U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE
SYSTEMS DEVELOPMENT OFFICE
TECHNIQUES DEVELOPMENT LABORATORY

TDL OFFICE NOTE 83-7

COMPARATIVE VERIFICATION OF GUIDANCE AND LOCAL AVIATION/PUBLIC WEATHER FORECASTS--No.14
(April 1982-September 1982)

Gary M. Carter, J. Paul Dallavalle,
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May 1983

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1. INTRODUCTION

This is the fourteenth in the series of Techniques Development Laboratory (TDL) office notes which compare the performance of TDL's automated guidance forecasts with National Weather Service (NWS) local forecasts made at Weather Service Forecast Offices (WSFO's). The local forecasts, which are produced subjectively, may or may not be based on the automated guidance. In this report, we present verification statistics for the warm season months of April through September 1982 for probability of precipitation (PoP), surface wind, opaque sky cover (cloud amount), ceiling height, visibility, and maximum/minimum (max/min) temperature. The PoP, ceiling height, visibility, and max/min temperature verification results are provided for both the 0000 and 1200 GMT forecast cycles.

The objective guidance is based on equations developed through application of the Model Output Statistics (MOS) technique (Glahn and Lowry, 1972). We derived these prediction equations by using archived surface observations and forecast fields from the Limited-area Fine Mesh (LFM) model (Gerrity, 1977; Newell and Deaven, 1981; National Weather Service, 1981b), the Trajectory model (Reap, 1972), and/or the 6-layer coarse mesh Primitive Equation (PE) model (Shuman and Hovermale, 1968). Unless indicated otherwise, we usually refer to MOS forecasts based on the LFM model as "early" guidance; "final" guidance indicates the objective forecasts were based primarily on PE data. Also, the observation times of surface weather elements used as predictors in the early and final guidance generally differed. The final guidance is no longer disseminated operationally due to the superiority of the early guidance, but comparative results for previous years are included on the figures presented in this report.

The local aviation forecasts from the WSFO's were collected by the Scientific Procedures Branch of the Office of Meteorology for the purposes of the NWS combined aviation/public weather verification system (National Weather Service, 1973). These forecasts were recorded for verification according to the direction that they be "... not inconsistent with ..." the official weather prognosis. Surface observations as late as 2 hours before the first valid forecast time may have been used in the preparation of the local forecasts.

The local public weather PoP forecasts used for this verification were official forecasts obtained from the Coded City Forecast (FPUS4) bulletin. Unfortunately, in 1982, problems associated with the automated collection of FPUS4 bulletins from the communications system caused the loss of much local public weather forecast data. Hence, the 1982 warm season verification results for PoP are not compared with those for previous years.

In the past, local max/mim forecasts from the FPUS4 bulletin were compared with the MOS temperature guidance. However, the verification procedure was controversial because the local forecast was valid for a 12- or 18-h period, while the corresponding guidance applied to a particular calendar day. Hence, in conformance with a recommendation from the 1982 NWS Line Forecasters Technical Advisory Committee, this report contains temperature verification results for the guidance only. We will continue this policy in future reports until the new verification system outlined in the NWS National Verification Plan (National Weather Service, 1982a) is fully implemented.

We obtained all required observed verification data from the National Climatic Data Center in Asheville, North Carolina. The observations were carefully error-checked prior to computation of any of the verification scores.

2. PROBABILITY OF PRECIPITATION

Objective PoP forecasts were produced by the set of warm season prediction equations described in Technical Procedures Bulletin No. 299 (National Weather Service, 1981a). Only the early guidance has been available since the 1980 warm season. The guidance was available for the first, second, and third periods, which correspond to forecast projections of 12-24 hours, 24-36 hours, and 36-48 hours, respectively, after 0000 or 1200 GMT. The majority of the predictor variables were forecast fields from the LFM model; surface variables observed at the forecast site at 0300 or 1500 GMT were included as predictors for the first period.

The PoP forecasts were verified by computing Brier scores (Brier, 1950) for the 87 stations shown in Table 2.1. Please note that we used the standard NWS Brier score which is one-half the original score defined by Brier. Brier scores will vary from one station to the next and from one year to the next because of changes in the relative frequency of precipitation; in particular, the scores usually are better for periods of below normal precipitation. Therefore, we also computed the percent improvement over climate, that is, the percent improvement of Brier scores obtained from the local or guidance forecasts over analogous Brier scores produced by climatic forecasts. Climatic forecasts are defined as relative frequencies of precipitation by month and by station as determined from a 15-year sample (Jorgensen, 1967).

As mentioned in the introduction, operational problems caused the periodic loss of local forecast data throughout the entire 1982 warm season. The percent fewer cases compared to the previous warm season's verification varied by NWS region in the following manner: Eastern Region (67%), Southern Region (51%), Central Region (30%), and Western Region (20%).

Tables 2.2 and 2.7 present the 1982 results for all 87 stations combined for the 0000 and 1200 GMT cycle forecasts, respectively. Tables 2.3-2.6 and Tables 2.8-2.11 show scores for the NWS Eastern, Southern, Central, and Western Regions, for the 0000 and 1200 GMT cycles, respectively. The overall Brier scores and improvements over climate in Tables 2.2 and 2.7 indicate the first-period local forecast were superior to guidance by 3.6 and 1.4% for the 0000 and 1200 GMT cycles, respectively. First-period local forecasts were also superior for each region and cycle, except for the Central Region for 1200 GMT.

However, the guidance forecasts were as good or better overall as the locals for the second and third periods for both cycles. Regional scores for 0000 GMT show the guidance to be better in the Central Region and worse in the Eastern and Western Regions. For 1200 GMT, the guidance is better in the Eastern, Southern, and Central Regions and worse in the Western Regions.

Fig. 2.1 shows the trend since 1971 in skill (expressed in terms of percent improvement over climate) for the first- and third-period 0000 GMT cycle forecasts. Due to the loss of data, we did not feel justified in adding the results for the 1982 warm season, so Fig. 2.1 is a repeat of the graph which appeared in TDL Office Note 82-8 (Carter et al., 1982). For the third-period forecasts, the results indicate that both the guidance and locals have improved over the years.

3. SURFACE WIND

The objective surface wind forecasts were generated by the LFM-based equations valid for the warm season described in Technical Procedure Bulletin No. 316 (National Weather Service, 1982b). Only the early guidance has been available since the 1978 warm season. In addition to LFM model forecasts, predictors in the equations included the sine and cosine of the day of the year and of twice the day of the year; also, surface weather observations were used as predictors for the 6- and 12-h projections. During the 1981 warm season, a significant change occurred in the operational early guidance wind prediction system. New equations which had been developed without screening as predictors any surface pressure or boundary layer fields from the LFM model were implemented on May 28, 1981. The impact of removal of the surface pressure and boundary layer fields as predictors in objective surface wind forecasting is described by Janowiak (1981).

We verified the 18-, 30-, and 42-h forecasts from 0000 GMT; these were the only projections for which local forecasts were available. The surface wind forecasts were defined in the same way as the observed wind, namely, the 1-minute average wind direction and speed for a specific time. Since the local forecasts were recorded as calm if the wind speed was expected to be less than 8 knots, the wind forecasts were verified in two ways. First, for all those cases in which both the local and objective wind speed forecasts were at least 8 knots, the mean absolute error (MAE) of speed was computed. Cases where the observed wind was calm were then eliminated from this sample and the MAE of direction was computed. Second, for all cases where both local and automated forecasts were available, skill score[1], percent correct, and bias by category[2] were computed from contingency tables of wind speed. The seven categories in the tables were: <8, 8-12, 13-17, 18-22, 23-27, 28-32, and >32 knots. Table 3.1 lists the 89 stations used in this verification. Note that

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[1] The skill score used throughout this paper is the Heidke skill score (Panofsky and Brier, 1965).

[2] In the discussion of surface wind, opaque sky cover, ceiling height, and visibility, bias by category refers to the number of forecasts of a particular category (event) divided by the number of observations of that category. A value of 1.0 denotes unbiased forecasts for a particular category.

all the objective forecasts of wind speed were adjusted by an "inflation" technique (Klein et al., 1959) involving the multiple correlation coefficient and the mean value of wind speed for each particular station and forecast valid time.

The results for all 89 stations combined are shown in Tables 3.2 and 3.3. The MAE's for the direction reveal an advantage for the guidance that is 3° for the 18- and 42-h projections and 4° for the 30-h projection. Overall, the skill scores and percent correct for wind speed were better for the guidance. The bias by category values in Table 3.2 and the contingency tables in Table 3.3 indicate the guidance overestimated winds stronger than 22 knots (i.e., categories 5, 6, and 7) for all three forecast projections, whereas the local forecasts underestimated winds in these categories. This is the second warm season where the guidance has been overforecasting the stronger winds; we think this is partly due to the implementation of new equations. We also think some of the overforecasting was caused by LFM model errors in forecasting the movement and intensity of synoptic scale weather systems throughout the United States. We have noticed this problem since the 1981-82 cool season.

Tables 3.4-3.7 show scores for the NWS Eastern, Southern, Central, and Western Regions, respectively. The regional comparisons generally have the same characteristics as for the entire group of stations, except the advantage of the guidance over the local forecasts varies from region to region. However, for the Southern Region (Table 3.5) and Central Region (Table 3.6), the MAE's of the local wind speed forecasts are slightly better than those for the guidance.

Table 3.8 shows the distribution of wind direction absolute errors by categories--0-30°, 40-60°, 70-90°, 100-120°, 130-150°, and 160-180°--for all 89 stations combined. Note that the guidance had about 4% fewer errors of 40° or more than did the local forecasts for the 18- and 30-h projections, and about 3% fewer for the 42-h projection.

Distribution of direction errors for the individual regions are given in Tables 3.9-3.12. In general, these results are much like those in Table 3.8 except, once again, the advantage of the guidance over local forecasts differs from region to region.

A comparison of the overall MAE's and skill scores during the past nine warm seasons for the 18- and 42-h guidance and local forecasts is presented in Figs. 3.1-3.3. The verification data throughout this perid were relatively homogeneous; the number of stations varied only slightly from season-to-season, while the basic set of verification stations remained the same. In general, the MAE's and skill scores in these diagrams reveal the consistent superiority of the early guidance over both the final guidance and the local forecasts.

The MAE's for direction are given in Fig. 3.1. The curves indicate that the guidance and local forecasts for both projections improved during the period from 1975 to 1978. In contrast, the MAE's for speed in Fig. 3.2 denote a general decrease in accuracy for the final guidance forecasts after the introduction of inflation in July of 1975. We realized that inflation would have this effect; however, previous wind speed verifications indicated that the bias by category values of inflated forecasts were somewhat closer to 1.0 compared to the values of uninflated forecasts (Carter and Hollenbaugh, 1976). Despite use of the inflation technique, the MAE's for the 18-h early guidance are generally as good as the 1974 (pre-inflation) values. Note the superiority of the early guidance forecasts over the local forecasts for the 18-h projection.

Figure 3.3 is a comparison of guidance and local skill scores computed on five (instead of seven) categories of wind speed; the fifth category includes all speeds greater than 22 knots. Of particular note is the magnitude of the advantage of the guidance over the locals for both projections.

4. OPAQUE SKY COVER

During the 1982 warm season, the opaque sky cover forecasts were produced by the warm season prediction equations described in Technical Procedures Bulletin No. 303 (National Weather Service, 1981c). These equations used LFM model output and 0300 (1500) GMT surface observations to produce forecasts for 10 projections at specific 6-h intervals from 6 to 60 hours after 0000 and 1200 GMT. Only early guidance was available for verification since the final guidance was terminated after the 1979 warm season. Regionalized equations produced probability forecasts of the four categories of opaque sky cover, more commonly known as cloud amount, shown in Table 4.1. We converted the probability estimates to single "best category" forecasts in a manner which produced good bias characteristics, that is, a bias value of approximately 1.0 for each category. The threshold technique described in Technical Procedures Bulletin No. 303 was used to obtain the best category forecast.

We compared the local forecasts with a matched sample of guidance forecasts for the 89 stations listed in Table 3.1 for 18-, 30-, and 42-h forecast projections from 0000 GMT. The local forecasts and the surface observations used for verification were converted from opaque sky cover amounts to the categories given in Table 4.1. Four-category (clear, scattered, broken, and overcast), forecast-observed contingency tables were prepared from the local and objective categorical predictions. Using these tables, we computed the percent correct, skill score, and bias by category.

The results for all stations combined are shown in Table 4.2. For the 30- and 42-h projections, the guidance forecasts were superior to the local forecasts in terms of percent correct and skill score. For the 18-h projection, there was little difference between the scores for the guidance and local forecasts. Examination of the bias by category scores shows that the guidance forecasts were better (i.e., closer to 1.0) than the local forecasts for each projection and category except for the 42-h forecasts of broken. The local forecasts generally exhibited a tendency to underforecast the clear and overcast categories, and overforecast the scattered and broken categories.

The verification scores for stations in the NWS Eastern, Southern, Central, and Western Regions are given in Tables 4.3-4.6, respectively. The percent correct and skill scores for the guidance forecasts for the 30- and 42-h projections were superior to those for the locals. However, for the 18-h projection, the local forecasts for the Southern, Central and Western Regions were as good as, or better than, the guidance in terms of percent correct. The 18-h local forecasts for the Central and Western Regions also were as good as, or better than, the guidance in terms of the skill score. However, the bias by category values for the guidance forecasts generally were closer to 1.0 than those for the local forecasts.

Percents correct and skill scores for the past eight warm seasons are shown in Figs. 4.1 and 4.2, respectively, for the 18- and 42-h projections. These figures indicate the 1982 guidance and local forecasts decreased in accuracy compared to the results for the previous year, especially the 18-h guidance forecasts. The results also show that, for the first time since the early guidance was introduced, the local forecasts were as good as the guidance for the 18-h projection.

Figures 4.3-4.6 show bias values for categories 1 through 4, respectively, for the 18-h forecasts.[3] The local forecast biases for all four categories, with some minor fluctuations, have remained relatively constant over the years. The graphs also show that the locals have a tendency to underforecast the clear and overcast categories, and overforecast the scattered and (to a lesser extent) the broken categories. The biases for the guidance forecasts have, for all but the broken category, been consistently superior to the local forecasts. For the broken category, both the guidance and local forecasts have had good bias characteristics. We also note that, during 1982, the bias values for the 18-h guidance forecasts of category 1 (clear) deteriorated.

5. CEILING AND VISIBILITY

During the 1982 warm season, the ceiling and visibility guidance was produced by the warm season prediction equations described in Technical Procedures Bulletin No. 303 (National Weather Service, 1981c). Operationally, the guidance was based primarily on LFM output and 0300 (1500) GMT surface observations. Forecasts were produced for 6-h intervals from 6 to 60 hours after 0000 (1200) GMT.

Verification scores were computed for both local and guidance forecasts for the 89 stations listed in Table 3.1. In each case, persistence, based on an observation taken at 0900 GMT for the 0000 GMT cycle and at 2100 GMT (or 2200 GMT) for the 1200 GMT cycle, provided a standard of comparison. Guidance forecasts were verified for both cycles for the 12-, 18-, 24-, 36-, and 48-h projections. The local forecasts were verified for 12-, 15-, and 21-h projections from 0000 and 1200 GMT. On a day-to-day basis, the guidance and the persistence observations usually were available in time for preparation of the local forecasts.

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[3] In most of our past verification reports (e.g., Maglaras et al., 1981), the bias by category graphs were plotted on a linear scale. Here, the bias graphs are plotted on a semi-log scale. The reason for the change is because we think that biases of X and 1/X are equally bad. For example, forecasting an event four times as often as it occurred should appear as bad as forecasting that event only one-fourth as many times as it occurred.

We constructed forecast-observed contingency tables for the six categories given in Table 5.1 for all the forecasts involved in the comparative verification. These categories were used for computing several different scores: bias by category, percent correct, and skill score. We then collapsed the tables to two categories (categories 1 and 2 combined versus categories 3 through 6 combined) and calculated the bias and the threat score[4] for categories 1 and 2 combined. Skill score and percent correct also were calculated for the two-category contingency tables. We have summarized the results in Tables 5.2-5.9. Skill scores and bias values for categories 1 and 2 combined for the past seven warm seasons also are shown in Figs. 5.1-5.8 for selected projections from 0000 GMT.

Tables 5.2-5.5 present verification results for the six-category ceiling and visibility forecasts. The scores in Table 5.3 for the 12-h projection from 0000 GMT indicate the skill of the local visibility forecasts exceeded the skill of persistence. For both forecast cycles and weather elements, the 12-h guidance forecasts had lower (worse) skill scores than those for the locals and persistence. With the exception of the visibility forecasts for the 15-h projection from 1200 GMT (Table 5.5), the local forecasts of ceiling and visibility had higher skill scores than persistence for the 15- and 21-h projections from both 0000 and 1200 GMT. For the 18-, 24-, 36- and 48-h projections, the guidance usually outperformed persistence by a wide margin in terms of skill score. Also, for projections of more than 12 hours, the guidance bias by category characteristics were better (i.e., closer to 1.0) than those for persistence. For the 12-h projection (actually a 3-h projection for both the local and persistence forecasts, and a 9-h projection for the guidance), the bias values for both the guidance and persistence generally were better than those for the local forecasts. Of note in Tables 5.2-5.5 is the rarity (generally less than 20 cases in a sample of more than 14,000) of category 1 ceiling and visibility events during afternoon and evening hours.

Tables 5.6-5.9 show comparative verification results for the two-category ceiling and visibility forecasts. The relative frequency of ceiling less than 500 feet and visibility less than 1 mile ranged from 0.002 to 0.049. This fact, plus lower skill scores for the two-category tables as compared to the six-category tables, indicates these events are difficult to forecast. For the 12-h projection from 0000 GMT, the persistence forecasts of ceiling and visibility had the highest skill scores. For the 12-h projection from 1200 GMT, the persistence forecasts had the highest skill scores for ceiling, but the local forecasts had the highest skill scores for visibility. In contrast, the guidance skill scores were much lower than those for persistence and the locals. For the 15-h projection, the persistence skill scores were higher than those for the local ceiling forecasts from both 0000 and 1200 GMT; however, for visibility, the local skill scores were higher than those of persistence for both cycles. For the 21-h projection, the skill score for the local forecasts was much higher than that of persistence. The skill of the

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[4] Threat score = H/(F+O-H) where H is the number of correct forecasts of a category, and F and O are the number of forecasts and observations of that category, respectively.

guidance forecasts for the 18-, 24-, 36-, and 48-h projections varied a great deal from projection to projection, but usually it was much higher than the score for persistence.

Figs. 5.1-5.8 are trend graphs for skill score and bias for selected projections for the 0000 GMT cycle, two-category ceiling and visibility forecasts. The scores in Figs. 5.1-5.4 show that the skill of the visibility guidance for the 12-h projection, as well as local forecast ceiling and visibility skill scores, improved over the 1981 warm season scores. The results in Figs. 5.5-5.8 (see footnote 3 for details about the format) indicate the guidance bias characteristics improved substantially after the threshold technique for category selection was introduced in 1977. The bias values for the 12-h projection have remained relatively unchanged since 1977 for all types of forecasts. The graphs also reveal a consistent low bias for the local forecasts for the 15-h projection (i.e., a tendency to underforecast the operationally significant weather conditions which these categories represent), and a large improvement from 1981 in the guidance bias values for the 18-h projection.

