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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE
SYSTEMS DEVELOPMENT OFFICE
TECHNIQUES DEVELOPMENT LABORATORY

TDL OFFICE NOTE 76-2

THUNDERSTORM RELATIVE FREQUENCY DISTRIBUTIONS FOR USE IN DERIVING THUNDERSTORM FORECAST EQUATIONS

Donald S. Foster

January 1976

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THUNDERSTORM RELATIVE FREQUENCY DISTRIBUTIONS FOR USE IN DERIVING THUNDERSTORM FORECAST EQUATIONS

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1. Introduction

The screening regression equation for general thunderstorm prediction developed by Reap and Foster (1975) for the 1975 spring and summer months had, as its second term, the six-month averaged relative frequencies of thunderstorms based on a manually-digitized radar (MDR) code of 4 or greater (see figure 1). This term made a very significant contribution to the resultant forecast probability especially in the southeastern states where thunderstorm frequency was high. In fact, it became apparent during the thunderstorm season that the large monthly departures of the relative frequency from the six-month average caused the forecast probabilities to be too high in the early spring and late summer and much too low in mid-summer.

2. Relative Frequencies to be Used in 1976

In an effort to overcome this deficiency before the 1976 season, monthly relative frequencies were computed starting in November 1973. As two years of monthly frequencies became available they were averaged. Figure 2 shows the monthly frequencies compared with the six-month average for one MDR block in southern Alabama. The peak frequency of 60 percent in August is 22% higher than the six-month average. Considering the coefficient of 0.8972 in the regression equation this would result in a probability forecast 20% too low, other factors being the same. In fact, the variation in the monthly frequencies was so large that we decided to offer daily frequencies interpolated from the monthly values as a predictor in deriving the regression equation for 1976. The monthly values will be applied at the middle of the month and a linear interpolation applied on a day-to-day basis between mid-months. We hope this will result in a significant improvement in next year's thunderstorm probability forecasts.

The figures in Appendix A are relative frequency maps for the 2-year period from November 1973 through October 1975. They consist of monthly frequencies for each year and a two-year average. November and December are averaged for 1973 and 1974 while the other months are averaged for 1974 and 1975. A 9-block smoothing routine was applied to each month's frequencies in order to smooth over irregularities. Some blocks were so distant from a radar site that the MDR code may have been reported less than 4 although it would have been more than 4 had the block been closer to the radar site. Even with this amount of smoothing and averaging there are two noticeable areas of suspiciously low frequencies, namely, the areas around northeastern Texas and West Virginia. In spite of this deficiency, the addition of the frequency term is expected to add significant accuracy to the new 1976 thunderstorm probability equation.

The National Severe Storm Forecast Center at Kansas City has asked TDL to expand the thunderstorm probability outlook to a 24-hour period, ± 12 hours from 00Z. In preparation for deriving a forecast probability equation for this period, 24-hour frequencies have been computed from the same 2-year period as the 6-hour frequencies. These 24-hour frequencies are shown in Appendix B.

3. References

Reap, R. M. and D. S. Foster, 1975: New operational thunderstorm and severe storm probability forecasts based on model output statistics (MOS). Proc. Ninth Conf. on Severe Local Storms, Am. Meteor. Soc., Boston, Mass., 58-63.

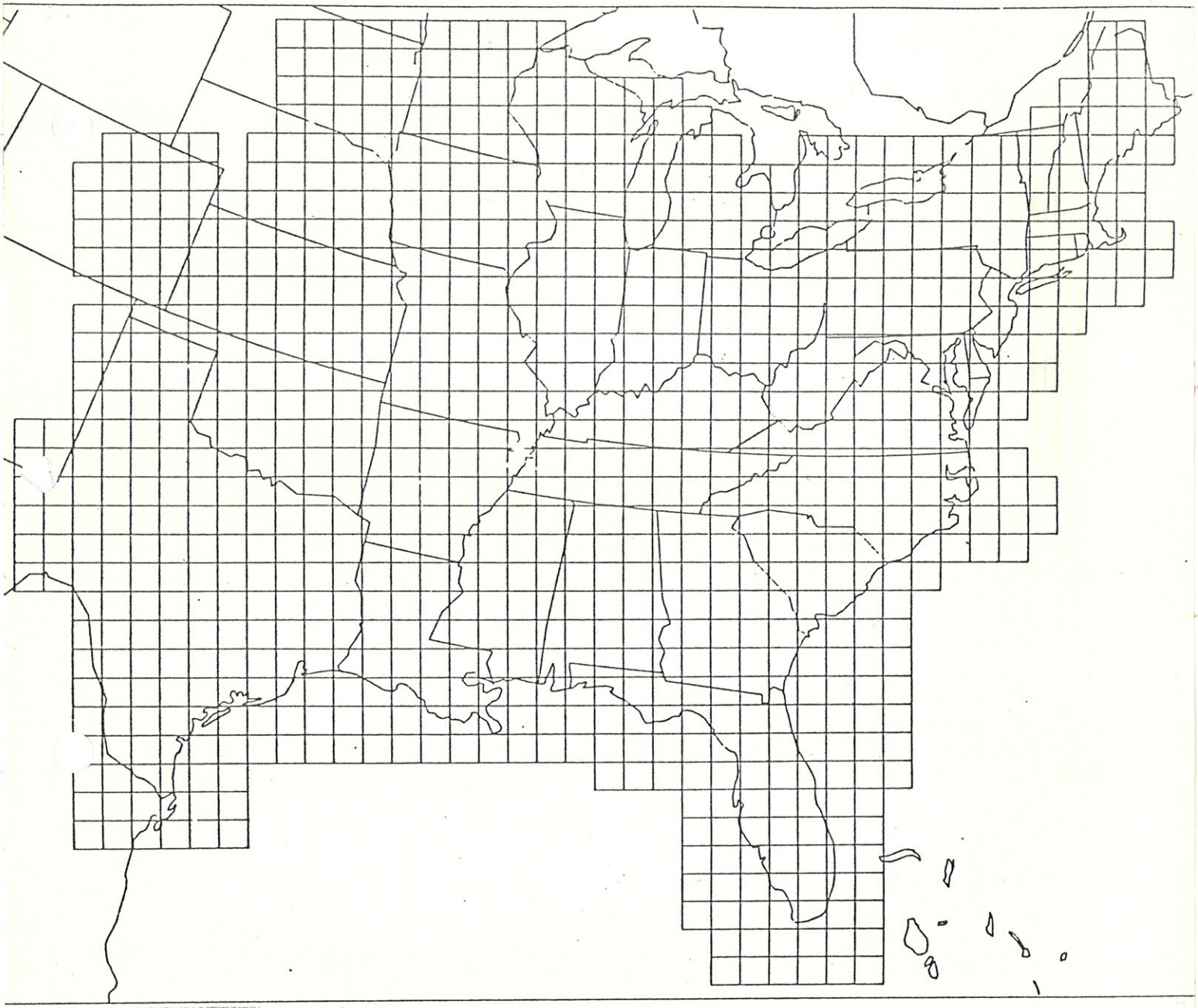


Figure 1. MDR grid for which data were collected for verification.

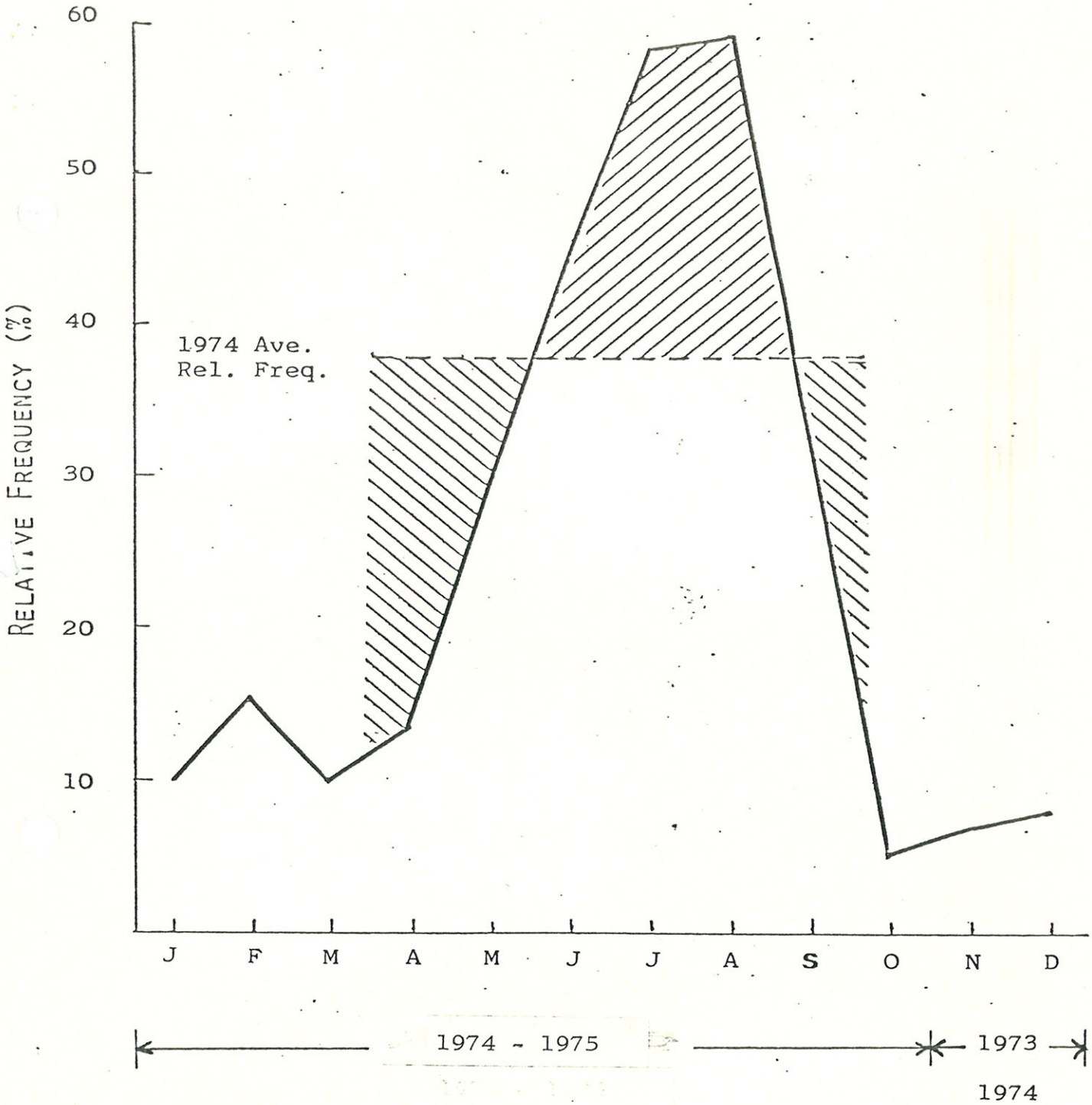


Figure 2. Relative frequency of MDR code $\geq$ 4 for one MDR block in Southern Alabama for 0000 GMT $\pm$ 3 hrs.

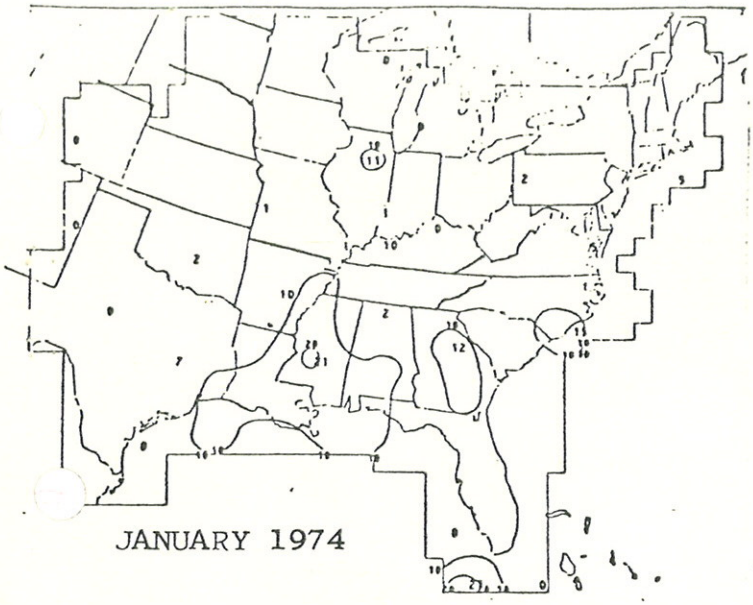
Appendix A

Page

Thunderstorm relative frequencies for 6-hour period centered on 0000 GMT for:

January and February	1974 and 1975	.1
March and April	1974 and 1975	.2
May and June	1974 and 1975	.3
July and August	1974 and 1975	.4
September and October	1974 and 1975	.5
November and December	1973 and 1974	.6

TSTM RELATIVE FREQUENCY DISTRIBUTION (PERCENT) FOR PRD ± 3 HRS FM 00Z



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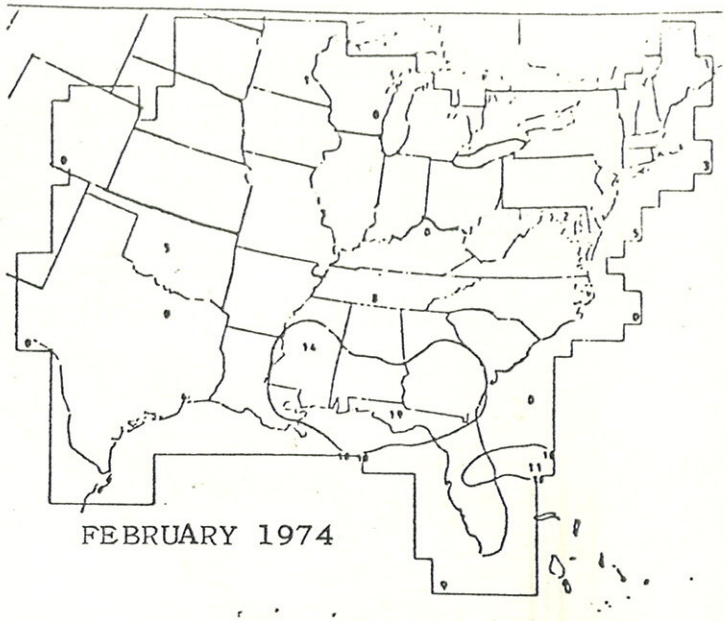

