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AFOS-ERA VERIFICATION OF GUIDANCE AND LOCAL AVIATION/PUBLIC WEATHER FORECASTS--NO. 10 (APRIL 1988-SEPTEMBER 1988)

Valery J. Dagostaro, Gary M. Carter, and J. Paul Dallavalle

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1. INTRODUCTION

This is the tenth in the series of Techniques Development Laboratory (TDL) office notes which compare the performance of TDL's automated guidance with National Weather Service (NWS) local forecasts made at Weather Service Forecast Offices (WSFO's). Verification statistics are presented for the warm season months of April 1988 through September 1988 for probability of precipitation (POP), surface wind, cloud amount, ceiling height, visibility, and maximum/minimum (max/min) temperature. Verification summaries are provided for both forecast cycles, 0000 and 1200 UTC. The scores are those recommended in the NWS National Verification Plan (National Weather Service, 1982).

The local PoP and max/min forecasts used for verification were official public weather forecasts obtained from the Coded City Forecast (FPUS4) bulletin. The local forecasts for the aviation weather elements were obtained from the NWS official terminal forecasts (FT's). In contrast, the local cloud amount and 42-h significant wind forecasts were manually entered by the forecasters at the WSFO's. These subjective forecasts may or may not be based on the objective guidance. Also, surface observations as late as 2 hours before the first valid forecast time may have been used in preparation of the local forecasts.

The automated guidance was based on forecast equations developed by application of the Model Output Statistics (MOS) technique (Glahn and Lowry, 1972). In particular, these prediction equations were derived by using archived surface observations and forecast fields from the Limited-area Fine Mesh (LFM) Model (Gerrity, 1977; Newell and Deaven, 1981). The surface observations used as predictors in these equations were taken at least 9 hours before the first verification valid time.

Due to a change in the issuance time of the FT's in December 1986, the projections of the local and guidance forecasts for the aviation weather elements (ceiling height, visibility, and wind speed and direction) no longer match. Moreover, the observations saved locally now correspond only to the valid time of the local forecasts. The issuance time of the local forecasts is based on local time rather than the forecast cycle. Although the actual time varies with time zone and changes from standard to daylight time, for simplicity, we will refer to the FT issuance times as if they occur at the same time for all stations. We verified the local forecasts associated with the FT issuance times of approximately 0900 and 1800 UTC. Persistence forecasts corresponding to the local forecasts are also now based on the local time. Since the valid time of the automated guidance has not changed, it is no longer possible to perform a comparative verification for the aviation weather elements.

For the aviation elements, the local forecasts, along with the corresponding persistence and verifying observations, were collected locally at the WSFO's, transmitted via the Automation of Field Operations and Services (AFOS) system to the National Meteorological Center (NMC), and archived centrally by TDL.

The automated guidance for these elements was also collected locally and transmitted to NMC. The persistence and verifying observations corresponding to the guidance were taken from hourly reports archived centrally by TDL. For the remaining weather elements, including the 42-h significant wind, all of the forecasts (both local and guidance) and the verifying observations were collected locally at the WSFO's and transmitted to NMC. The local collection system is described by Ruth and Alex (1987). The national AFOS-era verification data processing system is described in detail by Dagostaro (1985), while guidelines for the public/aviation forecast verification program are given in National Weather Service (1983).

As noted in the following sections, implementation of the AFOS-era verification system introduced significant changes from past verifications in regard to the characteristics of the local forecasts and the verifying observations. For example, the local and guidance max/min temperature forecasts are verified by using max/min temperatures observed during approximately 12-h periods instead of 24-h (calendar day) periods. Also, the cloud amount observations are given in terms of total sky cover rather than opaque sky cover. Hence, we do not think it is meaningful to compare results for the 1988 warm season with statistics based on the pre-AFOS verification system (e.g., Maglaras et al., 1984).

In addition, due to the change in the issuance time of the FT's, direct comparison of the local statistics with those for the guidance is no longer possible for the aviation weather elements. Direct comparison of results for the local aviation elements for the 1988 warm season with previous warm seasons is also no longer possible.

2. PROBABILITY OF PRECIPITATION

MOS PoP forecasts were produced by the warm season prediction equations described in Technical Procedures Bulletin No. 299 (National Weather Service, 1981a). This guidance was available for the first, second, and third periods, which correspond to 12-24, 24-36, and 36-48 hours, respectively, after 0000 and 1200 UTC. The predictors for the equation development were forecast variables from the LFM model and weather elements observed at the forecast site at 0300 or 1500 UTC. However, in day-to-day operations, surface observations at 0200 or 1400 UTC (or even 0100 or 1300 UTC) were used as input to the prediction equations. The LFM model schedule makes this necessary, and the guidance is available earlier than if the 0300 and 1500 UTC observations were used.

The forecasts were verified by computing Brier scores (Brier, 1950) for 93 of the 94 stations listed in Table 2.1. Note that we used the standard NWS Brier score for PoP 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. 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 determined from a 15-yr sample (Jorgensen, 1967). Because local forecasters are encouraged to depart from the guidance if they think it is incorrect, the Brier score was also computed when the local forecasters deviated from the guidance by at least 20%.

Tables 2.2 and 2.7 present the 1988 warm season results for all 93 stations combined, for the 0000 and 1200 UTC 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 UTC cycles, respectively.

3. SURFACE WIND

The objective surface wind forecasts were generated by the warm season, LFM-based equations described in Technical Procedures Bulletin No. 347 (National Weather Service, 1984). Prior to the 1984 warm season, the surface wind prediction equations were rederived to account for the latest available data from the LFM model. The objective surface wind forecast is defined in the same way as the observed wind, namely, the 1-min average wind direction and speed for a specific time. All 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.

We verified both the local and guidance forecasts for three projections; however, due to the change in issuance time of the FT's, the projections no longer match. The guidance forecasts are valid at 12, 18, and 24 hours after both 0000 and 1200 UTC, while the local forecasts correspond to approximately 3-, 9-, and 15-h projections from the FT issuance times of approximately 0900 and 1800 UTC.

Although the MOS and local forecasts were verified separately, we used the same method of verification as in previous seasons. First, for those cases in which the wind speed forecasts were $\geq$10 kt, the mean absolute error and the mean algebraic error (forecast minus observed wind speed) of the forecasts were 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 the forecasts were available, the skill score[1], percent correct, bias by category[2], and threat score[3] were computed from contingency tables of wind speed. The definitions of the categories used in the contingency tables for wind speed and direction are given in Table 3.1. The threat score used here was calculated by combining events of the upper two categories (winds $\geq$28 kt). In addition, for all cases in which the wind speed forecasts were at least 10 kt, the skill score for the wind direction forecasts was computed from contingency tables. The 92 stations used in the verification are listed in Table 2.1.

For the guidance forecasts, the results for all 92 stations combined for the 0000 and 1200 UTC cycles are presented in Tables 3.2 and 3.7, respectively.

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

[2]In the discussion of surface wind, cloud amount, 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.

[3]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.