6. MAXIMUM/MINIMUM TEMPERATURE

The objective max/min temperature guidance for April 1982 through September 1982 was generated by the LFM-based regression equations described in Technical Procedures Bulletin No. 285 (National Weather Service, 1980). The predictand data for these equations consisted of local calendar day max or min temperatures valid approximately 24, 36, 48, and 60 hours after the model initial data times of 0000 and 1200 GMT. The guidance was based on equations developed by stratifying archived LFM model forecasts, station observations, and the first two harmonics of the day of the year into seasons of 3-month duration (Dallavalle et al., 1980). We defined spring as March-May, summer as June-August, and fall as September-November. Station observations taken 3 hours after initial model time were also used as predictors in much of the guidance for the first two periods.

Since the automated max/min forecasts are valid for the local calendar day, the first period objective forecast of the max based on 0000 GMT model data is provided for the calendar day starting at the subsequent midnight. The max/min guidance for the other periods corresponds to specific calendar days in an analogous manner. The calendar day max/min temperature observations used to verify the objective forecasts were obtained from the National Climatic Data Center.

In prior verification reports (Carter et al., 1982), we compared the skill of the local max/min temperature forecasts with that of the objective guidance. However, the valid period of the local forecasts corresponds to a daytime max and a nighttime min, rather than a particular calendar day. Our procedure of using a calendar day verifying observation generated a considerable amount of controversy. Because appropriate daytime max and nighttime min observations are not available for verification, the 1982 NWS Line Forecasters Technical Advisory Committee recommended that comparisons between local and objective max/min forecasts no longer be published. In this report, we have complied with this request; only the automated forecasts were verified and discussed. Eventually, with implementation of the new AFOS verification system, the required observations will be available and comparisons between the guidance and locals will be possible.

For the 1982 warm season, we verified both the 0000 and 1200 GMT cycle objective forecasts. Because a matched sample between the local forecasts and automated guidance was not required, the number of cases increased by approximately 15% from the previous warm season. We do not think that this increase in sample size changed the results in a significant manner. The max/min verification statistics generally are based on large, stable samples so relatively small changes in the number of cases do not alter the overall measures of skill. For the 1982 warm season, the mean algebraic error (forecast minus observed temperature), mean absolute error, and the number of absolute errors $\geq$ 10°F were computed for 87 stations (Table 2.1). For the 0000 GMT cycle, forecast projections of approximately 24 (max), 36 (min), 48 (max), and 60 (min) hours were verified; for the 1200 GMT cycle, forecasts of approximately 24 (min), 36 (max), 48 (min), and 60 (max) hours were verified.

The results for all stations combined for 0000 and 1200 GMT are shown in Tables 6.1 and 6.6, respectively. Similarly, Tables 6.2-6.5 give the 0000 GMT verification scores for the Eastern, Southern, Central, and Western Regions, respectively. Tables 6.7-6.10 show analogous scores by NWS region for the 1200 GMT cycle.

In general, for the 0000 GMT cycle forecasts, the guidance tended to be too warm (positive algebraic error) for nearly all projections and all regions. The largest warm biases at 0000 GMT occurred for the Western Region 24- and 48-h max forecasts. In contrast, for the 1200 GMT cycle forecasts, the MOS forecasts tended to be too cold in the Eastern and Southern Regions, but too warm in the Central and Western Regions. The largest biases at 1200 GMT occurred in the Western Region for the 36- and 60-h max forecasts. The verifications for all stations combined indicate the max temperature was more difficult to predict than the min for the same projection. For the 48-h projection, the max guidance had a mean absolute error of 3.5°F while the min guidance had an error of 3.1°F. This trend in the relative difficulty of forecasting the max or min temperature was evident in the scores for all four regions and all projections, but it was most pronounced in the results for the Central and Western Regions. Overall, the greatest number of temperature forecasts with errors greater than or equal to 10°F occurred for the 48- and 60-h max guidance. We think this difficulty in predicting the max temperature during the warm season is due to localized convective activity which is outside the resolution of the LFM model.

Max temperature forecast MAE's for the 0000 GMT cycle during the last 12 warm seasons are shown in Fig. 6.1. The final guidance, which was based on output from the coarse-mesh primitive equation model (Shuman and Hovermale, 1968) or the Spectral model (Sela, 1980), was ended in December 1980 because of poor performance compared to the LFM-based early guidance. The error curves in Fig. 6.1 are irregular because of natural variability and also because of the difficulty in predicting max temperatures during the warm season. Nevertheless, over the 12-year period, the objective forecasts have improved substantially with the smallest errors being recorded in 1982. From

1971 to 1982, the MAE for both the 24- and 48-h max decreased by over 0.5°F. Although the comparisons between the local and objective forecasts are not available, we think the local forecasters have continued to improve upon the automated guidance. Also, from Fig. 6.1, we note that the skill of the objective forecasts increased in 1974 when MOS equations were introduced (Klein and Hammons, 1975) and again in 1976 when 3-month equations were first used (Hammons et al., 1976). The 24-h early guidance was enhanced in 1978 with the introduction of LFM-based equations (Carter et al., 1979). In 1980, the 48-h MOS forecasts improved with the application of new, 3-month equations (Dallavalle et al., 1980).

An analogous time series is shown in Fig. 6.2 for the min forecasts from 0000 GMT. For both the 36- and 60-h projections, there has been overall improvement in the objective forecasts since the verifications began. Similar to the max temperature guidance, the greatest improvements in accuracy for the 36-h min forecasts were in 1974 and 1976. For the 60-h guidance, the MAE's for the 1982 warm season were the lowest observed during the entire period of record.

7. SUMMARY

Highlights of the 1982 warm season verification results, summarized by general type of weather element, are:

- Probability of Precipitation - The comparative verifications involved 87 stations and forecast projections of 12-24, 24-36, and 36-48 hours from both 0000 and 1200 GMT. For all stations combined, the NWS Brier scores show the first-period local forecasts were better than the guidance for both forecast cycles. In contrast, the accuracy of the second- and third-period guidance forecasts were as good or better than the locals for both 0000 and 1200 GMT. Operational problems associated with the automated collection of local PoP forecasts from the communications system resulted in the periodic loss of data throughout the entire 1982 warm season. Hence, we were unable to compare the scores for 1982 with those for the previous warm seasons.

- Surface Wind - The wind verification study was conducted for 89 stations and forecast projections of 18, 30, and 42 hours from 0000 GMT. While the overall results indicate the surface wind direction and speed guidance was consistently more accurate than the local forecasts, there was a slight drop in the accuracy and skill of the guidance in comparison with the results for previous warm seasons. This is similar to the deterioration noticed in the 1981-82 cool season wind guidance verification scores.

- Opaque Sky Cover - Verification results for all 89 stations combined indicate the 0000 GMT cycle guidance was better than the local forecasts in terms of percent correct, skill score, and bias by category for the 30- and 42-h projections; there was little difference between guidance and local scores for the 18-h projection. The percent correct, skill score, and bias by category values for both the guidance and local forecasts generally deteriorated when compared with the scores for the 1981 warm season.

- Ceiling and Visibility - The verifications involved the comparison of local forecasts, MOS guidance, and persistence for 89 stations and for projections ranging from 12 to 48 hours from both 0000 and 1200 GMT. However, direct comparison of local, MOS, and persistence forecasts was possible only for the 12-h projection. This projection is actually a 3-h forecast from the latest available surface observation for the locals and persistence, and in this sense it is a 9-h forecast for the guidance. Most of the 12-h projection verification scores for both ceiling and visibility show the local and persistence forecasts were superior to the guidance. However, for the longer range projections, the local and guidance forecasts generally were much better than persistence. In comparison to the previous warm season, the 0000 and 1200 GMT cycle forecasts for the lowest two categories of ceiling and visibility usually either increased in accuracy or remained about the same.

- Maximum/Minimum Temperature - Objective max/min forecasts were verified for 87 stations for both the 0000 and 1200 GMT cycles. At 0000 (1200) GMT, the maximum temperature guidance was valid for calendar day periods approximately 24 (36) and 48 (60) hours in advance, while the minimum temperature forecasts were valid for calendar day periods approximately 36 (24) and 60 (48) hours after the initial model time. Overall, in terms of the mean absolute error, we found that the max/min guidance disseminated during the 1982 warm season was the most skillful produced during our period of record. As is usual during the warm season, the minimum temperature forecasts verified better for the same projection than did the maximum temperature forecasts. We think this is related to the frequency of small-scale convective activity during the afternoon, the time of day during which the maximum temperature generally occurs. We will not compare the accuracy of guidance and local max/min forecasts until the new verification system outlined in the NWS National Verification Plan (National Weather Service, 1982a) is implemented.

8. ACKNOWLEDGEMENTS

We wish to thank the Scientific Procedures Branch of the Office of Meteorology for providing us with the local aviation forecasts. We are grateful to Fred Marshall and Eston Pennington for assistance in archiving the guidance, and also to Gladys Hodge and Gloria Cooper for typing the text and the many tables shown in this report. Special thanks are extended to Normalee Foat for her dedicated assistance in error checking the observations used for verification, proofreading the text, and preparing the figures.

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Table 2.1. Eighty-seven stations used for comparative verification of automated and local PoP and max/min temperature forecasts.

BDL	Hartford, Connecticut
DCA	Washington, D.C.
PWM	Portland, Maine
BWI	Baltimore, Maryland
BOS	Boston, Massachusetts
ALB	Albany, New York
BUF	Buffalo, New York
JFK	New York (Kennedy), New York
SYR	Syracuse, New York
AVL	Asheville, North Carolina
CLT	Charlotte, North Carolina
RDU	Raleigh-Durham, North Carolina
CLE	Cleveland, Ohio
CMH	Columbus, Ohio
CVG	Cincinnati, Ohio
DAY	Dayton, Ohio
PHL	Philadelphia, Pennsylvania
PIT	Pittsburgh, Pennsylvania
PVD	Providence, Rhode Island
CAE	Columbia, South Carolina
CHS	Charleston, South Carolina
BTV	Burlington, Vermont
ORF	Norfolk, Virginia
RIC	Richmond, Virginia
CRW	Charleston, West Virginia
BHM	Birmingham, Alabama
LIT	Little Rock, Arkansas
JAX	Jacksonville, Florida
MIA	Miami, Florida
ORL	Orlando, Florida
TPA	Tampa, Florida
ATL	Atlanta, Georgia
MSY	New Orleans, Louisiana
SHV	Shreveport, Louisiana
JAN	Jackson, Mississippi
ABQ	Albuquerque, New Mexico
OKC	Oklahoma City, Oklahoma
TUL	Tulsa, Oklahoma
BNA	Nashville, Tennessee
MEM	Memphis, Tennessee
AMA	Amarillo, Texas
AUS	Austin, Texas
BRO	Brownsville, Texas
DFW	Dallas-Fort Worth, Texas
ELP	El Paso, Texas
IAH	Houston, Texas
LBB	Lubbock, Texas
MAF	Midland, Texas
SAT	San Antonio, Texas
DEN	Denver, Colorado
ORD	Chicago (O'Hare), Illinois
EVV	Evansville, Indiana
IND	Indianapolis, Indiana
DSM	Des Moines, Iowa
ICT	Wichita, Kansas
TOP	Topeka, Kansas
SDF	Louisville, Kentucky
DTW	Detroit, Michigan
SSM	Sault Ste. Marie, Michigan
DLH	Duluth, Minnesota
MSP	Minneapolis, Minnesota
MCI	Kansas City, Missouri
STL	St. Louis, Missouri
LBF	North Platte, Nebraska
OMA	Omaha, Nebraska
BIS	Bismarck, North Dakota
FAR	Fargo, North Dakota
FSD	Sioux Falls, South Dakota
RAP	Rapid City, South Dakota
MKE	Milwaukee, Wisconsin
CPR	Casper, Wyoming
CYS	Cheyenne, Wyoming
FLG	Flagstaff, Arizona
PHX	Phoenix, Arizona
TUS	Tucson, Arizona
SAN	San Diego, California
SFO	San Francisco, California
BOI	Boise, Idaho
BIL	Billings, Montana
GTF	Great Falls, Montana
HLN	Helena, Montana
LAS	Las Vegas, Nevada
RNO	Reno, Nevada
PDX	Portland, Oregon
SLC	Salt Lake City, Utah
GEG	Spokane, Washington
SEA	Seattle-Tacoma, Washington

Table 2.2 Comparative verification of early guidance and local PoP forecasts for 87 stations, 0000 GMT cycle.

Projection (h)	Type of Forecast	Brier Score	Improvement Over Guidance (%)	Improvement Over Climate (%)	Number of Cases
12-24	Early	.1121		26.1	
(1st period)	Local	.1081	3.6	28.7	7124
24-36	Early	.1212		22.0	
(2nd period)	Local	.1219	-0.5	21.6	7118
36-48	Early	.1277		17.3	
(3rd period)	Local	.1277	0.0	17.3	7122

Table 2.3. Same as Table 2.2 except for 25 stations in the Eastern Region.

Projection (h)	Type of Forecast	Brier Score	Improvement Over Guidance (%)	Improvement Over Climate (%)	Number of Cases
12-24 (1st period)	Early	.1261		34.2	
	Local	.1244	1.4	35.2	1232
24-36 (2nd period)	Early	.1064		38.1	
	Local	.1048	1.5	39.0	1232
36-48 (3rd period)	Early	.1263		27.0	
	Local	.1259	0.4	27.3	1232

Table 2.4. Same as Table 2.2 except for 24 stations in the Southern Region.

Projection (h)	Type of Forecast	Brier Score	Improvement Over Guidance (%)	Improvement Over Climate (%)	Number of Cases
12-24 (1st period)	Early	.1252		17.4	
	Local	.1225	2.1	19.2	1757
24-36 (2nd period)	Early	.1239		14.7	
	Local	.1283	-3.6	11.6	1757
36-48 (3rd period)	Early	.1371		11.2	
	Local	.1353	1.3	12.4	1757

Table 2.5. Same as Table 2.2 except for 23 stations in the Central Region.

Projection (h)	Type of Forecast	Brier Score	Improvement Over Guidance (%)	Improvement Over Climate (%)	Number of Cases
12-24	Early	.1131		28.4	
(1st period)	Local	.1090	3.6	31.0	2468
24-36	Early	.1417		20.4	
(2nd period)	Local	.1425	-0.6	19.9	2461
36-48	Early	.1400		17.5	
(3rd period)	Local	.1428	-2.0	15.8	2466

Table 2.6. Same as Table 2.2 except for 15 stations in the Western Region.

Projection (h)	Type of Forecast	Brier Score	Improvement Over Guidance (%)	Improvement Over Climate (%)	Number of Cases
12-24	Early	.0867		23.3	
(1st period)	Local	.0797	8.1	29.5	1667
24-36	Early	.0993		17.7	
(2nd period)	Local	.0972	2.1	19.4	1668
36-48	Early	.1006		15.0	
(3rd period)	Local	.0988	1.9	16.6	1667

Table 2.7. Comparative verification of early guidance and local PoP forecasts for 87 stations, 1200 GMT cycle.

Projection (h)	Type of Forecast	Brier Score	Improvement Over Guidance (%)	Improvement Over Climate (%)	Number of Cases
12-24 (1st period)	Early	.1118		26.3	6598
	Local	.1102	1.4	27.4	
24-36 (2nd period)	Early	.1186		21.6	6600
	Local	.1196	-0.8	22.3	
36-48 (3rd period)	Early	.1285		18.6	6599
	Local	.1316	-2.4	16.7	

Table 2.8. Same as Table 2.7 except for 25 stations in the Eastern Region.

Projection (h)	Type of Forecast	Brier Score	Improvement Over Guidance (%)	Improvement Over Climate (%)	Number of Cases
12-24	Early	.1051		41.5	
(1st period)	Local	.1023	2.7	43.1	1198
24-36	Early	.1271		33.6	
(2nd period)	Local	.1287	-1.3	32.7	1198
36-48	Early	.1220		30.2	
(3rd period)	Local	.1239	-1.6	29.1	1198

Table 2.9. Same as Table 2.7 except for 24 stations in the Southern Region.

Projection (h)	Type of Forecast	Brier Score	Improvement Over Guidance (%)	Improvement Over Climate (%)	Number of Cases
12-24	Early	.1217		13.2	
(1st period)	Local	.1204	1.1	14.1	1402
24-36	Early	.1334		13.0	
(2nd period)	Local	.1367	-2.5	10.9	1401
36-48	Early	.1252		13.0	
(3rd period)	Local	.1312	-4.7	9.2	1402

Table 2.10. Same as Table 2.7 except for 23 stations in the Central Region.

Projection (h)	Type of Forecast	Brier Score	Improvement Over Guidance (%)	Improvement Over Climate (%)	Number of Cases
12-24	Early	.1295		25.5	
(1st period)	Local	.1300	-0.4	25.1	2323
24-36	Early	.1251		22.2	
(2nd period)	Local	.1266	-1.2	21.2	2327
36-48	Early	.1515		17.6	
(3rd period)	Local	.1586	-4.7	13.8	2324

Table 2.11. Same as Table 2.7 except for 15 stations in the Western Region.

Projection (h)	Type of Forecast	Brier Score	Improvement Over Guidance (%)	Improvement Over Climate (%)	Number of Cases
12-24	Early	.0836		24.5	
(1st period)	Local	.0797	4.7	28.0	1675
24-36	Early	.0913		19.3	
(2nd period)	Local	.0890	2.5	21.3	1674
36-48	Early	.1041		13.9	
(3rd period)	Local	.0999	4.1	17.4	1675

Table 3.1. Eighty-nine stations used for comparative verification of guidance and local surface wind, opaque sky cover, ceiling height, and visibility forecasts.