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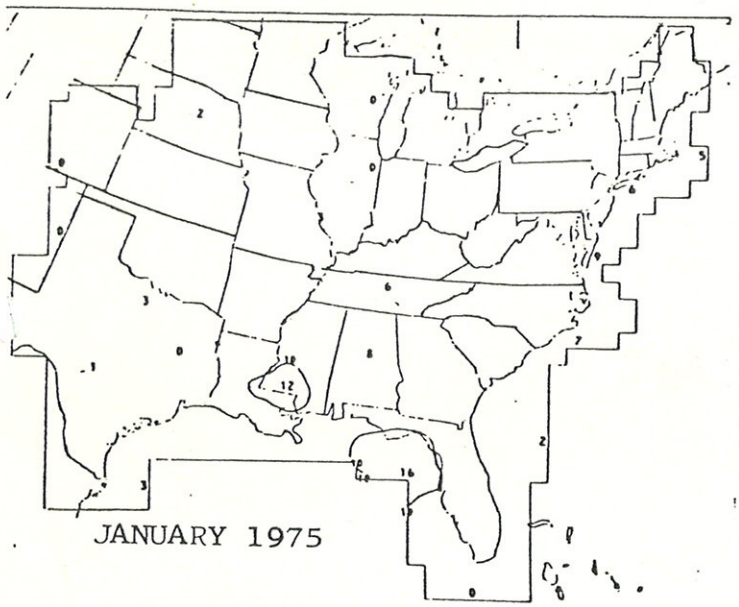

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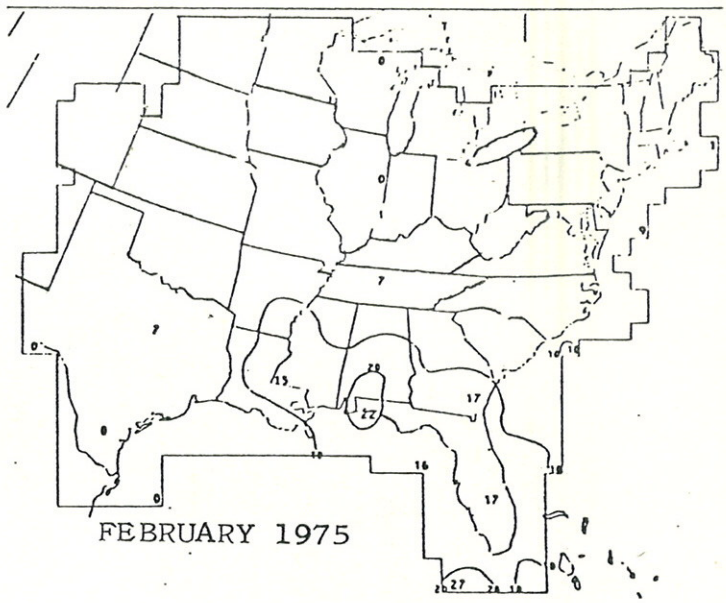

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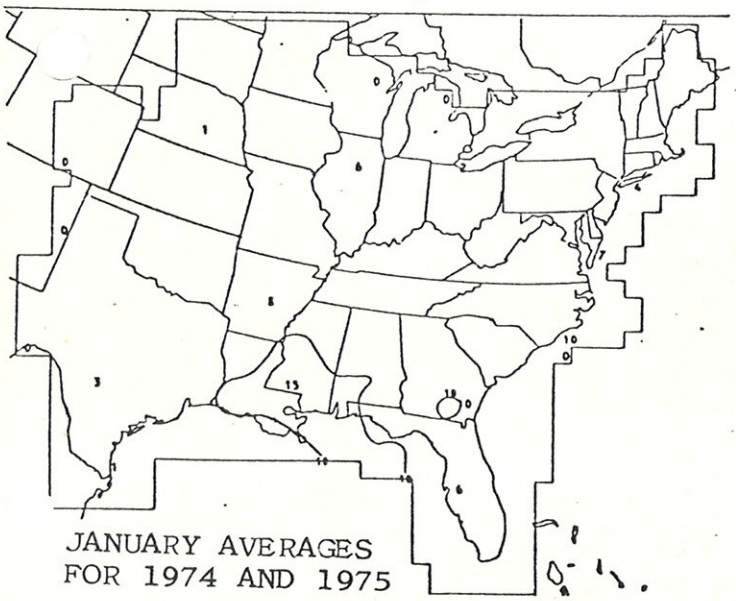

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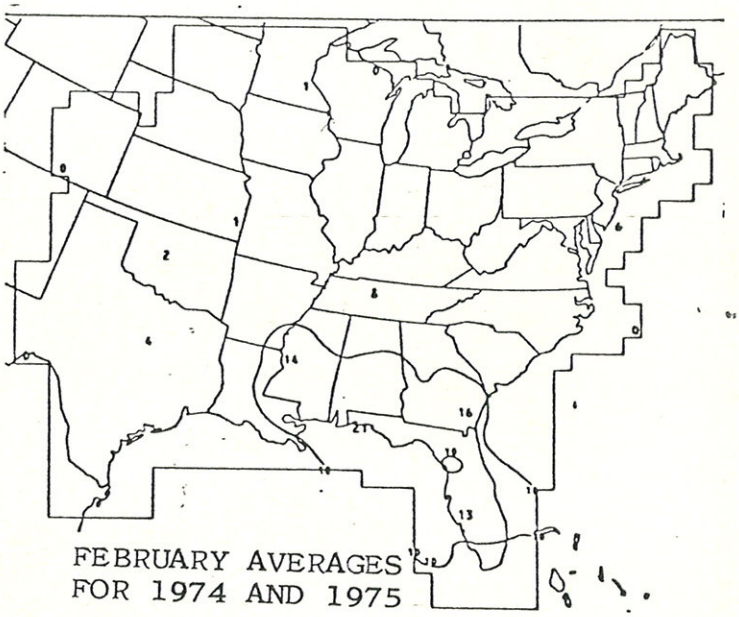
FOR 1974 AND 1975



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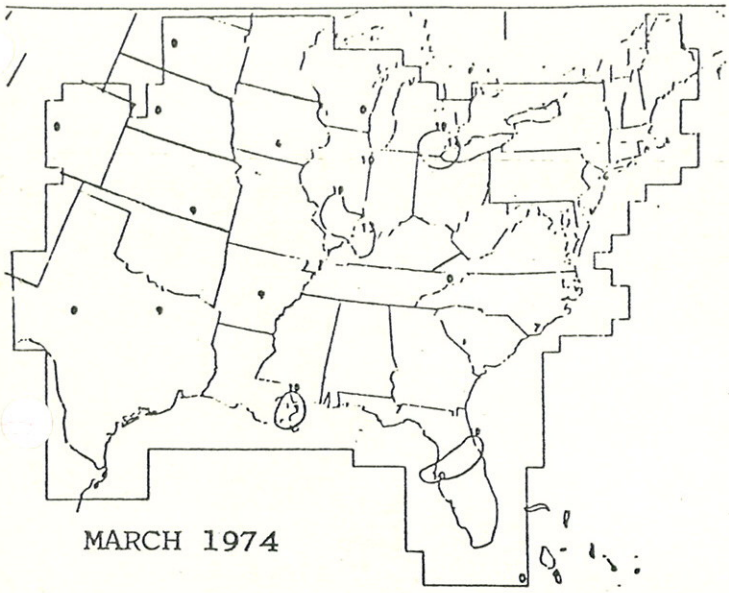

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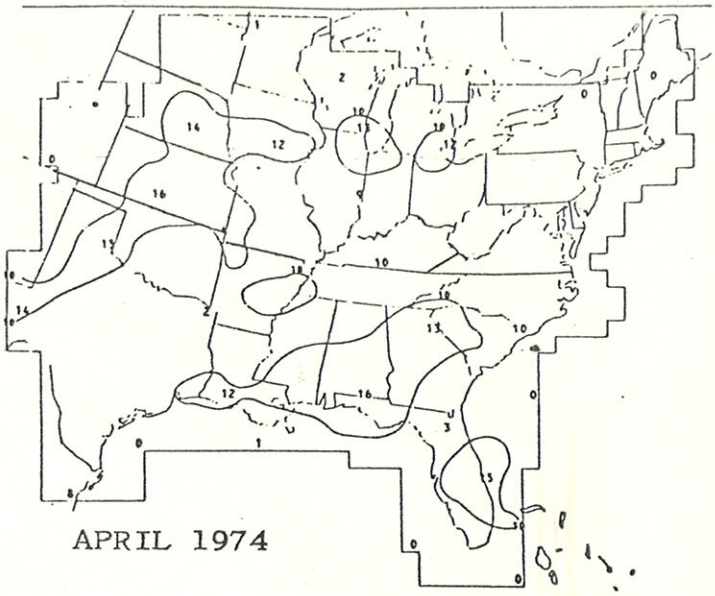

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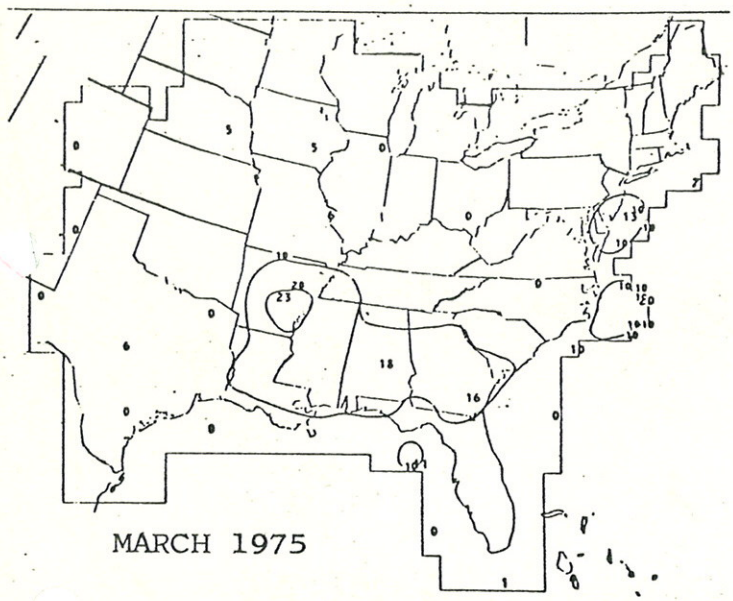

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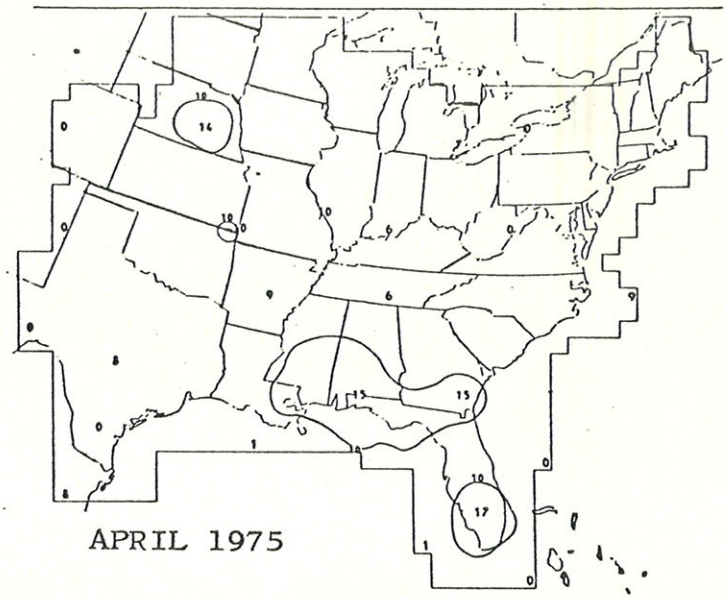

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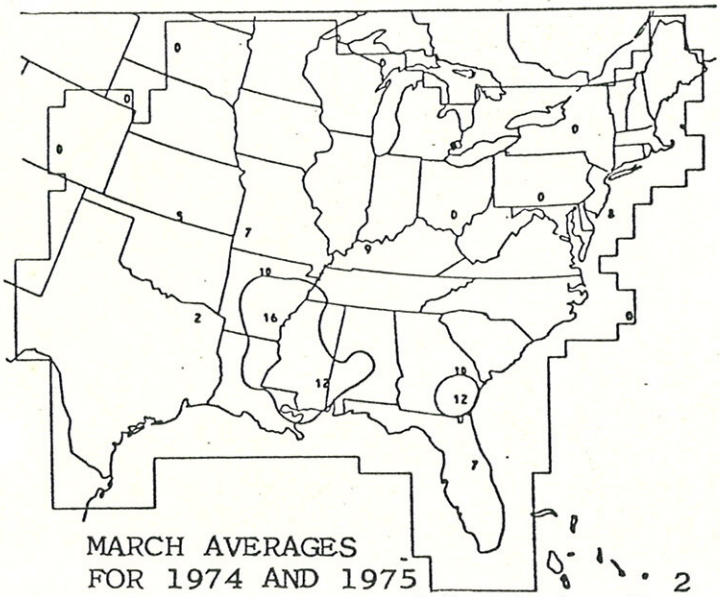

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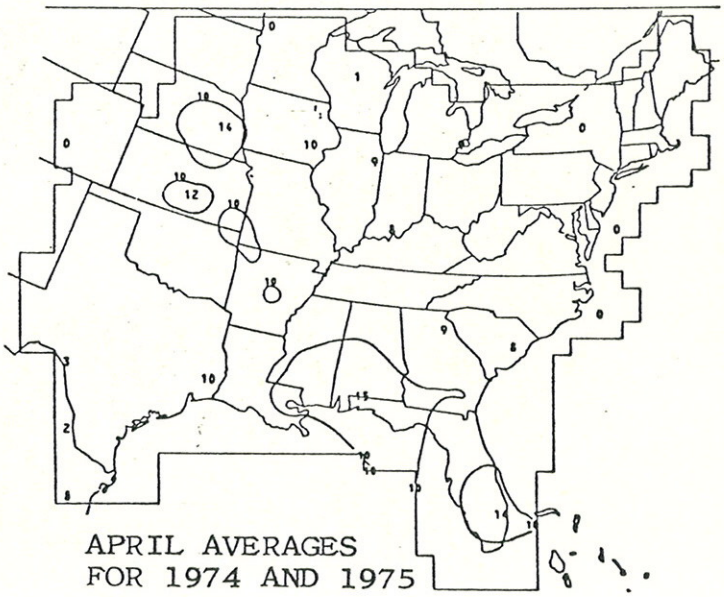

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FOR 1974 AND 1975

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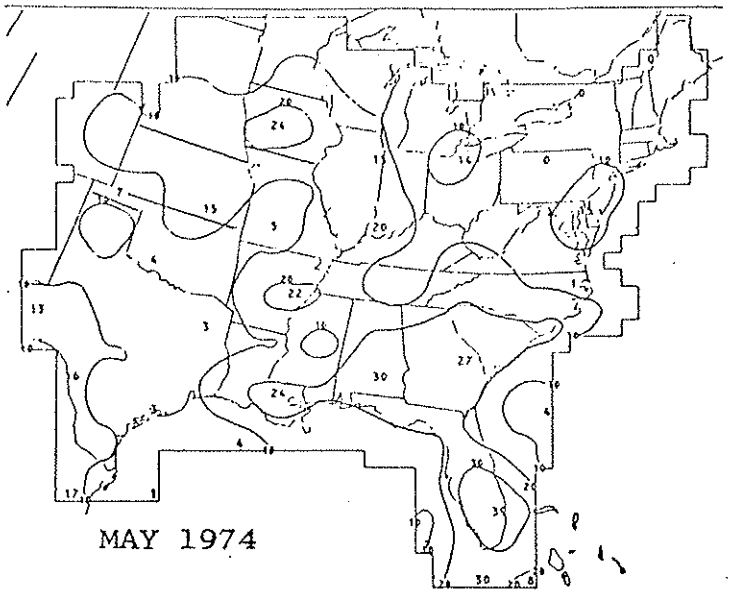

