A Comparative Micro-weather and Micro-climate Study of Seminole and Wewoka, Oklahoma

CHARLES E. WEBB, Kansas State Teachers College, Emporia, Kansas

INTRODUCTION

One of the most discussed topics in man's daily conversation is weather. He talks about the current weather conditions, weather of the past, and the extremes of temperature and precipitation. Frequently, conversations concerning weather are directed toward the comparison of the weather phenomena of adjacent or nearby areas. One individual may comment that it seems to be cooler at grandfather's farm than at his own home in a town only ten miles distant. A farmer in the western sector of a county will point out that his crops have been without rain while those in the eastern part of the same county have recently received more than an inch of rainfall. City residents viewing the evening weather report on their television sets will often notice several degrees of temperature difference between reporting stations within the city limits.

Some of the variations in weather elements may be imagined or exaggerated. There is also the possibility of inaccurate instrument reading or faulty instruments. A difference of temperature or precipitation on a particular day might be real but random. In certain areas, however, there is enough consistency in reported variations to infer the possible existence of definite patterns of micro-weather or micro-climatological differentiation.

The Seminole and Wewoka, Oklahoma areas were selected for a micro-weather comparison, because residents and former residents of the two areas indicated that noticeable variations of temperature and precipitation existed there. Examination of available weather data appeared to verify their general observation and justify further study.

Both areas met certain minimum requirements permitting investigation. Each has an official station to record temperature and precipitation. The instruments used for gathering data are of the same type, quality, and commercial brand and are housed in instrument shelters of like construction. Both have replaced their maximum-minimum thermometers at least once during the study period. The two stations have similar reporting schedules and a complete set of records for the five-year study period. The horizontal distance between the two is approximately nine miles, while the difference in elevation is only 51 feet.

January and July statistics were selected for this study in an effort to sample winter and summer characteristics. Comparison of data for these months was done for a selected five-year period, to somewhat minimize the effect of chance or coincidental variations.

Location and Physical Setting

Seminole and Wewoka are central Oklahoma cities in Seminole County. The Seminole weather recording instruments are situated at the local fire station in the downtown area of the city at 35° 14' N. Lat. 96° 40' W. Long. The Wewoka instruments are kept at radio station KWSH, located in a narrow sparsely inhabited valley three miles west of that city at 35° 10' N. Lat. 96° 33' W. Long.

The Seminole recording facility occupies a grass-covered corridor at the edge of an asphalt and gravel parking lot. The site is adjacent to a fire station and is near the crest of a low ridge at an elevation of 865 feet. Buildings, streets and parking areas cover most of the surrounding region. Vegetation is limited to occasional lawns and trees in curbside parkages. Wind exposure is greatest from the south and southwest.

Wewoka's recording equipment is located on a small knoll on the floor of a north-south trending stream valley at an elevation of 814 feet. The site is near the studio and parking lot of a radio station. Vegetative cover in the immediate proximity of the instruments is predominantly grass and weeds, with moderate tree growth at distances of 200 to 400 yards. Wind exposure is greatest from the south and southeast.

Based upon long-time records, the climate for both cities of the study area is classified as humid subtropical. The terrain of the broad general region is dominated by low ridges and shallow valleys that have a general north to south orientation.

Comparison oe January Temperatures

Wewoka has a local reputation for experiencing consistently lower January temperatures than Seminole. Statistics appear to justify this reputation. Wewoka recorded the lower minimum temperature on 104 of 155 January days while tying for the low 11 other days. The average daily differences in low temperatures for the 104 days cited was 3.6 F. The greatest variation during the period was 8 F and was experienced on several occasions. In January, 1962, Wewoka recorded the lower temperature on 28 of the 31 days.

Variation of maximum daily temperatures were similar to the pattern established by the daily minimums. Seminole recorded the greater maximum on 94 of 155 days while registering the same maximum 29 times. A high percentage of the days having like maximum temperatures occurred during days of snow cover.

An indication of overall temperature contrast may be obtained by comparison of degree days heating for each location. (Degree days of heating refers to the difference between 65 F and the mean temperatures of a given day that is cooler than 65.) Wewoka accumulated 4458 January degree days heating in 5 years, compared to 4211 degree days for Seminole in the same period of time. The average monthly variation in degree heating days in the 5-year period was 49.4 F. This difference represents not only a measurable index of contrast, but a tangible factor in determining fuel consumption.

There can be little doubt that Wewoka has had a tendency to be the cooler of the two recording points. To determine why the difference between the two occurs, it is necessary to compare the immediate environment of each. Three factors appear to be the most responsible for the variation in January temperatures between the two weather stations.

The difference in the absorptive quality of the surface surrounding each area is great enough to create a differential in the rate of absorption of solar energy. The black, grey and brick red of streets, parking areas,

walls and tar-covered roofs in the Seminole urban region readily absorb energy during daylight hours. Conduction and terrestrial radiation would have a tendency to retard cooling in the period of darkness. Grass and tree cover in the Wewoka vicinity, because of deciduous characteristics, develops tan and brown coloration in the winter months. The relatively light colors have a reflective quality, not conducive to maximum absorption of solar energy. Such bright surfaces are prone to rapid dissipation of heat, especially on cloudless nights.