DCA	Washington, D. C.
PWM	Portland, Maine
BOS	Boston, Massachusetts
CON	Concord, New Hampshire
ACY	Atlantic City, New Jersey
EWR	Newark, New Jersey
ALB	Albany, New York
BUF	Buffalo, New York
JFK	New York (Kennedy), New York
SYR	Syracuse, New York
CLT	Charlotte, North Carolina
RDU	Raleigh-Durham, North Carolina
CLE	Cleveland, Ohio
CMH	Columbus, Ohio
ERI	Erie, Pennsylvania
PHL	Philadelphia, Pennsylvania
PIT	Pittsburgh, Pennsylvania
PVD	Providence, Rhode Island
CAE	Columbia, South Carolina
GSP	Greenville, South Carolina
ORF	Norfolk, Virginia
CRW	Charleston, West Virginia
HTS	Huntington, West Virginia
BHM	Birmingham, Alabama
MOB	Mobile, Alabama
FSM	Fort Smith, Arkansas
LIT	Little Rock, Arkansas
JAX	Jacksonville, Florida
MIA	Miami, Florida
ATL	Atlanta, Georgia
SAV	Savannah, Georgia
MSY	New Orleans, Louisiana
SHV	Shreveport, Louisiana
JAN	Jackson, Mississippi
MEI	Meridian, Mississippi
ABQ	Albuquerque, New Mexico
TCC	Tucumcari, New Mexico
OKC	Oklahoma City, Oklahoma
TUL	Tulsa, Oklahoma
MEM	Memphis, Tennessee
TYS	Knoxville, Tennessee
ABI	Abilene, Texas
DFW	Dallas-Ft. Worth, Texas
IAH	Houston, Texas
SAT	San Antonio, Texas
DEN	Denver, Colorado
GJT	Grand Junction, Colorado
ORD	Chicago (O'Hare), Illinois
SPI	Springfield, Illinois
IND	Indianapolis, Indiana
SBN	South Bend, Indiana
ALO	Waterloo, Iowa
DSM	Des Moines, Iowa
DDC	Dodge City, Kansas
TOP	Topeka, Kansas
LEX	Lexington, Kentucky
SDF	Louisville, Kentucy
APN	Alpena, Michigan
DTW	Detroit, Michigan
INL	International Falls, Minnesota
MSP	Minneapolis, Minnesota
MCI	Kansas City, Missouri
STL	St. Louis, Missouri
BFF	Scottsbluff, Nebraska
OMA	Omaha, Nebraska
BIS	Bismarck, North Dakota
FAR	Fargo North Dakota
FSD	Sioux Falls, South Dakota
RAP	Rapid City, South Dakota
MKE	Milwaukee, Wisconsin
MSN	Madison, Wisconsin
CYS	Cheyenne, Wyoming
SHR	Sheridan, Wyoming
PHX	Phoenix, Arizona
FAT	Fresno, California
LAX	Los Angeles, California
SAN	San Diego, California
SFO	San Francisco, California
BOI	Boise, Idaho
PIH	Pocatello, Idaho
GTF	Great Falls, Montana
MSO	Missoula, Montana
RNO	Reno, Nevada
PDT	Pendleton, Oregon
PDX	Portland, Oregon
CDC	Cedar City, Utah
SLC	Salt Lake City, Utah
GEG	Spokane, Washington
SEA	Seattle-Tacoma, Washington

Table 3.2. Comparative verification of early guidance and local surface wind forecasts for 89 stations, 0000 GMT cycle.

		Direction		Speed													
								Contingency Table									
										Bias by Category							
Fcst. Proj. (h)	Type of Fcst.	Mean Abs. Error (Deg)	No. of Cases	Mean Abs. Error (Kts)	Mean Fcst. (Kts)	Mean Obs. (Kts)	No. of Cases	Skill Score	Percent Fcst. Correct	1 (No. Obs)	2 (No. Obs)	3 (No. Obs)	4 (No. Obs)	5 (No. Obs)	6 (No. Obs)	7 (No. Obs)	No. of Cases
18	Early	32	7180	3.1	12.4	11.3	7217	.318	55.7	1.05	0.94	0.94	1.17	1.41	2.38	2.55	14882
	Local	35		3.2	12.4			.261	52.1	0.84 (6152)	1.15 (5959)	1.06 (2136)	0.95 (489)	0.54 (109)	1.26 (26)	1.09 (11)	
30	Early	33	3404	3.9	11.9	9.7	3476	.334	68.7	0.97	1.03	1.29	1.02	1.00	1.63	0.25	14829
	Local	37		3.8	11.6			.279	65.4	0.93 (10357)	1.23 (3420)	1.09 (796)	0.74 (199)	0.53 (45)	0.50 (8)	0.00 (4)	
42	Early	40	7059	3.7	12.7	10.9	7110	.242	50.4	1.01	0.94	1.01	1.32	1.91	2.57	2.67	14849
	Local	43		3.6	12.1			.193	48.3	0.85 (6154)	1.20 (5931)	0.94 (2137)	0.74 (493)	0.56 (102)	0.87 (23)	0.44 (9)	

Table 3.3. Contingency tables for early guidance and local surface wind speed forecasts for 89 stations, 0000 GMT cycle.

18-h Forecasts

Guidance

		1	2	3	4	5	6	7	T
	1	4210	1696	209	32	4	0	1	6152
	2	2067	3018	751	108	14	1	0	5959
	3	149	832	862	230	52	10	1	2136
OBS	4	6	71	169	163	54	24	2	489
	5	0	5	21	30	26	22	5	109
	6	0	1	1	6	4	2	12	26
	7	0	0	0	1	0	3	7	11
	T	6432	5623	2013	570	154	62	28	14882

Local

		1	2	3	4	5	6	7	T
	1	3385	2458	281	26	2	0	0	6152
	2	1618	3370	892	75	4	0	0	5959
	3	164	953	828	171	17	3	0	2136
OBS	4	14	85	217	143	20	8	2	489
	5	0	9	36	40	12	8	4	109
	6	0	2	2	6	1	11	4	26
	7	0	0	0	3	3	3	2	11
	T	5181	6877	2256	464	59	33	12	14882

30-h Forecasts

Guidance

		1	2	3	4	5	6	7	T
	1	8413	1650	264	28	2	0	0	10357
	2	1439	1480	435	57	8	1	0	3420
	3	123	350	245	61	16	1	0	796
OBS	4	25	49	65	42	11	6	1	199
	5	1	8	18	11	5	2	0	45
	6	0	0	2	3	2	1	0	8
	7	0	1	0	0	1	2	0	4
	T	10001	3538	1029	202	45	13	1	14829

Local

		1	2	3	4	5	6	7	T
	1	7916	2190	232	17	1	1	0	10357
	2	1483	1548	341	45	3	0	0	3420
	3	163	387	202	39	5	0	0	796
OBS	4	25	61	71	31	10	1	0	199
	5	2	10	19	11	2	1	6	45
	6	0	2	1	3	2	0	0	8
	7	0	1	0	1	1	1	0	4
	T	9589	4199	866	147	24	4	0	14829

42-h Forecasts

Guidance

		1	2	3	4	5	6	7	T
	1	3857	1867	355	59	13	3	0	6154
	2	2089	2747	880	176	37	2	0	5931
	3	241	841	716	258	63	14	4	2137
OBS	4	14	100	175	128	54	15	7	493
	5	2	8	22	29	22	15	4	102
	6	0	1	4	1	4	8	5	23
	7	0	0	1	0	2	2	4	9
	T	6203	5564	2153	651	195	59	24	14849

Local

		1	2	3	4	5	6	7	T
	1	3140	2641	339	31	3	0	0	6154
	2	1775	3271	786	92	6	1	0	5931
	3	304	1041	656	120	14	2	0	2137
OBS	4	23	165	197	84	18	5	1	493
	5	2	22	34	32	7	4	1	102
	6	0	2	3	5	5	7	1	23
	7	0	0	0	3	4	1	1	9
	T	5244	7142	2015	367	57	20	4	14849

Table 3.4. Same as Table 3.2 except for 23 stations in the Eastern Region.

		Direction		Speed													
								Contingency Table									
										Bias by Category							
Fcst. Proj. (h)	Type of Fcst.	Mean Abs. Error (Deg)	No. of Cases	Mean Abs. Error (Kts)	Mean Fcst. (Kts)	Mean Obs. (Kts)	No. of Cases	Skill Score	Percent Fcst. Correct	1 (No. Obs)	2 (No. Obs)	3 (No. Obs)	4 (No. Obs)	5 (No. Obs)	6 (No. Obs)	7 (No. Obs)	No. of Cases
18	Early	31	1978	2.9	12.1	11.3	1987	.301	54.9	1.08	0.98	0.77	1.10	1.18	4.17	2.67	3822
	Local	36		3.1	12.5			.256	51.8	0.80 (1444)	1.16 (1647)	1.07 (567)	1.06 (116)	0.54 (39)	2.33 (6)	1.00 (3)	
30	Early	31	754	3.7	11.7	9.6	771	.340	73.5	1.01	0.97	1.09	0.79	1.06	2.00	*	3796
	Local	35		4.0	11.9			.289	67.9	0.89 (2827)	1.32 (758)	1.61 (140)	0.83 (52)	0.59 (17)	0.50 (2)	* (0)	
42	Early	40	1959	3.3	12.3	10.9	1967	.249	51.1	1.04	0.94	0.98	1.22	1.21	3.50	6.00	3814
	Local	43		3.4	12.2			.195	48.7	0.82 (1452)	1.18 (1651)	1.01 (558)	0.87 (112)	0.35 (34)	0.83 (6)	0.00 (1)	

*This category was neither forecast nor observed.

Table 3.5. Same as Table 3.2 except for 22 stations in the Southern Region.

		Direction		Speed													
								Contingency Table									
										Bias by Category							
Fcst. Proj. (h)	Type of Fcst.	Mean Abs. Error (Deg)	No. of Cases	Mean Abs. Error (Kts)	Mean Fcst. (Kts)	Mean Obs. (Kts)	No. of Cases	Skill Score	Percent Fcst. Correct	1 (No. Obs)	2 (No. Obs)	3 (No. Obs)	4 (No. Obs)	5 (No. Obs)	6 (No. Obs)	7 (No. Obs)	No. of Cases
18	Early	32	1724	2.9	12.0	10.8	1732	.331	57.9	1.13	0.85	0.96	1.33	2.00	3.00	1.00	3819
	Local	34		2.9	11.9			.252	53.3	0.80 (1632)	1.23 (1593)	0.97 (487)	0.85 (93)	0.82 (11)	1.00 (2)	0.00 (1)	
30	Early	31	744	3.9	12.2	9.5	757	.391	74.1	0.96	1.02	1.48	1.16	3.00	3.00	**	3788
	Local	35		3.5	11.2			.331	71.3	0.94 (2817)	1.28 (751)	0.97 (173)	0.41 (44)	1.50 (2)	0.00 (1)	* (0)	
42	Early	38	1724	3.6	12.3	10.5	1738	.251	52.4	1.06	0.89	1.01	1.52	2.73	4.00	2.00	3796
	Local	42		3.2	11.6			.178	49.2	0.76 (1627)	1.32 (1572)	0.86 (489)	0.52 (94)	0.36 (11)	0.50 (2)	0.00 (1)	

*This category was neither forecast nor observed.
**This category was forecast once but was never observed.

Table 3.6. Same as Table 3.2 except for 28 stations in the Central Region.

Fcst. Proj. (h)	Type of Fcst.	Direction		Speed													
								Contingency Table									
										Bias by Category							
		Mean Abs. Error (Deg)	No. of Cases	Mean Abs. Error (Kts)	Mean Fcst. (Kts)	Mean Obs. (Kts)	No. of Cases	Skill Score	Percent Fcst. Correct	1 (No. Obs)	2 (No. Obs)	3 (No. Obs)	4 (No. Obs)	5 (No. Obs)	6 (No. Obs)	7 (No. Obs)	No. of Cases
18	Early	30	2698	3.3	12.9	11.7	2712	.288	51.4	1.03	0.94	1.00	1.15	1.45	1.53	2.71	4629
	Local	34		3.3	12.7			.232	48.5	0.85 (1541)	1.11 (1944)	1.05 (862)	0.98 (211)	0.43 (49)	0.87 (15)	1.14 (7)	
30	Early	35	1320	4.1	12.0	9.9	1347	.315	64.7	0.96	1.02	1.20	1.21	1.00	1.50	0.00	4629
	Local	39		3.9	11.7			.255	60.1	0.88 (3020)	1.32 (1184)	1.06 (322)	0.89 (76)	0.53 (19)	0.75 (4)	0.00 (4)	
42	Early	40	2652	4.0	13.2	11.4	2669	.197	44.7	1.03	0.92	0.98	1.32	2.06	2.15	2.00	4622
	Local	41		3.8	12.5			.157	43.9	0.84 (1545)	1.18 (1933)	0.95 (862)	0.84 (215)	0.72 (47)	1.08 (13)	0.57 (7)	

Table 3.7. Same as Table 3.2 except for 16 stations in the Western Region.

		Direction		Speed													
								Contingency Table									
										Bias by Category							
Fcst. Proj. (h)	Type of Fcst.	Mean Abs. Error (Deg)	No. of Cases	Mean Abs. Error (Kts)	Mean Fcst. (Kts)	Mean Obs. (Kts)	No. of Cases	Skill Score	Percent Fcst. Correct	1 (No. Obs)	2 (No. Obs)	3 (No. Obs)	4 (No. Obs)	5 (No. Obs)	6 (No. Obs)	7 (No. Obs)	No. of Cases
18	Early	38	780	3.7	12.5	10.7	786	.325	61.3	0.94	1.07	1.12	1.10	1.50	2.67	*	2612
	Local	41		3.8	12.5			.251	57.0	0.93 (1535)	1.09 (775)	1.22 (220)	0.81 (69)	0.80 (10)	1.33 (3)	** (0)	
30	Early	33	586	3.8	11.5	9.5	601	.260	61.0	0.91	1.14	1.45	0.67	0.29	0.00	*	2616
	Local	38		3.8	11.3			.227	62.7	1.06 (1693)	0.93 (727)	0.83 (161)	0.67 (27)	0.14 (7)	0.00 (1)	* (0)	
42	Early	46	724	4.4	12.8	10.2	736	.255	56.4	0.91	1.09	1.18	1.22	2.70	1.00	***	2617
	Local	52		4.3	12.0			.176	54.0	0.99 (1530)	1.07 (775)	0.94 (228)	0.57 (72)	0.70 (10)	0.00 (2)	* (0)	

*This category was neither forecast nor observed.
**This category was forecast once but was never observed.
***This category was forecast twice but was never observed.

Table 3.8. Distribution of absolute errors associated with early guidance and local forecasts of surface wind direction for 89 stations, 0000 GMT cycle.

Forecast Projection (h)	Type of Forecast	Percentage Frequency of Absolute Errors by Category					
		0-30°	40-60°	70-90°	100-120°	130-150°	160-180°
18	Early	69.1	18.8	5.8	2.9	1.9	1.5
	Local	65.0	19.7	7.3	3.5	2.7	1.8
30	Early	69.8	15.9	5.9	3.6	2.8	2.1
	Local	65.4	17.4	7.2	4.0	3.4	2.6
42	Early	60.3	20.6	8.0	4.7	3.3	3.0
	Local	57.0	21.1	9.5	4.9	4.2	3.3

Table 3.9. Same as Table 3.8 except for 23 stations in the Eastern Region.

Forecast Projection (h)	Type of Forecast	Percentage Frequency of Absolute Errors by Category					
		0-30°	40-60°	70-90°	100-120°	130-150°	160-180°
18	Early	68.8	19.5	6.2	2.4	1.9	1.2
	Local	63.7	20.9	8.1	3.2	2.6	1.5
30	Early	69.2	19.8	5.3	2.7	2.0	1.1
	Local	64.1	21.2	7.7	3.2	2.8	1.1
42	Early	59.5	22.8	7.6	3.8	3.4	2.9
	Local	56.8	20.8	10.2	5.0	4.3	3.0

Table 3.10. Same as Table 3.8 except for 22 stations in the Southern Region.

Forecast Projection (h)	Type of Forecast	Percentage Frequency of Absolute Errors by Category					
		0-30°	40-60°	70-90°	100-120°	130-150°	160-180°
18	Early	68.6	20.0	4.8	3.2	2.0	1.5
	Local	65.8	19.8	7.3	3.5	2.3	1.3
30	Early	72.6	12.5	7.1	3.4	2.0	2.4
	Local	67.7	15.9	7.7	3.8	2.2	2.8
42	Early	62.5	19.7	7.5	5.2	2.7	2.3
	Local	57.5	22.0	8.9	4.6	3.9	3.1

Table 3.11. Same as Table 3.8 except for 28 stations in the Central Region.

Forecast Projection (h)	Type of Forecast	Percentage Frequency of Absolute Errors By Category					
		0-30°	40-60°	70-90°	100-120°	130-150°	160-180°
18	Early	70.6	18.7	5.5	2.3	1.7	1.2
	Local	66.0	19.9	6.8	3.0	2.5	1.9
30	Early	67.5	16.7	6.4	3.8	3.3	2.3
	Local	64.2	16.7	7.9	4.2	4.2	2.7
42	Early	60.9	19.8	8.7	4.4	2.9	3.4
	Local	58.6	21.2	9.1	4.6	3.5	3.1

Table 3.12. Same as Table 3.8 except for 16 stations in the Western Region.

Forecast Projection (h)	Type of Forecast	Percentage Frequency of Absolute Errors By Category					
		0-30°	40-60°	70-90°	100-120°	130-150°	160-180°
18	Early	65.8	14.9	7.8	5.5	2.2	3.8
	Local	62.9	16.2	7.1	6.4	4.4	3.1
30	Early	72.4	13.3	3.8	4.4	3.8	2.4
	Local	66.6	16.0	4.6	4.8	4.3	3.8
42	Early	55.5	19.9	7.9	6.8	5.9	4.0
	Local	50.8	19.1	10.4	7.0	6.9	5.8

Table 4.1. Definitions of the cloud amount categories used for the local forecasts of opaque sky cover. The same definitions were used for the guidance forecasts except category 1 included only 0 tenths of opaque sky cover, while category 2 included 1-5 tenths.

Category	Cloud Amount (Opaque Sky Cover in tenths)
1	0-1
2	2-5
3	6-9
4	10

Table 4.2. Comparative verification of early guidance and local forecasts of four categories of cloud amount (clear, scattered, broken, and overcast) for 89 stations, 0000 GMT cycle.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	Percent Correct	Skill Score	Number of Cases
18	Early	0.60	1.24	1.00	1.12	48.1	.299	14786
	Local	0.59	1.39	1.17	0.69	48.2	.293	
	No. Obs.	3645	4606	3579	2956			
30	Early	0.92	1.23	0.82	1.05	49.8	.292	14566
	Local	0.60	1.99	1.54	0.59	41.7	.223	
	No. Obs.	6237	2888	1996	3445			
42	Early	0.89	1.16	0.88	1.04	46.3	.275	14855
	Local	0.52	1.64	1.09	0.49	41.2	.190	
	No. Obs.	3655	4631	3595	2974			

Table 4.3. Same as Table 4.2 except for 23 stations in the Eastern Region.

Projection (h)	Type of Forecast	Bias by Category				Percent Correct	Skill Score	Number of Cases
		1	2	3	4			
18	Early	0.40	1.19	1.04	1.23	48.3	.297	3803
	Local	0.53	1.40	1.21	0.66	46.7	.272	
	No. Obs.	769	1156	979	899			
30	Early	0.87	1.15	0.81	1.15	49.7	.299	3818
	Local	0.66	1.94	1.54	0.63	42.4	.240	
	No. Obs.	1401	680	537	1200			
42	Early	0.59	1.08	0.97	1.27	46.1	.271	3818
	Local	0.47	1.52	1.17	0.60	41.8	.201	
	No. Obs.	767	1174	972	905			

Table 4.4. Same as Table 4.2 except for 22 stations in the Southern Region.

