

LONG TERM TEMPERATURE AND PRECIPITATION TRENDS FOR MEMPHIS, TENNESSEE, 1872-1985

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ABSTRACT

Long term climatic data sets are useful for studying the relationship between climate and various human and environmental processes, but are also uncommon. Climate data for Memphis, Tennessee are available since 1871. This long term data set offers an opportunity to examine climatic trends for a period of over 114 years. An examination of mean annual temperatures indicates four general trends during the data period. Whereas, an analysis of mean annual precipitation totals reveals five general trends over the 114 year period. A comparison of temperature and precipitation trends indicates a weak inverse relationship.

INTRODUCTION

There are numerous research articles that have analyzed long term temperature and precipitation trends in the United States and other parts of the world (Budyko, 1977; Lamb, 1977; Agee, 1982; Barnett, 1983; Baker et al., 1985; Skeeter, 1985). Long term trends of temperature and precipitation are useful for studying the relationship between climate and various human and environmental processes. Climate data sets spanning more than a century are especially useful for studying temperature and precipitation trends, but are also rare. For Memphis, Tennessee, a long term data set exists which includes climate data since 1871. This data set offers an opportunity to examine climatic trends in Memphis for a period of over 114 years. The objective of this paper is to examine the temperature and precipitation trends for Memphis, Tennessee over the last century, and make this information available to others.

METHODS

The Memphis, Tennessee climate data set includes monthly values of temperature and precipitation since February, 1871. The data were obtained from several government publications: 1) Meteorological Summary with Comparative Data, Memphis, Tennessee; 1871-1940, U.S. Department of Agriculture; 2) Local Climatological Data with Comparative Data, Annual Summary, Memphis, Tennessee,

1941-1960, U.S. Department of Commerce; and 3) Climatological Data, Annual Summary, Memphis, Tennessee, 1961-1985, U.S. Department of Commerce. The data for 1871 were not used in this analysis as they are incomplete, thus the data period used in this study spans the years 1872 to 1985. Monthly values of temperature and precipitation were combined to provide annual averages of temperature and annual totals of precipitation for the examination of overall trends in the data. The raw annual averages and totals are highly variable and make it difficult to identify trends. To facilitate analysis of the data, five-year moving averages were calculated. Therefore, the graphs depicting the data begin in 1874 (representing 1872 to 1876) and end at 1983 (representing 1981 to 1985).

ANNUAL TEMPERATURE TRENDS

Figure 1 represents the five-year moving average mean annual temperatures for Memphis, Tennessee, for the period of 1872 to 1985. The average mean annual temperature for the 114 year period is 16.6 degrees Celsius. In Figure 1 several periods of warmer than normal and cooler than normal temperatures are evident. For example, mean annual temperatures were below the 114 year mean for most of the late 1800's and early 1900's up until around 1920. After 1920, mean annual temperatures remained above normal for nearly 30 years, with the exception of a short cool period between 1942 and 1950. In the late 1950's mean annual temperatures dropped below normal until the mid 1970's. Since the mid 1970's mean annual temperatures have been above normal.

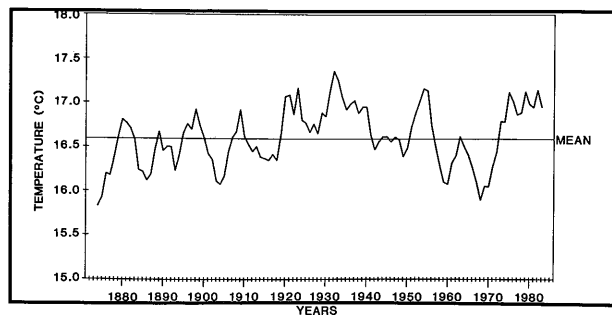


Figure 1. Five-year moving average mean annual temperatures for Memphis, Tennessee, 1872-1985.

The temperature trends in Memphis are similar to those at other locations in the Northern Hemisphere. The consensus of most research is that in the Northern Hemisphere, during the last 100 years, there have been three general periods of temperature change; a cooling during the mid to late 1800's, a warming around the turn of the century to a maximum near 1930, and then a general cooling from the 1940's to the present (Agee, 1982). The mean annual temperature data for Memphis appear to support this idea, except for the warming since the mid 1970's evident in the Memphis data.

ANNUAL PRECIPITATION TRENDS

Figure 2 represents the five-year moving average annual precipitation totals for Memphis for the period of 1872 to 1985. The mean annual total precipitation for the 114 year period is 1,251.7 millimeters. There are several trends apparent in Figure 2. Precipitation levels were above normal from the 1870's until the 1890's. Annual precipitation totals then remained below normal, except for a few years, until the mid 1940's. Subsequently, annual precipitation totals rose to above normal through most of the 1950's, and then dropped to below normal through the 1960's. In the 1970's annual precipitation totals increased to above normal and remained above normal through the end of the data period.

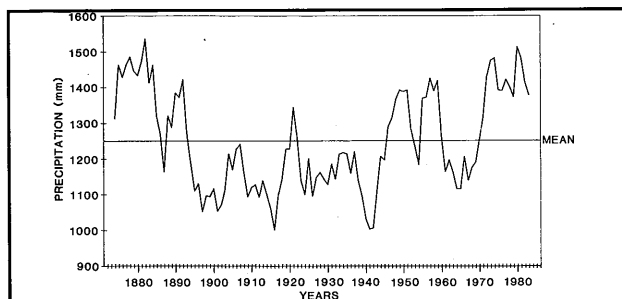


Figure 2. Five-year moving average annual precipitation totals for Memphis, Tennessee, 1872–1985.

COMPARISON OF TEMPERATURE AND PRECIPITATION TRENDS

It is often interesting to compare temperature and precipitation trends to identify relationships between these two climatic variables. The comparison of temperature and precipitation trends in Memphis, from 1872 to 1985, results in a slight negative correlation ($r = -.19$). The negative correlation indicates that there is a slight inverse relationship between temperature and precipitation. During warmer than normal periods, precipitation is lower than normal, and during cooler than normal years, precipitation is

higher than normal. The correlation is small, however, and barely significant at the .05 level. The statistical significance at the .05 level is primarily due to the large size of the data set, not to a good relationship between temperature and precipitation. Thus, there is no strong relationship between temperature and precipitation trends in Memphis over the long term.

By comparing Figures 1 and 2 there are some interesting relationships that can be identified. For example, during the 1920's to the 1940's, mean annual temperatures were much above normal, while at the same time annual precipitation levels were much below normal. This combination of higher than normal temperatures and lower than normal precipitation occurred during the dust bowl years of the Plains states. Since the mid 1970's mean annual temperatures have again been above normal, but at the same time annual precipitation totals have also been above normal. Therefore, no severe drought conditions have resulted.

CONCLUSION

The trends of mean annual temperature in Memphis appear to coincide with the trends found for other locations in the United States. A cooler than normal period occurred during the late 1800's, with a subsequent warming to a maximum around 1930. Into the 1940's mean annual temperatures began to drop. With the exception of a few years in the early 1950's, mean annual temperatures remained below normal until the mid 1970's. Since the mid 1970's mean annual temperatures have risen to above normal. The comparison of temperature and precipitation trends indicates a slight, but weak, inverse relationship.

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