A second probable reason for lower Wewoka temperatures, particularly during the hours of darkness, may be the difference in topography. Wewoka, located in a valley floor, is subject to drainage of cold air from higher terrain. This condition is indicated in statements made by local residents concerning frequent ground fog in the valley. Seminole has an elevation similar to that of Wewoka, but is located near the crest of a ridge. It, therefore, is not subject to the pooling of cold air. The noted infrequency of ground fog in the immediate vicinity of the weather instruments contrasts with that phenomenon at the Wewoka site.

A third factor having an influence on the temperature characteristics of the two study points is the contrast between urban and rural environment. Seminole has the greater potential for atmospheric heating by culturally induced conditions. Air temperature is slightly increased due to radiation from heated homes, shops, and offices. An additional capacity to absorb earth radiation may result because of the induction of carbon dioxide into the atmosphere from automobile exhausts and filterless chimneys. The contribution of vegetative cover to atmospheric heating during winter months is insignificant by comparison.

Comparison of January Precipitation

January precipitation in the Wewoka and Seminole areas is rather slight, making it difficult to establish obvious variations. Wewoka recorded a total of 5.49 inches of precipitation for the 155-day study period compared to 4.10 inches at Seminole. Perhaps the most significant statistic concerns the frequency of precipitation days. Wewoka recorded 32 days having rainfall or snow while its Seminole counterpart reported 26.

In addition to the possibility of coincidence, there are two valid potential causes for the greater number of rainy days reported at Wewoka. The valley in which the station is located is open to invasion of moisture-bearing breezes from both the north and south. The cooler temperatures might cause the atmosphere to be cooled to its dew point more frequently than at Seminole.

Comparison of July Temperatures

The most obvious pattern of temperature variation may be found by examining the July maximums for each station. Seminole registered the higher temperature on 141 of 155 days, while Wewoka claimed the higher reading on only three occasions. The greatest difference between maximum temperatures was 8 F.

July minimum temperatures were almost equally as dominated by the Wewoka recording facility. That station scored the lower minimum 123 times.

Two basic factors appear to account for the divergence of July heat characteristics. The most important may once again be traced to unlike rates of solar energy absorption. The man-made landscape features of Seminole again provide the more effective surface for energy absorption and heat retention.

The second agent contributing to temperature differentials is more subtle and difficult to evaluate. Involved is a reduction of absorption because of the reflection of broadleaf plants and the increased surface exposed to insolation by a vegetative cover. This trait of tree and grass cover is not actually separate from the absorption situation mentioned earlier, but rather an additional and complementary factor.

The probability that absorption and reflection qualities control the heating variance is strongly indicated by noting the lack of temperature difference on days of limited insolation. Ten of the 14 dates on which Seminole failed to exhibit a greater degree of heating were days having precipitation. It might well be concluded that by nullifying the absorption factor, both areas will share the similar atmospheric properties of a given air mass. To test the validity of this conclusion, sample observations were made of atmospheric conditions on a clear July day and the procedure repeated on a day a few hours after precipitation had ocurred.

On July 5, 1965, 0.02 inches of precipitation fell at each station. Following the rainfall, temperatures were examined and a reading of 90 F. was observed at both points. Both places had approximately 75% cloud cover and light southerly breezes. A check of relative humidity, using a sling psychrometer, revealed 49% relative humidity at Wewoka compared to 46% at Seminole.

On 7 July 1965, no precipitation occurred. Atmospheric observation was made at the same hour as that taken 5 July. Seminole's temperature was 94 F, while Wewoka registered 91 F. The cloud cover at Seminole was approximately 40%; that of Wewoka about 25%. Relative humidity displayed the most outstanding change, with Wewoka being at 50% of saturation and Seminole at 34%.

Comparison of July Precipitation

Very little deviation of July precipitation patterns for the areas is discernible. Seminole averaged 3.8 inches of rainfall per month for the five-year period of examination, compared to an 3.6-inch average at Wewoka. The total number of rainy days at Seminole was 44 and only one less at Wewoka.

Occasionally, both reporting points recorded rain on a given date and only one of the two indicated rain on the following day. This appears to result from a difference in the duration of a particular rainfall period. In some instances, rainfall at one of the stations extended past the 7 A.M. instrument reading time.

Conclusions

It appears rather certain that weather conditions may present marked contrasts within limited areas. This contrast can occur despite the fact that an entire region has the same climatic classification. Some of the differences are slight and insignificant, while others are obvious and easily measured.

The factors that control the nature and degree of variation are numerous and may be found in almost unlimited combinations. These factors may be the result of either natural physical features or characteristics of the cultural environment.

Determination of the extent of weather differences is made somewhat difficult by the lack of extensive data gathering facilities. Unlike reporting periods and different instrumentation may also complicate the verification of suspected contrasts in atmospheric properties.

The specific example of the Seminole and Wewoka micro-weather

study serves to illustrate that locally observed weather anomalies are not only real, but measurable. It also offers an opportunity to establish practical relationships betwen earth surface environments and local weather conditions. An ability to accurately perform such studies may prove valuable to both agriculture and industry.

The individual planting orchards will be interested in understanding local frost or freezing characteristics. Industries working with cotton or woolen fibers are interested in humidity. Oil companies need to be familiar with heating conditions when pumping or pipelining petroleum products. Most industrial establishments and individual home owners are vitally concerned with the cost of heating buildings. The most equitable temperature, precipitation or humidity regime for a particular activity may be more effectively determined on the basis of micro-weather or micro-climatic studies than by evaluation of gross climatic regions.