Projection (h)	Type of Forecast	Bias by Category				Percent Correct	Skill Score	Number of Cases
		1	2	3	4			
18	Early	0.57	1.23	0.97	1.04	49.3	.281	3793
	Local	0.59	1.42	0.98	0.52	49.4	.266	
	No. Obs.	713	1404	1114	562			
30	Early	0.84	1.38	0.87	1.04	47.6	.249	3805
	Local	0.58	2.10	1.33	0.39	40.4	.178	
	No. Obs.	1787	880	510	628			
42	Early	0.87	1.24	0.89	0.77	47.1	.249	3814
	Local	0.43	1.68	0.88	0.26	44.2	.170	
	No. Obs.	718	1415	1113	568			

Table 4.5. Same as Table 4.2 except for 28 stations in the Central Region.

Projection (h)	Type of Forecast	Bias by Category				Percent Correct	Skill Score	Number of Cases
		1	2	3	4			
18	Early	0.48	1.28	1.10	1.07	45.5	.264	4593
	Local	0.50	1.39	1.31	0.71	45.6	.264	
	No. Obs.	1117	1406	1010	1060			
30	Early	0.92	1.26	0.90	1.00	49.8	.296	4465
	Local	0.52	2.09	1.74	0.62	40.4	.220	
	No. Obs.	1839	835	594	1197			
42	Early	0.83	1.23	0.90	0.97	43.7	.241	4614
	Local	0.46	1.68	1.20	0.48	37.8	.150	
	No. Obs.	1119	1405	1020	1070			

Table 4.6. Same as Table 4.2 except for 16 stations in the Western Region.

Projection (h)	Type of Forecast	Bias by Category				Percent Correct	Skill Score	Number of Cases
		1	2	3	4			
18	Early	0.91	1.24	0.78	1.11	51.0	.319	2597
	Local	0.74	1.31	1.26	0.90	53.2	.362	
	No. Obs.	1046	640	476	435			
30	Early	1.10	1.04	0.64	0.97	53.5	.291	2478
	Local	0.68	1.68	1.48	0.71	45.2	.239	
	No. Obs.	1210	493	355	420			
42	Early	1.17	0.96	0.61	1.09	50.1	.288	2609
	Local	0.70	1.66	1.17	0.57	41.9	.206	
	No. Obs.	1051	637	490	431			

Table 5.1. Definitions of the categories used for guidance forecasts of ceiling height and visibility.

Category	Ceiling (ft)	Visibility (mi)
1	<200	<1/2
2	200-400	1/2-7/8
3	500-900	1-2 1/2
4	1000-2900	3-4
5	3000-7500	5-6
6	>7500	>6

Table 5.2. Comparative verification of early guidance, persistence, and local ceiling forecasts for 89 stations, 0000 GMT cycle.

Projection (h)	Type of Forecast	Bias by Category						Percent Correct	Skill Score
		1	2	3	4	5	6		
12	Early	0.68	0.97	0.90	0.93	1.17	1.00	68.4	.345
	Local	0.62	0.87	0.76	1.18	1.15	0.98	75.4	.497
	Persistence	0.85	0.66	0.82	0.91	1.05	1.04	76.9	.505
	No. Obs.	214	507	723	1363	1555	10273		
15	Local	0.28	0.43	0.49	0.99	1.41	1.00	71.1	.395
	Persistence	7.36	1.33	0.82	0.61	1.19	1.04	70.7	.370
	No. Obs.	25	254	734	2066	1396	10429		
18	Early	0.29	0.90	0.87	0.90	1.25	0.98	67.8	.342
	Persistence	26.14	4.05	1.74	0.60	0.81	1.05	66.4	.280
	No. Obs.	7	83	341	2065	2010	10169		
21	Local	0.43	0.30	0.40	0.97	1.16	0.99	68.4	.293
	Persistence	26.29	3.62	2.40	0.99	0.65	1.01	64.8	.215
	No. Obs.	7	93	249	1273	2536	10735		
24	Early	0.94	0.77	0.91	1.00	1.21	0.97	73.2	.312
	Persistence	10.76	3.12	2.31	1.41	0.82	0.94	65.7	.169
	No. Obs.	17	108	257	882	2011	11416		
36	Early	0.68	0.90	1.04	0.93	0.98	1.02	65.7	.281
	Persistence	0.85	0.66	0.82	0.90	1.05	1.04	60.5	.156
	No. Obs.	219	511	725	1392	1573	10320		
48	Early	0.56	1.42	1.08	0.81	0.96	1.02	72.6	.252
	Persistence	10.22	3.05	2.28	1.40	0.82	0.94	61.3	.064
	No. Obs.	18	111	262	892	2013	11460		

Table 5.3. Same as Table 5.2 except for visibility, 0000 GMT cycle.

Projection (h)	Type of Forecast	Bias by Category						Percent Correct	Skill Score
		1	2	3	4	5	6		
12	Early	0.73	1.04	0.91	0.94	1.08	1.01	67.6	.333
	Local	0.50	0.86	0.56	1.49	1.50	0.95	70.1	.416
	Persistence	0.72	0.57	0.46	0.80	1.03	1.11	73.4	.403
	No. Obs.	327	235	1268	1199	1407	10137		
15	Local	0.39	0.54	0.33	0.92	1.42	0.99	73.8	.316
	Persistence	10.48	2.12	0.90	0.93	0.95	0.99	73.2	.307
	No. Obs.	23	65	649	1045	1556	11503		
18	Early	0.15	0.74	0.62	1.03	0.99	1.01	80.8	.277
	Persistence	18.38	5.91	1.71	1.52	1.18	0.91	73.9	.224
	No. Obs.	13	23	343	631	1228	12378		
21	Local	0.21	0.25	0.21	0.63	1.48	1.00	81.0	.227
	Persistence	17.21	3.81	2.03	1.74	1.34	0.89	74.0	.196
	No. Obs.	14	36	290	561	1099	12836		
24	Early	2.38	0.64	0.83	1.00	1.01	1.00	82.4	.274
	Persistence	11.43	2.72	2.02	1.74	1.38	0.89	73.6	.181
	No. Obs.	21	50	290	552	1049	12678		
36	Early	0.86	0.91	0.88	1.13	1.10	0.99	65.7	.313
	Persistence	0.73	0.58	0.45	0.79	1.01	1.11	63.8	.193
	No. Obs.	329	237	1302	1219	1439	10165		
48	Early	0.52	0.70	1.08	1.04	1.07	0.99	81.1	.241
	Persistence	11.48	2.94	2.03	1.74	1.37	0.89	71.4	.115
	No. Obs.	21	47	290	556	1060	12736		

Table 5.4. Same as Table 5.2 except for ceiling, 1200 GMT cycle.

Projection (h)	Type of Forecast	Bias by Category						Percent Correct	Skill Score
		1	2	3	4	5	6		
12	Early	0.82	0.92	0.97	1.04	1.14	0.97	75.2	.354
	Local	0.41	0.68	0.65	1.44	1.26	0.93	77.0	.432
	Persistence	0.47	0.89	0.91	1.38	1.19	0.94	77.9	.449
	No. Obs.	17	108	250	884	2027	11560		
15	Local	0.26	0.51	0.63	1.54	1.03	0.97	75.7	.366
	Persistence	0.24	0.60	0.74	1.44	1.27	0.94	72.1	.306
	No. Obs.	34	161	309	861	1918	11697		
18	Early	1.39	1.00	0.98	1.10	1.12	0.97	72.7	.321
	Persistence	0.12	0.39	0.59	1.28	1.39	0.95	69.2	.250
	No. Obs.	69	241	387	946	1727	11330		
21	Local	0.20	0.49	0.71	1.53	0.90	1.00	70.4	.330
	Persistence	0.05	0.27	0.40	1.00	1.46	1.00	65.0	.203
	No. Obs.	171	349	567	1232	1658	10853		
24	Early	1.14	1.19	0.96	1.00	1.06	0.98	66.0	.306
	Persistence	0.04	0.19	0.31	0.89	1.54	1.04	61.7	.167
	No. Obs.	212	508	724	1376	1561	10368		
36	Early	0.24	0.67	1.20	1.03	0.97	1.00	73.4	.282
	Persistence	0.47	0.86	0.89	1.39	1.19	0.94	64.0	.105
	No. Obs.	17	111	258	888	2037	11601		
48	Early	0.82	1.04	0.77	0.86	0.96	1.04	66.2	.272
	Persistence	0.04	0.19	0.32	0.90	1.52	1.04	56.9	.064
	No. Obs.	215	513	717	1372	1579	10370		

Table 5.5. Same as Table 5.2 except for visibility, 1200 GMT cycle.

Projection (h)	Type of Forecast	Bias by Category						Percent Correct	Skill Score
		1	2	3	4	5	6		
12	Early	0.68	1.00	1.05	1.16	1.07	0.99	83.0	.319
	Local	0.59	0.56	0.43	1.18	1.69	0.95	84.5	.436
	Persistence	0.55	0.70	1.01	0.99	1.31	0.98	87.1	.496
	No. Obs.	22	50	280	549	1057	12835		
15	Local	0.29	0.71	0.74	1.55	1.85	0.92	81.0	.344
	Persistence	0.34	0.73	1.17	0.93	1.43	0.97	84.0	.370
	No. Obs.	35	48	247	596	978	13025		
18	Early	1.63	1.07	0.77	0.86	1.17	1.00	80.4	.295
	Persistence	0.15	0.50	0.78	0.69	1.45	1.00	80.6	.298
	No. Obs.	80	70	365	794	956	12426		
21	Local	0.22	0.66	1.13	1.92	1.59	0.88	70.2	.294
	Persistence	0.05	0.27	0.53	0.57	1.23	1.06	75.8	.233
	No. Obs.	230	132	541	970	1130	11780		
24	Early	0.96	1.04	1.06	1.15	1.08	0.96	65.7	.329
	Persistence	0.04	0.15	0.22	0.45	0.97	1.22	66.7	.167
	No. Obs.	324	241	1289	1217	1437	10183		
36	Early	0.45	0.82	1.07	1.02	1.03	1.00	81.3	.231
	Persistence	0.55	0.78	0.99	0.99	1.31	0.98	78.6	.167
	No. Obs.	22	45	288	555	1063	12906		
48	Early	0.89	0.91	1.00	1.21	1.14	0.96	63.8	.296
	Persistence	0.04	0.14	0.22	0.45	0.95	1.22	64.2	.107
	No. Obs.	334	245	1301	1221	1463	10177		

Table 5.6. Comparative verification for early guidance, persistence, and local ceiling forecasts for 89 stations, 0000 GMT cycle. Scores are computed from two-category (categories 1 and 2 combined versus categories 3-6 combined) contingency tables.

Projection (h)	Type of Forecast	Rel. Freq. Cats. 1&2 combined	Bias Cats. 1&2 combined	Percent Correct	Skill Score	Threat Score
12	Early	0.049	0.88	93.2	.234	.156
	Local		0.80	95.4	.461	.320
	Persistence		0.72	95.8	.476	.332
15	Local	0.019	0.41	97.9	.199	.116
	Persistence		1.87	96.0	.236	.146
18	Early	0.006	0.86	99.1	.175	.099
	Persistence		5.77	96.2	.076	.045
21	Local	0.006	0.31	99.3	.181	.101
	Persistence		5.21	96.2	.073	.044
24	Early	0.009	0.79	98.8	.199	.114
	Persistence		4.16	96.0	.080	.049
36	Early	0.049	0.83	92.9	.181	.122
	Persistence		0.72	92.9	.124	.087
48	Early	0.009	1.31	98.2	.099	.057
	Persistence		4.05	95.8	.042	.028

Table 5.7. Same as Table 5.6 except for visibility, 0000 GMT cycle.

Projection (h)	Type of Forecast	Rel. Freq. Cats. 1&2 combined	Bias Cats. 1&2 combined	Percent Correct	Skill Score	Threat Score
12	Early	0.039	0.86	94.9	.256	.165
	Local		0.64	96.7	.459	.312
	Persistence		0.66	96.8	.481	.330
15	Local	0.005	0.50	99.3	.179	.100
	Persistence		4.31	97.2	.098	.057
18	Early	0.002	0.53	99.7	.071	.038
	Persistence		10.42	97.3	.025	.015
21	Local	0.003	0.24	99.6	.096	.051
	Persistence		7.56	97.2	.032	.019
24	Early	0.005	1.15	99.0	.047	.027
	Persistence		5.30	97.1	.037	.023
36	Early	0.039	0.88	94.7	.243	.156
	Persistence		0.66	94.8	.167	.107
48	Early	0.005	0.65	99.3	.032	.018
	Persistence		5.57	97.1	.024	.016

Table 5.8. Same as Table 5.6 except for ceiling, 1200 GMT cycle.

Projection (h)	Type of Forecast	Rel. Freq. Cats. 1&2 combined	Bias Cats. 1&2 combined	Percent Correct	Skill Score	Threat Score
12	Early	0.008	0.90	98.7	.204	.117
	Local		0.64	99.3	.465	.306
	Persistence		0.83	99.2	.503	.339
15	Local	0.013	0.47	98.7	.337	.207
	Persistence		0.53	98.7	.349	.215
18	Early	0.021	1.09	96.6	.211	.129
	Persistence		0.33	97.9	.229	.135
21	Local	0.035	0.39	96.2	.214	.129
	Persistence		0.20	96.4	.128	.074
24	Early	0.049	1.18	92.2	.226	.154
	Persistence		0.14	94.9	.076	.046
36	Early	0.009	0.61	98.8	.091	.051
	Persistence		0.81	98.6	.088	.050
48	Early	0.049	0.97	92.3	.167	.116
	Persistence		0.14	94.6	.036	.025

Table 5.9. Same as Table 5.6 except for visibility, 1200 GMT cycle.

Projection (h)	Type of Forecast	Rel. Freq. Cats. 1&2 combined	Bias Cats. 1&2 combined	Percent Correct	Skill Score	Threat Score
12	Early	0.005	0.84	99.2	.142	.079
	Local		0.53	99.6	.423	.270
	Persistence		0.61	99.5	.334	.202
15	Local	0.006	0.53	99.4	.265	.155
	Persistence		0.57	99.3	.212	.121
18	Early	0.010	1.37	98.0	.165	.096
	Persistence		0.31	98.8	.107	.059
21	Local	0.024	0.38	97.4	.214	.126
	Persistence		0.13	97.3	.034	.020
24	Early	0.038	0.99	94.2	.206	.134
	Persistence		0.08	96.0	.030	.018
36	Early	0.005	0.70	99.3	.049	.027
	Persistence		0.70	99.3	.049	.027
48	Early	0.039	0.90	94.1	.178	.117
	Persistence		0.08	95.9	.020	.013

Table 6.1. Verification of the guidance max/min temperature forecasts for 87 stations, 0000 GMT cycle.

Forecast Projection (h)	Mean Algebraic Error (°F)	Mean Absolute Error (°F)	Number (%) of Absolute Errors ≥ 10°	Number of Cases
24 (Max)	0.8	2.8	344 (2.2)	15564
36 (Min)	0.5	2.9	283 (1.8)	15552
48 (Max)	0.6	3.5	795 (5.1)	15565
60 (Min)	0.1	3.3	523 (3.4)	15553

Table 6.2. Same as Table 6.1 except for 25 stations in the Eastern Region.

Forecast Projection (h)	Mean Algebraic Error (°F)	Mean Absolute Error (°F)	Number (%) of Absolute Errors ≥ 10°	Number of Cases
24 (Max)	0.4	2.7	54 (1.2)	4470
36 (Min)	0.4	3.0	57 (1.3)	4470
48 (Max)	0.1	3.4	168 (3.8)	4472
60 (Min)	0.4	3.4	123 (2.8)	4472

Table 6.3. Same as Table 6.1 except for 24 stations in the Southern Region.

Forecast Projection (h)	Mean Algebraic Error (°F)	Mean Absolute Error (°F)	Number(%) of Absolute Errors ≥ 10°	Number of Cases
24 (Max)	0.5	2.5	86 (2.0)	4294
36 (Min)	0.5	2.6	63 (1.5)	4294
48 (Max)	0.0	3.0	130 (3.0)	4295
60 (Min)	-0.1	3.0	132 (3.1)	4294

Table 6.4. Same as Table 6.1 except for 23 stations in the Central Region.

Forecast Projection (h)	Mean Algebraic Error (°F)	Mean Absolute Error (°F)	Number (%) of Absolute Errors ≥ 10°	Number of Cases
24 (Max)	0.9	3.2	125 (3.0)	4115
36 (Min)	0.6	3.3	116 (2.8)	4104
48 (Max)	1.0	4.0	309 (7.5)	4114
60 (Min)	0.2	3.7	191 (4.7)	4104

Table 6.5. Same as Table 6.1 except for 15 stations in the Western Region.

Forecast Projection (h)	Mean Algebraic Error (°F)	Mean Absolute Error (°F)	Number (%) of Absolute Errors ≥ 10°	Number of Cases
24 (Max)	1.5	3.0	79 (2.9)	2685
36 (Min)	0.3	2.7	47 (1.8)	2684
48 (Max)	1.7	3.9	188 (7.0)	2684
60 (Min)	-0.0	3.1	77 (2.9)	2683

Table 6.6. Verification of the guidance max/min temperature forecasts for 87 stations, 1200 GMT cycle.

Forecast Projection (h)	Mean Algebraic Error (°F)	Mean Absolute Error (°F)	Number (%) of Absolute Errors ≥ 10°	Number of Cases
24 (Min)	-0.1	2.7	215 (1.4)	15642
36 (Max)	0.2	3.3	597 (3.8)	15651
48 (Min)	-0.1	3.1	363 (2.3)	15646
60 (Max)	0.3	3.8	1015 (6.5)	15656

Table 6.7. Same as Table 6.6 except for 25 stations in the Eastern Region.

Forecast Projection (h)	Mean Algebraic Error (°F)	Mean Absolute Error (°F)	Number (%) of Absolute Errors ≥ 10°	Number of Cases
24 (Min)	-0.2	2.7	46 (1.0)	4495
36 (Max)	-0.2	3.2	131 (2.9)	4495
48 (Min)	-0.2	3.1	89 (2.0)	4498
60 (Max)	-0.1	3.5	197 (4.4)	4500

Table 6.8. Same as Table 6.6 except for 24 stations in the Southern Region.

Forecast Projection (h)	Mean Algebraic Error (°F)	Mean Absolute Error (°F)	Number(%) of Absolute Errors ≥ 10°	Number of Cases
24 (Min)	-0.0	2.4	45 (1.0)	4320
36 (Max)	-0.3	2.8	104 (2.4)	4318
48 (Min)	-0.3	2.8	76 (1.8)	4319
60 (Max)	-0.5	3.2	165 (3.8)	4319

Table 6.9. Same as Table 6.6 except for 23 stations in the Central Region.