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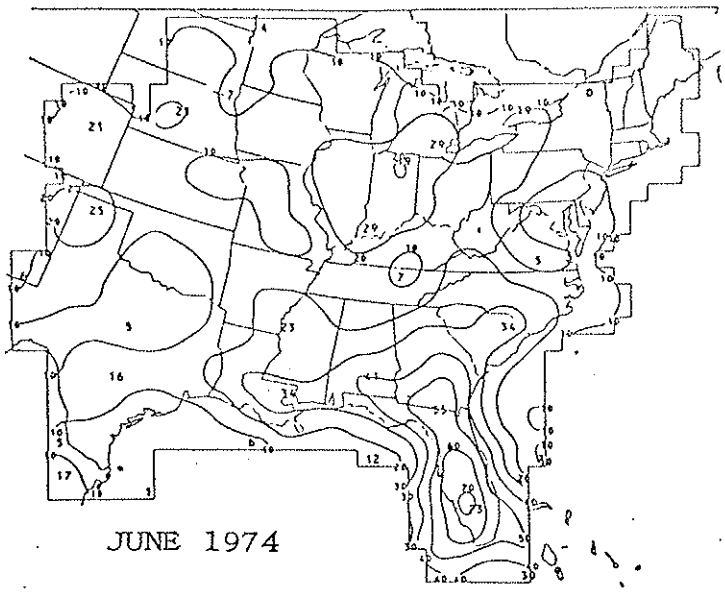

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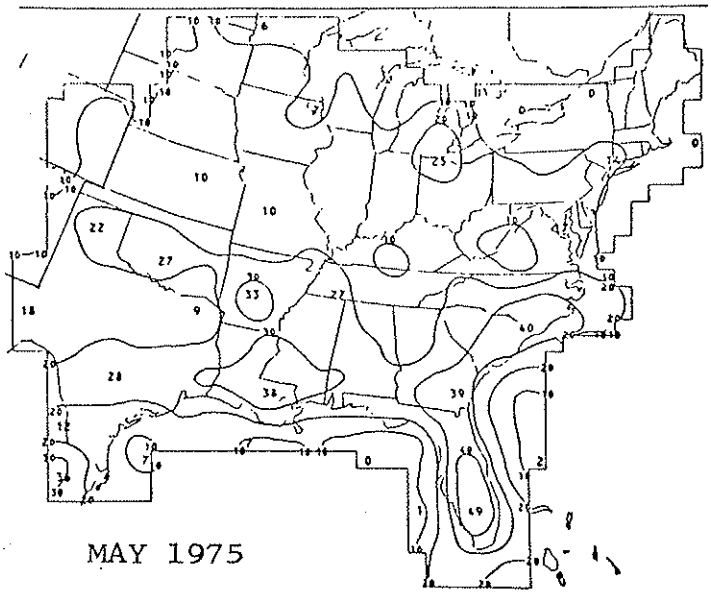

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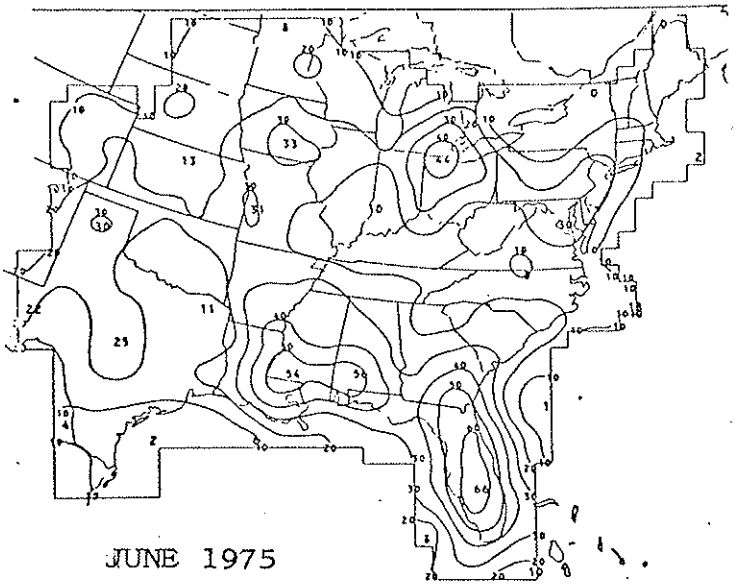

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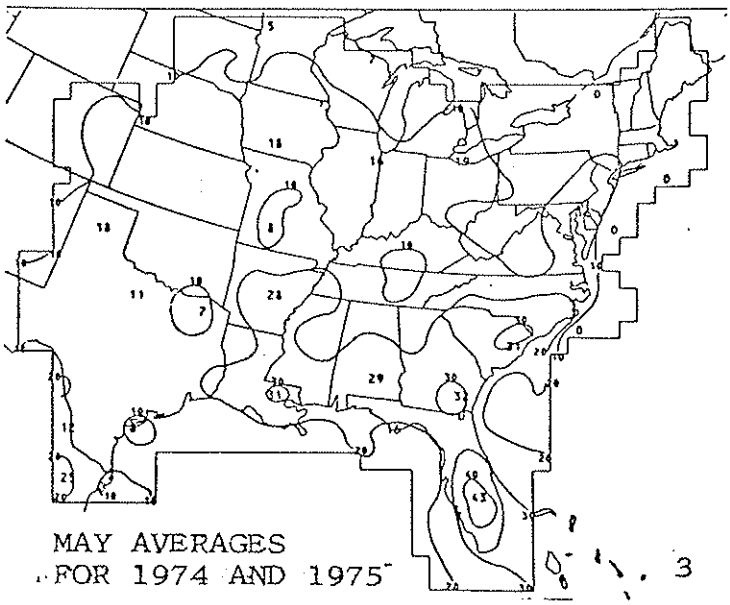

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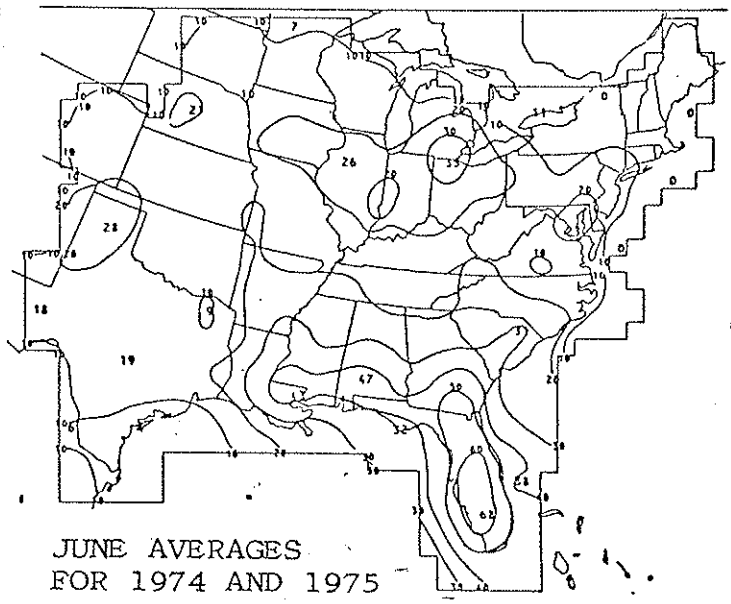

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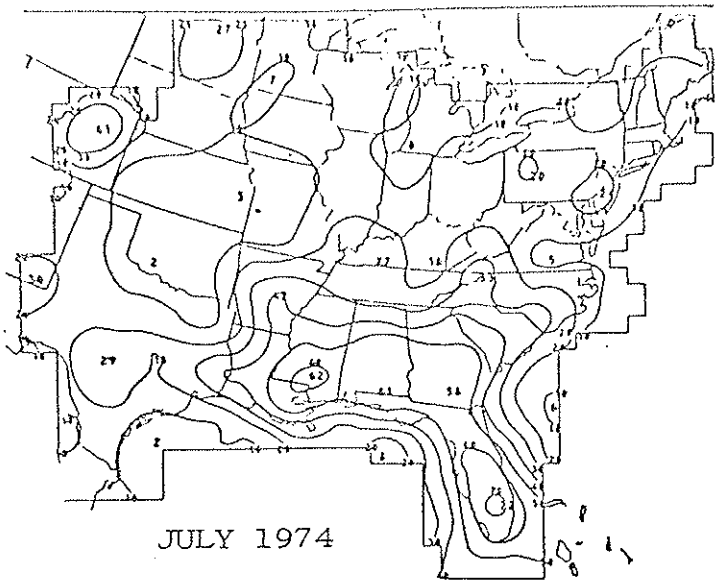

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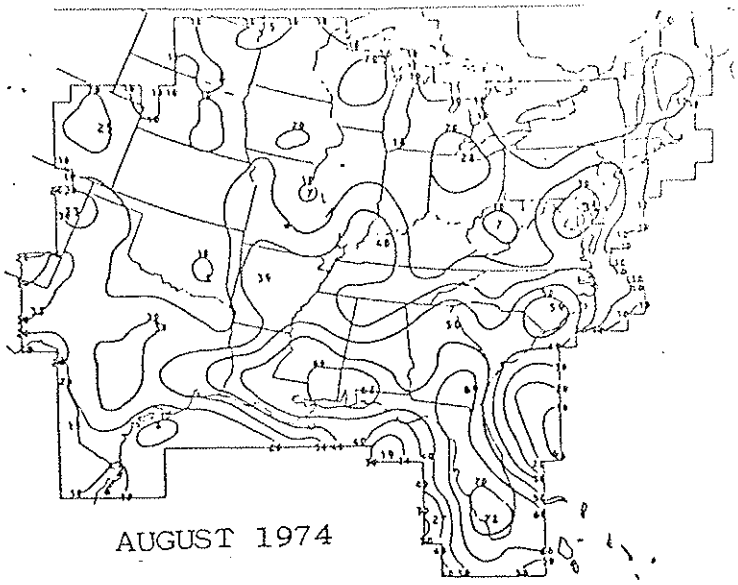

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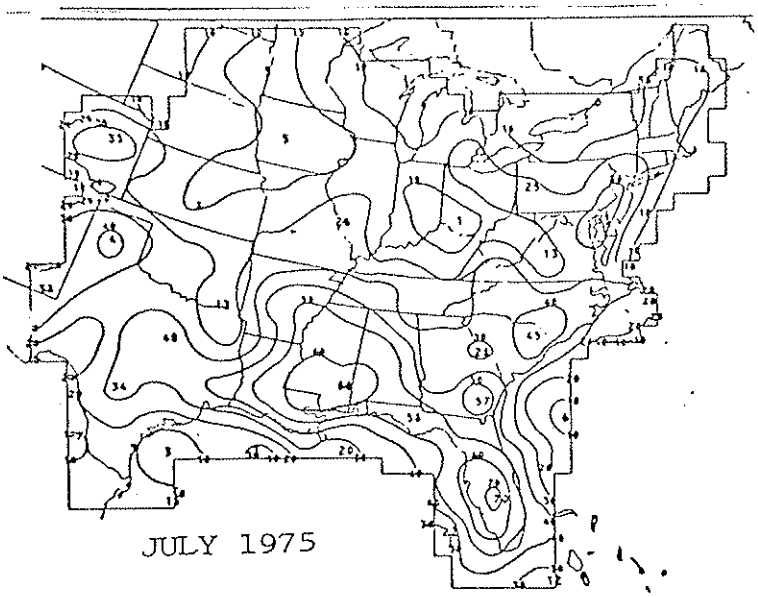

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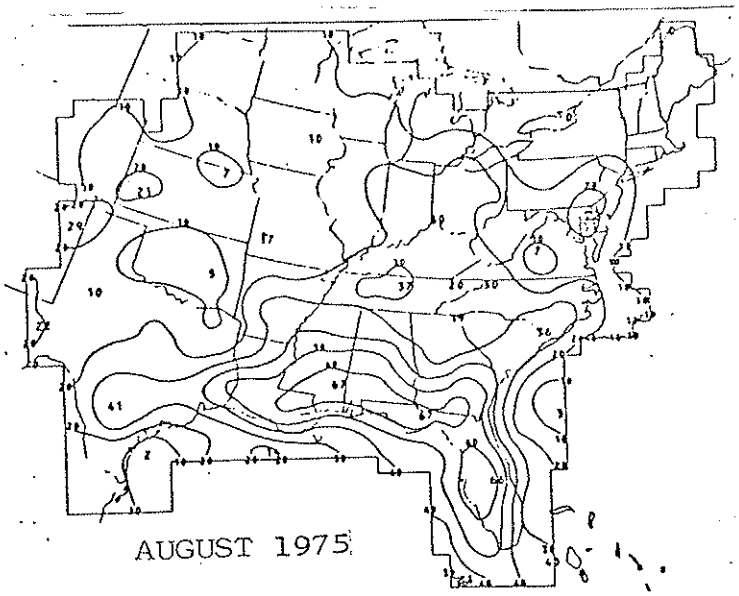

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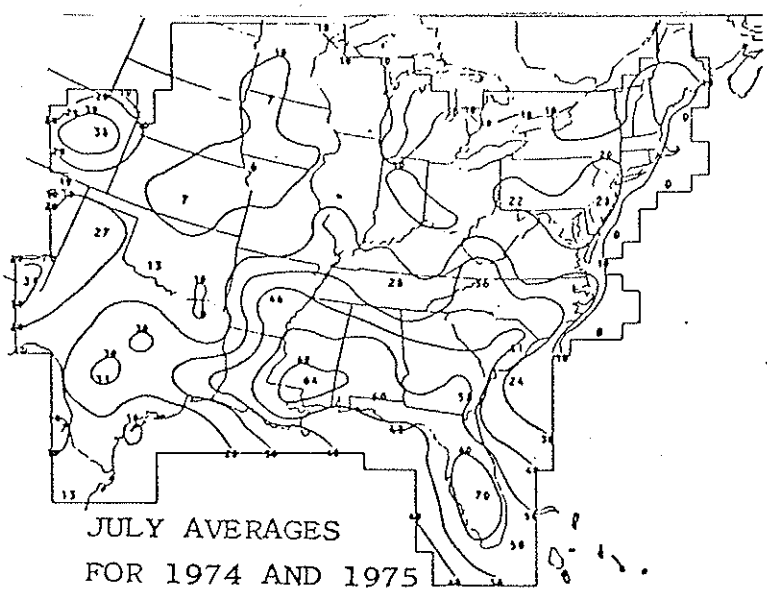