Tables 3.3-3.6 and 3.8-3.11 show guidance scores for the NWS Eastern, Southern, Central, and Western Regions for 0000 and 1200 UTC, respectively. For the local forecasts, Table 3.12 (3.17) shows the results for all 91 (92) stations combined for the FT issuance time of approximately 0900 (1800) UTC. Local forecast results for the NWS Eastern, Southern, Central, and Western Regions are presented in Tables 3.13-3.16 and 3.18-3.21, respectively, for the two issuance times. Although 42-h forecasts of winds $\geq$23 knots were also collected as part of the AFOS-era verification system, the sample was insufficient to provide a meaningful comparative verification.

4. CLOUD AMOUNT

During the 1988 warm season, the objective cloud amount forecasts were produced by the prediction equations described in Technical Procedures Bulletin No. 378 (National Weather Service, 1988). Prior to the 1988 warm season, the cloud amount prediction equations were rederived on a larger, more recent data sample from the LFM model. These regionalized equations used LFM model output and 0000 (1200) UTC surface observations to produce probability forecasts of the four categories of cloud amount shown in Table 4.1. We converted the probability estimates to "best category" forecasts by an algorithm that produced good bias characteristics (bias of approximately 1.0 for each category) on the developmental sample. The algorithm used to obtain the best category is described in Technical Procedures Bulletin No. 378.

We compared the local forecasts with a matched sample of guidance forecasts for the 94 stations listed in Table 2.1 for the 12-, 18-, and 24-h projections from 0000 and 1200 UTC. 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. Prior to the 1984 warm season, opaque sky cover amounts from surface observations were used in determining the observed categories. However, the hourly surface reports from which the verifying observations are now taken do not record total opaque sky cover as part of the observation; hence, thin clouds are also included. For example, a report of overcast with eight tenths opaque and two tenths thin, which previously was put into the broken category, now is categorized as overcast. The result of this change is to decrease (increase) the number of observations of the broken (overcast) category compared to previous verifications. At the same time, the number of observations of clear (scattered) has increased (decreased) because reports of thin scattered, thin broken, and thin overcast clouds are all categorized as clear. These changes have greatly affected the overall bias by category statistics for both the guidance and local forecasts.

The results for all stations combined are shown in Tables 4.2 and 4.7 for the 0000 and 1200 UTC cycle forecasts, respectively. Tables 4.3-4.6 and Tables 4.8-4.11 show scores for the NWS Eastern, Southern, Central, and Western Regions, for the 0000 and 1200 UTC cycles, respectively.

5. CEILING AND VISIBILITY

During the 1988 warm season, the ceiling and visibility guidance was produced by the prediction equations described in Technical Procedures Bulletin No. 303 (National Weather Service, 1981b). Operationally, the guidance was based

primarily on LFM model output and either 0100 or 0200 (1300 or 1400) UTC surface observations.

Verification scores were computed separately for the local and guidance forecasts. A comparative verification of local and persistence forecasts was performed for 91 (92) of the 94 stations listed in Table 2.1 for the FT issuance time of approximately 0900 (1800) UTC. The local forecasts and verifying observations correspond to approximately 3-, 6-, 9-, and 15-h projections from the beginning of the scheduled FT valid period. Persistence is also based on the local time, and the projections are from the beginning of the scheduled FT valid period.

A comparative verification of guidance and persistence forecasts was performed for the same 91 (92) stations for the 0000 (1200) UTC cycle. Here, persistence for the 0000 (1200) UTC forecast cycle was based on an observation taken at the subsequent 0900 (2100) UTC. The objective and persistence forecasts were verified for 12-, 18-, and 24-h projections from both cycles. Note that the persistence forecasts for the 12-, 18-, and 24-h projections are actually 3-, 9-, and 15-h forecasts, respectively, from the latest available surface observation.

We constructed forecast-observed contingency tables for the four categories of ceiling and visibility given in Table 5.1. These categories were used for computing several different scores: bias by category, percent correct, skill score, and log score.[4] Table 5.2 (5.3) shows the MOS ceiling height verification results for all 91 (92) stations combined for the 0000 (1200) UTC cycle. Table 5.4 (5.5) presents the local ceiling height scores for the same 91 (92) stations except for the FT issuance time of approximately 0900 (1800) UTC. Visibility scores are given for all stations combined for the MOS forecasts in Tables 5.6 and 5.7 for the 0000 and 1200 UTC cycles, respectively. Similarly, results for the local visibility forecasts are given in Tables 5.8 and 5.9 for the FT issuance times of approximately 0900 and 1800 UTC, respectively.

6. MAXIMUM/MINIMUM TEMPERATURE

Throughout the 1988 warm season, the max/min temperature guidance was generated by the prediction equations described in Technical Procedures Bulletin No. 356 (National Weather Service, 1985). These equations forecast daytime max and nighttime min temperatures. During the warm season, daytime is defined as 8 a.m. to 7 p.m. Local Standard Time (LST), while nighttime extends from 7 p.m. to 8 a.m. LST. The guidance equations were developed by stratifying archived LFM model forecasts, station observations, and the first two harmonics of the day of the year into seasons of 3-mo duration (Erickson and Dallavalle, 1986). The spring season is defined as March-May; the summer, as June-August; and the fall, as September-November. During the 0000 UTC cycle, the MOS max/min guidance is valid for periods corresponding to today's max, tonight's min, tomorrow's max, and tomorrow night's min. Similarly, for the 1200 UTC forecast cycle, guidance is available for tonight's min, tomorrow's max, tomorrow night's min, and the day after tomorrow's max. Station observations at 0000 UTC

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[4]The log score is proportional to the absolute value of $\log_{10} f_i - \log_{10} O_i$, where f_i is the forecast category for each case and O_i is the observed category for each case. The result is averaged over all cases and scaled by multiplying by 50.

(1200 UTC) are used as possible predictors only in the first period forecast of today's max (tonight's min). The valid periods of the guidance closely approximate those of the local forecaster who makes predictions of today's high, tonight's low, and so forth.

In this publication, we present results for both guidance and local forecasts that were verified by using observations approximating the daytime high or nighttime low. In the local AFOS-era verification software (Ruth and Alex, 1987), daytime is defined as 7 a.m to 7 p.m. LST and nighttime as 7 p.m. to 8 a.m. LST. The local program scans the synoptic and hourly reports to determine if the max/min observation adequately represents the daytime or nighttime period. If this observation is satisfactory, it is kept. If, however, the reported value is not representative of the day or night period, then an algorithm is used to deduce the appropriate value from available synoptic and hourly temperature observations. The local forecaster is also provided the option of replacing the estimated observation with the exact nighttime low or daytime high. It's important to note, then, that the verifying observations correspond reasonably well to the local and guidance forecast periods.

We verified the local and MOS max/min temperature forecasts for both the 0000 and 1200 UTC cycles. The mean algebraic error (forecast minus observed temperature), mean absolute error, percent of absolute errors $>10^{o}F$, probability of detection[5] of min temperatures $\leq 32^{o}F$, false alarm ratio[6] for min temperatures $\leq 32^{o}F$, and percent improvement over climate[7] were computed for 93 stations in the conterminous United States (see Table 2.1). At 0000 (1200) UTC, the local max temperature forecasts are valid for daytime periods ending approximately 24 (36) and 48 (60) hours after 0000 (1200) UTC. Similarly, at 0000 (1200) UTC, the local min temperature forecasts are valid for nighttime periods ending about 36 (24) and 60 (48) hours after 0000 (1200) UTC.