Forecast Projection (h)	Mean Algebraic Error (°F)	Mean Absolute Error (°F)	Number (%) of Absolute Errors ≥ 10°	Number of Cases
24 (Min)	0.1	3.0	91 (2.2)	4128
36 (Max)	0.5	3.7	229 (5.5)	4138
48 (Min)	0.0	3.4	133 (3.2)	4130
60 (Max)	0.8	4.4	393 (9.5)	4137

Table 6.10. Same as Table 6.6 except for 15 stations in the Western Region.

Forecast Projection (h)	Mean Algebraic Error (°F)	Mean Absolute Error (°F)	Number (%) of Absolute Errors ≥ 10°	Number of Cases
24 (Min)	-0.3	2.6	33 (1.2)	2699
36 (Max)	1.1	3.5	133 (4.9)	2700
48 (Min)	0.0	2.9	65 (2.4)	2699
60 (Max)	1.6	4.3	260 (9.6)	2700

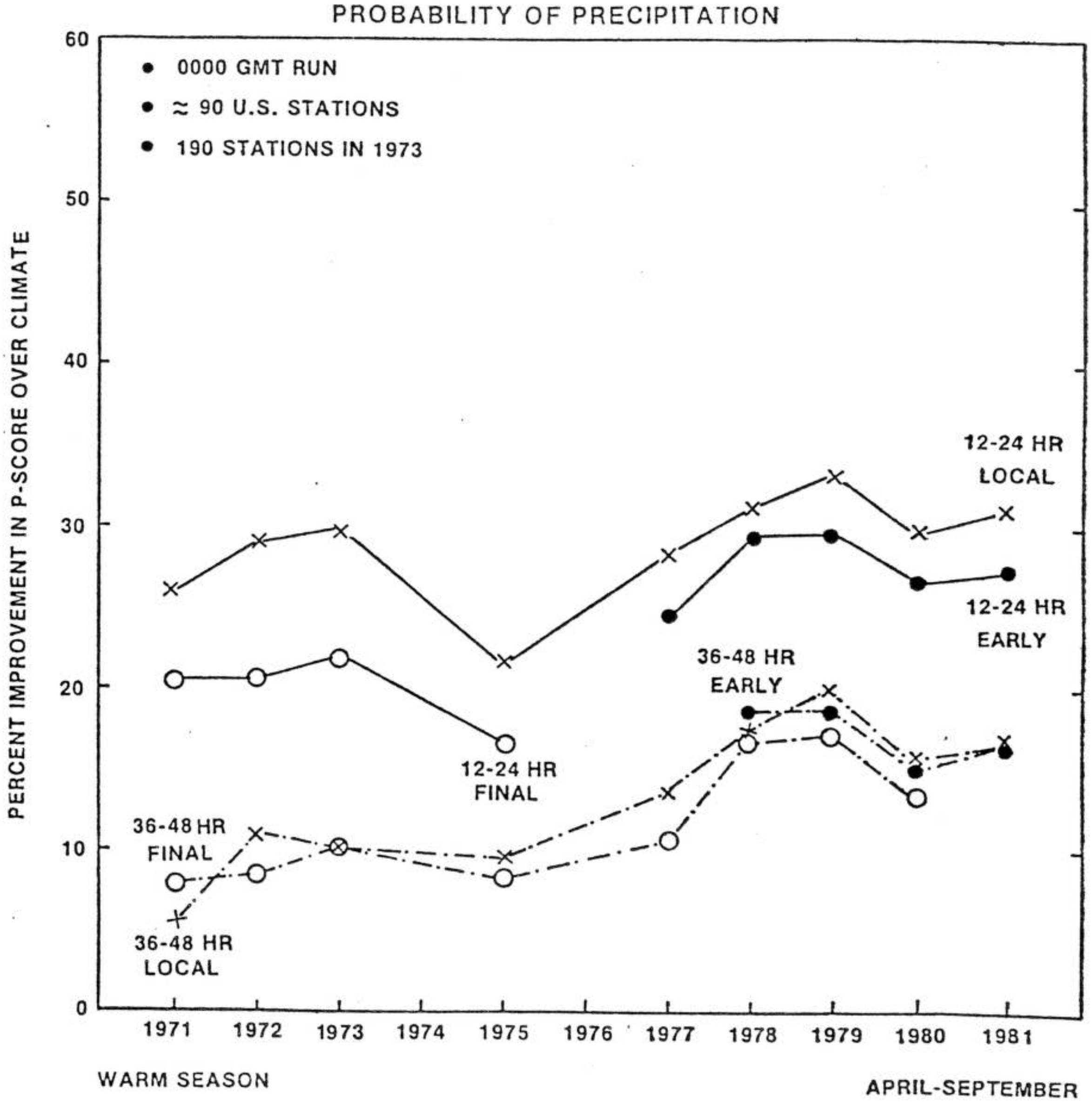

Figure 2.1. Percent improvement over climate in the Brier score of the local and the early and final guidance PoP forecasts. Results for 1974 and 1976 are unavailable because of missing data.

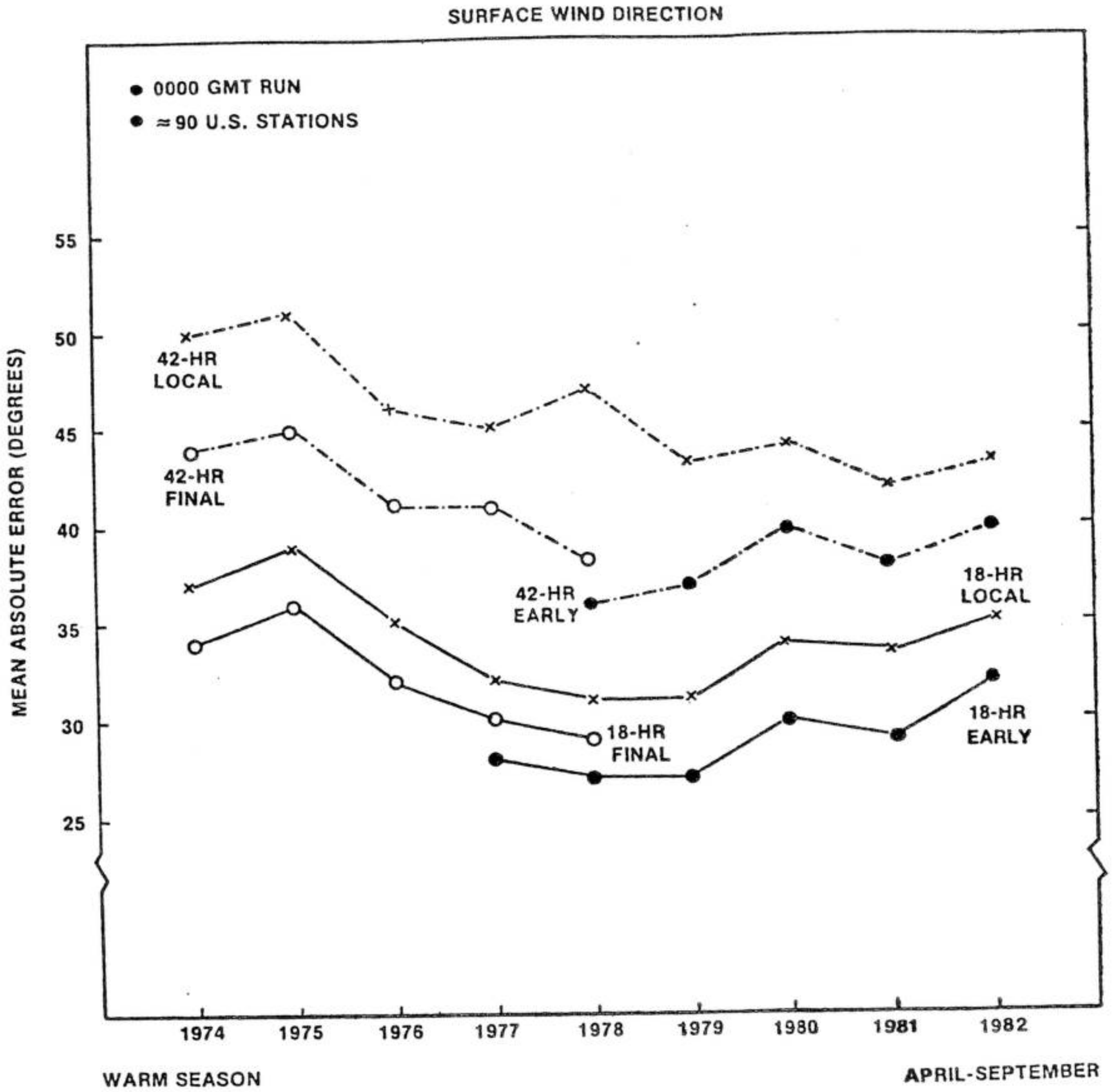

Figure 3.1. Mean absolute error for the local and the early and final guidance surface wind direction forecasts.

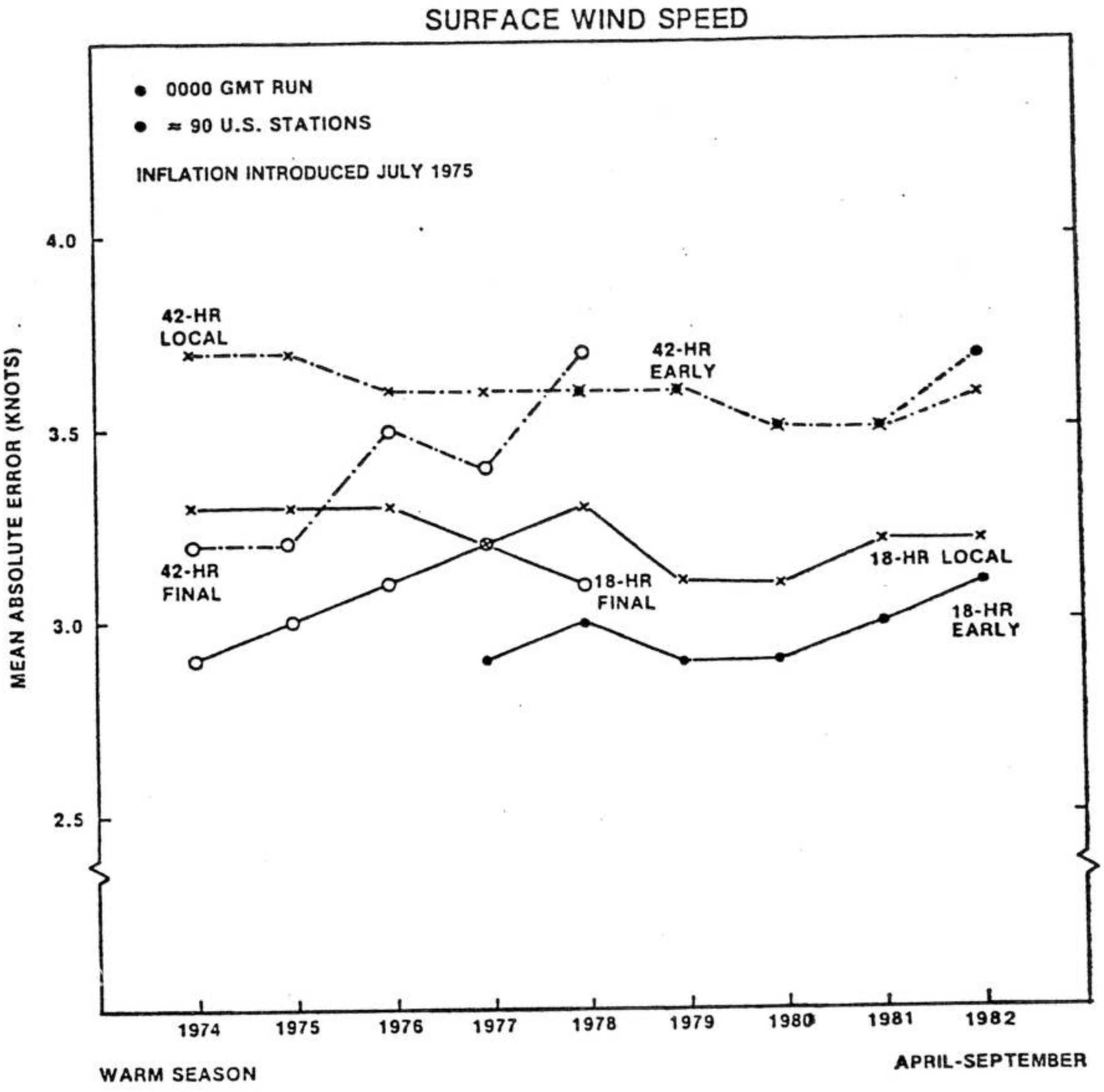

Figure 3.2. Same as Fig. 3.1 except for surface wind speed.

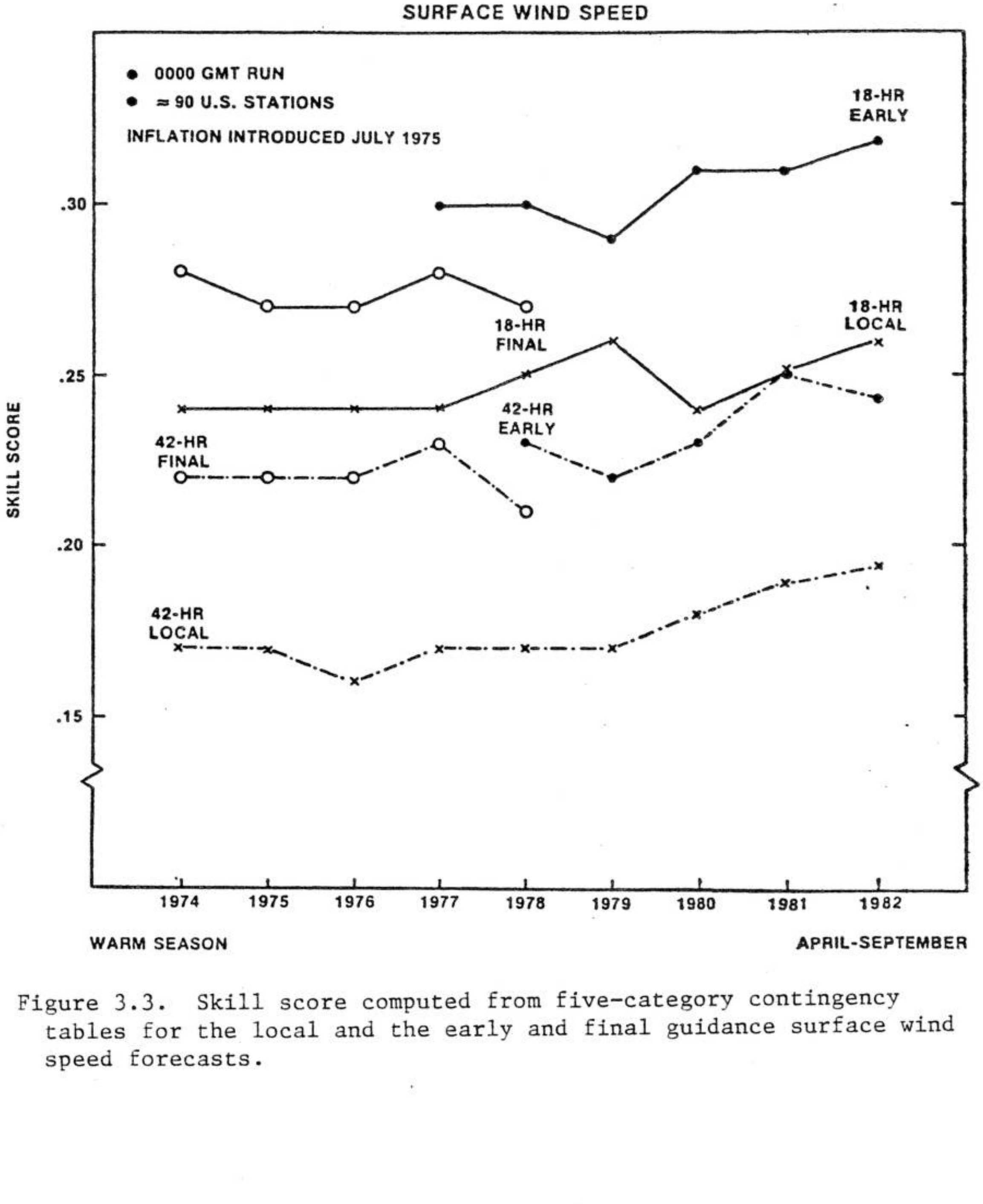

Figure 3.3. Skill score computed from five-category contingency tables for the local and the early and final guidance surface wind speed forecasts.

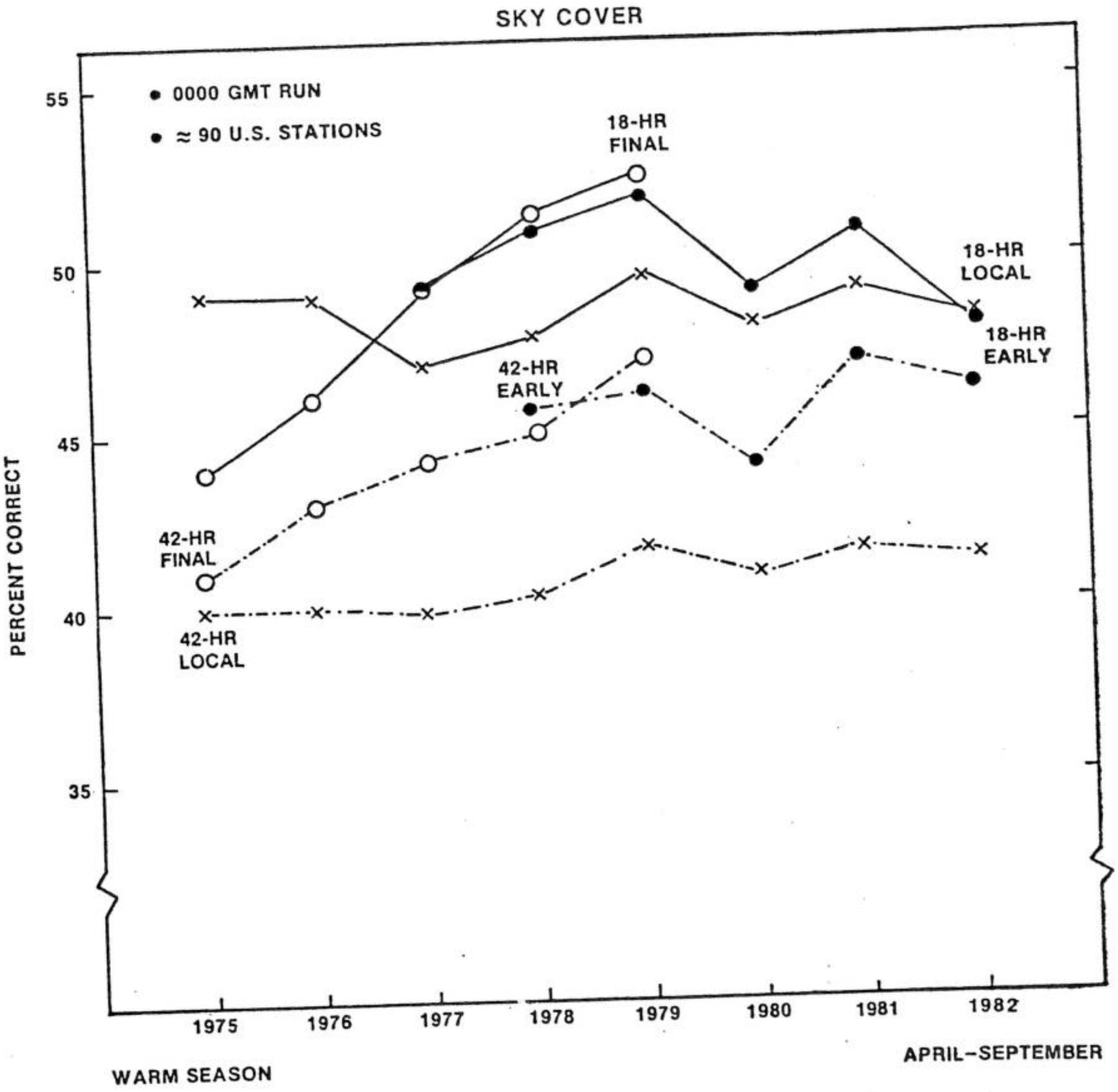

Figure 4.1. Percent correct for the local and the early and final guidance opaque sky cover forecasts.