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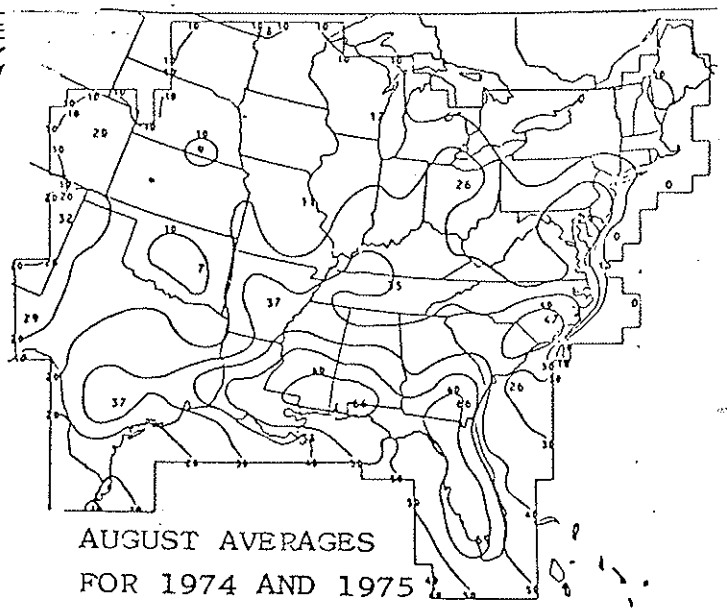

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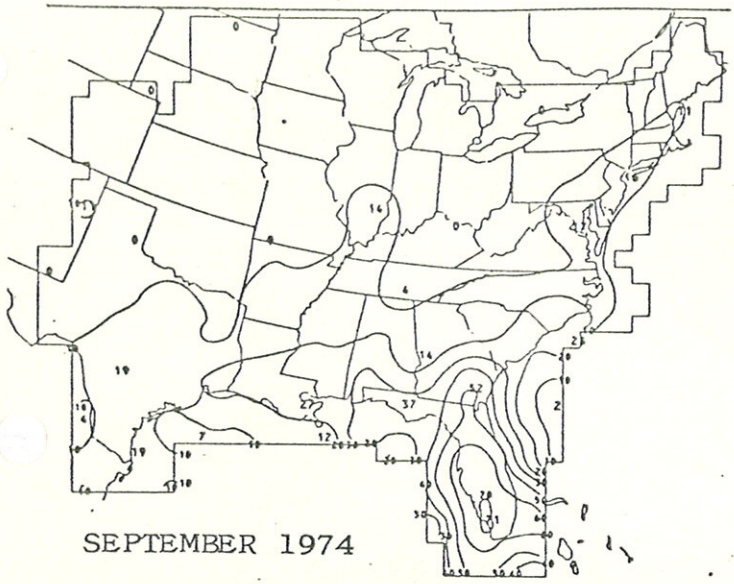

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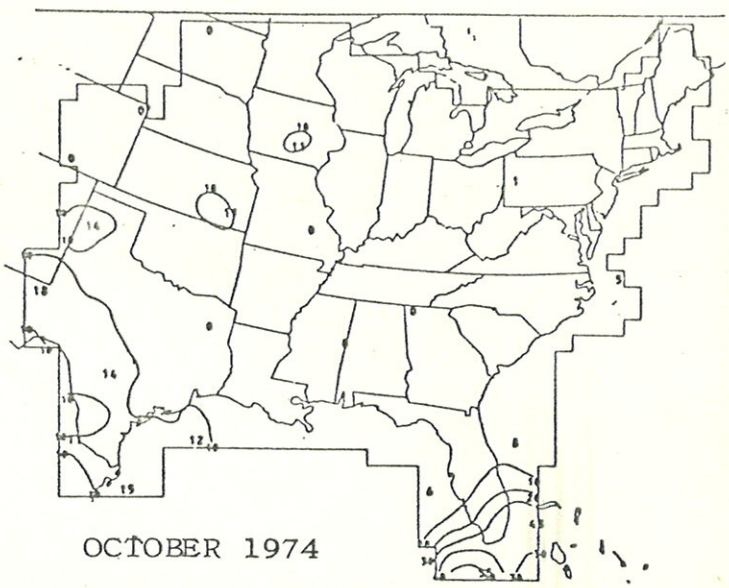

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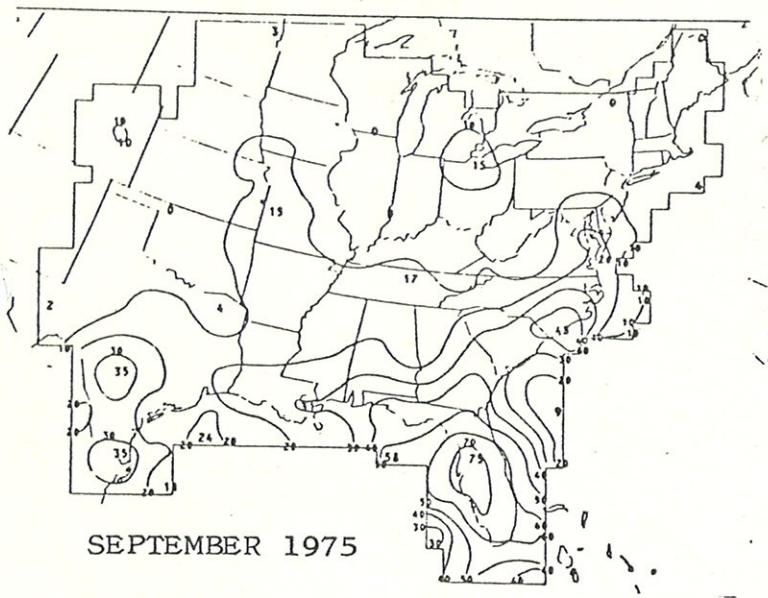

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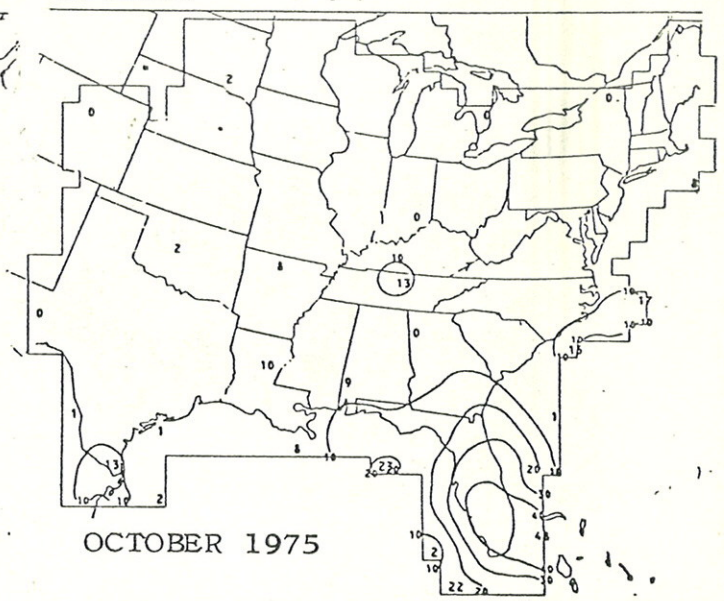

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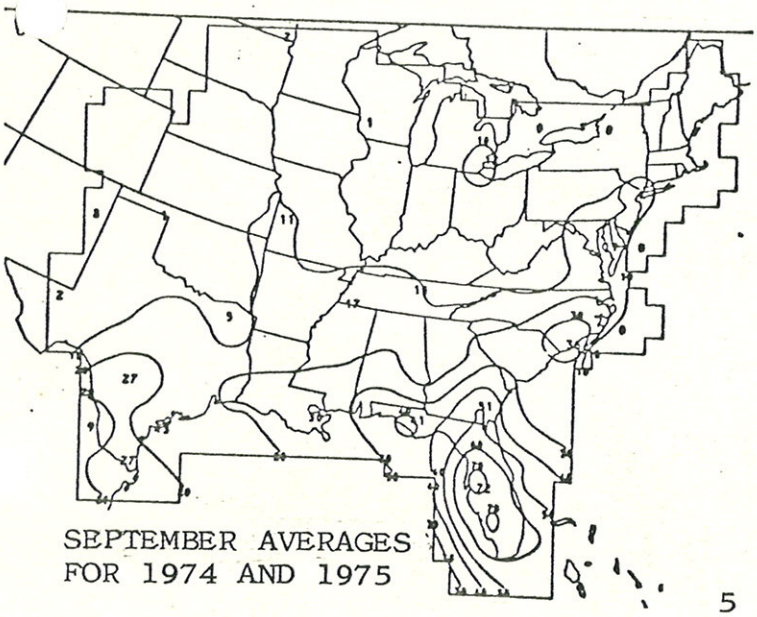
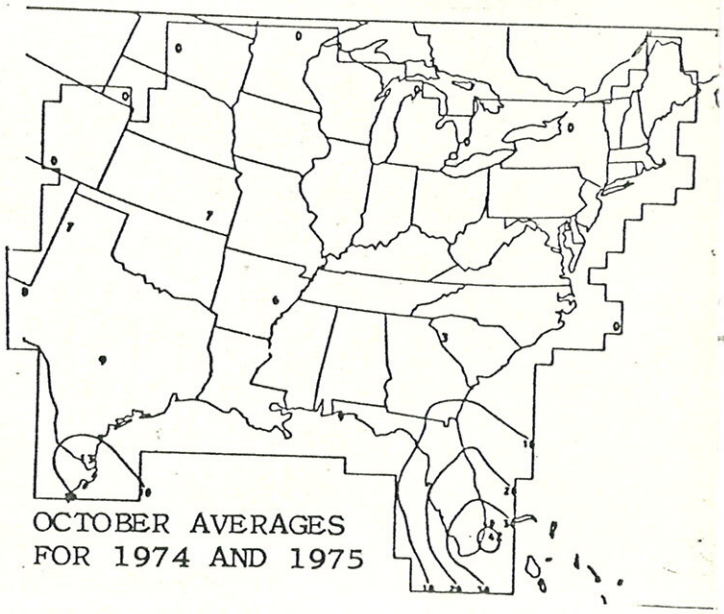


SEPTEMBER AVERAGES
FOR 1974 AND 1975



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FOR 1974 AND 1975

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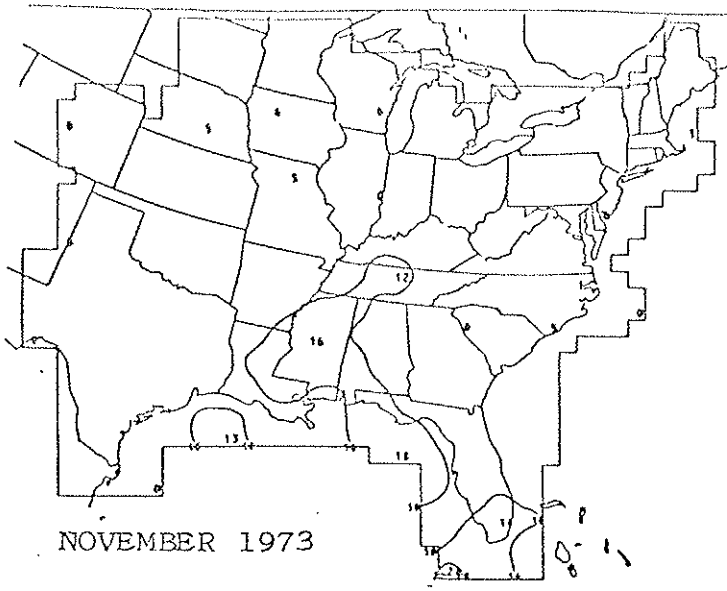

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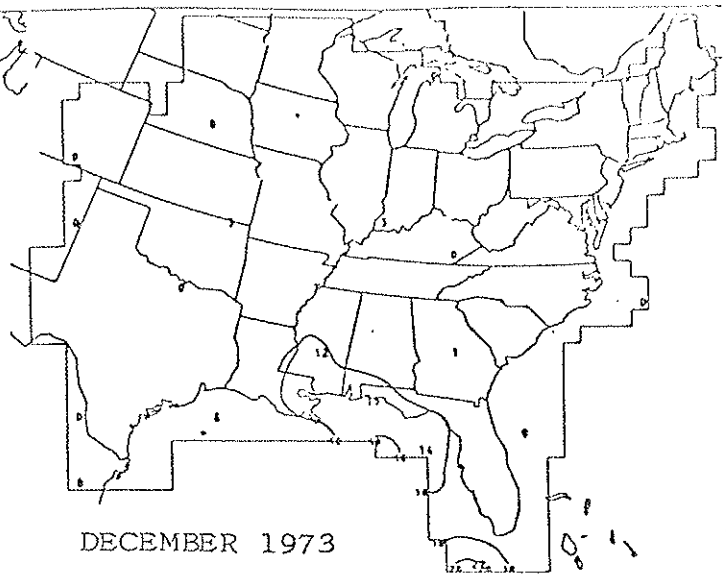

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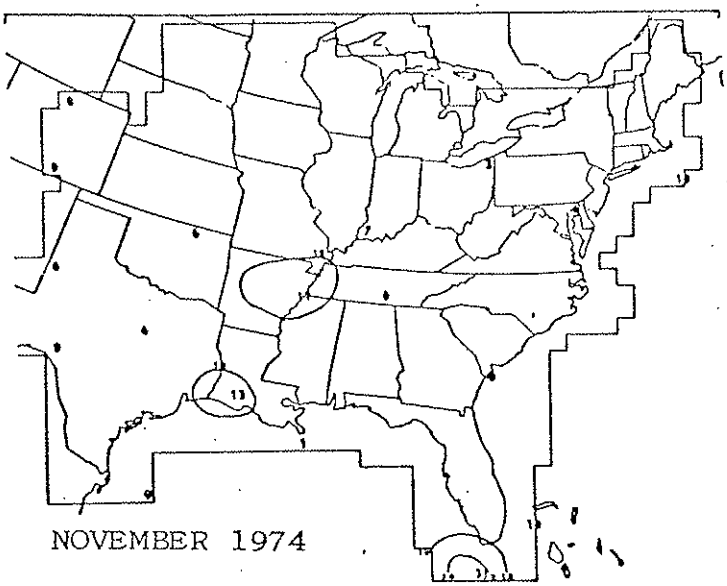