For all stations combined, the results for 0000 and 1200 UTC are shown in Tables 6.1 and 6.6, respectively. Similarly, Tables 6.2-6.5 give the 0000 UTC cycle 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 UTC cycle.

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[5]Here, the probability of detection is defined to be the fraction of time the min temperature was correctly forecast to be $\leq 32^{o}F$ when the previous day's min was $\geq 40^{o}F$.

[6]Here, the false alarm ratio is defined to be the fraction of forecasts of $\leq 32^{o}F$ that failed to verify when the previous day's min was $\geq 40^{o}F$.

[7]The percent improvement over climate is the percent improvement of mean square errors obtained from the local or guidance forecasts over analogous mean square errors produced by climatic forecasts. The climatic values used here are the National Climatic Data Center's normal max or min temperatures for each station determined from a 30-yr sample.

7. SUMMARY

Highlights of the 1988 warm season verification results, summarized by general type of weather element, are:

- Probability of Precipitation - The PoP verification involved 93 stations and forecast projections of 12-24, 24-36, and 36-48 hours from 0000 and 1200 UTC. The NWS Brier scores for all stations and both forecast cycles combined show that the local forecasts were 2.9% better than the guidance for the first period, 1.3% better for the second period, and less than 1% better for the third period. Depending on the projection and cycle, the local forecasters deviated by 20% or more from the guidance about 10% of the time. In those cases, the NWS Brier scores for all stations and both forecast cycles combined show that the local forecasters were 7.0% better than the guidance for the first period, 2.4% better for the second period, and 1.2% better for the third period. The Brier scores and percent improvement over climate scores for all three periods and both forecast cycles combined indicate that the local and guidance forecasts were better than those for the previous warm season (Dagostaro et al., 1988).

- Surface Wind - Statistics were computed for local and guidance forecasts of surface wind speed and direction. Local forecasts for 91 (92) stations for projections of around 3, 9, and 15 hours from the FT issuance times of approximately 0900 and 1800 UTC were verified. Local forecasts based on the new FT issuance time were first verified for an entire warm season in 1988; thus, a comparison of results with those of the previous warm season was not possible.

  Guidance forecasts for the same 92 stations for projections of 12, 18, and 24 hours from 0000 and 1200 UTC were verified. The mean absolute error and skill score for all stations, projections, and both forecast cycles combined show that the MOS wind direction forecasts were generally better than for the previous warm season. The bias by category for all stations, projections, and both cycles show that the wind speed forecasts were generally better than those for the previous warm season for wind speeds $\geq$13 kt; however, in terms of percent correct, the forecasts for all speeds (including those $\leq$12 kt) were worse than last year's results. The mean absolute error, mean algebraic error, skill score, and threat score varied from projection to projection and cycle to cycle, indicating no clear trends.

- Cloud Amount - The verification for cloud amount involved 94 stations and forecasts for projections of 12, 18, and 24 hours from 0000 and 1200 UTC. The skill scores and percents correct for all stations combined indicate both the 0000 and 1200 UTC cycle local forecasts were better than the corresponding guidance for the 12-h projection, while the guidance was better than the local forecasts for the 18- and 24-h projections. In terms of bias by category (clear, scattered, broken, and overcast), the local forecasts were usually better than the guidance for predictions of scattered, but were worse than the guidance for predictions of clear and broken.

In terms of skill score and percent correct, the guidance forecasts were generally better than those for the previous warm season. For the local forecasts, results varied from projection to projection and cycle to cycle, indicating no clear trends.

- Ceiling and Visibility - Both the local and guidance forecasts were verified against their corresponding persistence forecasts. For the local forecasts, a comparative verification was performed for 91 (92) stations for projections of around 3, 6, 9, and 15 hours from the FT issuance times of approximately 0900 and 1800 UTC. For the guidance, the verification involved the comparison of MOS forecasts and persistence for the same 91 (92) stations for projections of 12, 18, and 24 hours from 0000 (1200) UTC. These are actually 3-, 9-, and 15-h forecasts from the latest available surface observations for persistence.

  For both forecast cycles, the log scores, percents correct, and skill scores show that persistence was more accurate than the guidance forecasts for the 12-h projection for both ceiling and visibility. The guidance was always better than persistence for the 18- and 24-h projections from 0000 UTC. For these same two projections from 1200 UTC, the guidance was usually better than persistence in terms of skill score, but worse in terms of log score and percent correct. The bias by category scores varied greatly from projection to projection and cycle to cycle. In terms of log score and percent correct, the guidance forecasts for ceiling and visibility were better than those for the previous warm season; however, in terms of skill score, the guidance was usually worse than last year's forecasts.

  For the local forecasts of ceiling and visibility, the log score, percent correct, and skill score indicate that the forecasts were usually worse than persistence for the 3-h projection, but were usually better for the 9- and 15-h projections. The bias by category results varied, except that the lowest two categories were underforecast by the local forecasters for all projections. Local forecasts based on the new FT issuance time were first verified for an entire warm season in 1988; thus, a comparison of results with those of the previous warm season was not possible.

- Maximum/Minimum Temperature - Objective and local forecasts were verified for 93 stations for both the 0000 and 1200 UTC cycles. At 0000 (1200) UTC, the local maximum temperature forecasts were valid for daytime periods ending approximately 24 (36) and 48 (60) hours after 0000 or 1200 UTC, while the minimum temperature forecasts were valid for nighttime periods ending approximately 36 (24) and 60 (48) hours after initial model time. The valid periods of the guidance closely approximate those of the local forecasts. As verifying observations, max or min temperatures for daytime or nighttime intervals were used.

  For all stations and projections combined, we found the mean absolute errors of the local max and min temperature forecasts were 0.3°F and 0.1°F, respectively, more accurate than the MOS guidance. For all stations combined, the local forecasters were almost always able to improve over the MOS guidance, both in terms of mean absolute error and the percentage of errors >10°F. For all stations and projections combined, both the local and guidance verification results were worse than for the previous warm season in terms of mean algebraic error, mean absolute error, and percentage of errors >10°F; however, the mean absolute

error for the 1987 warm season was the lowest recorded for the warm season since 1966 (Carter and Polger, 1986).

8. ACKNOWLEDGMENTS

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REFERENCES

Brier, G. W., 1950: Verification of forecasts expressed in terms of probability. Mon. Wea. Rev., 78, 1-3.

Carter, G. M., and P. D. Polger, 1986: A 20-year summary of national weather service verification results for temperature and precipitation. NOAA Technical Memorandum NWS FCST-31, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 50 pp.

Dagostaro, V. J., 1985: The national AFOS-era verification data processing system. TDL Office Note 85-9, National Weather Service, NOAA, U.S. Department of Commerce, 47 pp.

