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VERIFICATION OF FORECASTS MADE FROM THE THUNDERSTORM PROBABILITY NOMOGRAM FOR WASHINGTON, D.C.

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1. INTRODUCTION

Last spring a thunderstorm probability nomogram (Foster and Reap, 1977) was distributed to operational forecasters in the National Weather Service. The nomogram is designed for use when the operational MOS thunderstorm probabilities described in Technical Procedures Bulletin No. 199 (National Weather Service, 1977) are not available. The nomogram requires as input the thunderstorm relative frequency, the current date, and the forecast 24-h K stability index. It gives the probability of a radar echo of intensity 3 or greater, as measured by the WSR-57 video integrator and processor (VIP), occurring during the interval 12-36 hours following initial data time in a manually digitized radar (MDR) grid block 75-80 km on a side. Because of the size of the grid block, we suggested its use for a large metropolitan area where the forecast is made for the city and vicinity. To illustrate its potential as forecast guidance, we used the nomogram during the spring and summer of 1977 to prepare daily thunderstorm forecasts for Washington, D.C. and vicinity. The purpose of this paper is to present an evaluation of the accuracy of these forecasts.

2. PREPARING THE FORECAST

Fig. 1 shows the nomogram prepared for the MDR grid block containing Washington, D.C. The forecast 24-h K stability index was taken from the 4-panel Trajectory Model chart transmitted on the forecast office facsimile (FOFAX) circuit in slot F050C. This chart is described in Technical Procedures Bulletin No. 225 (National Weather Service, 1978). To use the nomogram, move vertically upward from the current date at the base of the frequency graph until the frequency curve is intercepted. From this point move horizontally to the right until a vertical line through the forecast K stability index is intercepted. At this point read the thunderstorm probability from the labels on the curves. Interpolation by eye between curves is perfectly acceptable. A sample forecast is shown by the dotted line on Fig. 1. This forecast gives a 12-36 h thunderstorm probability of 63 percent on June 16 with a K index forecast of 30.

3. VERIFICATION

An MDR code value of 4 or greater occurring in the MDR block any time during the forecast valid time was used to verify a thunderstorm occurrence. The radar station reporting for the block containing Washington, D.C. is located at Patuxent River, Maryland in the adjoining block to the east. The verification period consisted of 152 days extending from April 8, 1977 to September 15, 1977, with 9 missing days.

Comparison of the thunderstorm probability forecasts with the observed frequency of thunderstorms for the MDR block containing Washington, D.C. was made using the ratio:

$$\frac{(N \times R) - O}{N} \times 100$$

where

N = number of forecasts,
R = average probability of the forecasts,
O = number of thunderstorm observations.

For Washington, D.C. and vicinity the ratio was -1, indicating the average probability forecast for the spring and summer season was very close to the observed relative frequency of thunderstorms.

Another measure applied to the probability forecasts was the P score (Panofsky and Brier, 1958) which is given by:

$$P = \frac{1}{N} \sum_{i=1}^{N} (R_i - I_i)^2$$

where

N = number of forecasts,
R_i = probability forecast the ith day,
I_i = 1 for a thunderstorm occurrence or 0 for no thunderstorm.

For Washington, D.C. and vicinity the P score was 0.14 which, on the basis of previous thunderstorm probability verification (Foster and Reap, 1976), is slightly better than the P score of 0.16 obtained for the entire MDR grid.

In a recent study, Foster and Reap (1978) found that a threshold probability of 35% produced the best categorical (yes/no) thunderstorm forecasts for the entire MDR grid. We verified the forecasts for Washington, D.C. on this basis. That is, when the probability was 35% or greater we forecast thunderstorms; when less than 35% we forecast no thunderstorms. The resulting contingency table is shown in table 1.

Table 1. Contingency table of yes/no thunderstorm forecasts based on a threshold probability value of 35% for Washington, D.C. and vicinity.

Observed	Forecast	
	Thunderstorm	No thunderstorm
Thunderstorm	52	4
No thunderstorm	31	65

Some forecast scores (Donaldson et al., 1975) derived from this contingency table are as follows:

Critical success index (CSI) or threat score	=	.60
Probability of detection (POD)	=	.93
False alarm ratio (FAR)	=	.37
Bias	=	1.48
Skill score	=	.55

4. SUMMARY AND CONCLUSIONS

The thunderstorm probability nomogram developed by Foster and Reap (1977) was applied to Washington, D.C. and vicinity during the spring and summer of 1977. We have verified these forecasts and found the average forecast probability to be very close to the observed relative frequency. The probability of detection indicates that 93% of the thunderstorm days were correctly forecast. The false alarm ratio indicated that on 37% of the days when thunderstorms were called for they did not occur. The bias of 1.48 is typical of the amount of overforecasting expected in categorical thunderstorm forecasts and is certainly acceptable. The critical success index (threat score) and skill score are quite high, indicating this nomogram is a useful operational tool for Washington, D.C. and its immediate environs.

