
	1918	25.0	28.6	3/ 75
	1925	39.3	17.9	1/ 72
	1926	35.7	14.3	1/ 72
	1927	28.6	46.4	7/ 74
	1930	39.3	14.3	3/ 73
	1932	31.0	34.5	5/ 72
	1938	42.9	21.4	1/ 70
	1944	20.7	27.6	5/ 73
	1949	39.3	7.1	2/ 73
	1950	32.1	14.3	2/ 71
	1951	25.0	21.4	4/ 72
	1952	34.5	10.3	1/ 70
	1954	42.9	7.1	1/ 72
	1956	17.2	20.7	0
	1957	32.2	28.6	3/ 72
	1961	39.3	7.1	1/ 70
	1962	42.9	21.4	1/ 74
	1976	51.7	13.8	1/ 71
	1990	32.1	17.9	3/ 74

* UW, denotes unusually warm average temperatures (between 6 and 14 degrees above the record average).

** EW, denotes extremely warm average temperatures (more than 14 degrees above the record average).

TABLE VII

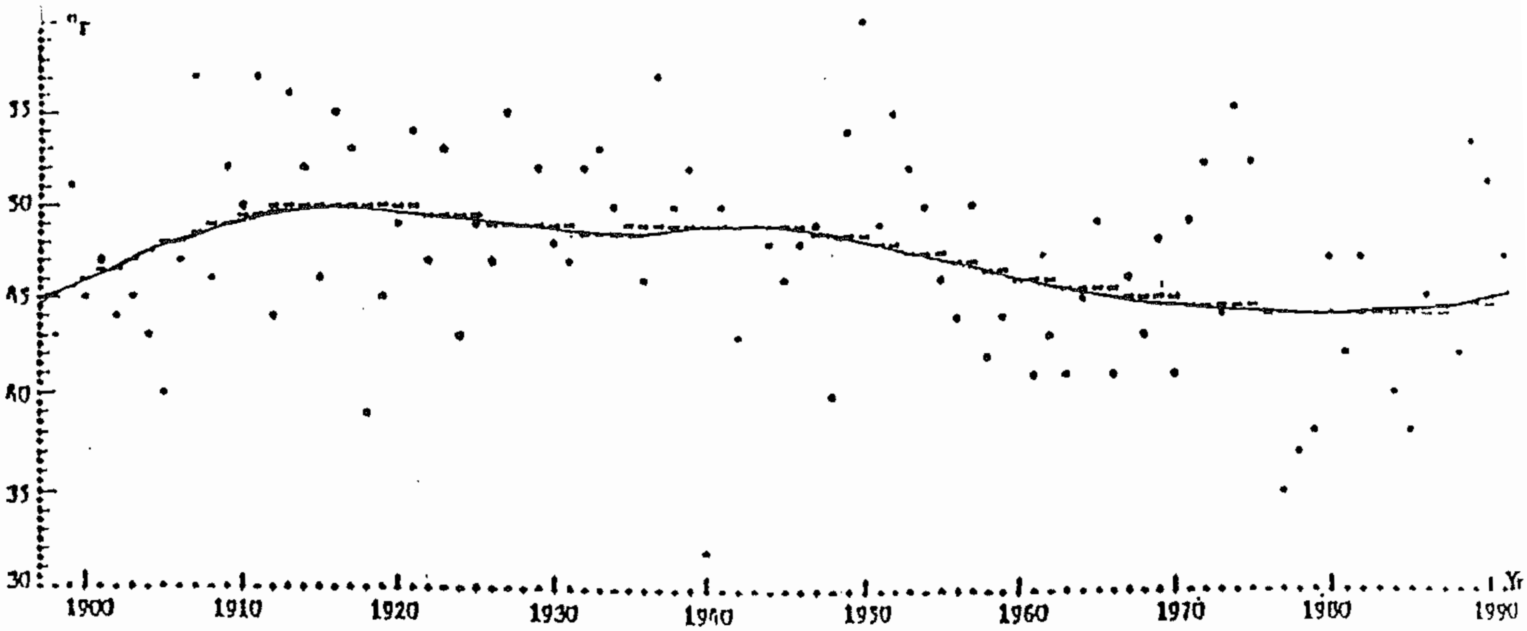
MONTHLY TEMPERATURE PROFILES

(1896-1991)

