

EASTERN REGION TECHNICAL ATTACHMENT

No. 75-11-24

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THE SKILL OF THE NATIONAL METEOROLOGICAL CENTER'S SIX-HOUR MAXIMUM PRECIPITATION AMOUNT FORECASTS

NMC indicates expected precipitation amounts of 1", 2", 3", etc., on the 6-hourly QPF charts (N40, N104, F012, and F081) by annotating areas within the 0.50" isohyet. These forecasts are verified by examining all first-order station precipitation amount reports that fall within the 0.50" isohyet. Verification proceeds in the following manner:

1. The number of first-order stations enclosed by the 0.50" isohyet is counted. This figure represents the number of forecasts of the annotated maximum precipitation amount for each prog.

2. Regardless of the amount forecast, the number of first-order stations, enclosed by the 0.50" isohyet and reporting one, two or three inches, is tabulated. This represents the number of observations of excessive precipitation (1", 2" and 3"). Observations of excessive precipitation outside of the 0.50" isohyet are not counted. A range of precipitation amounts is used to place each observation in the 1", 2" or 3" category. The ranges are

<u>Observation</u>	<u>Category</u>
0.50" - 1.49"	1.00"
1.50" - 2.49"	2.00"
2.50" - 3.49"	3.00"

3. The number of observations of the amount forecast is tabulated, e.g., 5 observations within the range of 0.50-1.49" when the maximum precipitation forecast was 1.00" count as 5 hits.

Before presenting the verification statistics, we should review some definitions.

$$1. \text{ Threat Score} = \frac{\# \text{ Hits}}{\# \text{ Fcsts} + \# \text{ Obs} - \# \text{ Hits}}$$

The Threat Score measures the relative frequency of correctly forecasting the event in which the event was a threat. Threatening situations are those in which either the event occurred or was forecast to occur.

$$2. \text{ Post Agreement} = \frac{\# \text{ Hits}}{\# \text{ Fcsts}}$$

The Post Agreement is the relative frequency of correct forecasts. The Post Agreement can be considered the probability of success for a forecast of the event in the future provided that the forecast technique and climatology remain relatively unchanged.

$$3. \text{ Prefigurance} = \frac{\# \text{ Hits}}{\# \text{ Obs}}$$

The Prefigurance measures the relative frequency of correctly forecasting the observed event.

The reader should note that the above scores are related. In each case, "1" is a perfect score. It is possible to force the Prefigurance to equal "1" by always forecasting the event. However, this strategy improves the Prefigurance at the expense of the Threat Score, Post Agreement, and the forecaster's credibility with his users.

Another set of scores (1), which are related, are derived from the above. Their names may have more meaning to the user, and it may be worthwhile to introduce these terms in discussions with users and user groups.

$$1. \text{ Probability of Detection} \equiv \text{Prefigurance} \\ = \frac{\# \text{ Hits}}{\# \text{ Obs}}$$

$$2. \text{ False Alarm Ratio} = 1 - (\text{Post Agreement}) \\ = 1 - \left(\frac{\# \text{ Hits}}{\# \text{ Fcsts}} \right)$$

The user should be able to provide the desired values for these two scores. Of course, we may not be able to reach these values today, but they can serve as goals. We can also provide the current value of these scores to the user.

Tables 1a and b and 2a and b vividly demonstrate the sharp reductions in the frequency of heavy precipitation events from summer to winter. The frequency drops by a factor of 1/2 to 1/4 from one season to the other. As mentioned above, the Post Agreement (Tables 1c and d and 2c and d) can be used as a probability statement for future forecasts.

Caution is advised in examining and using the Threat Score and Prefigurance. As noted earlier, observations of excessive precipitation falling outside the forecast 0.50" isohyet are not considered; therefore, the Threat Score and Prefigurance are much higher than in verifications in which all observations are considered.

ACKNOWLEDGMENT

The data used in this Attachment were provided by the Quantitative Precipitation Branch, NMC.

REFERENCE

- (1) Donaldson, Ralph J., Jr., et al., March 1975: "Assessment of Conventional Radar Capability for Severe Storm Identification." Aerospace Science Review (U.S.A.F.), pp. 19-22.

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Attachments: Tables 1a, b, c, d, 2a, b, c, d

First Six-Hour Period (Eastern Half of U.S.)
Summer (April-September) 1975

		<u>Forecast</u>			Σ
		1"	2"	3"	
<u>Observed</u>	1"	329			381
	2"		36		98
	3"			1	30
Σ		564	97	9	

Table 1a. Contingency table for NMC forecasts vs. observed excessive precipitation amounts. In this and the following contingency tables, the boxes off the diagonal are empty because the data were not compiled.

Second Six-Hour Period (Eastern Half of U.S.)
Summer (April-September) 1975

		<u>Forecast</u>			Σ
		1"	2"	3"	
<u>Observed</u>	1"	316			385
	2"		28		104
	3"			0	27
Σ		565	85	5	

Table 1b. Contingency table for NMC forecasts vs. observed excessive precipitation amounts.

First Six-Hour Period (Eastern Half of U.S.)
Summer (April-September) 1975

	1''	2''	3''
Threat Score	0.534	0.226	0.026
Post Agreement	0.583	0.371	0.111
Prefiguration	0.864	0.367	0.033

Table 1c. Verification statistics derived from Table 1a.

Second Six-Hour Period (Eastern Half of U.S.)
Summer (April-September) 1975

	1''	2''	3''
Threat Score	0.498	0.174	0
Post Agreement	0.559	0.329	0
Prefiguration	0.821	0.269	0

Table 1d. Verification statistics derived from Table 1b.

First Six-Hour Period (Eastern Half of U.S.)
Winter (October-March) 1974-1975

		<u>Forecast</u>			
		1"	2"	3"	Σ
<u>Observed</u>	1"	157			184
	2"		12		29
	3"			1	7
Σ		230	47	3	

Table 2a. Contingency table for NMC forecasts vs. observed excessive precipitation amounts.

Second Six-Hour Period (Eastern Half of U.S.)
Winter (October-March) 1974-1975

		<u>Forecast</u>			
		1"	2"	3"	Σ
<u>Observed</u>	1"	142			181
	2"		15		40
	3"			1	11
Σ		234	39	2	

Table 2b. Contingency table for NMC forecasts vs. observed excessive precipitation amounts.

First Six-Hour Period (Eastern Half of U.S.)
Winter (October-March) 1974-1975

	1''	2''	3'' *
Threat Score	0.611	0.188	0.111
Post Agreement	0.683	0.255	0.333
Prefigurance	0.853	0.414	0.143

*Use caution because of small sample

Table 2c. Verification statistics derived from Table 2a.

Second Six-Hour Period (Eastern Half of U.S.)
Winter (October-March) 1974-1975

	1''	2''	3'' *
Threat Score	0.520	0.234	0.083
Post Agreement	0.607	0.385	0.500
Prefigurance	0.785	0.375	0.091

*Use caution because of small sample

Table 2d. Verification statistics derived from Table 2b.