AN EXPERIMENT IN FORECASTING PRECIPITATION FOR SMALLER AREAS . . . PREPARING FOR THE NWS MODERNIZATION

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ABSTRACT

The Modernization and Associated Restructuring (MAR) of the National Weather Service during this decade will require forecasters to make forecasts for smaller areas (zones) than they do today. This study was conducted to determine how accurately forecasters could forecast the probability of precipitation (PoP) for smaller zones. Over a one year period, forecasters were asked to issue separate PoP forecasts for two sub-zones within each of three Mississippi Zones any time they felt that the PoP for the original zone could be further refined. The PoP forecasts were compared to actual areal coverage of precipitation as estimated from 12-hourly composites of radar overlays. For one of the zones, a comparison was made of verification results using areal rainfall coverage estimates and verification results using conventional point-verification methods. The results of this study are encouraging, and indicate that today's forecasters are well equipped to address the challenges and opportunities of forecasting for smaller areas during the MAR era.

1. INTRODUCTION

In anticipation of forecasting for smaller areas (zones) after modernization of the National Weather Service (NWS), a two part study was conducted beginning in 1988. The first part of the study (McKee 1988) not only revealed that NWS forecasters were quite receptive to the challenge of forecasting precipitation for small areas, but also showed a high degree of skill in determining relative rainfall distribution within a conventional zone. Although it answered the question of whether or not forecasters could divide today's zones into smaller areas and accurately forecast where rain was most likely (they could 80% of the time), the question of how accurate the forecasts were (i.e., statistical verification) was left unanswered. This study addresses that question.

2. METHODOLOGY

Three zones (MS06, MS08, MS11) were selected to represent North, Central and South Mississippi (Fig. 1). Probability of precipitation (PoP) forecasts were made as usual from August 25, 1987 to August 31, 1988. However, forecasters were asked to divide any or all of the three designated zones into two sub-zones and issue a separate PoP forecast for the sub-zones any time they felt that the original zone PoP could be further refined (again, see Fig. 1). This experiment focused on the first 12 hours since that forecast period will draw increased emphasis in the future. Excluding those occasions when no rain was forecast anywhere in the state, zones were sub-divided 37% of the time. When the forecasters chose not

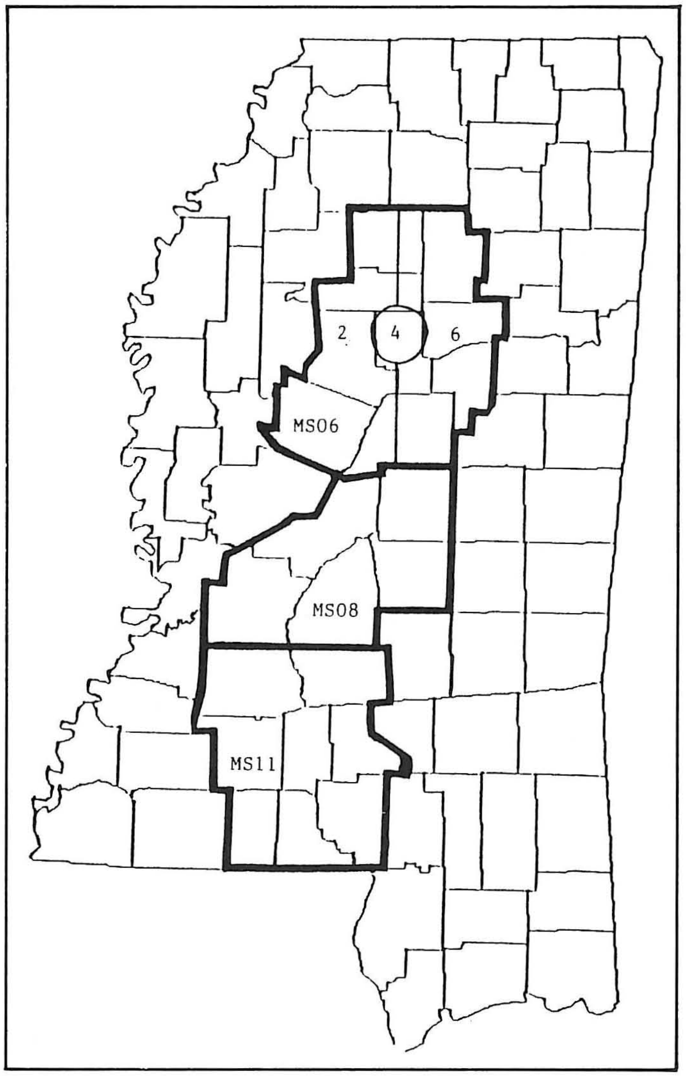

Fig. 1. Location of the three Mississippi Zones used in this study and example of a divided zone. MS06, with an original zone PoP of 40%, has been divided into sub-zones with PoPs of 20% and 60%.

to divide a zone, the PoPs for the sub-zones were considered identical to the entire zone's PoP. The PoP forecasts were then compared to actual areal coverage of precipitation by inspection of the 12-h composites of the Weather Service Forecast Office (WSFO) Jackson radar overlays. Estimates of areal coverage for each of the three zones and each of the six sub-zones were made every 12 hours during the period of the study. The practice of using rainfall areal coverage to verify PoP forecasts has been documented in the past (Smith 1977, McKee 1980), and offers an attractive alternative to point-verification.