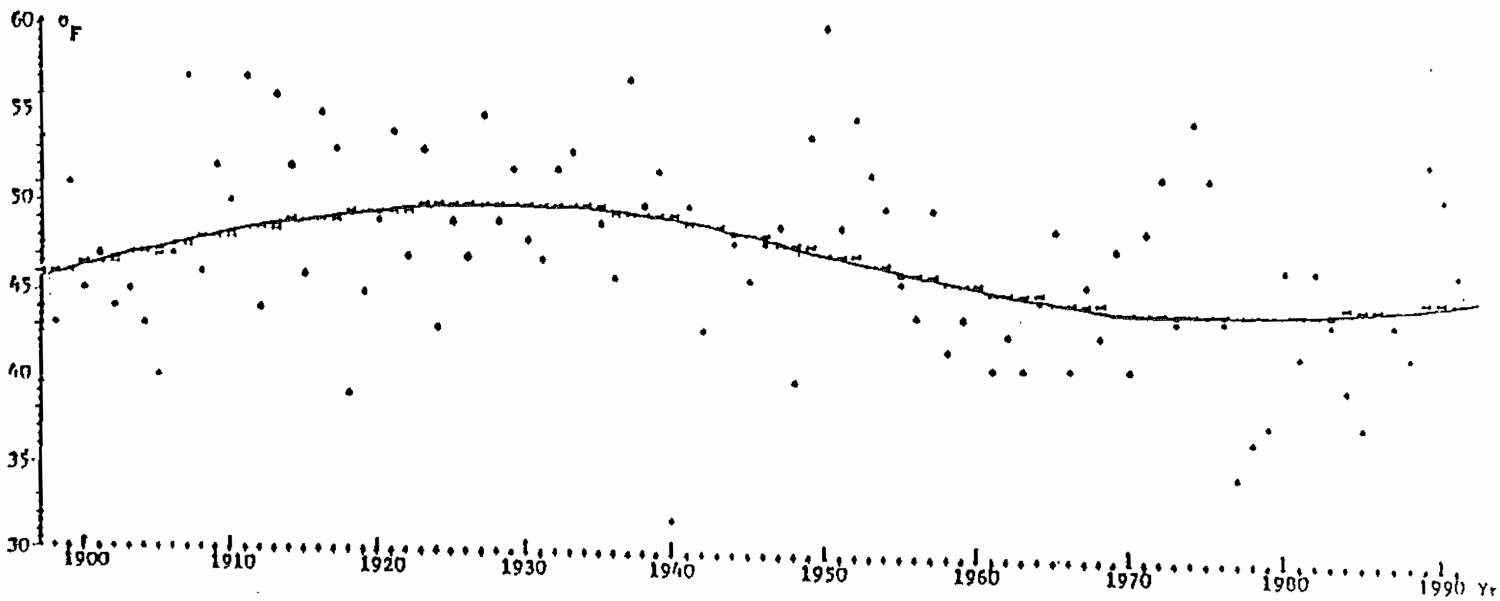
YEAR	COLD SKEW	BALANCED	WARM SKEW
1896		JAN/FEB	
1897		JAN/FEB	
1898		FEB	JAN
1899	--	--	--
1900	FEB	JAN	
1901	FEB	JAN	
1902	FEB	JAN	
1903		JAN/FEB	
1904*	JAN		
1905	JAN/FEB		
1906		JAN/FEB	
1907		FEB	JAN
1908		JAN/FEB	
1909		FEB	JAN
1910		JAN/FEB	
1911			JAN/FEB
1912		JAN/FEB	
1913		FEB	JAN
1914		FEB	JAN
1915		JAN/FEB	
1916		FEB	JAN
1917		FEB	JAN
1918	JAN		FEB
1919		JAN/FEB	
1920		JAN/FEB	
1921*			JAN
1922		JAN/FEB	
1923		FEB	JAN
1924		JAN/FEB	
1925		JAN	FEB
1926		JAN	FEB
1927			JAN/FEB
1928		JAN/FEB	
1929		FEB	JAN
1930		JAN	FEB
1931		JAN/FEB	
1932			JAN/FEB
1933		FEB	JAN
1934		FEB	JAN
1935		JAN/FEB	
1936		JAN/FEB	
1937		FEB	JAN
1938		JAN	FEB
1939		FEB	JAN
1940	JAN/FEB		
1941	FEB	JAN	
1942	FEB	JAN	
1943		JAN/FEB	
1944		JAN	FEB
1945		JAN/FEB	
1946		JAN/FEB	
1947	FEB	JAN	
1948	JAN	FEB	
1949			JAN/FEB
1950			JAN/FEB
1951		JAN	FEB
1952			JAN/FEB
1953		FEB	JAN
1954		JAN	FEB
1955		JAN/FEB	
1956	JAN		FEB
1957		JAN	FEB
1958	JAN/FEB		
1959		JAN/FEB	
1960	FEB	JAN	
1961	JAN		FEB
1962		JAN	FEB
1963	JAN/FEB		
1964	FEB	JAN	
1965		JAN/FEB	
1966	JAN/FEB		
1967	FEB	JAN	
1968	JAN/FEB		
1969		JAN/FEB	
1970	JAN/FEB		
1971		JAN/FEB	
1972		FEB	JAN
1973		JAN/FEB	
1974		FEB	JAN
1975		FEB	JAN
1976		JAN	FEB
1977	JAN	FEB	
1978	JAN/FEB		
1979	JAN/FEB		
1980	FEB	JAN	
1981	JAN	FEB	
1982		JAN/FEB	
1983		JAN/FEB	
1984	JAN	FEB	
1985	JAN/FEB		
1986		JAN/FEB	
1987		JAN/FEB	
1988	JAN	FEB	
1989		FEB	JAN
1990			JAN/FEB
1991		JAN/FEB	

