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The Relationship of K-Values to Areal Coverage of Showers in the Mid-South

by

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1. Introduction.

Shower and thundershower forecasting from late spring until late fall has been a very significant problem and one of the most important services for the Mid-South agricultural program. Air mass as well as occasional frontal thundershowers occur during this time with air mass activity playing the dominant role. This article describes and illustrates preliminary results of a statistical relationship which appears useful for forecasting areal coverage of showers and thundershowers over the Mid-South agricultural area including the Missouri Bootheel, West Tennessee, Arkansas, northeast Louisiana, and the northern half of Mississippi.

2. Procedures.

The forecast problem was defined as: What percent of the Mid-South agricultural area will receive measurable rain during the 24-hour period following the 1200Z observation time?

Rainfall records from 74 reporting stations connected by the teletype and agricultural communications network over the Mid-South area were used to determine the percent of these 74 stations receiving measurable rain during this 24 hours. It is assumed that the percent of stations receiving rain is a reasonable estimate of the areal coverage.

K-values, as described by George (1), combine both moisture and stability parameters into a single, easily computed index which can be quickly plotted and analyzed. The formula for computing K-values is as follows:

K = (850 mb Temp - 500 mb Temp) + (850 mb dew point) - (700 mb dew point depression)

K-values can be computed for the areas east of the Rocky Mountains in approximately 10 minutes. The chart is then analyzed by drawing K-value isopleths with intervals of 5 units. This simple K-chart has proved to be very useful in the agricultural program, as well as the state and aviation forecast programs, and has led to this attempt to objectively relate K-values to the areal distribution of showers.

An attempt was first made to relate a single station K-value (Little Rock, Ark.) with the amount of areal coverage of precipitation and average rainfall amounts over the Mid-South area. Although this showed a significant relationship, it was found that better results were obtained when a group of K-values from at least four stations were averaged. Due to the general eastward progression of upper air parameters, the most useful results were obtained when K-values were averaged for the following four stations: Little Rock, Shreveport, Fort Worth, and Oklahoma City.

The following table illustrates the relationship obtained from these two months of data between this average K-value and the areal coverage and average amounts of rainfall.

K-values	Percent of areal coverage and average rainfall amounts
Less than 20	13% coverage with 2.40" average total rainfall for the 74 stations per day, or .03" per station.
20 - 24	30% coverage with 5.39" average total rainfall, or .08" per station.
25 - 29	44% coverage with 13.28" average total rainfall, or .18" per station.
30 and greater	61% coverage with 14.96" average total rainfall, or .20" per station.

The number of cases in each category of K-values was fairly equally divided among these four groupings. Eventually, as enough cases are accumulated, the distribution of the percentage of stations will be shown for each class interval.

Although the relationship shown in the above table should prove to be very useful in forecasting the areal coverage of precipitation over the Mid-South agricultural area, study is being made of the respective weights of the variables that make up the K-values. It appears from preliminary results that the instability represented by 850 mb Temp - 500 mb Temp is more significant than moisture at 700 mb. This is true particularly in stable situations when no precipitation occurs with high K-values that result from saturation with a middle cloud deck at the 700 mb level. There are indications, also, that the relationship of K-values to the occurrence of precipitation may vary with latitude and season, with decreasing coverage in southern sections of the Mid-South and with the advance of summer. Thus far, there appears to be a definite correlation between heavy rainfall amounts and high K-values, but much more information is needed before concrete conclusions are reached.

3. Concluding remarks.

Although this report is not conclusive, as much more data needs to be obtained, a start with the simple K-chart has proved very useful. This K-value information is available earlier than any facsimile charts that use the 1200Z data, and can be drawn up very rapidly. Forecast movement of these K-values has created some problems, but it appears that there is a good correlation between this movement and vertical motion and advective changes of moisture and stability.

It is hoped that this brief report on preliminary results will stimulate more extensive use and experimentation with K-value charts. A much more complete analysis will be reported upon after more data has been accumulated.

4. Acknowledgements.

The entire staff of WBAS, Memphis contributed to this study. Much of the statistical work was done by Miss Marilyn Mitchell, Youth Opportunity Employee.

References

(1) J. J. George, 1960 "Weather Forecasting for Aeronautics", pp 409-415.

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