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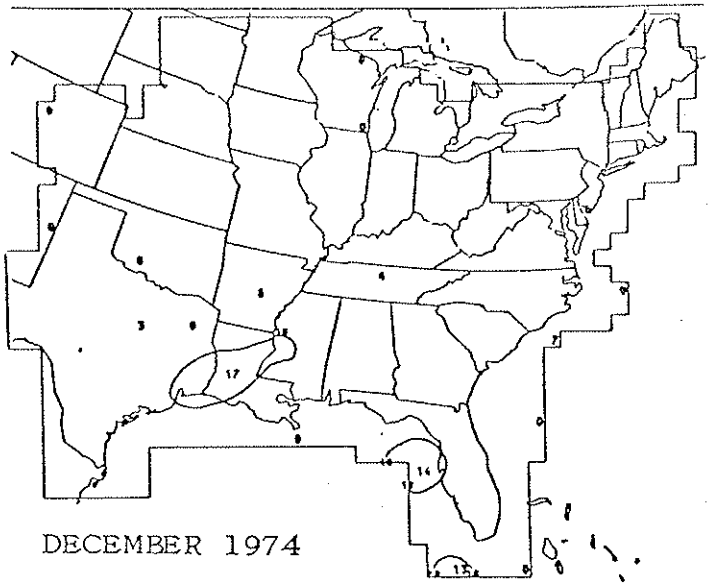

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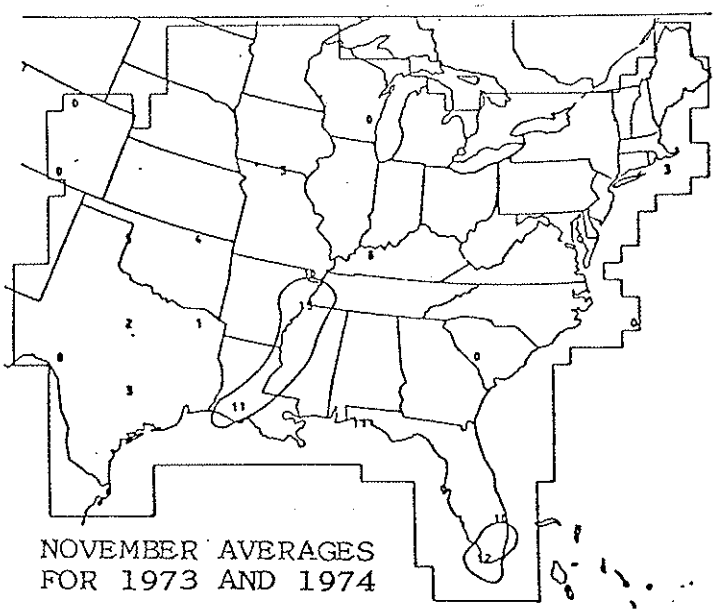
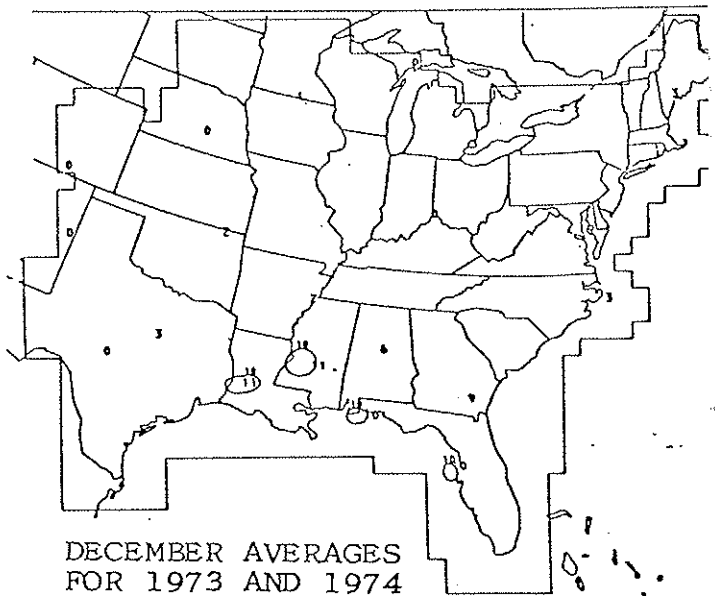


NOVEMBER AVERAGES
FOR 1973 AND 1974



DECEMBER AVERAGES
FOR 1973 AND 1974

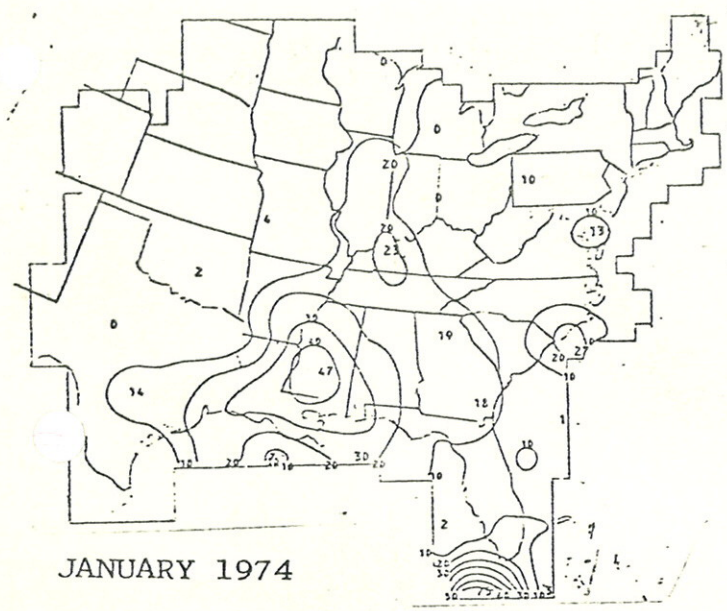
Appendix B

Page

Thunderstorm relative frequencies for 24-hour period centered on 0000 GMT for:

January and February	1974 and 1975	1
March and April	1974 and 1975	2
May and June	1974 and 1975	3
July and August	1974 and 1975	4
September and October	1974 and 1975	5
November and December	1973 and 1974	6

TSTM RELATIVE FREQUENCY DISTRIBUTION (PERCENT) FOR PRD ± 12 HRS FM 00Z



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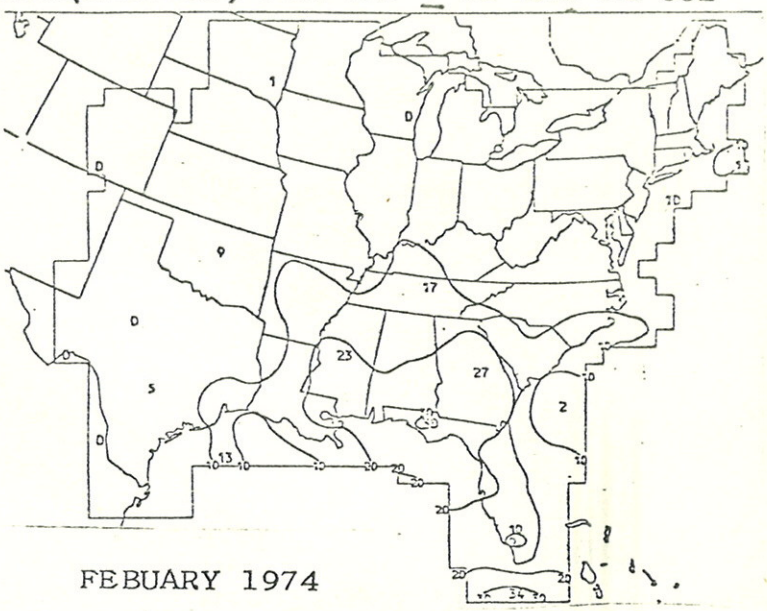

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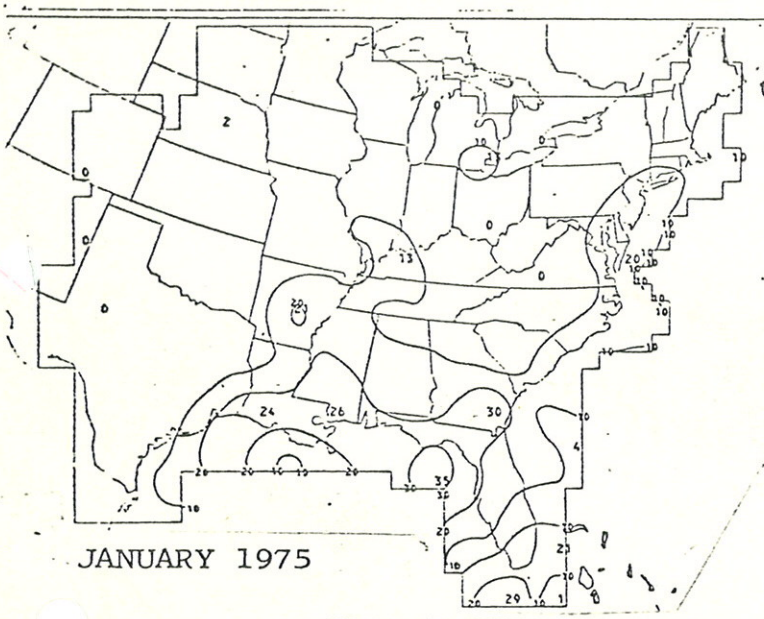

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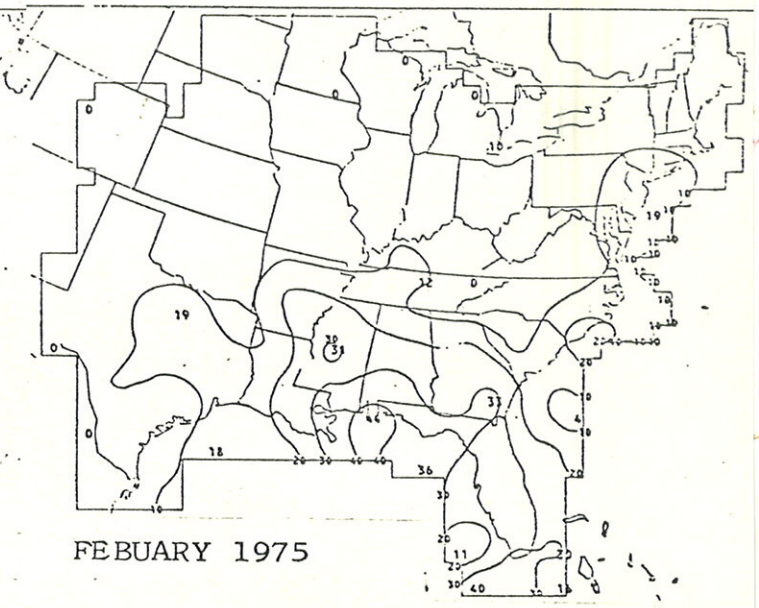

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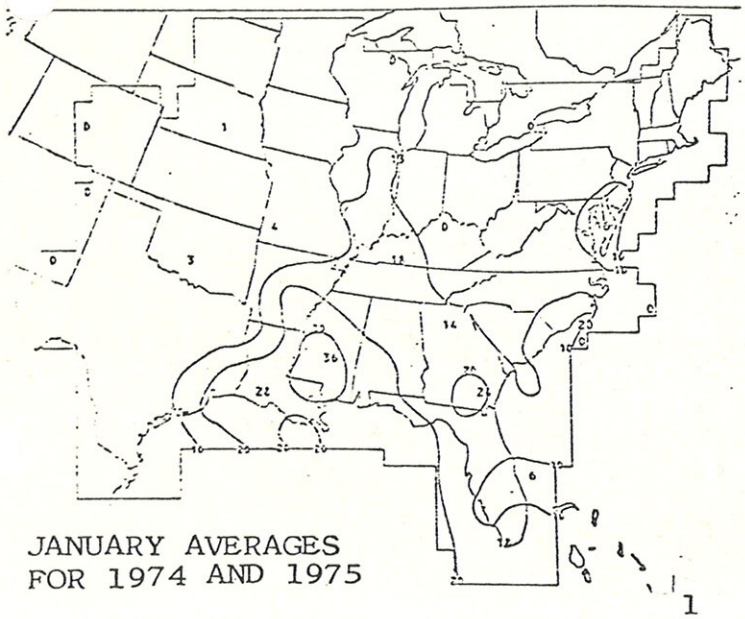
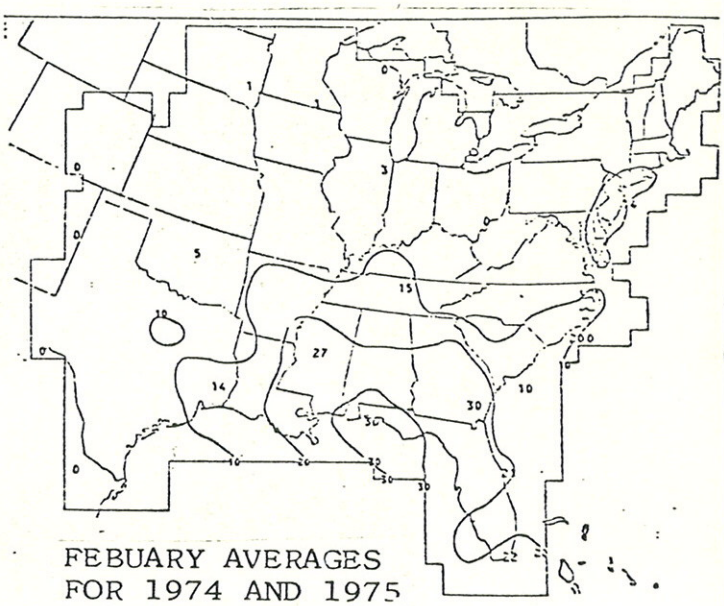
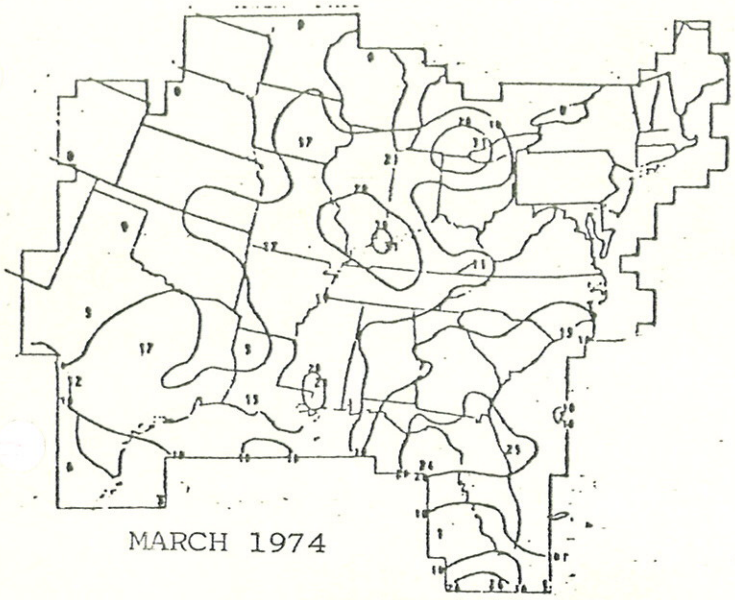


