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NGM QPF VERIFICATION AT BISMARCK

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1. Introduction

Quantitative precipitation forecasts (QPF's) are important not only to the hydrologic forecast but also to the public forecast. The automated QPF from the NGM is an important input to the forecast process. The QPF is also an important predictor in the FWC PoP equations.

From October 1989 through December 1990, QPF's for Bismarck (as taken from the FRHT70 bulletin) were verified against observed precipitation at the Bismarck WSFO. The 6-hourly data was combined into four 12-hour QPF's. The QPF was verified in four categories by amount; <.01,.01-.09,.10-.24 and >.24 inches. The purpose of the study was to see how reliable the QPF was in a dry continental climate.

2. Cold Season (Mid-October Through April) Results

The cold season data is summarized in Table 1. The cold season was dominated by light precipitation events. Of the roughly 500 cold season periods (2000 forecasts), a trace or less of moisture was observed 90% of the time (over 100 trace events) while >.24 inches was observed only once (an early spring rain event).

A quick glance at Table 1 shows some clustering of the data around the "perfect forecast diagonal" indicating some level of skill in the cold season QPF's. Although measurable precipitation was recorded less than 7% of the time when the QPF was 0 inches, nearly 54% of the precipitation events occurred when the NGM indicated no precipitation. When the NGM forecast precipitation, measurable precipitation occurred only 47% of the time. The NGM slightly underforecast the occurrence of <.10 inches of moisture but had a tendency to overforecast the occurrence for amounts >.10 inches.

Tables for the four forecast periods (not shown) give some additional insights. During the first 12 hours of the forecast, the NGM had a dry bias with roughly two-thirds of the precipitation events occurring with a 0 QPF. This dry bias is probably the result of the initialization process of the NGM (National Weather Service, 1987). However, in the rare event when precipitation was forecast in the first 12 hours, measurable amounts were observed 75% of the time.

The 12-24 hour QPF showed the most skill taking into account the scatter about the diagonal as well as the forecast bias. The skill level dropped off for the 24-36 hour and 36-48 hour periods as the scatter about the diagonal increased and the QPF's developed an increasing wet bias (again the results of the initialization; National Weather Service, 1987). In fact, the NGM forecasts precipitation nearly three times as often in the 36-48 hour period as in the 00-12 hour period. Also, three-fourths of all the forecasts of >.24 inches were in the 3rd and 4th periods and as Table 1 shows these forecasts were not very skillful (these were largely due to poor track forecasts of ejecting Colorado lows).

Table 1. Cool season QPF contingency table for Bismarck.

		OBSERVED					
		<.01	.01-.09	.10-.24	>.24	PoP	BIAS
FORECAST	<.01	1678	107	13	2	6.8%	1.00
	.01-.09	98	67	6	2	43.4%	0.87
	.10-.24	15	20	7	0	64.3%	1.40
	>.24	14	5	4	0	39.1%	5.75

3. Warm Season (May Through Mid-October) Results

The results for the warm season are summarized in Table 2. The precipitation during this particular warm season was dominated by convective events. Of the roughly 250 periods (1000 forecasts), the percentage of precipitation events was higher than the cold season and the amounts were more evenly distributed over the categories. However, heavy amounts of rain were rare with only three rain events >.50 inches and of these only one was greater than an inch.

Due to the increased variability of amounts in time and space and the smaller scale of convective events, one would expect the NGM QPF's to be poorer in the warm season. A glance at Table 2 confirms this as there is little clustering along the diagonal but rather a broad distribution throughout the contingency table. The NGM had a tendency to overforecast the occurrence of precipitation; however, the bias was not extreme.

Even though the actual amount is not well forecast, Table 2 shows that the PoP increased rather sharply as the QPF value increased. When the NGM forecast precipitation, measurable events occurred only 45% of the time. However, roughly 47% of all events occurred with a 0 QPF.

Unlike the cold season, the 0-12 hour warm season data does not show a strong dry bias. Although, amounts >.24 inches were underforecast. The warm season data shows only a weak tendency to become wetter through 36 hours. However, the 36-48 hour QPF showed an increasing wet bias especially in the higher QPF categories.

Table 2. Cool season QPF contingency table for Bismarck.

FORECAST	OBSERVED <.01	.01-.09	.10-.24	>.24	PoP	BIAS
<.01	719	50	19	18	10.8%	0.96
.01-.09	73	15	12	8	32.4%	1.35
.10-.24	29	9	10	11	50.8%	1.13
>.24	21	6	11	17	61.8%	1.02

4. Summary

The NGM QPF's at Bismarck showed some skill during the cool season. However, 54% of all the precipitation events occurred with a 0 QPF. When the NGM forecast precipitation, measurable precipitation was recorded 47% of the time. The NGM showed a tendency to become too wet with time beyond 24 hours.

The warm season QPF's showed little skill in forecasting precipitation amounts. However, the occurrence of precipitation did increase with increasing QPF. About 47% of all precipitation events occurred with a 0 QPF. When the NGM forecast precipitation, measurable precipitation was recorded 45% of the time. The warm season QPF did not have a large dry bias in the first 12 hours as did the cool season. Also, the NGM had a weaker tendency to become wetter with time in the warm season than in the cold season.

5. Reference

National Weather Service, 1987: Changing the Normal Mode Initialization in the Regional Analysis and Forecasting System (RAFS). Technical Procedures Bulletin No. 372, available from National Weather Service Headquarters, National Meteorological Center, Silver Spring, MD.