_____, Carter, G. M., and J. P. Dallavalle, 1988: AFOS-era verification of guidance and local aviation/public weather forecasts--No. 8 (April 1987-September 1987). TDL Office Note 88-1, National Weather Service, NOAA, U.S. Department of Commerce, 43 pp.

Erickson, M. C., and J. P. Dallavalle, 1986: Objectively forecasting the short-range maximum/minimum temperature - A new look. Preprints Eleventh Conference on Weather Forecasting and Analysis, Kansas City, Amer. Meteor. Soc., 33-38.

Gerrity, J. P., Jr., 1977: The LFM model--1976: A documentation. NOAA Technical Memorandum NWS NMC-60, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 68 pp.

Glahn, H. R., and D. A. Lowry, 1972: The use of Model Output Statistics (MOS) in objective weather forecasting. J. Appl. Meteor., 11, 1203-1211.

Jorgensen, D. L., 1967: Climatological probabilities of precipitation for the conterminous United States. ESSA Tech. Report WB-5, Environmental Science Services Administration, U.S. Department of Commerce, 60 pp.

Klein, W. H., B. M. Lewis, and I. Enger, 1959: Objective prediction of five-day mean temperatures during winter. J. Meteor., 16, 672-682.

Maglaras, G. J., G. M. Carter, J. P. Dallavalle, G. W. Hollenbaugh, and B. E. Schwartz, 1984: Comparative verification of guidance and local aviation/public weather forecasts--No. 16 (April 1983-September 1983). TDL Office Note 84-4, National Weather Service, NOAA, U.S. Department of Commerce, 69 pp.

National Weather Service, 1981a: The use of Model Output Statistics for predicting probability of precipitation (PoP). NWS Technical Procedures Bulletin No. 299, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 12 pp.

_____, 1981b: The use of Model Output Statistics for predicting ceiling, visibility, cloud amount, and obstructions to vision. NWS Technical Procedures Bulletin No. 303, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 11 pp.

_____, 1982: National Verification Plan. National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 81 pp.

_____, 1983: Public/aviation forecast verification. NWS Operations Manual, Chapter C-73, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 18 pp.

_____, 1984: The use of Model Output Statistics for predicting surface wind. NWS Technical Procedures Bulletin No. 347, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 11 pp.

_____, 1985: Automated daytime maximum, nighttime minimum, 3-hourly surface temperature, and 3-hourly surface dew point guidance. NWS Technical Procedures Bulletin No. 356, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 14 pp.

_____, 1988: Updated LFM-based MOS cloud amount guidance. NWS Technical Procedures Bulletin No. 378, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 8 pp.

Newell, J. E., and D. G. Deaven, 1981: The LFM-II model--1980. NOAA Technical Memorandum NWS NMC-66, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 20 pp.

Panofsky, H. A., and G. W. Brier, 1965: Some Applications of Statistics to Meteorology. Pennsylvania State University, University Park, 224 pp.

Ruth, D. P., and C. L. Alex, 1987: AFOS-era forecast verification. NOAA Techniques Development Laboratory Computer Program NWS TDL CP 87-2, National Weather Service, NOAA, U.S. Department of Commerce, 50 pp.

Table 2.1. Ninety-four stations used for comparative verification of MOS guidance and local probability of precipitation, surface wind, cloud amount, ceiling height, visibility, and max/min temperature forecasts. Please note that LAX was not included in the PoP and max/min temperature verifications, and LBB and ELP were not included in the surface wind, ceiling height, and visibility verifications. TCC was not available during the 0000 GMT cycle for the local surface wind, ceiling height, and visibility verifications.

DCA	Washington, D.C.	ORF	Norfolk, Virginia
PWM	Portland, Maine	CON	Concord, New Hampshire
BOS	Boston, Massachusetts	PVD	Providence, Rhode Island
ALB	Albany, New York	BTV	Burlington, Vermont
BUF	Buffalo, New York	SYR	Syracuse, New York
LGA	New York (LaGuardia), New York	EWR	Newark, New Jersey
RDU	Raleigh-Durham, North Carolina	CLT	Charlotte, North Carolina
CLE	Cleveland, Ohio	CMH	Columbus, Ohio
PHL	Philadelphia, Pennsylvania	AVP	Scranton, Pennsylvania
PIT	Pittsburgh, Pennsylvania	ERI	Erie, Pennsylvania
CAE	Columbia, South Carolina	CHS	Charleston, South Carolina
CRW	Charleston, West Virginia	BKW	Beckley, West Virginia
BHM	Birmingham, Alabama	MOB	Mobile, Alabama
LIT	Little Rock, Arkansas	FSM	Fort Smith, Arkansas
MIA	Miami, Florida	TPA	Tampa, 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	BNA	Nashville, Tennessee
DFW	Dallas-Ft. Worth, Texas	ABI	Abilene, Texas
LBB	Lubbock, Texas	ELP	El Paso, Texas
SAT	San Antonio, Texas	IAH	Houston, Texas
DEN	Denver, Colorado	GJT	Grand Junction, Colorado
ORD	Chicago (O'Hare), Illinois	SPI	Springfield, Illinois
IND	Indianapolis, Indiana	SBN	South Bend, Indiana
DSM	Des Moines, Iowa	ALO	Waterloo, Iowa
TOP	Topeka, Kansas	ICT	Wichita, Kansas
SDF	Louisville, Kentucky	LEX	Lexington, Kentucky
DTW	Detroit, Michigan	GRR	Grand Rapids, Michigan
MSP	Minneapolis, Minnesota	DLH	Duluth, Minnesota
STL	St. Louis, Missouri	MCI	Kansas City, Missouri
OMA	Omaha, Nebraska	LBF	North Platte, 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	CPR	Casper, Wyoming
PHX	Phoenix, Arizona	TUS	Tucson, Arizona
LAX	Los Angeles, California	SAN	San Diego, California
SFO	San Francisco, California	FAT	Fresno, California
BOI	Boise, Idaho	PIH	Pocatello, Idaho
GTF	Great Falls, Montana	HLN	Helena, Montana
RNO	Reno, Nevada	LAS	Las Vegas, Nevada
PDX	Portland, Oregon	MFR	Medford, Oregon
SLC	Salt Lake City, Utah	CDC	Cedar City, Utah
SEA	Seattle-Tacoma, Washington	GEG	Spokane, Washington

Table 2.2. Comparative verification of MOS and local PoP forecasts for 93 stations, 0000 UTC cycle.

Forecast Projection (h)	Type of Forecast	Brier Score	% Imp. Over Guid.	% Imp. Over Clim.	No. of Cases	Changes GE 20% to Guidance: Brier Score	Changes GE 20% to Guidance: % Imp. Over Guid.	Changes GE 20% to Guidance: No. of Changes
12-24 (1st period)	MOS	0.0923		31.6		0.2002		
	LOCAL	0.0895	3.0	33.7	15951	0.1828	8.7	1768
24-36 (2nd period)	MOS	0.0949		27.4		0.2077		
	LOCAL	0.0930	1.9	28.8	15743	0.2039	1.8	1498
36-48 (3rd period)	MOS	0.1058		21.5		0.2025		
	LOCAL	0.1054	0.4	21.8	15957	0.2012	0.6	1529

Table 2.3. Same as Table 2.2 except for 24 stations in the Eastern Region.