JANUARY AVERAGES
FOR 1974 AND 1975



FEBUARY AVERAGES
FOR 1974 AND 1975

TSTM RELATIVE FREQUENCY DISTRIBUTION(PERCENT) FOR PRD ± 12 HRS FM 00Z



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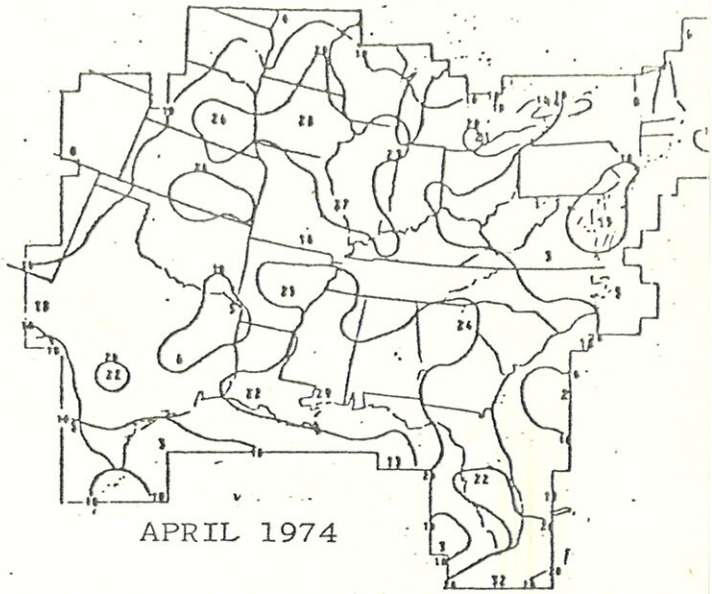

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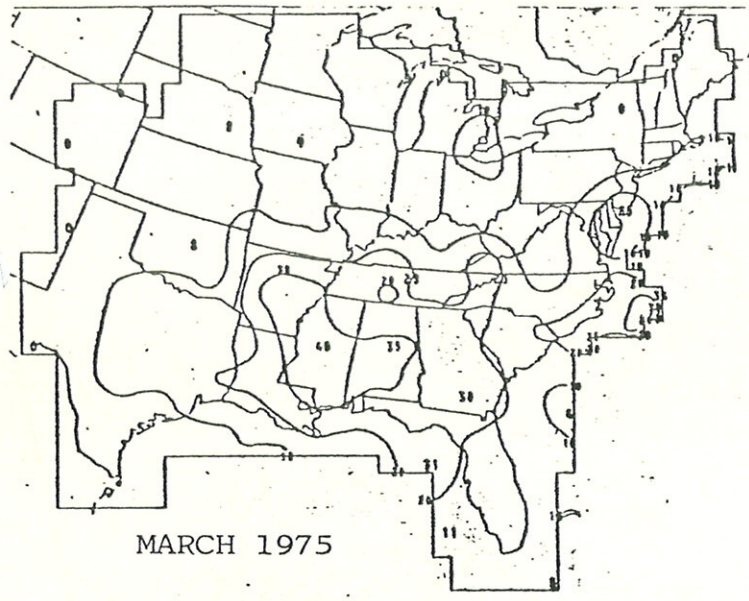

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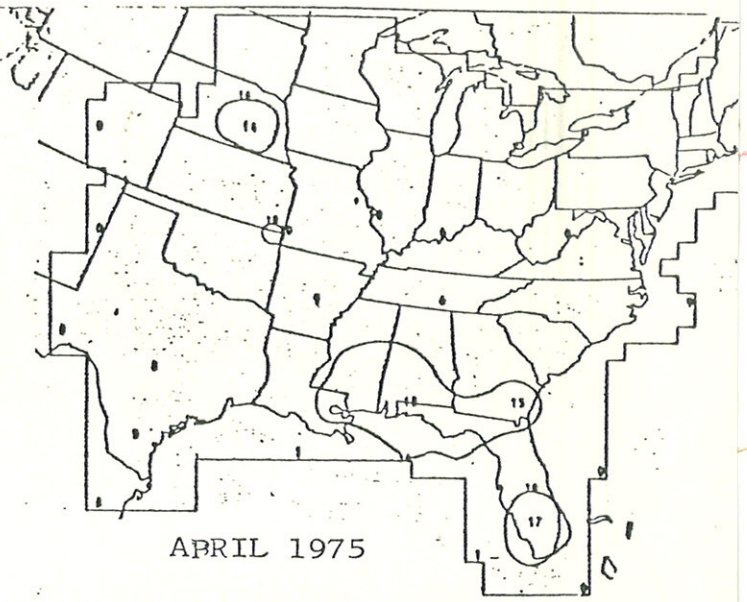

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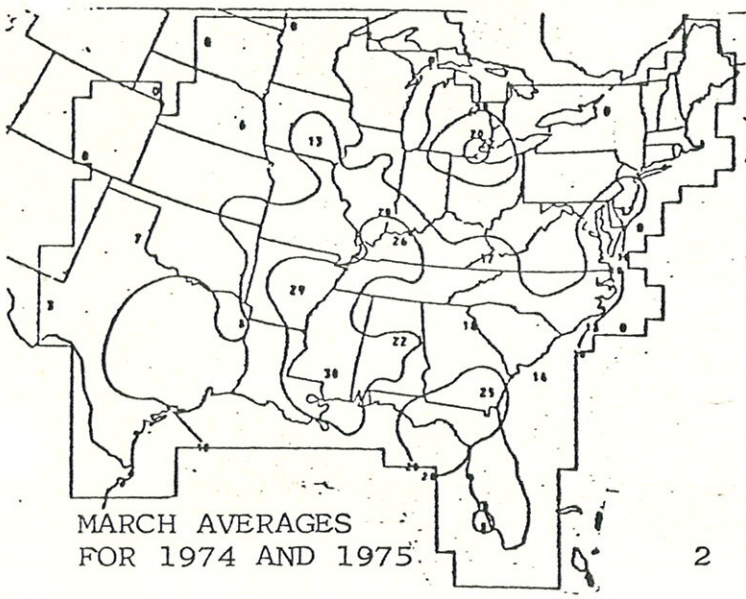
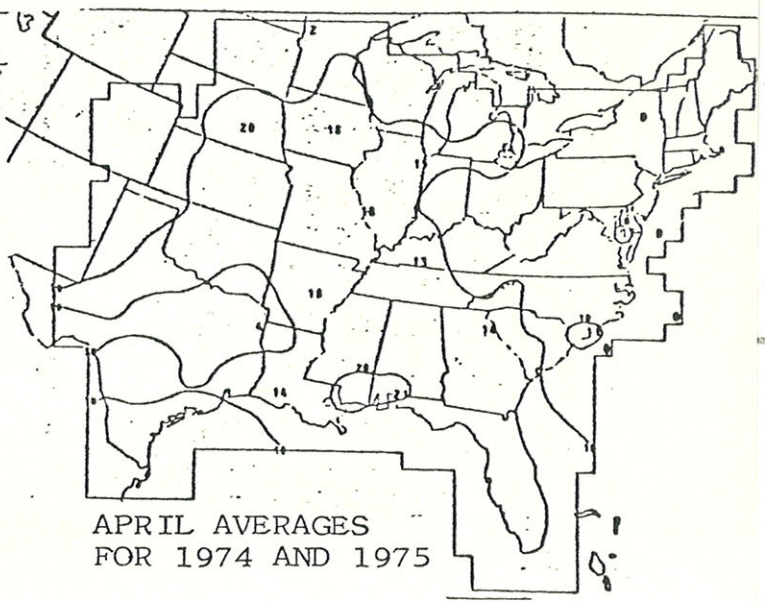
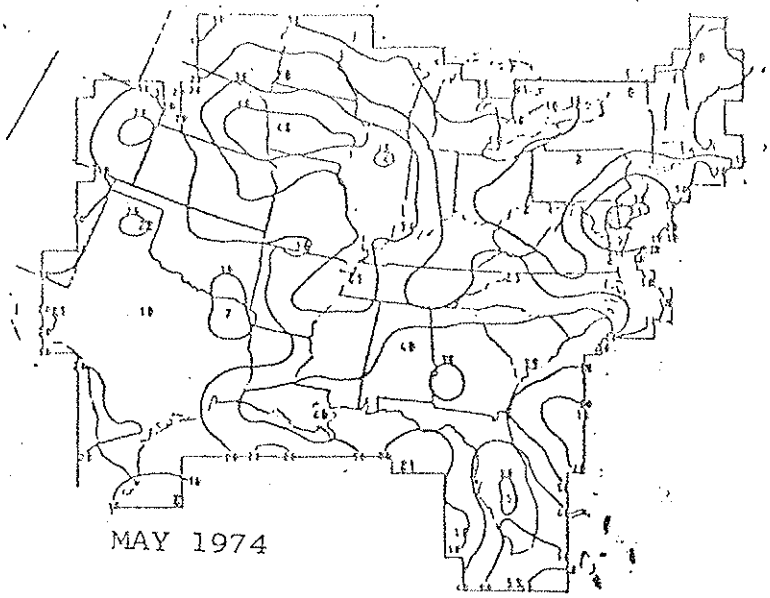