The data are examined from two different perspectives. First, a comparison is made of the zone and sub-zone PoP vs. observed rainfall coverage for all forecasts. This data set consists of PoP vs. areal coverage statistics for 2202 individual zone forecasts and for 4360 sub-zone forecasts. The second data set comprises only those occasions (676) when the forecasters issued PoPs for the sub-zones that were different from the zone PoPs (37% of the time, excluding no-rain situations). The first data set provides a good statistical overview of all forecasts for the zones and the sub-zones. The second data set is restricted to those forecast situations in which PoPs for each sub-zone and its parent zone were different.

3. RESULTS

Examination of the first data set, consisting of all forecast issuances (Fig. 2), leads to two observations: 1) the forecasts for the undivided zones were very good (observed areal rainfall coverage was usually within 5% of the forecast PoP), and 2) the forecasts for the sub-zones were even better.

The second data set is used to examine those occasions when different PoPs were assigned to the parent zone and to each sub-zone (an example would be a zone PoP of 40% with one sub-zone given a 20% PoP and the other a 60% PoP). With the exception of the 70% and the 90% PoPs, the forecasts for the zones and the sub-zones were again very good (Fig. 3). And again, the sub-zone statistics were better than those of the zones.

Climatologically, it was relatively dry during the period of the study, with most reporting stations in Mississippi receiving only two-thirds of normal rainfall. Whether or not this contributed to the high forecast accuracy shown by the reliability curves is unknown. It should be noted that the WSFO point-verification reliability curves for Jackson for the year just prior to and just after the study period (i.e., September 1986–August 1987 and September 1988–August 1989) showed very comparable accuracy.

The validity of using areal coverage of rainfall in near homogeneous geographical regimes to verify PoP forecasts has been previously documented. But there are few, if any, documented comparisons of verification results obtained from areal coverage estimates to those obtained from point-verification methods. Figure 4 shows such a comparison. The areal coverage verification statistics for zone 8 are compared with point-verification statistics for WSFO Jackson, which is in zone 8, over the entire study period. Again, only the first

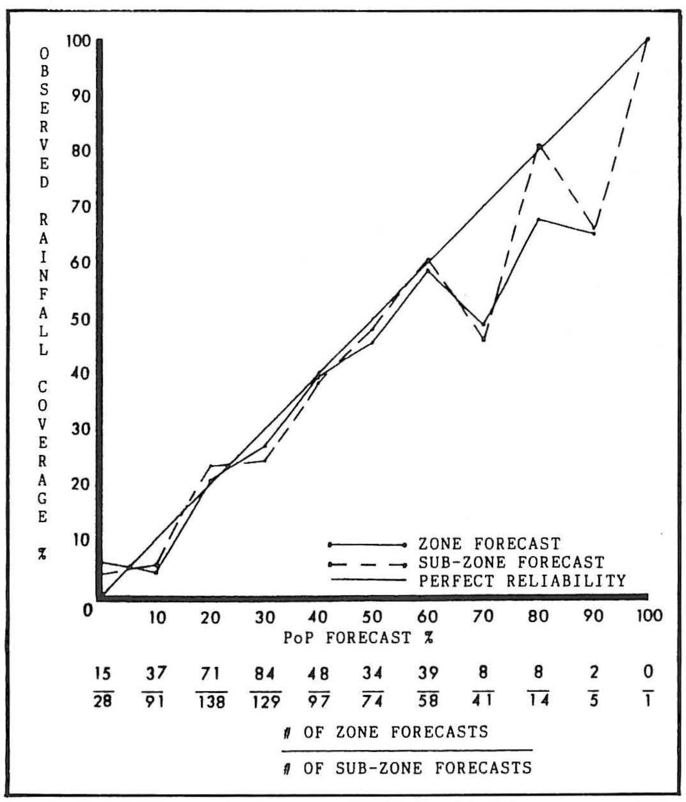

Fig. 3. Reliability graph of zone and sub-zone PoP forecasts excluding those occasions when zone PoPs and sub-zone PoPs were the same, August 25, 1987–August 31, 1988, for the first forecast period.