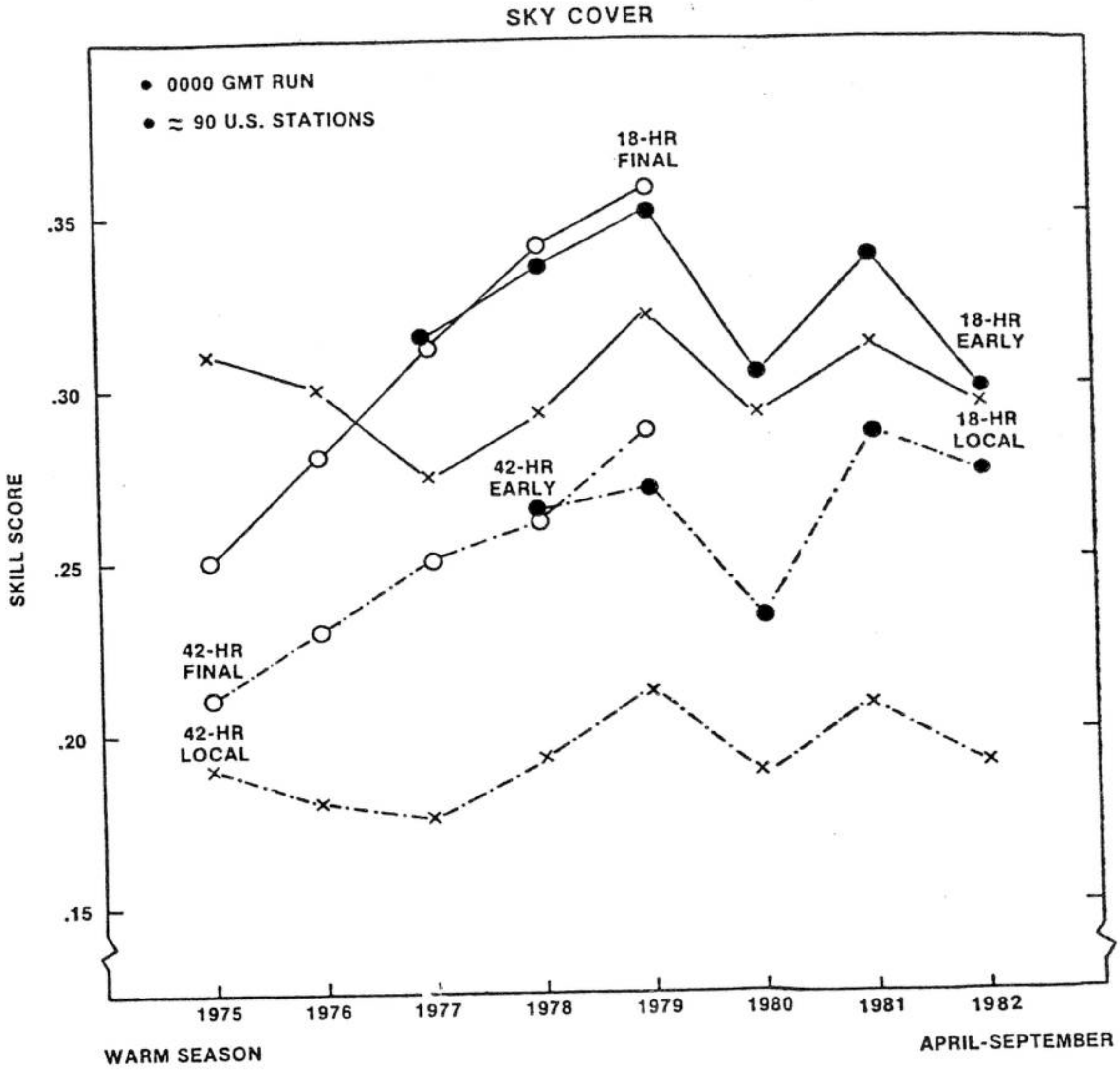

Figure 4.2. Skill score for the local and the early and final guidance opaque sky cover forecasts.

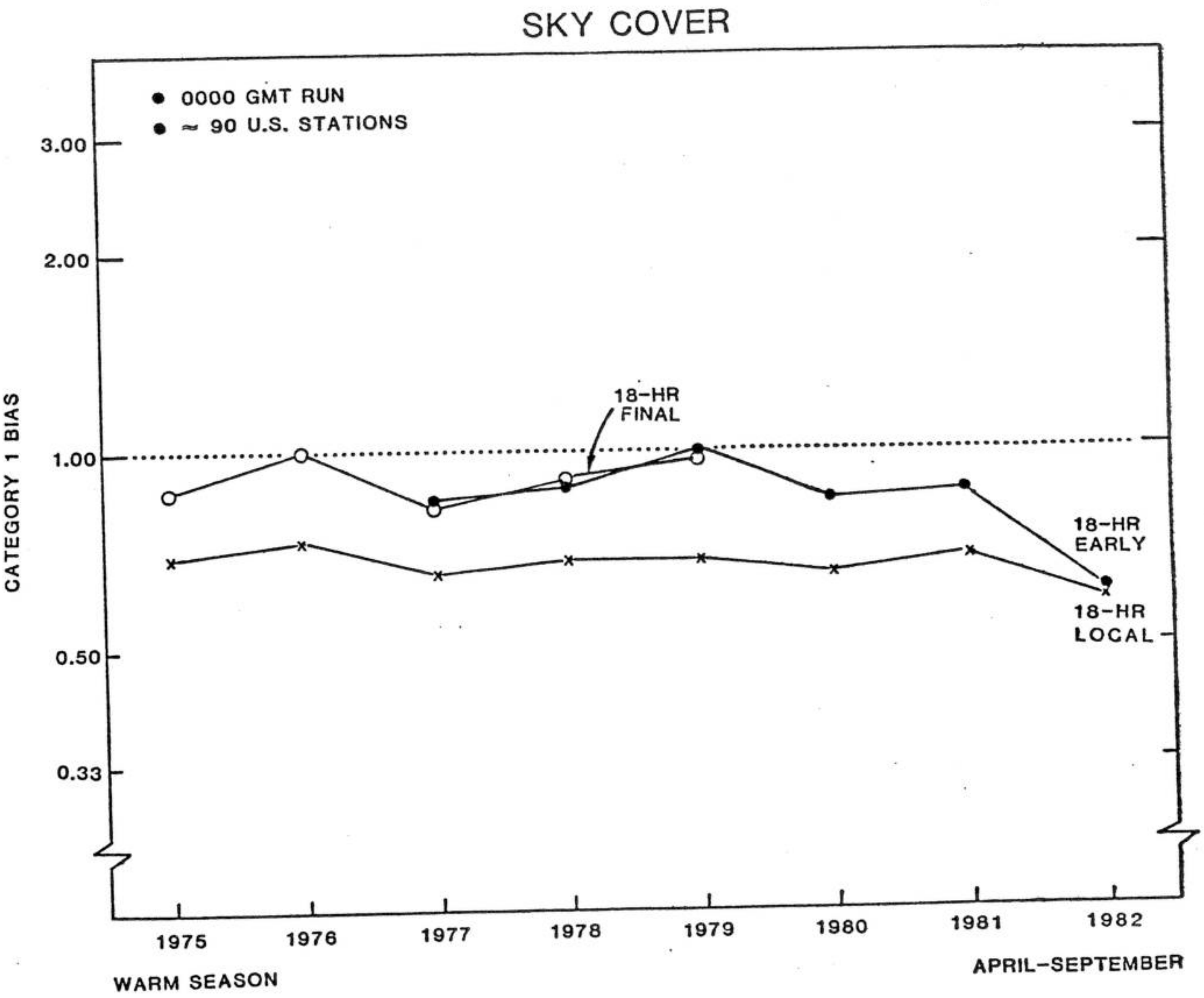

Figure 4.3. Category 1 bias for the local and the early and final guidance opaque sky cover forecasts.

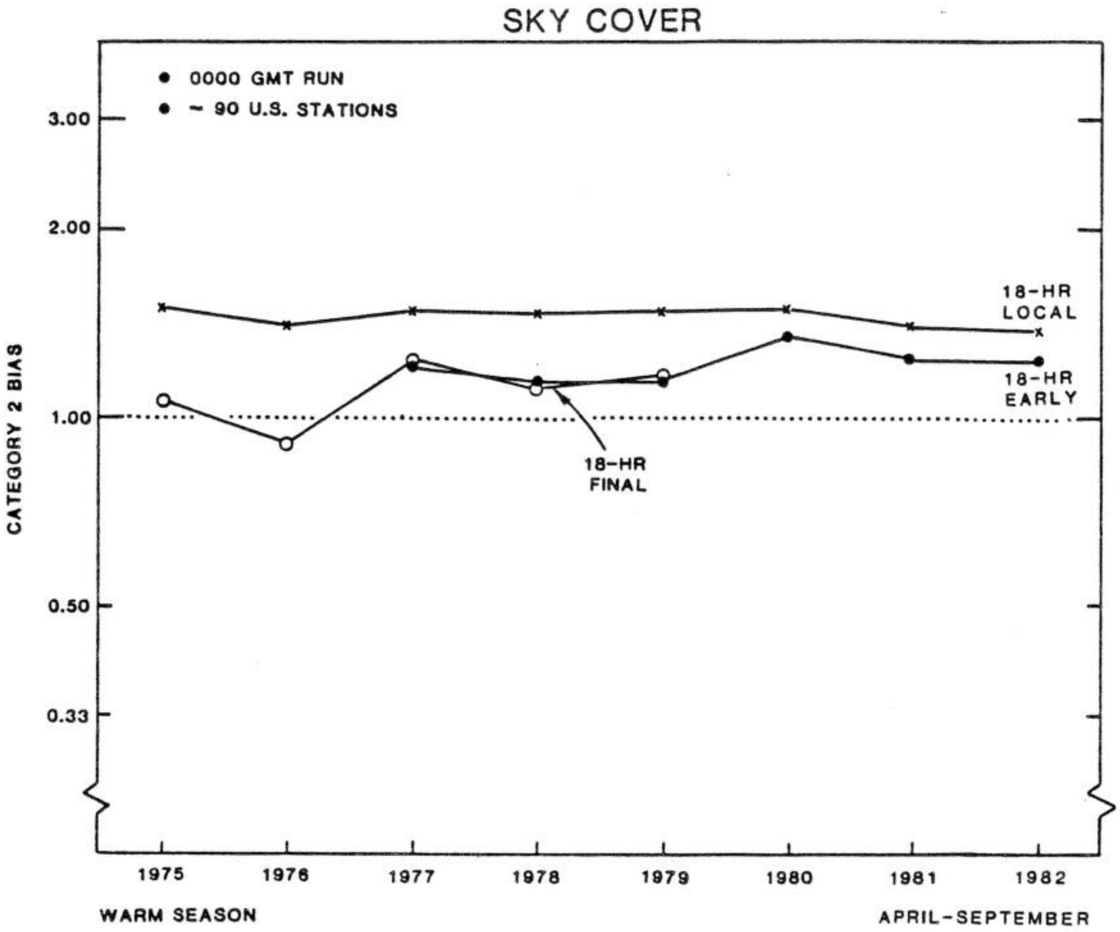

Figure 4.4. Same as Fig. 4.3 except for category 2 bias.

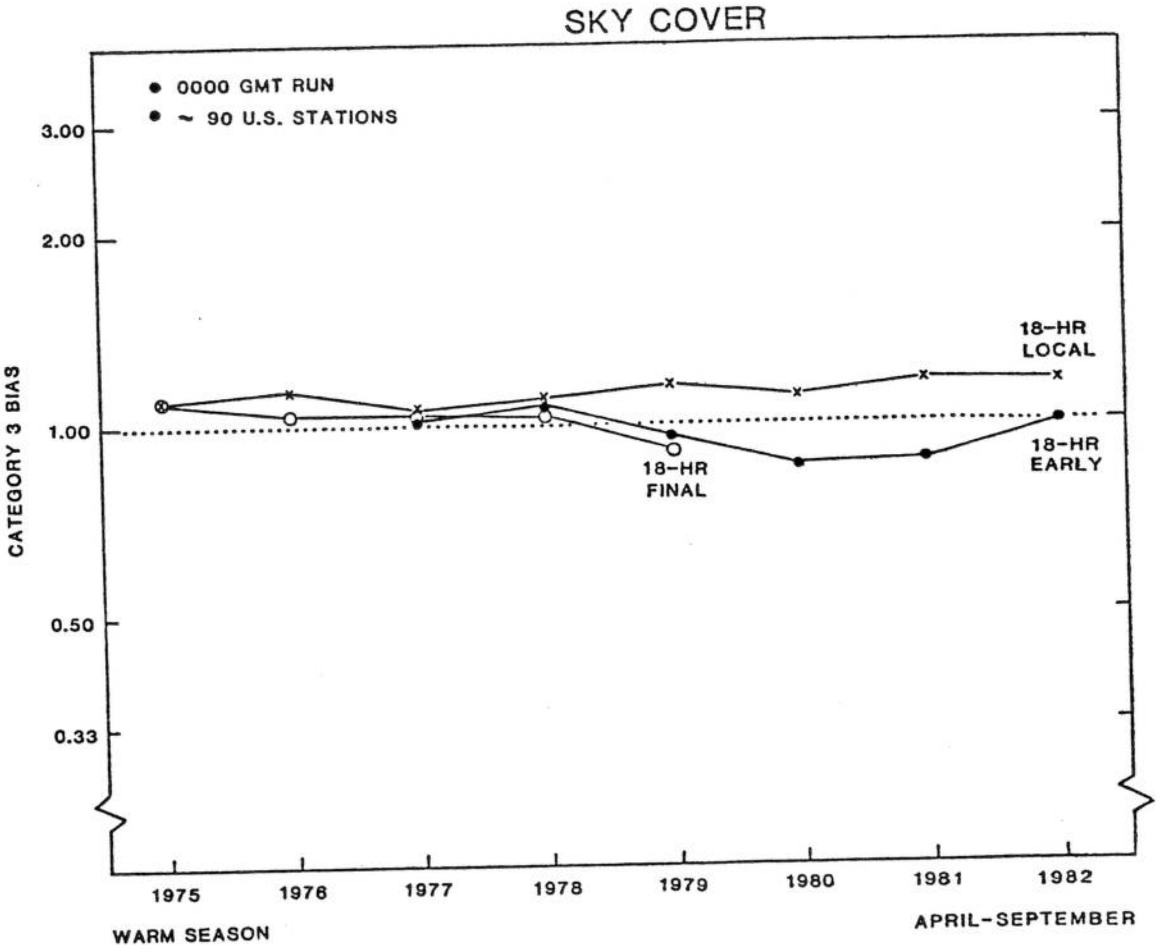

Figure 4.5. Same as Fig. 4.3 except for category 3 bias.

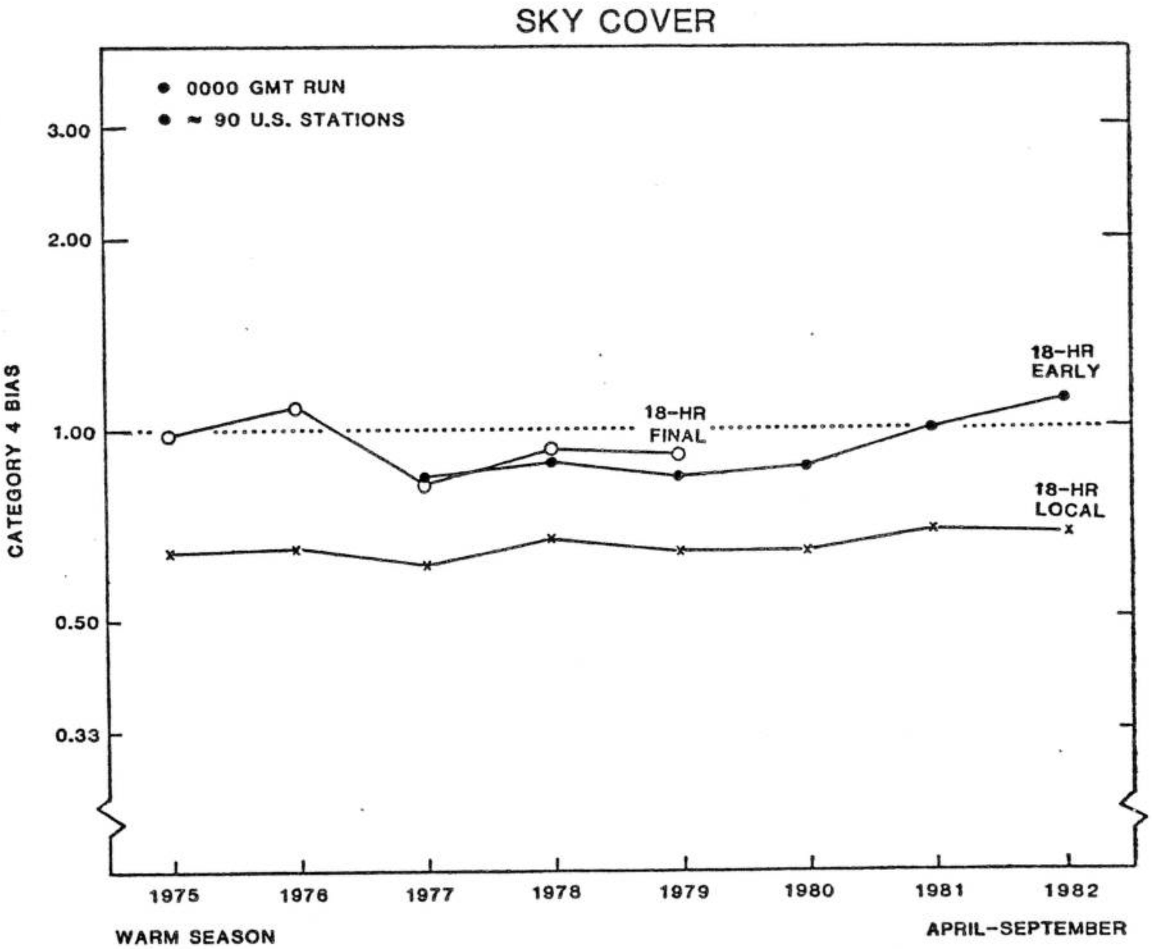

Figure 4.6. Same as Fig. 4.3 except for category 4 bias.