Forecast Projection (h)	Type of Forecast	Brier Score	% Imp. Over Guid.	% Imp. Over Clim.	No. of Cases	Changes GE 20% to Guidance: Brier Score	Changes GE 20% to Guidance: % Imp. Over Guid.	Changes GE 20% to Guidance: No. of Changes
12-24 (1st period)	MOS	0.1040		39.0		0.1901		
	LOCAL	0.1016	2.4	40.4	4141	0.1745	8.2	588
24-36 (2nd period)	MOS	0.1117		32.5		0.2137		
	LOCAL	0.1075	3.7	35.0	4044	0.1957	8.4	467
36-48 (3rd period)	MOS	0.1234		27.0		0.1900		
	LOCAL	0.1221	1.0	27.8	4146	0.1858	2.2	564

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

Forecast Projection (h)	Type of Forecast	Brier Score	% Imp. Over Guid.	% Imp. Over Clim.	No. of Cases	Changes GE 20% to Guidance: Brier Score	Changes GE 20% to Guidance: % Imp. Over Guid.	Changes GE 20% to Guidance: No. of Changes
12-24 (1st period)	MOS	0.1133		21.5		0.2173		
	LOCAL	0.1126	0.6	21.9	4144	0.2101	3.3	508
24-36 (2nd period)	MOS	0.0974		21.5		0.1951		
	LOCAL	0.1004	-3.2	19.0	4024	0.2227	-14.1	400
36-48 (3rd period)	MOS	0.1230		15.3		0.2097		
	LOCAL	0.1246	-1.3	14.2	4145	0.2209	-5.4	423

Table 2.5. Same as Table 2.2 except for 28 stations in the Central Region.

Forecast Projection (h)	Type of Forecast	Brier Score	% Imp. Over Guid.	% Imp. Over Clim.	No. of Cases	Changes GE 20% to Guidance: Brier Score	Changes GE 20% to Guidance: % Imp. Over Guid.	Changes GE 20% to Guidance: No. of Changes
12-24	MOS	0.0830		35.2		0.1801		
(1st period)	LOCAL	0.0791	4.6	38.2	4748	0.1621	10.0	500
24-36	MOS	0.0937		29.9		0.2034		
(2nd period)	LOCAL	0.0911	2.8	31.9	4756	0.1934	4.9	474
36-48	MOS	0.0990		22.6		0.2187		
(3rd period)	LOCAL	0.0979	1.1	23.5	4748	0.2078	5.0	408

Table 2.6. Same as Table 2.2 except for 17 stations in the Western Region.

Forecast Projection (h)	Type of Forecast	Brier Score	% Imp. Over Guid.	% Imp. Over Clim.	No. of Cases	Changes GE 20% to Guidance: Brier Score	Changes GE 20% to Guidance: % Imp. Over Guid.	Changes GE 20% to Guidance: No. of Changes
12-24	MOS	0.0609		26.5		0.2429		
(1st period)	LOCAL	0.0565	7.1	31.7	2918	0.1904	21.6	172
24-36	MOS	0.0699		19.2		0.2353		
(2nd period)	LOCAL	0.0657	6.0	24.0	2919	0.2123	9.8	157
36-48	MOS	0.0676		18.5		0.1830		
(3rd period)	LOCAL	0.0668	1.1	19.4	2918	0.1835	-0.3	134

Table 2.7. Comparative verification of MOS and local PoP forecasts for 93 stations, 1200 UTC cycle.

Forecast Projection (h)	Type of Forecast	Brier Score	% Imp. Over Guid.	% Imp. Over Clim.	No. of Cases	Changes GE 20% to Guidance: Brier Score	Changes GE 20% to Guidance: % Imp. Over Guid.	Changes GE 20% to Guidance: No. of Changes
12-24 (1st period)	MOS	0.0901		31.0		0.2028		
	LOCAL	0.0876	2.8	33.0	15747	0.1919	5.4	1902
24-36 (2nd period)	MOS	0.0985		27.0		0.2064		
	LOCAL	0.0978	0.7	27.6	15955	0.2005	2.9	1584
36-48 (3rd period)	MOS	0.1037		20.6		0.2140		
	LOCAL	0.1025	1.2	21.6	15729	0.2104	1.7	1586

Table 2.8. Same as Table 2.7 except for 24 stations in the Eastern Region.

Forecast Projection (h)	Type of Forecast	Brier Score	% Imp. Over Guid.	% Imp. Over Clim.	No. of Cases	Changes GE 20% to Guidance: Brier Score	Changes GE 20% to Guidance: % Imp. Over Guid.	Changes GE 20% to Guidance: No. of Changes
12-24 (1st period)	MOS	0.1069		35.9		0.1964		
	LOCAL	0.1042	2.5	37.5	4045	0.1903	3.1	544
24-36 (2nd period)	MOS	0.1142		33.1		0.1895		
	LOCAL	0.1138	0.3	33.3	4138	0.1892	0.2	537
36-48 (3rd period)	MOS	0.1259		24.9		0.2146		
	LOCAL	0.1230	2.3	26.6	4034	0.2031	5.3	503

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

Forecast Projection (h)	Type of Forecast	Brier Score	% Imp. Over Guid.	% Imp. Over Clim.	No. of Cases	Changes GE 20% to Guidance: Brier Score	Changes GE 20% to Guidance: % Imp. Over Guid.	Changes GE 20% to Guidance: No. of Changes
12-24 (1st period)	MOS	0.0950		23.1		0.1989		
	LOCAL	0.0944	0.7	23.6	4028	0.1933	2.8	537
24-36 (2nd period)	MOS	0.1166		18.7		0.2118		
	LOCAL	0.1162	0.4	19.0	4153	0.2034	4.0	485
36-48 (3rd period)	MOS	0.1043		15.6		0.2044		
	LOCAL	0.1075	-3.2	13.0	4031	0.2331	-14.0	425

Table 2.10. Same as Table 2.7 except for 28 stations in the Central Region.

Forecast Projection (h)	Type of Forecast	Brier Score	% Imp. Over Guid.	% Imp. Over Clim.	No. of Cases	Changes GE 20% to Guidance: Brier Score	Changes GE 20% to Guidance: % Imp. Over Guid.	Changes GE 20% to Guidance: No. of Changes
12-24	MOS	0.0864		34.7		0.2032		
(1st period)	LOCAL	0.0837	3.1	36.7	4749	0.1946	4.3	634
24-36	MOS	0.0897		30.1		0.2171		
(2nd period)	LOCAL	0.0886	1.2	31.0	4743	0.2103	3.1	428
36-48	MOS	0.1029		21.9		0.1998		
(3rd period)	LOCAL	0.1006	2.2	23.6	4745	0.1917	4.1	506

Table 2.11. Same as Table 2.7 except for 17 stations in the Western Region.