-- MISSING WINTER DATA   * MISSING FEBRUARY DATA

Fig. 1

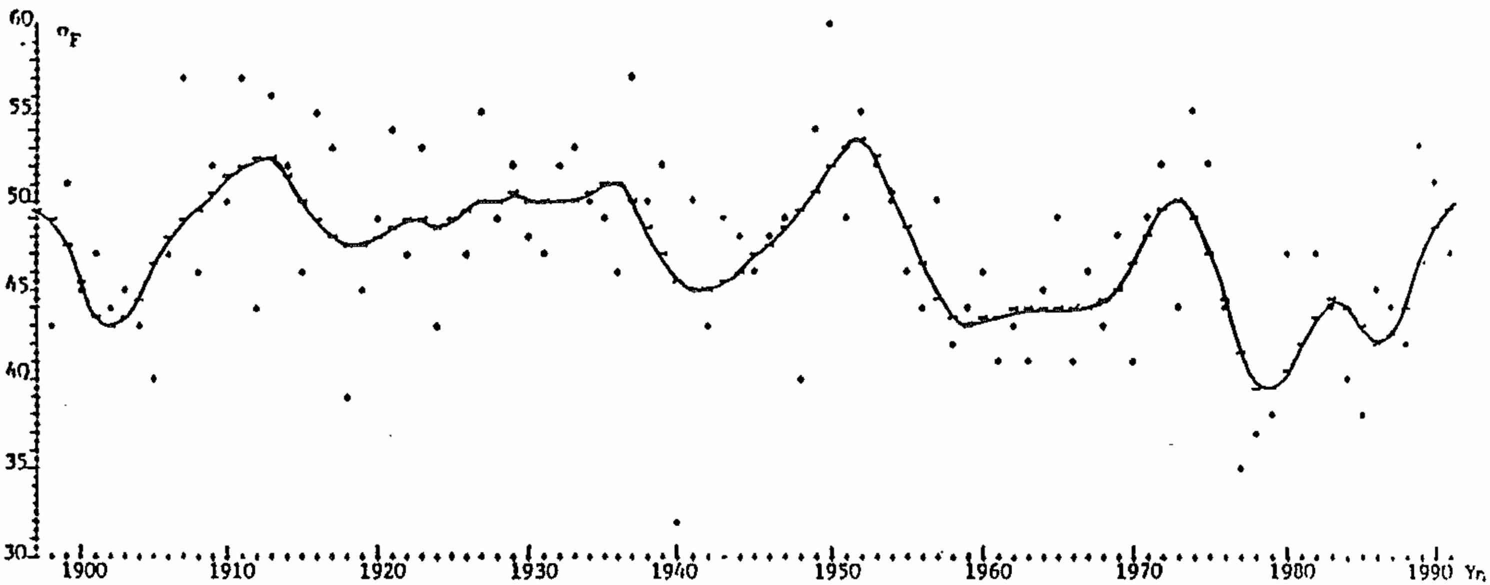


a) Third degree polynomial best-fit curve, fitted to average January temperatures for Jackson, Mississippi (1896-1991). Year with missing data: 1899.



b) First harmonic for average January temperatures at Jackson, Mississippi (1896-1991). Year with missing data: 1899.