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THUNDERSTORM PROBABILITY NOMOGRAM

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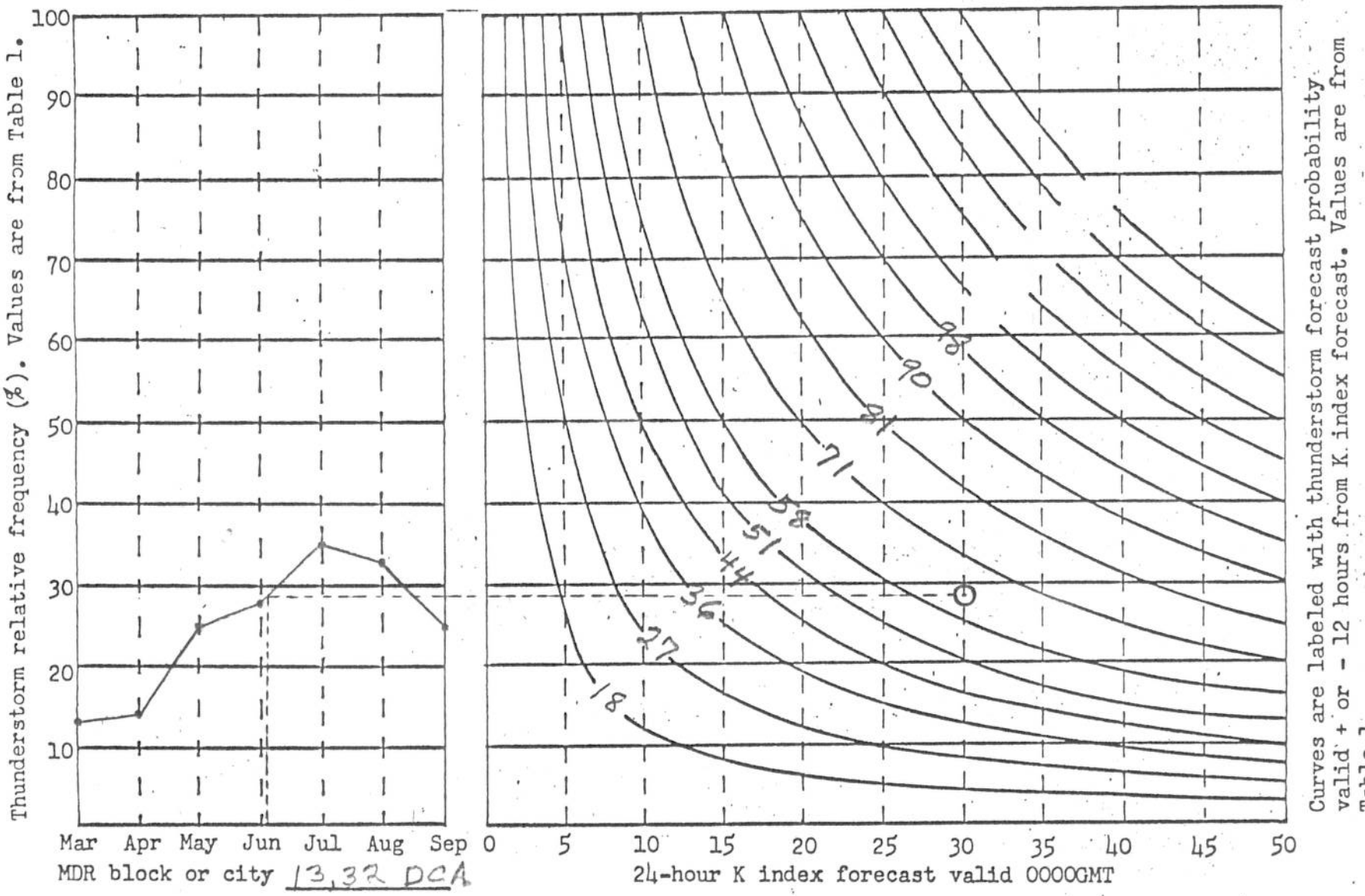

Figure 1. The thunderstorm probability nomogram prepared for Washington, D.C. and vicinity.