Forecast Projection (h)	Type of Forecast	Brier Score	% Imp. Over Guid.	% Imp. Over Clim.	No. of Cases	Changes GE 20% to Guidance: Brier Score	Changes GE 20% to Guidance: % Imp. Over Guid.	Changes GE 20% to Guidance: No. of Changes
12-24	MOS	0.0662		24.8		0.2311		
(1st period)	LOCAL	0.0615	7.0	30.1	2925	0.1833	20.7	187
24-36	MOS	0.0645		22.0		0.2207		
(2nd period)	LOCAL	0.0637	1.3	23.0	2921	0.2039	7.6	134
36-48	MOS	0.0738		16.1		0.2864		
(3rd period)	LOCAL	0.0704	4.6	19.9	2919	0.2334	18.5	152

Table 3.1. Definition of the categories used for MOS guidance, local forecasts, and surface observations of wind direction and speed.

Category	Direction (degrees)	Speed (kt)
1	340-20	≤ 12
2	30-60	13-17
3	70-110	18-22
4	120-150	23-27
5	160-200	28-32
6	210-240	≥ 33
7	250-290	---
8	300-330	---

Table 3.2. Verification of MOS surface wind guidance for 92 stations, 0000 UTC cycle.

		Direction			Speed											
								Contingency Table								
											Bias by Category					
Fcst Proj (h)	Type of Fcst.	Mean Abs. Error (deg)	Skill Score	No. of Cases	Mean Abs. Error (kt)	Mean Alg. Error (kt)	No. of Cases	Skill Score	Percent Fcst. Correct	Threat Score (>27 kt)	1 No. Obs	2 No. Obs	3 No. Obs	4 No. Obs	5 No. Obs	6 No. Obs
12	MOS	23	0.525	2530	3.3	1.9	2557	0.331	92.1	0.00	1.00 14512	0.97 820	1.04 126	0.56 27	1.33 3	* 0
18	MOS	26	0.441	5641	3.1	0.4	5653	0.352	78.6	0.09	1.08 12017	0.75 2758	0.68 637	0.40 114	0.45 29	0.20 5
24	MOS	30	0.416	4746	3.4	0.6	4760	0.293	79.9	0.09	1.08 12454	0.67 2331	0.60 582	0.60 112	0.29 24	0.25 4

* This category was neither forecast nor observed.

Table 3.3. Same as Table 3.2 except for 24 stations in the Eastern Region.

Fcst Proj (h)	Type of Fcst.	Direction			Speed											
								Contingency Table								
											Bias by Category					
		Mean Abs. Error (deg)	Skill Score	No. of Cases	Mean Abs. Error (kt)	Mean Alg. Error (kt)	No. of Cases	Skill Score	Percent Fcst. Correct	Threat Score (>27 kt)	1 No. Obs	2 No. Obs	3 No. Obs	4 No. Obs	5 No. Obs	6 No. Obs
12	MOS	21	0.531	657	3.1	1.5	662	0.303	91.4	0.00	1.02 3771	0.70 278	1.89 19	0.50 2	** 0	* 0
18	MOS	26	0.408	1626	2.9	0.5	1630	0.320	78.4	0.00	1.07 3192	0.78 749	0.70 111	0.06 17	0.00 3	* 0
24	MOS	31	0.399	839	3.3	1.3	843	0.233	88.2	0.00	1.05 3627	0.62 373	0.41 44	0.00 7	* 0	0.00 1

* This category was neither forecast nor observed.
** This category was forecast once but was not observed.

Table 3.4. Same as Table 3.2 except for 22 stations in the Southern Region.

Fcst Proj (h)	Type of Fcst.	Direction: Mean Abs. Error (deg)	Direction: Skill Score	Direction: No. of Cases	Speed: Mean Abs. Error (kt)	Speed: Mean Alg. Error (kt)	Speed: No. of Cases	Contingency Table: Skill Score	Contingency Table: Percent Fcst. Correct	Contingency Table: Threat Score (>27 kt)	Bias by Category: 1 No. Obs	Bias by Category: 2 No. Obs	Bias by Category: 3 No. Obs	Bias by Category: 4 No. Obs	Bias by Category: 5 No. Obs	Bias by Category: 6 No. Obs
12	MOS	26	0.445	456	3.5	2.5	461	0.358	95.4	0.00	0.99 3608	1.24 99	1.13 23	0.33 3	* 0	* 0
18	MOS	25	0.452	1258	3.1	1.0	1259	0.356	82.6	0.25	1.02 3107	0.88 495	0.87 104	0.64 14	1.50 2	* 0
24	MOS	29	0.416	984	3.2	1.5	988	0.280	85.6	0.50	1.03 3260	0.83 375	0.65 68	0.40 10	0.33 3	1.00 1

* This category was neither forecast nor observed.

Table 3.5. Same as Table 3.2 except for 28 stations in the Central Region.

		Direction			Speed											
								Contingency Table								
											Bias by Category					
Fcst Proj (h)	Type of Fcst.	Mean Abs. Error (deg)	Skill Score	No. of Cases	Mean Abs. Error (kt)	Mean Alg. Error (kt)	No. of Cases	Skill Score	Percent Fcst. Correct	Threat Score (>27 kt)	1 No. Obs	2 No. Obs	3 No. Obs	4 No. Obs	5 No. Obs	6 No. Obs
12	MOS	21	0.584	907	3.1	1.3	913	0.335	89.7	0.00	1.01 4298	0.94 333	0.74 61	0.63 16	1.00 3	* 0
18	MOS	23	0.489	2015	3.1	-0.6	2018	0.344	71.3	0.07	1.19 3095	0.66 1205	0.58 326	0.38 60	0.25 20	0.00 4
24	MOS	28	0.442	1550	3.3	-0.6	1553	0.280	74.7	0.00	1.18 3405	0.55 965	0.43 248	0.32 57	0.33 9	0.00 2

* This category was neither forecast nor observed.

Table 3.6. Same as Table 3.2 except for 18 stations in the Western Region.

Fcst Proj (h)	Type of Fcst.	Direction: Mean Abs. Error (deg)	Direction: Skill Score	Direction: No. of Cases	Speed: Mean Abs. Error (kt)	Speed: Mean Alg. Error (kt)	Speed: No. of Cases	Contingency Table: Skill Score	Contingency Table: Percent Fcst. Correct	Contingency Table: Threat Score (>27 kt)	Bias by Category: 1 No. Obs	Bias by Category: 2 No. Obs	Bias by Category: 3 No. Obs	Bias by Category: 4 No. Obs	Bias by Category: 5 No. Obs	Bias by Category: 6 No. Obs
12	MOS	29	0.427	510	4.0	3.0	521	0.327	92.9	0.00	0.98 2835	1.49 110	1.04 23	0.50 6	* 0	* 0
18	MOS	36	0.297	742	4.0	1.5	746	0.358	85.2	0.10	1.03 2623	0.83 309	0.78 96	0.57 23	1.25 4	1.00 1
24	MOS	33	0.301	1373	3.7	0.9	1376	0.288	69.9	0.07	1.07 2162	0.81 618	0.82 222	1.18 38	0.25 12	* 0

* This category was neither forecast nor observed.

Table 3.7. Verification of MOS surface wind guidance for 92 stations, 1200 UTC cycle.