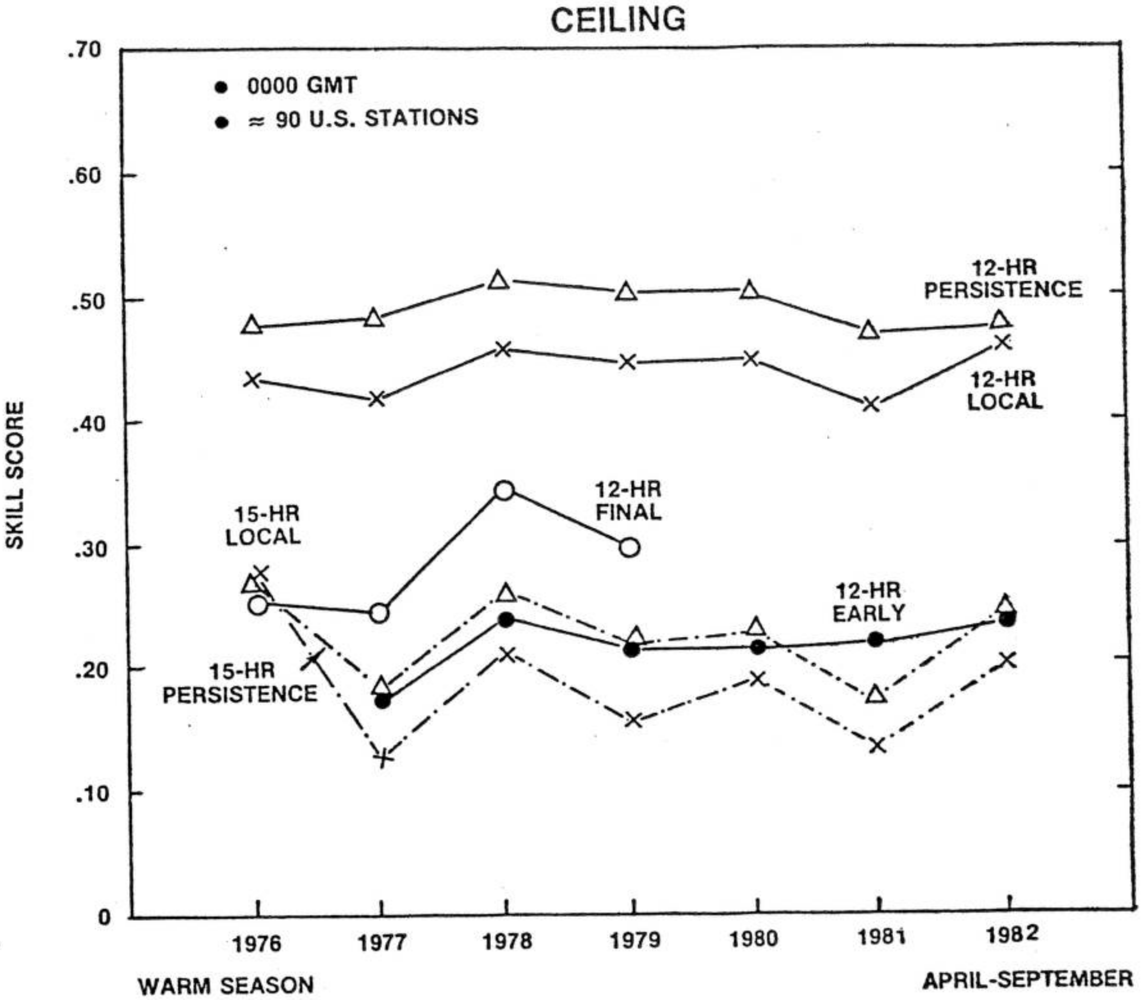

Figure 5.1. Skill score computed from two-category contingency tables for persistence, local, and guidance (early and final) ceiling height forecasts.

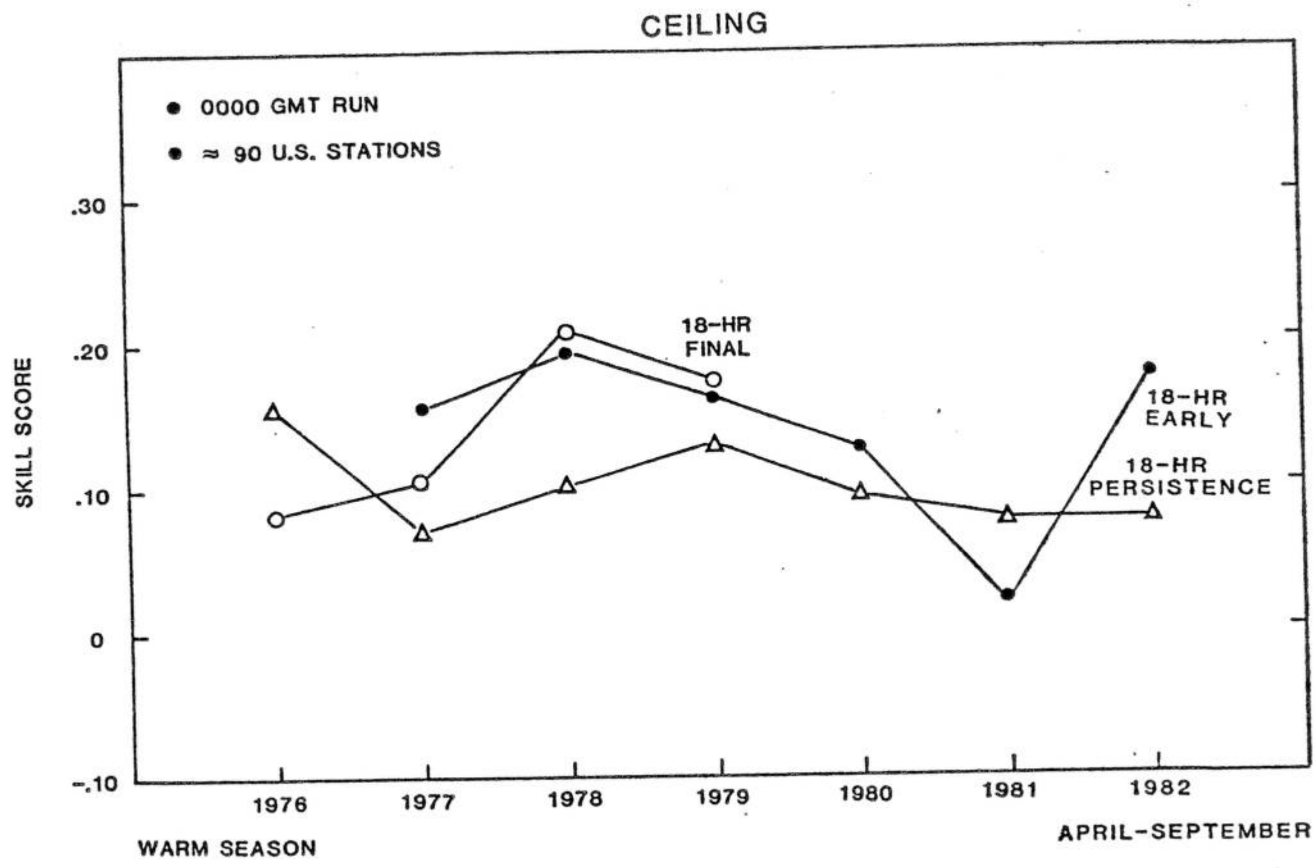

Figure 5.2. Same as Fig. 5.1 except for forecast projection.

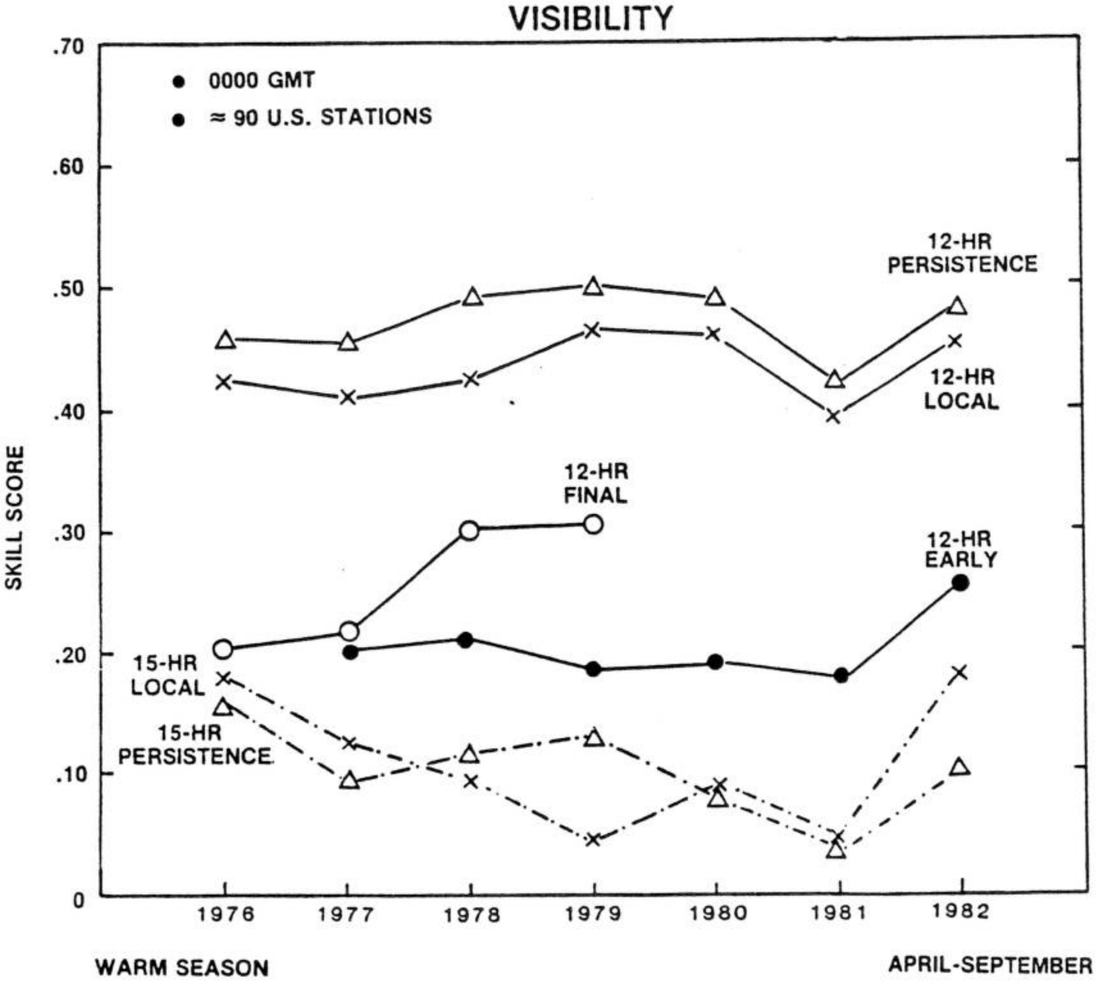

Figure 5.3. Same as Fig. 5.1 except for visibility.

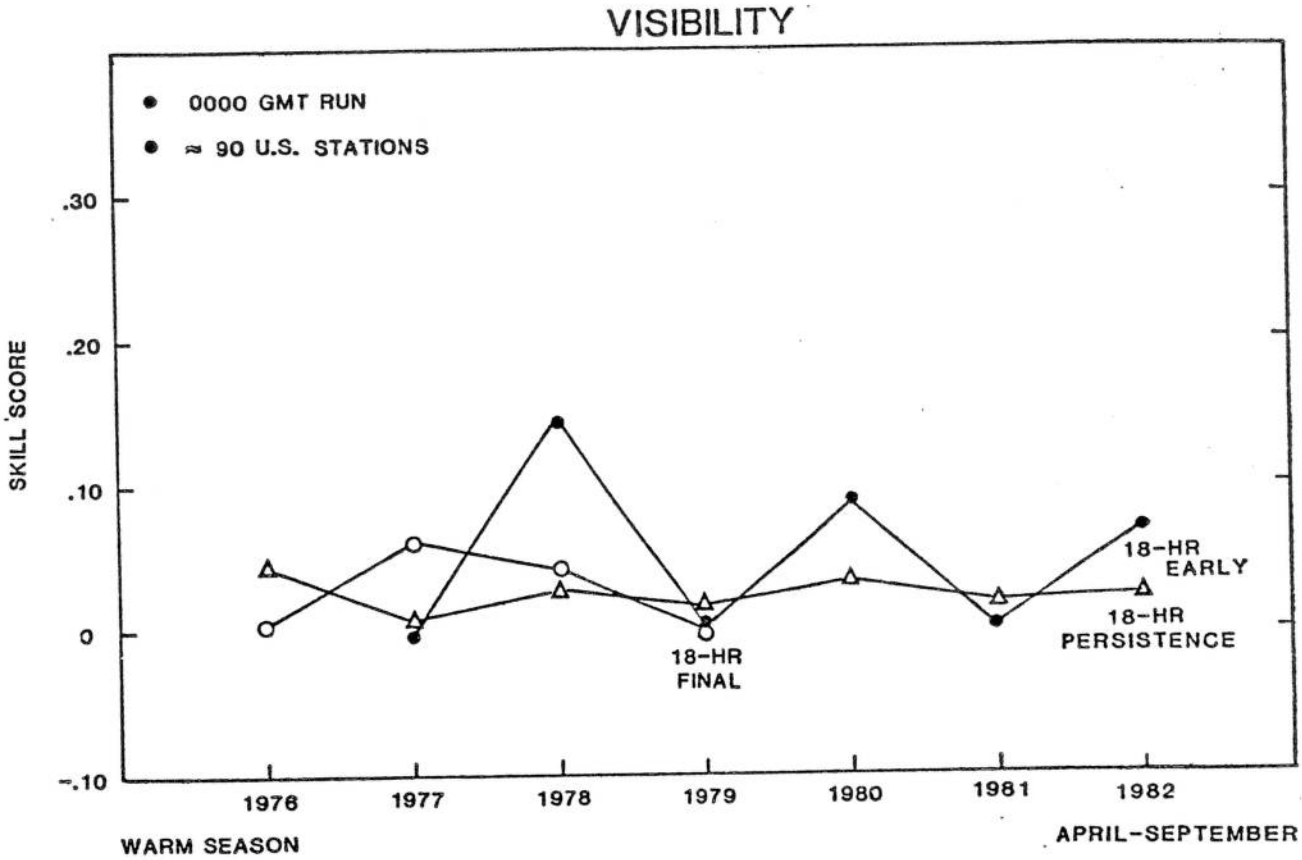

Figure 5.4. Same as Fig. 5.1 except for visibility and forecast projection.

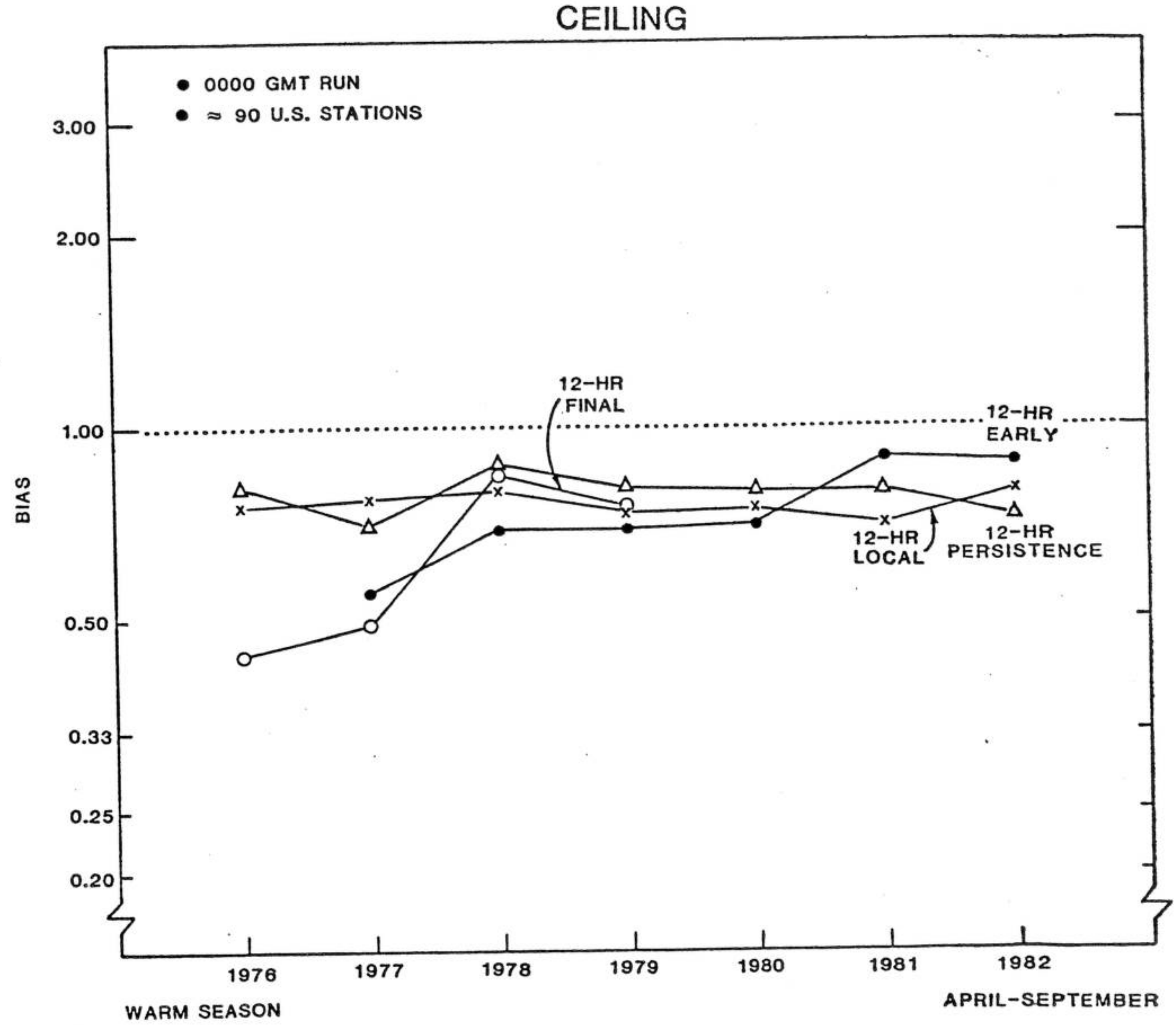

Figure 5.5. Bias for categories 1 and 2 combined for persistence, local, and guidance (early and final) ceiling height forecasts.