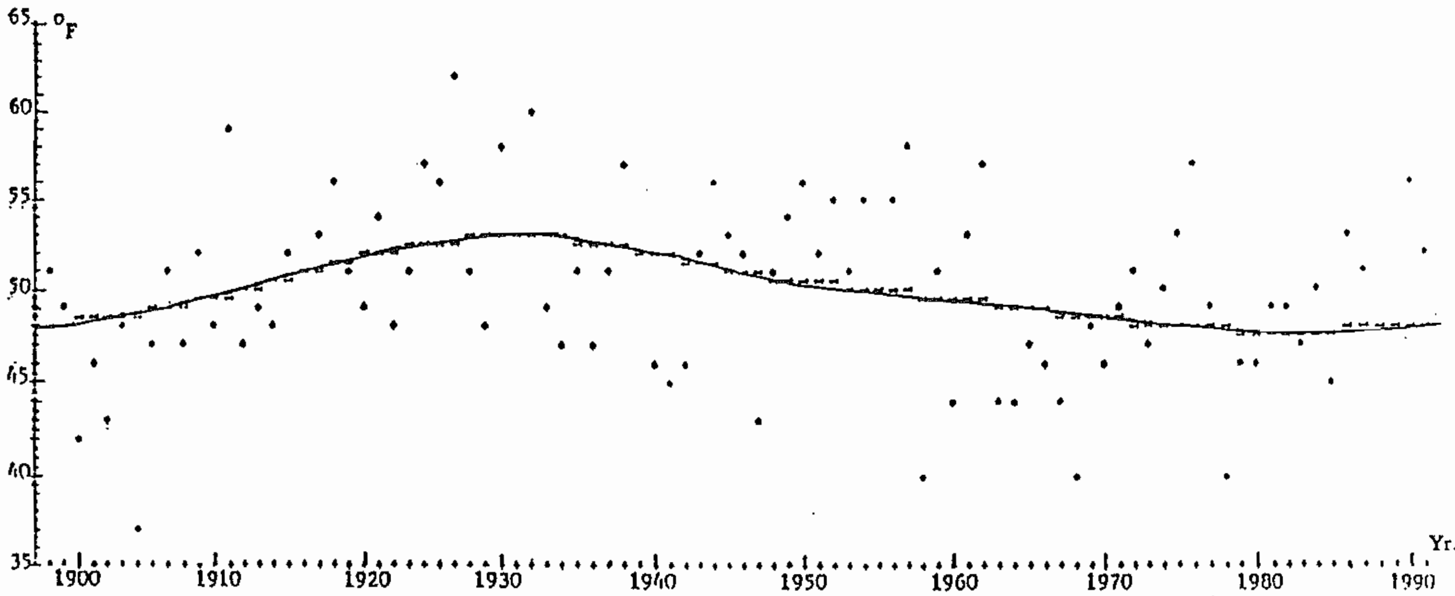
Fig. 2



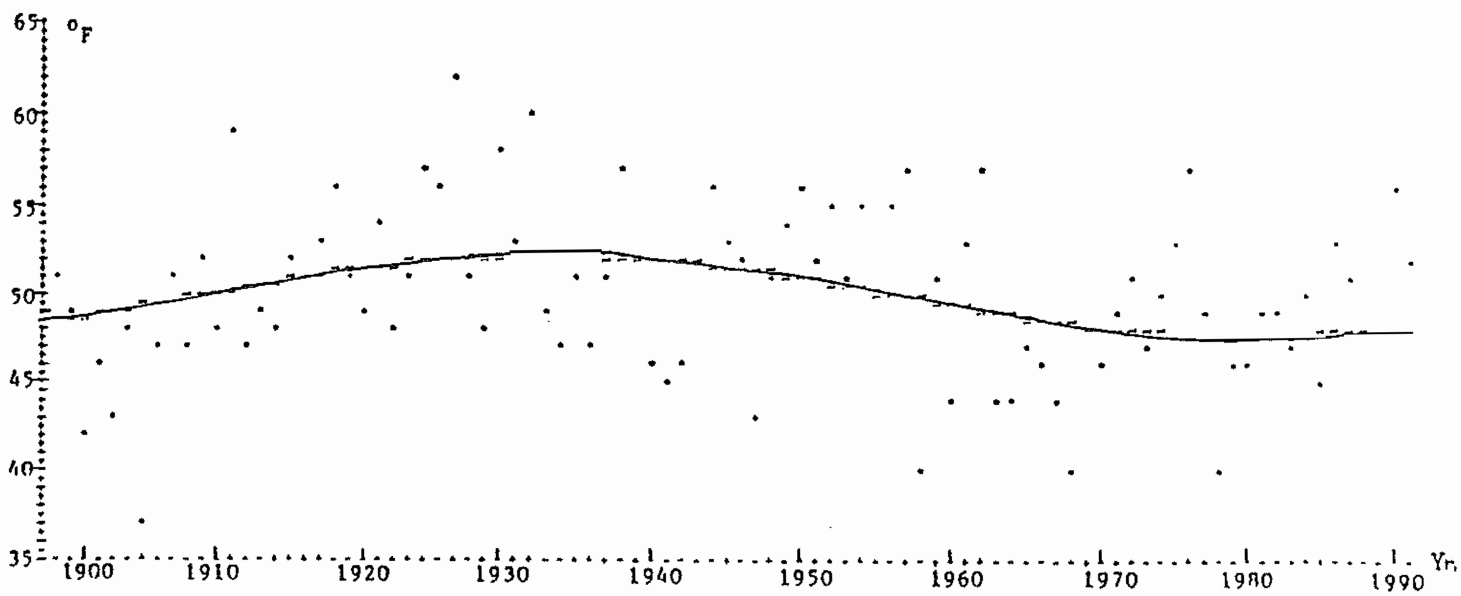
a) Twelfth degree polynomial best-fit curve, fitted to average January temperatures for Jackson, Mississippi (1896-1991). Year with missing data: 1899.

b) Running means for average January temperatures at Jackson, Mississippi (1898-1989).

Fig. 3