Fcst Proj (h)	Type of Fcst.	Direction			Speed											
								Contingency Table								
											Bias by Category					
		Mean Abs. Error (deg)	Skill Score	No. of Cases	Mean Abs. Error (kt)	Mean Alg. Error (kt)	No. of Cases	Skill Score	Percent Fcst. Correct	Threat Score (>27 kt)	1 No. Obs	2 No. Obs	3 No. Obs	4 No. Obs	5 No. Obs	6 No. Obs
12	MOS	27	0.467	4914	3.1	0.4	4929	0.347	81.0	0.10	1.07 12403	0.74 2328	0.60 568	0.62 115	0.38 26	0.14 7
18	MOS	26	0.461	2327	3.5	1.7	2348	0.289	91.3	0.00	1.02 14043	0.70 958	0.66 172	0.74 19	0.43 7	0.00 1
24	MOS	26	0.504	2018	3.7	1.9	2051	0.255	92.2	0.00	1.02 14453	0.77 813	0.70 126	0.36 28	1.00 3	* 0

* This category was neither forecast nor observed.

Table 3.8. Same as Table 3.7 except for 24 stations in the Eastern Region.

Fcst Proj (h)	Type of Fcst.	Direction			Speed											
								Contingency Table								
											Bias by Category					
		Mean Abs. Error (deg)	Skill Score	No. of Cases	Mean Abs. Error (kt)	Mean Alg. Error (kt)	No. of Cases	Skill Score	Percent Fcst. Correct	Threat Score (>27 kt)	1 No. Obs	2 No. Obs	3 No. Obs	4 No. Obs	5 No. Obs	6 No. Obs
12	MOS	28	0.430	889	3.1	1.1	893	0.292	88.4	0.00	1.03 3609	0.77 368	0.33 46	0.00 7	* 0	0.00 1
18	MOS	24	0.473	450	3.1	1.5	455	0.269	93.5	0.00	1.02 3723	0.67 200	0.32 25	0.00 1	* 0	* 0
24	MOS	25	0.481	564	3.2	1.3	572	0.236	91.5	0.00	1.03 3758	0.61 271	0.86 21	0.00 2	* 0	* 0

* This category was neither forecast nor observed.

Table 3.9. Same as Table 3.7 except for 22 stations in the Southern Region.

Fcst Proj (h)	Type of Fcst.	Direction: Mean Abs. Error (deg)	Direction: Skill Score	Direction: No. of Cases	Speed: Mean Abs. Error (kt)	Speed: Mean Alg. Error (kt)	Speed: No. of Cases	Contingency Table: Skill Score	Contingency Table: Percent Fcst. Correct	Contingency Table: Threat Score (>27 kt)	Bias by Category: 1 No. Obs	Bias by Category: 2 No. Obs	Bias by Category: 3 No. Obs	Bias by Category: 4 No. Obs	Bias by Category: 5 No. Obs	Bias by Category: 6 No. Obs
12	MOS	25	0.471	918	3.0	0.9	921	0.317	86.6	0.25	1.03 3253	0.83 367	0.65 66	0.36 11	0.33 3	0.00 1
18	MOS	25	0.395	449	3.9	2.6	454	0.256	93.4	0.00	1.00 3372	1.04 130	1.08 25	0.25 4	1.00 2	* 0
24	MOS	26	0.446	393	4.5	3.2	403	0.258	94.7	0.00	0.99 3585	1.36 97	0.82 22	0.33 3	** 0	* 0

* This category was neither forecast nor observed.
** This category was forecast once but was not observed.

Table 3.10. Same as Table 3.7 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)	Skill Score	No. of Cases	Mean Abs. Error (kt)	Mean Alg. Error (kt)	No. of Cases	Skill Score	Percent Fcst. Correct	Threat Score (>27 kt)	1 No. Obs	2 No. Obs	3 No. Obs	4 No. Obs	5 No. Obs	6 No. Obs
12	MOS	26	0.489	1671	3.0	-0.3	1675	0.341	76.2	0.00	1.16 3392	0.61 963	0.52 241	0.50 58	0.11 9	0.00 2
18	MOS	26	0.460	853	3.3	1.0	857	0.327	89.1	0.00	1.05 4160	0.59 423	0.56 75	1.11 9	0.33 3	0.00 1
24	MOS	24	0.535	658	3.4	1.1	665	0.272	90.3	0.00	1.04 4283	0.62 332	0.66 58	0.44 16	0.33 3	* 0

* This category was neither forecast nor observed.

Table 3.11. Same as Table 3.7 except for 18 stations in the Western Region.

Fcst Proj (h)	Type of Fcst.	Direction			Speed											
								Contingency Table								
											Bias by Category					
		Mean Abs. Error (deg)	Skill Score	No. of Cases	Mean Abs. Error (kt)	Mean Alg. Error (kt)	No. of Cases	Skill Score	Percent Fcst. Correct	Threat Score (>27 kt)	1 No. Obs	2 No. Obs	3 No. Obs	4 No. Obs	5 No. Obs	6 No. Obs
12	MOS	29	0.379	1436	3.3	0.6	1440	0.344	72.0	0.13	1.07 2149	0.86 630	0.73 215	0.97 39	0.57 14	0.33 3
18	MOS	30	0.423	575	3.8	2.1	582	0.253	89.5	0.00	1.02 2788	0.77 205	0.79 47	0.60 5	0.00 2	* 0
24	MOS	31	0.474	403	4.1	2.7	411	0.235	93.0	0.00	1.00 2827	1.09 113	0.56 25	0.29 7	** 0	* 0

* This category was neither forecast nor observed.
** This category was forecast once but was not observed.

Table 3.12. Verification of local surface wind forecasts for 91 stations for the FT issuance time of approximately 0900 UTC.

		Direction			Speed											
								Contingency Table								
											Bias by Category					
Fcst Proj (h)	Type of Fcst.	Mean Abs. Error (deg)	Skill Score	No. of Cases	Mean Abs. Error (kt)	Mean Alg. Error (kt)	No. of Cases	Skill Score	Percent Fcst. Correct	Threat Score (>27 kt)	1 No. Obs	2 No. Obs	3 No. Obs	4 No. Obs	5 No. Obs	6 No. Obs
3	LOCAL	28	0.470	4211	3.5	2.5	4278	0.359	92.2	0.25	0.99 14902	1.34 765	0.75 123	0.31 26	0.50 2	*** 0
9	LOCAL	35	0.368	9036	3.3	1.4	9099	0.337	77.1	0.03	1.01 12356	1.08 2674	0.54 601	0.25 115	0.29 21	0.00 7
15	LOCAL	37	0.345	9681	3.4	1.4	9736	0.307	74.0	0.05	1.01 12000	1.11 2846	0.60 693	0.23 145	0.28 29	0.00 5

*** This category was forecast twice but was not observed.

Table 3.13. Same as Table 3.12 except for 24 stations in the Eastern Region.