MARCH AVERAGES
FOR 1974 AND 1975

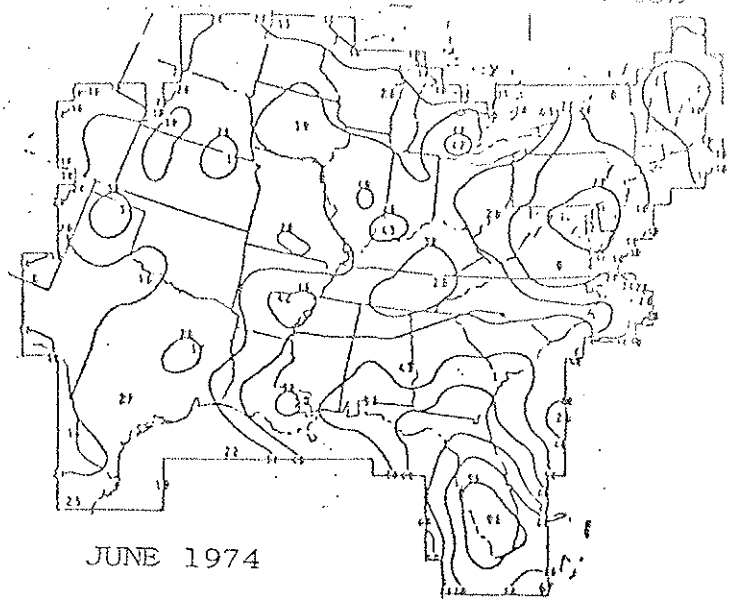


APRIL AVERAGES
FOR 1974 AND 1975

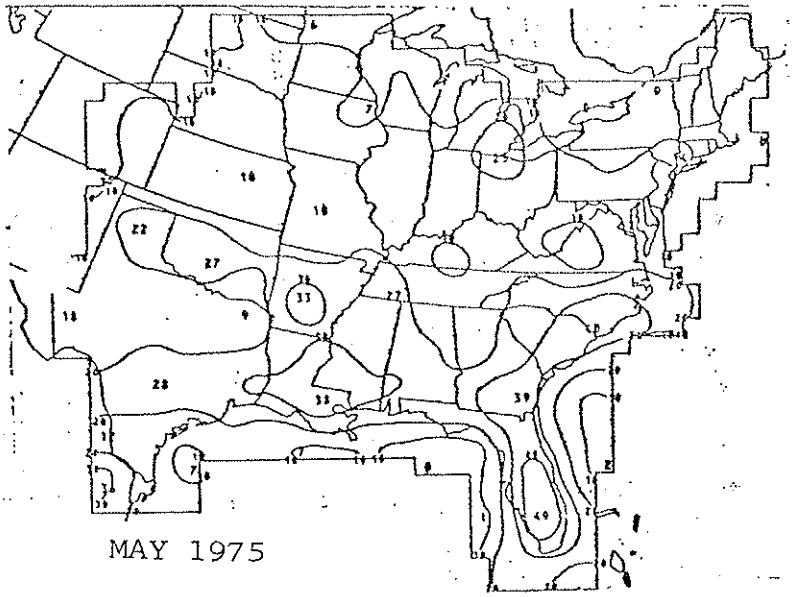
TSTM RELATIVE FREQUENCY DISTRIBUTION (PERCENT) FOR PRD + 12 HRS FM 00Z



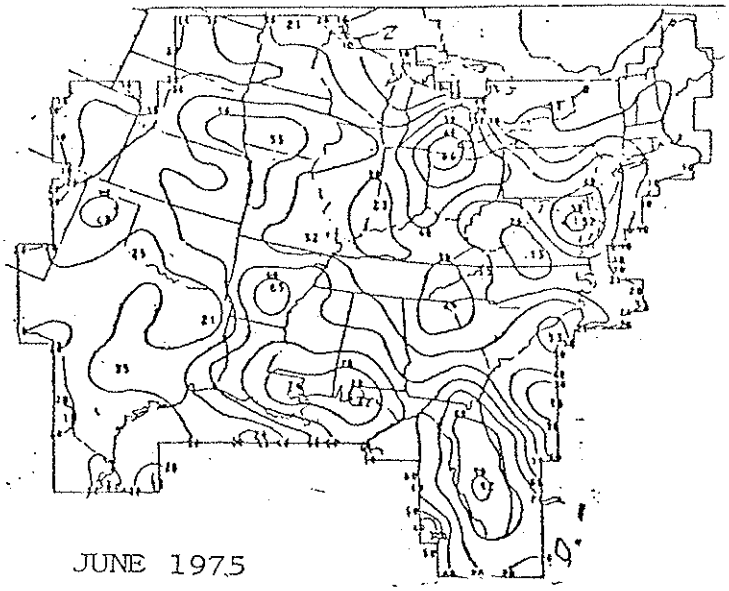
MAY 1974



JUNE 1974



MAY 1975



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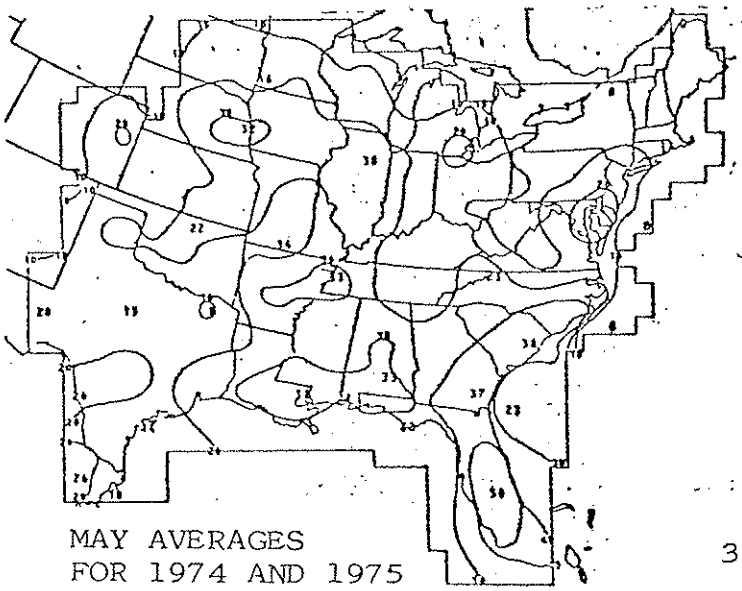
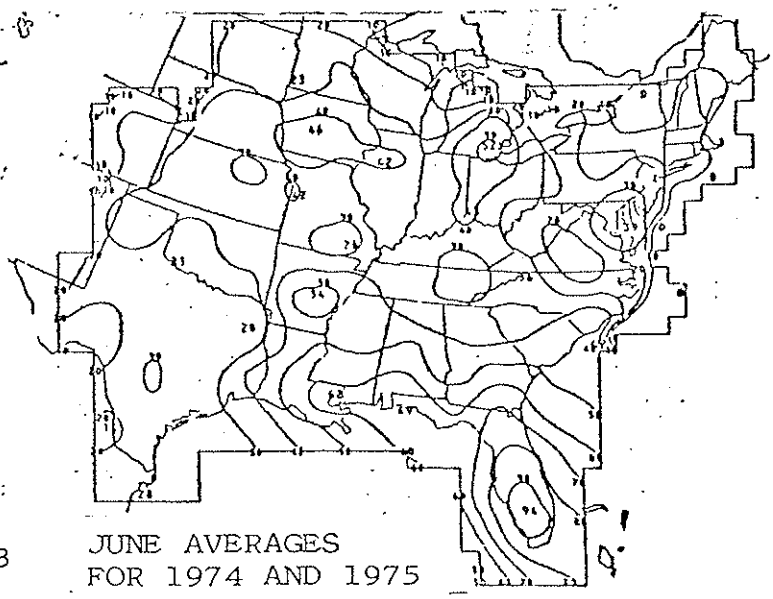
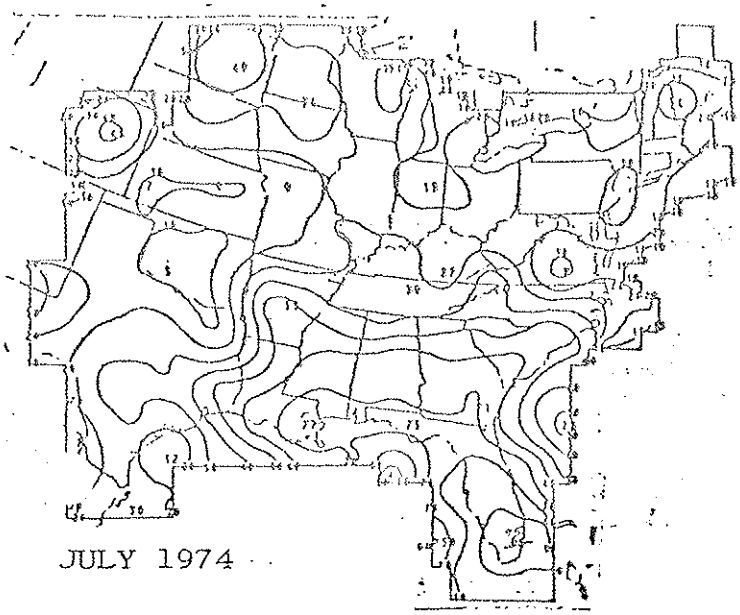


MAY AVERAGES
FOR 1974 AND 1975

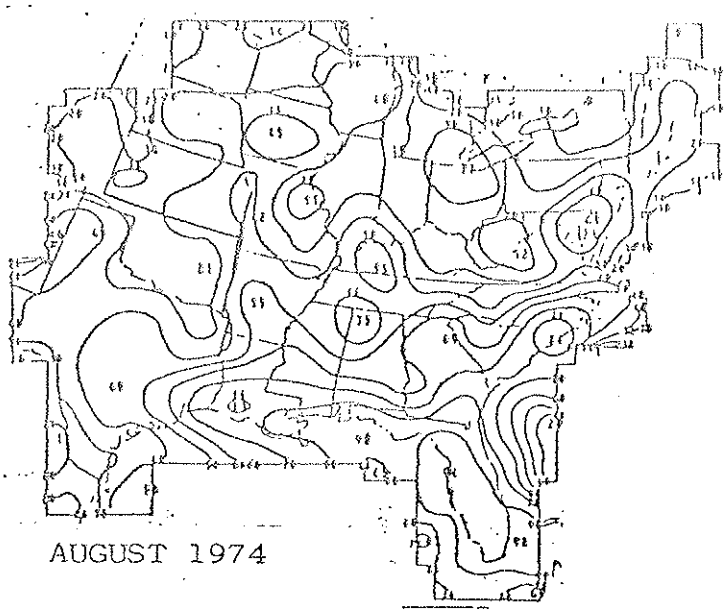


JUNE AVERAGES
FOR 1974 AND 1975

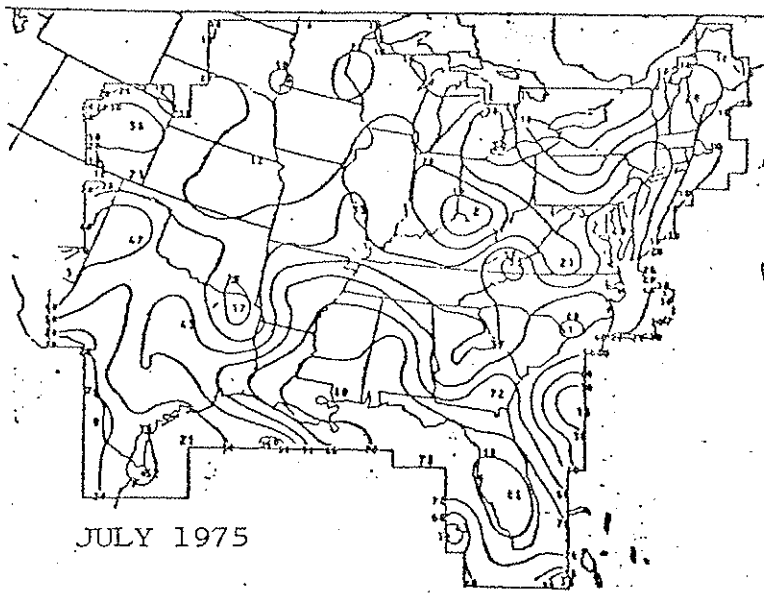
TSTM RELATIVE FREQUENCY DISTRIBUTION(PERCENT) FOR PRD ± 12 HRS FM 00Z



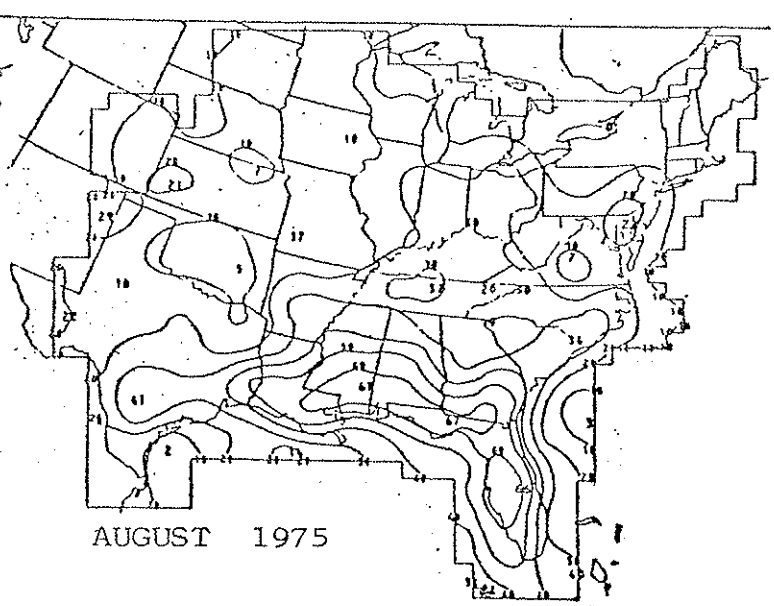
JULY 1974



AUGUST 1974



JULY 1975



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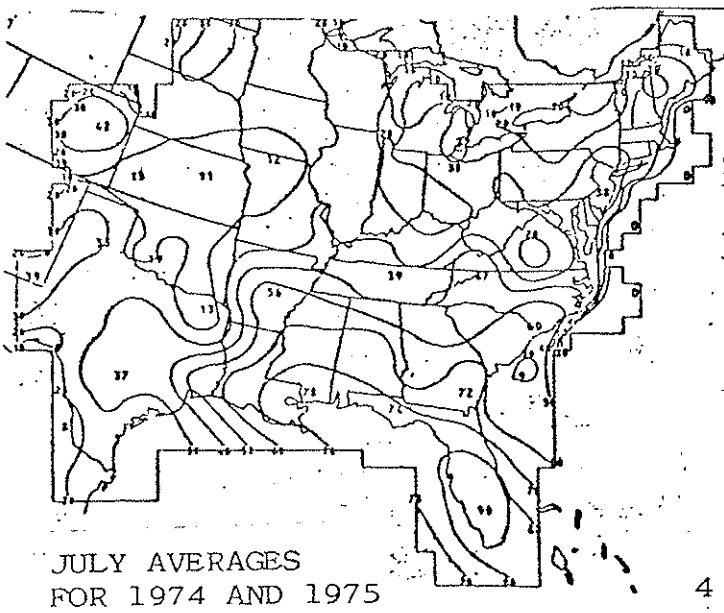
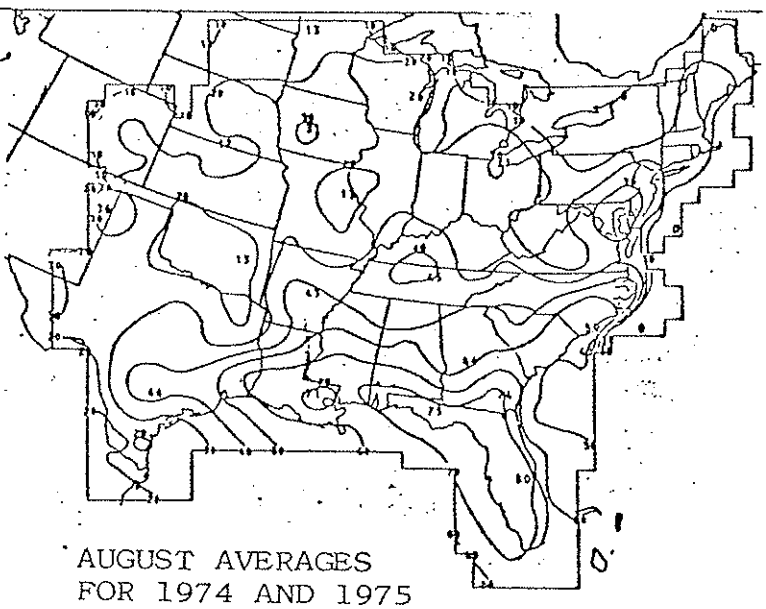
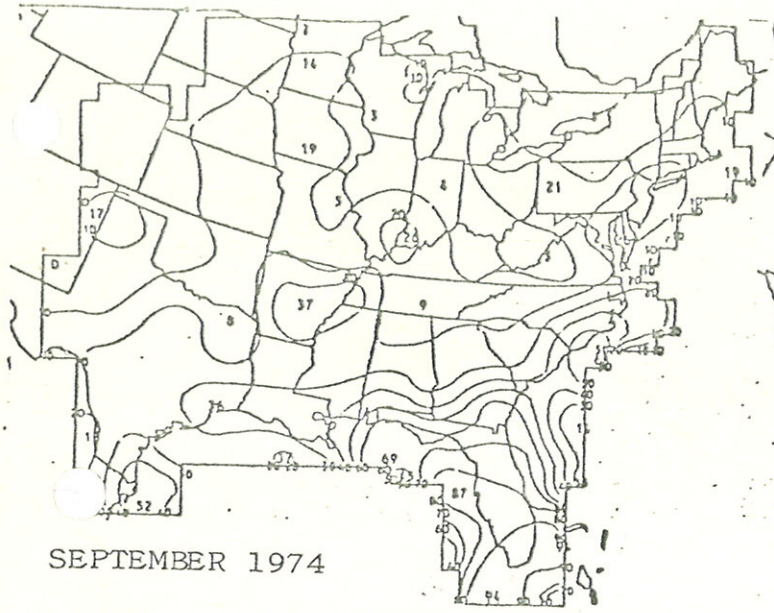