a) Third degree polynomial best-fit curve, fitted to average February temperatures for Jackson, Mississippi (1896-1991). Years with missing data: 1899, 1904, 1921.



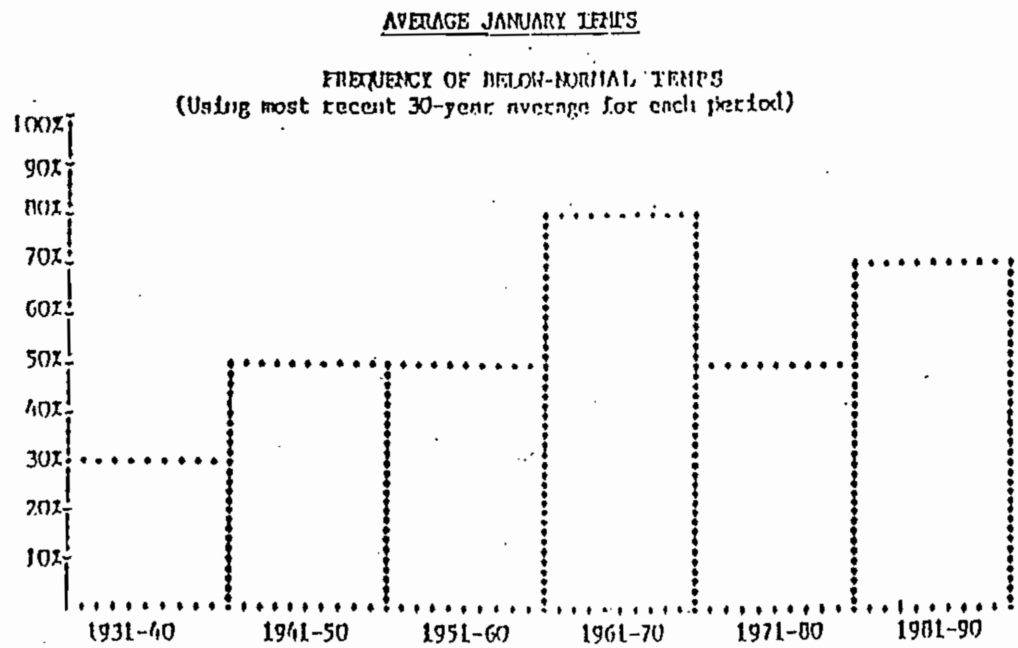
b) First harmonic for average February temperatures at Jackson, Mississippi (1896-1991). Years with missing data: 1899, 1904, 1921.