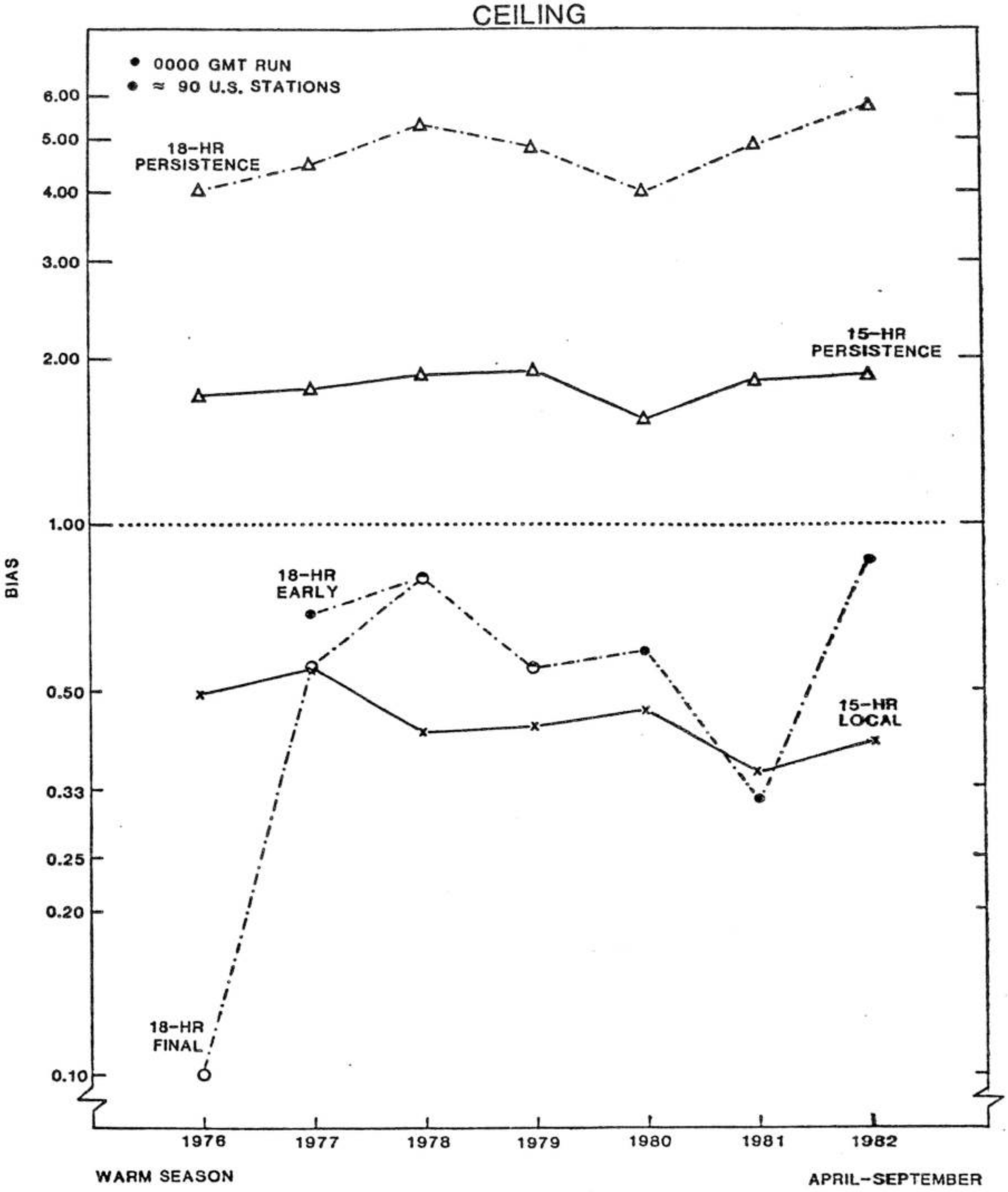

Figure 5.6. Same as Fig. 5.5 except for forecast projection.

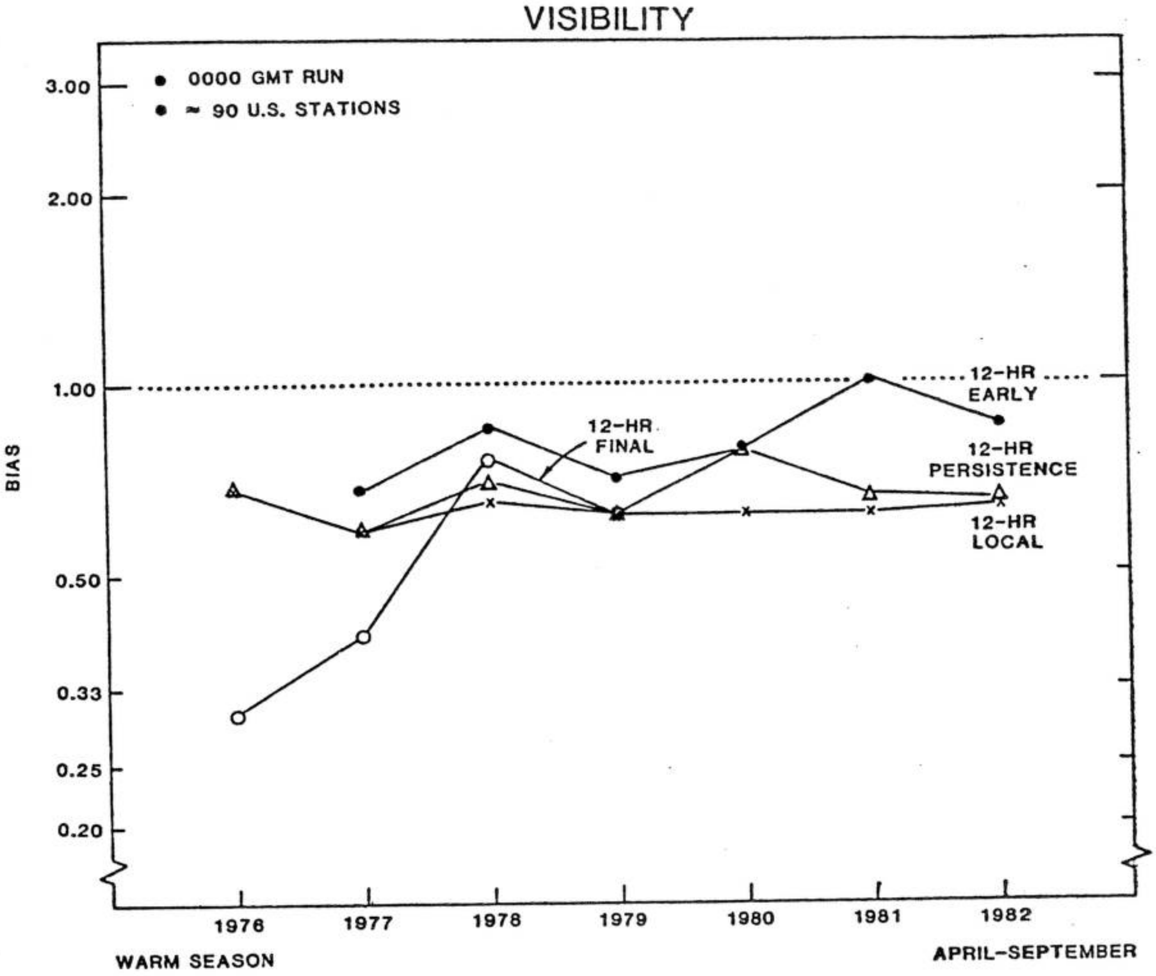

Figure 5.7. Same as Fig. 5.5 except for visibility.

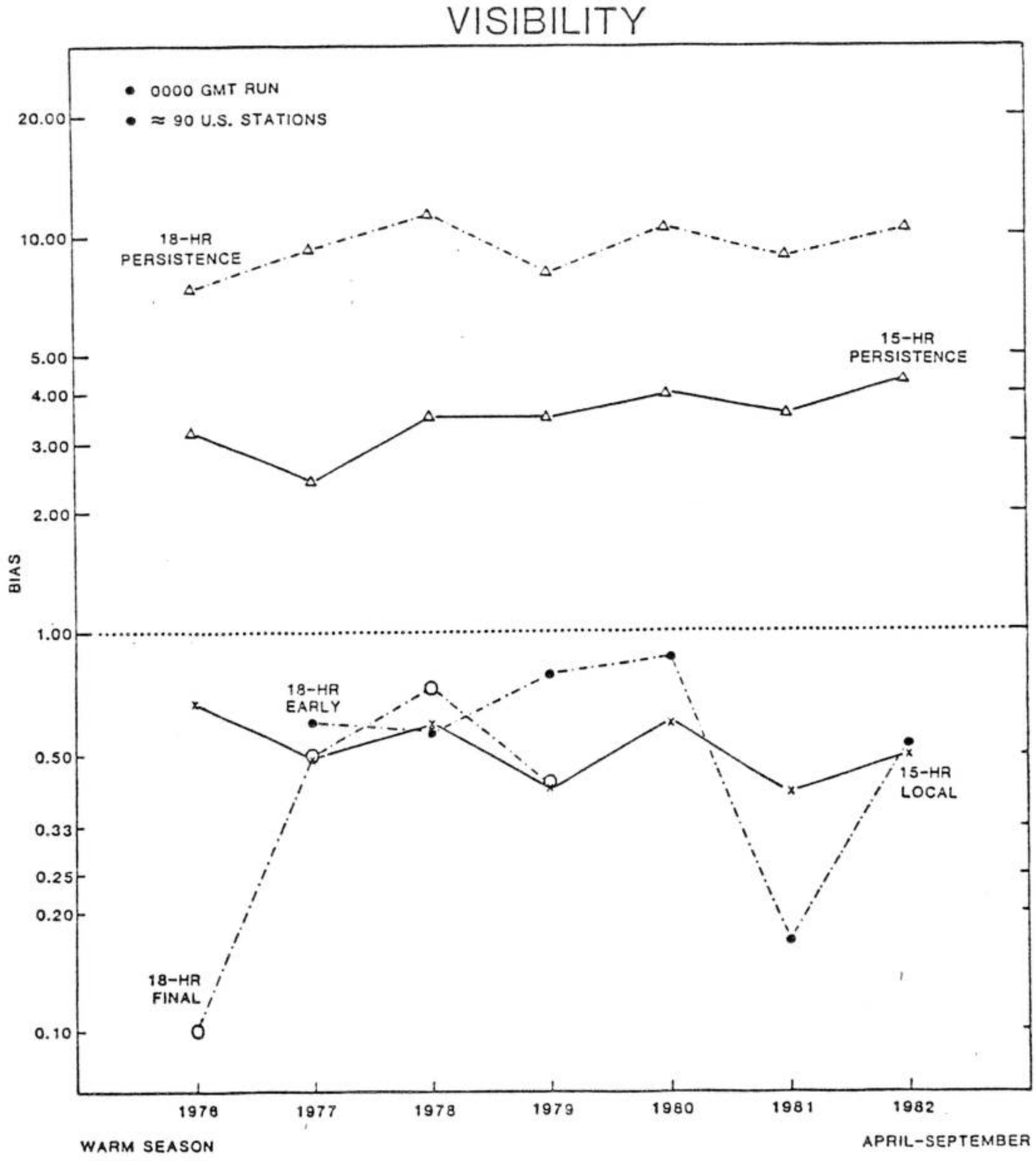

Figure 5.8. Same as Fig. 5.5 except for visibility and forecast projection.

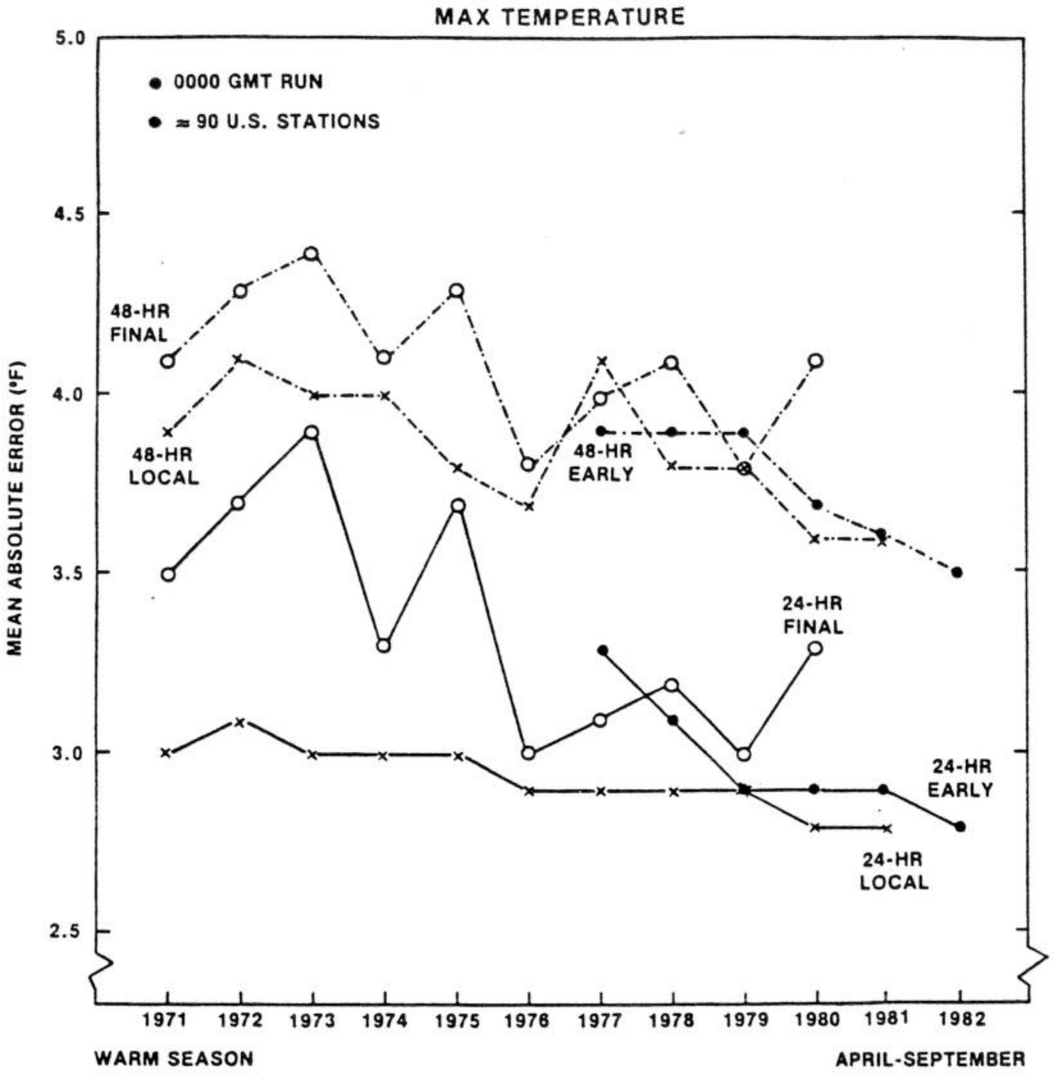

Figure 6.1. Mean absolute error for the local and the early and final guidance max temperature forecasts.

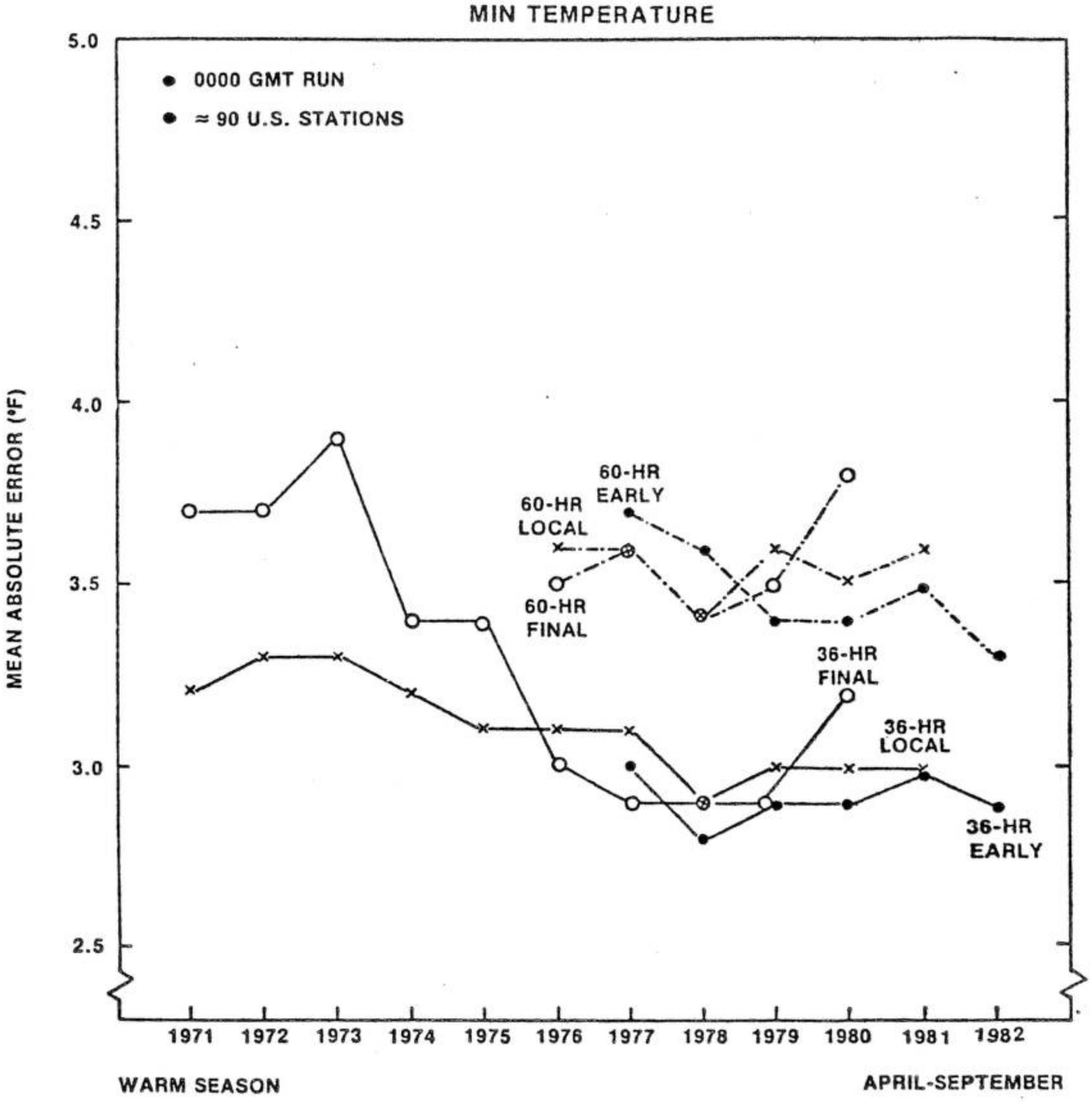

Figure 6.2. Same as Fig. 6.1 except for the min temperature.