JULY AVERAGES
FOR 1974 AND 1975

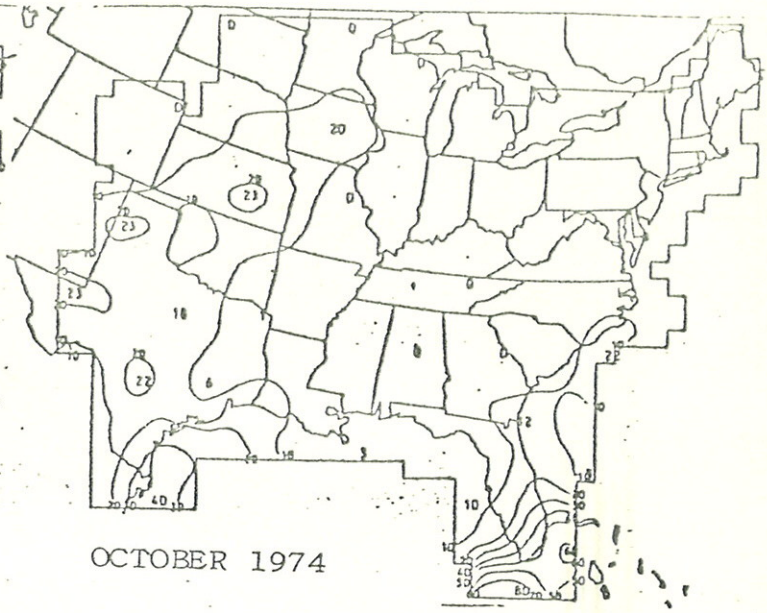


AUGUST AVERAGES
FOR 1974 AND 1975

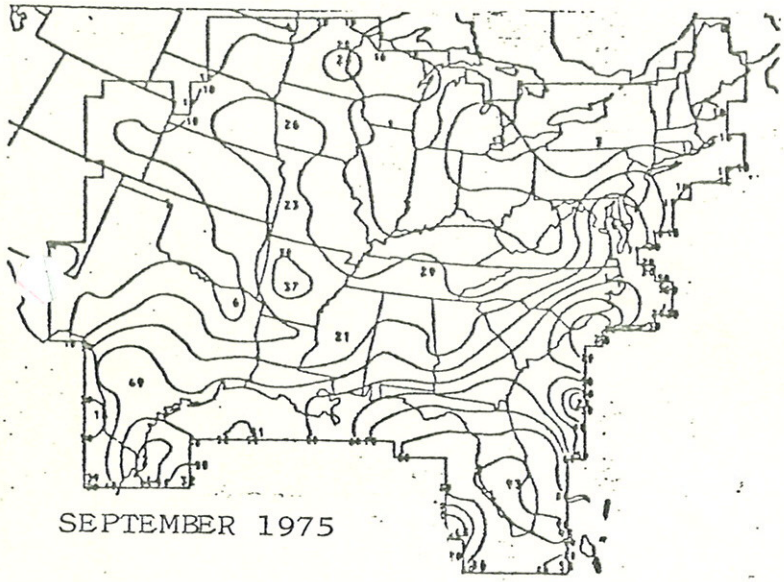
TSTM RELATIVE FREQUENCY DISTRIBUTION (PERCENT) FOR PRD ± 12 HRS FM 00Z



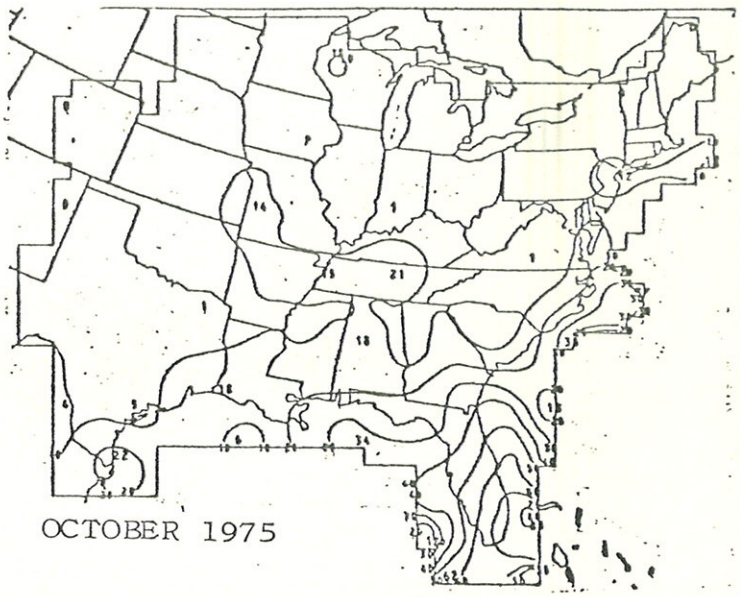
SEPTEMBER 1974



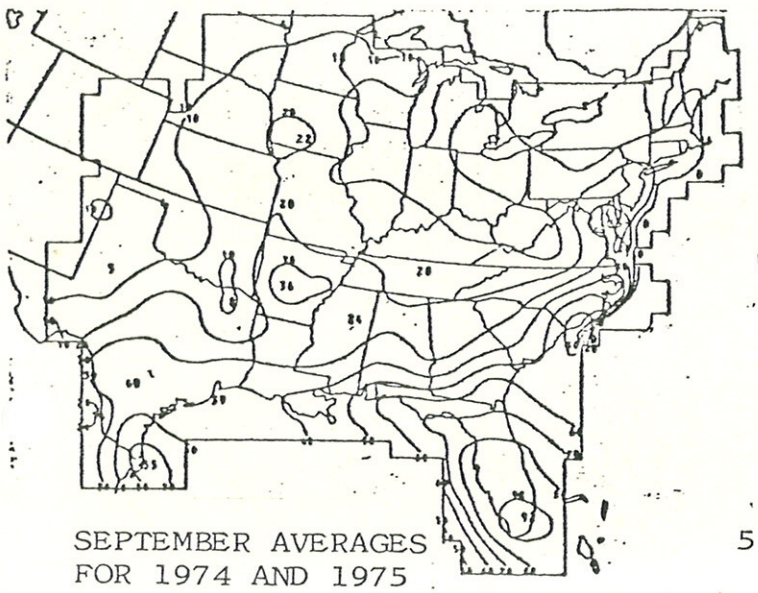
OCTOBER 1974



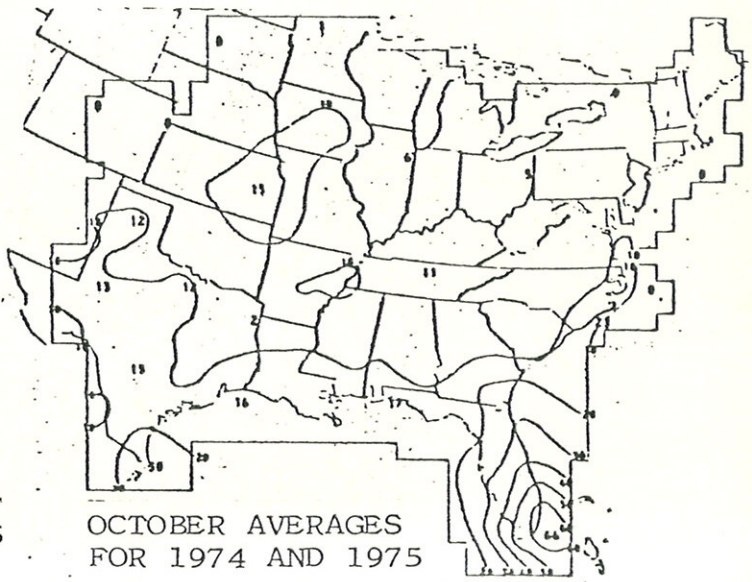
SEPTEMBER 1975



OCTOBER 1975

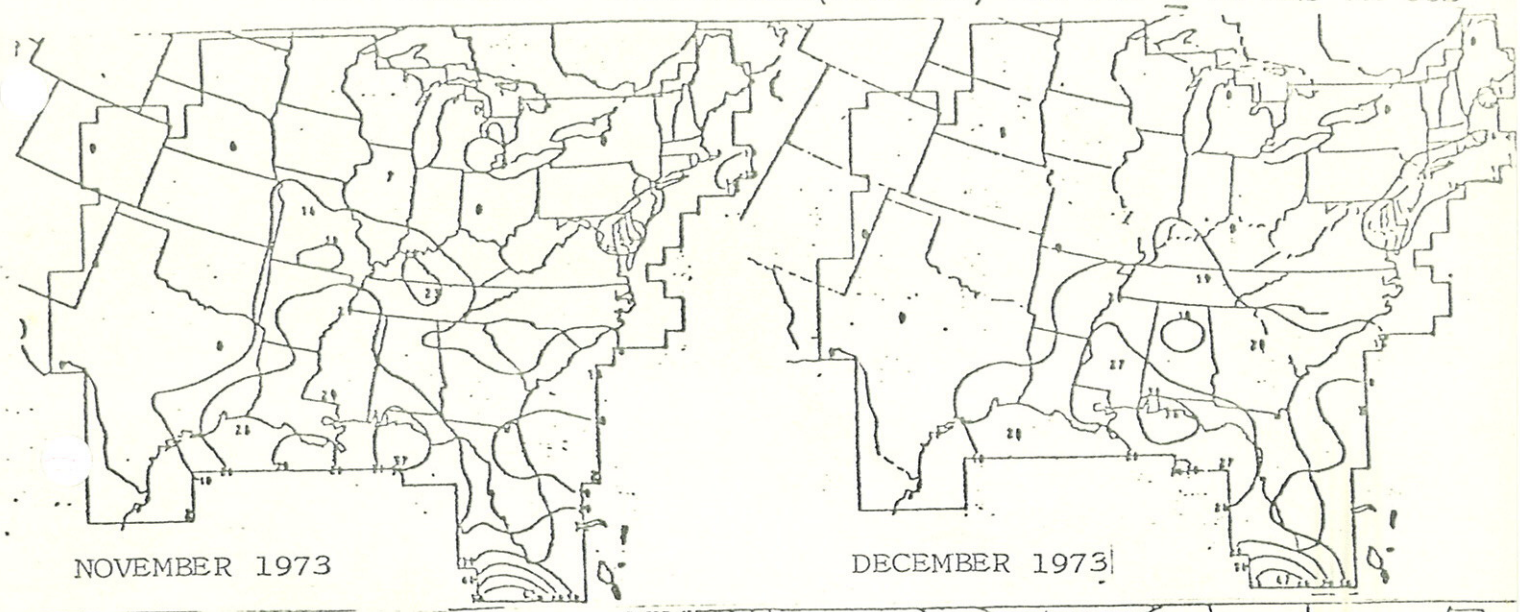


SEPTEMBER AVERAGES
FOR 1974 AND 1975



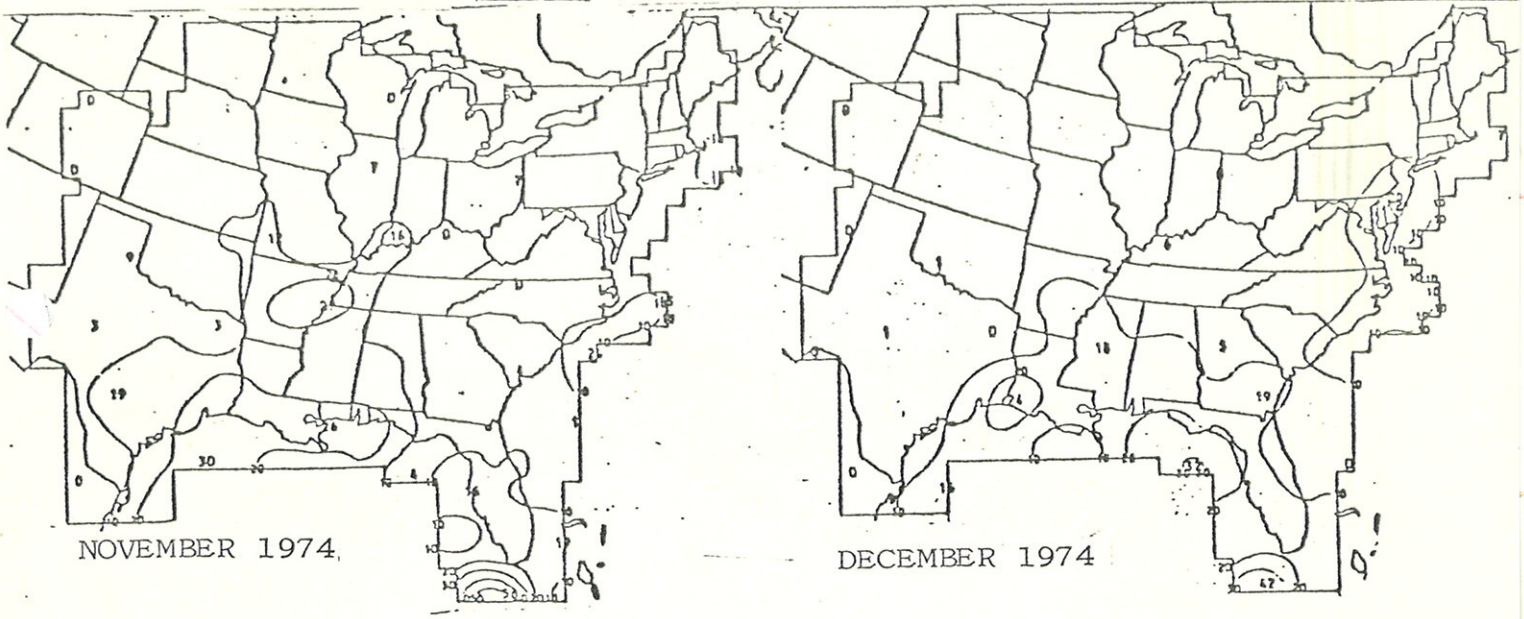
OCTOBER AVERAGES
FOR 1974 AND 1975

TSTM RELATIVE FREQUENCY DISTRIBUTION(PERCENT) FOR PRD ± 12 HRS FM 00Z



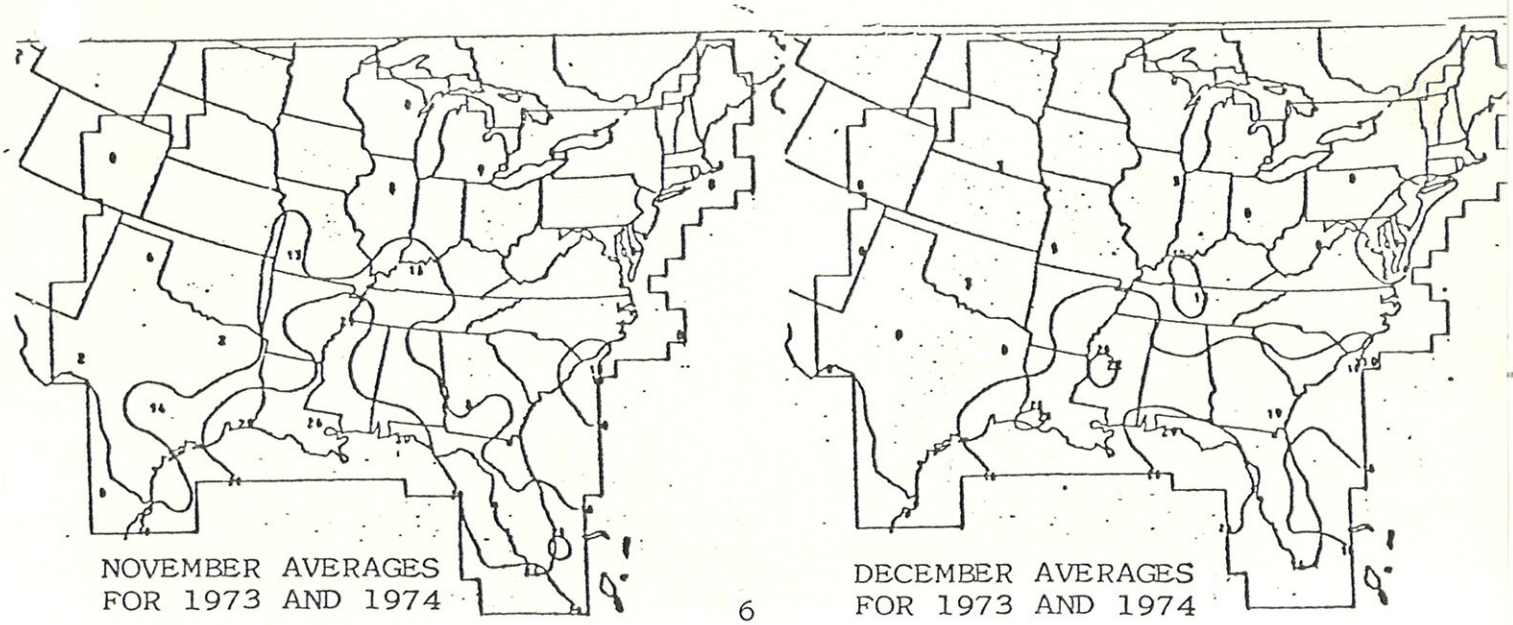
NOVEMBER 1973

DECEMBER 1973



NOVEMBER 1974

DECEMBER 1974



NOVEMBER AVERAGES FOR 1973 AND 1974

DECEMBER AVERAGES FOR 1973 AND 1974