Fig. 4

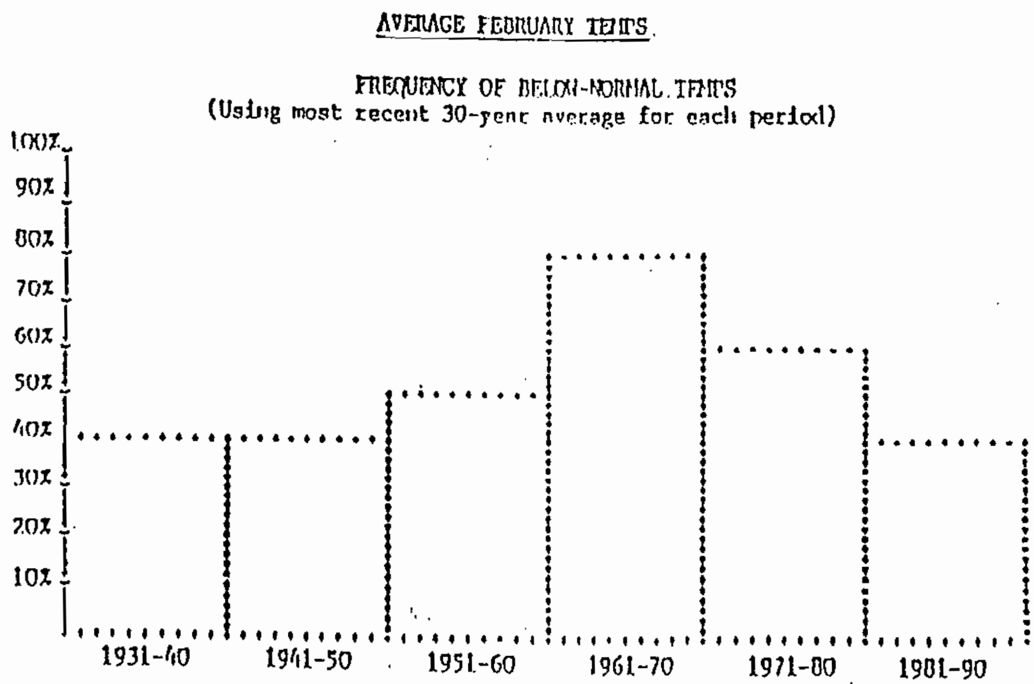
a) Twelfth degree polynomial best-fit curve, fitted to average February temperatures for Jackson, Mississippi (1896-1991). Years with missing data: 1899, 1904, 1921.

b) Running means for average February temperatures at Jackson, Mississippi (1898-1989).

Fig. 5



AVERAGE JANUARY TEMPS
FREQUENCY OF BELOW-NORMAL TEMPS
(Using most recent 30-year average for each period)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
1931-40
1941-50
1951-60
1961-70
1971-80
1981-90



AVERAGE FEBRUARY TEMPS
FREQUENCY OF BELOW-NORMAL TEMPS
(Using most recent 30-year average for each period)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
1931-40
1941-50
1951-60
1961-70
1971-80
1981-90