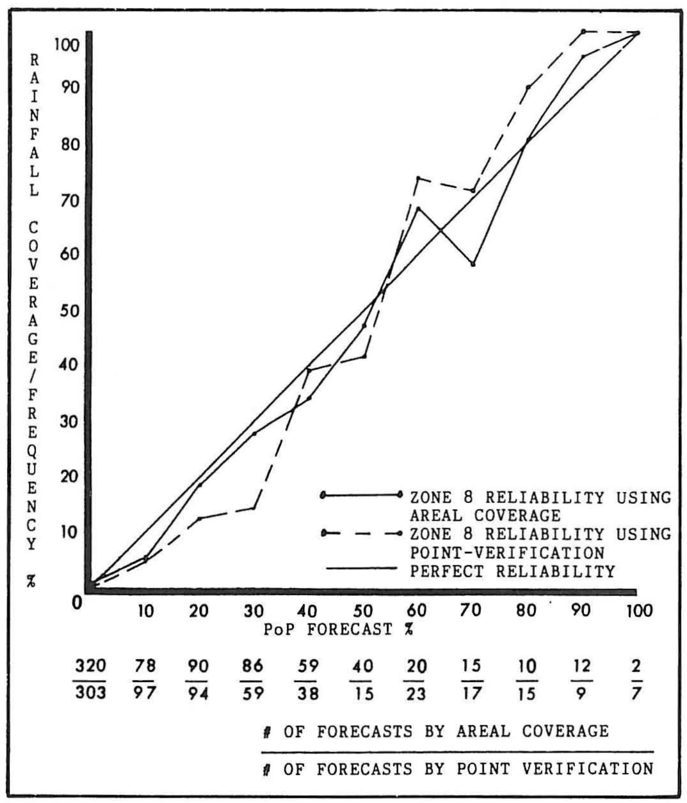

Fig. 4. Comparison of verification methods: areal coverage reliability curve vs. point-verification reliability curve. Areal coverage curve is for zone 8, while point-verification curve is for WSFO Jackson which is in zone 8, August 25, 1987–August 31, 1988, for the first forecast period.

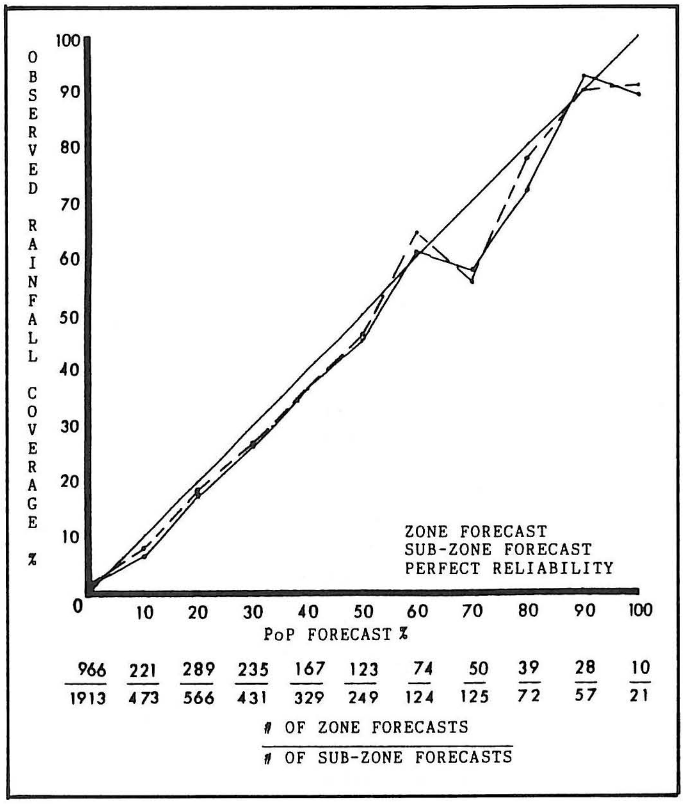

Fig. 2. Reliability graph of ALL zone and sub-zone PoP forecasts, August 25, 1987–August 31, 1988, for the first forecast period.

forecast period was investigated. The agreement between the two reliability curves in Figure 4 is good, and indicates compatibility of the two verification methods. There is some subjectivity involved in the estimates of areal coverage of rainfall, but their accuracy is probably +/− 10%.

4. CONCLUSIONS

Crucial to the success of the Modernization and Associated Restructuring (MAR) of the NWS will be our ability to provide forecast services in the future that are at least as good as the ones we now provide. Forecasters in the modernized NWS will be required to issue probability of precipitation forecasts for areas (zones) that are approximately half the size of today's forecast areas. Can this be done without a decrease in forecast accuracy? During the one year period of this study of 12-h PoP forecasts, forecasters were indeed able to do this, and it seems reasonable to expect similar results in the future (i.e., no degradation of services). *Were it not for the workload and communications restrictions, forecasts for smaller areas could probably be issued on a regular basis today.* The development and deployment of Doppler radar, advanced data assimilation and processing capabilities, new weather observing systems, etc. will certainly present new challenges to the operational forecaster, but will also present many opportunities. The results of this study suggest that our real MAR challenge will be in taking advantage of the new technology to provide not just equal, but significantly improved services.

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