Fcst Proj (h)	Type of Fcst.	Direction			Speed											
								Contingency Table								
											Bias by Category					
		Mean Abs. Error (deg)	Skill Score	No. of Cases	Mean Abs. Error (kt)	Mean Alg. Error (kt)	No. of Cases	Skill Score	Percent Fcst. Correct	Threat Score (>27 kt)	1 No. Obs	2 No. Obs	3 No. Obs	4 No. Obs	5 No. Obs	6 No. Obs
3	LOCAL	25	0.473	1101	3.2	2.4	1126	0.347	92.7	0.00	1.00 3894	1.09 223	0.64 14	0.00 2	* 0	* 0
9	LOCAL	35	0.357	2452	3.1	1.3	2464	0.277	77.5	0.00	1.05 3269	0.93 702	0.29 134	0.00 11	* 0	0.00 1
15	LOCAL	40	0.290	2330	3.5	2.2	2341	0.238	79.2	0.00	0.98 3483	1.19 540	0.49 77	0.00 10	0.00 1	* 0

* This category was neither forecast nor observed.

Table 3.14. Same as Table 3.12 except for 21 stations in the Southern Region.

Fcst Proj (h)	Type of Fcst.	Direction			Speed											
								Contingency Table								
											Bias by Category					
		Mean Abs. Error (deg)	Skill Score	No. of Cases	Mean Abs. Error (kt)	Mean Alg. Error (kt)	No. of Cases	Skill Score	Percent Fcst. Correct	Threat Score (>27 kt)	1 No. Obs	2 No. Obs	3 No. Obs	4 No. Obs	5 No. Obs	6 No. Obs
3	LOCAL	28	0.480	657	3.4	2.5	667	0.383	95.7	0.00	0.99 3660	1.62 89	0.60 20	0.00 3	* 0	** 0
9	LOCAL	35	0.346	1922	3.2	1.6	1934	0.309	82.8	0.00	1.02 3193	0.98 476	0.46 80	0.17 12	0.00 2	0.00 1
15	LOCAL	37	0.325	2056	3.3	1.7	2075	0.240	79.0	0.17	1.03 3107	0.95 541	0.54 82	0.13 16	0.50 4	0.00 1

* This category was neither forecast nor observed.
** This category was forecast once but was not observed.

Table 3.15. Same as Table 3.12 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)	Skill Score	No. of Cases	Mean Abs. Error (kt)	Mean Alg. Error (kt)	No. of Cases	Skill Score	Percent Fcst. Correct	Threat Score (>27 kt)	1 No. Obs	2 No. Obs	3 No. Obs	4 No. Obs	5 No. Obs	6 No. Obs
3	LOCAL	27	0.474	1819	3.6	2.5	1840	0.348	87.8	0.50	0.97 4396	1.53 331	0.79 67	0.50 16	0.50 2	* 0
9	LOCAL	33	0.399	3297	3.3	1.1	3315	0.353	69.4	0.00	0.96 3297	1.24 1133	0.66 282	0.30 63	0.18 17	0.00 4
15	LOCAL	36	0.368	3344	3.4	1.0	3359	0.306	66.2	0.06	0.96 3216	1.30 1141	0.55 331	0.24 75	0.31 13	0.00 1

* This category was neither forecast nor observed.

Table 3.16. Same as Table 3.12 except for 18 stations in the Western Region.

Fcst Proj (h)	Type of Fcst.	Direction			Speed											
								Contingency Table								
											Bias by Category					
		Mean Abs. Error (deg)	Skill Score	No. of Cases	Mean Abs. Error (kt)	Mean Alg. Error (kt)	No. of Cases	Skill Score	Percent Fcst. Correct	Threat Score (>27 kt)	1 No. Obs	2 No. Obs	3 No. Obs	4 No. Obs	5 No. Obs	6 No. Obs
3	LOCAL	34	0.402	634	3.8	2.6	645	0.352	93.9	0.00	1.00 2952	1.11 122	0.82 22	0.00 5	* 0	** 0
9	LOCAL	43	0.294	1365	3.9	2.0	1386	0.295	81.5	0.20	1.03 2597	0.96 363	0.61 105	0.28 29	1.50 2	0.00 1
15	LOCAL	38	0.314	1951	3.3	1.0	1961	0.345	73.2	0.00	1.09 2194	0.84 624	0.74 203	0.32 44	0.18 11	0.00 3

* This category was neither forecast nor observed.
** This category was forecast once but was not observed.

Table 3.17. Verification of local surface wind forecasts for 92 stations for the FT issuance time of approximately 1800 UTC.

		Direction			Speed											
								Contingency Table								
											Bias by Category					
Fcst Proj (h)	Type of Fcst.	Mean Abs. Error (deg)	Skill Score	No. of Cases	Mean Abs. Error (kt)	Mean Alg. Error (kt)	No. of Cases	Skill Score	Percent Fcst. Correct	Threat Score (>27 kt)	1 No. Obs	2 No. Obs	3 No. Obs	4 No. Obs	5 No. Obs	6 No. Obs
3	LOCAL	31	0.412	10376	3.0	1.0	10421	0.388	75.1	0.07	1.02 11764	1.03 3266	0.70 843	0.32 177	0.42 26	0.22 9
9	LOCAL	41	0.310	6168	4.2	3.1	6306	0.245	85.0	0.00	0.97 14571	1.46 1216	0.88 246	0.50 36	0.17 12	0.00 2
15	LOCAL	41	0.318	4308	4.4	3.4	4510	0.234	90.0	0.11	0.98 14768	1.44 784	0.72 137	0.33 18	0.29 7	0.00 1

Table 3.18. Same as Table 3.17 except for 24 stations in the Eastern Region.

Fcst Proj (h)	Type of Fcst.	Direction: Mean Abs. Error (deg)	Direction: Skill Score	Direction: No. of Cases	Speed: Mean Abs. Error (kt)	Speed: Mean Alg. Error (kt)	Speed: No. of Cases	Contingency Table: Skill Score	Contingency Table: Percent Fcst. Correct	Contingency Table: Threat Score (>27 kt)	Bias by Category: 1 No. Obs	Bias by Category: 2 No. Obs	Bias by Category: 3 No. Obs	Bias by Category: 4 No. Obs	Bias by Category: 5 No. Obs	Bias by Category: 6 No. Obs
3	LOCAL	30	0.402	2613	2.8	0.8	2621	0.351	77.1	0.00	1.06 3195	0.91 846	0.35 153	0.19 16	0.00 1	* 0
9	LOCAL	43	0.269	1487	4.3	3.3	1538	0.241	88.7	0.00	0.98 3920	1.45 254	0.53 32	0.00 3	0.00 1	0.00 1
15	LOCAL	44	0.259	1127	4.6	3.7	1200	0.173	91.3	0.00	0.98 3913	1.41 177	0.47 17	0.00 2	0.00 1	* 0

* This category was neither forecast nor observed.

Table 3.19. Same as Table 3.17 except for 22 stations in the Southern Region.

Fcst Proj (h)	Type of Fcst.	Direction			Speed											
								Contingency Table								
											Bias by Category					
		Mean Abs. Error (deg)	Skill Score	No. of Cases	Mean Abs. Error (kt)	Mean Alg. Error (kt)	No. of Cases	Skill Score	Percent Fcst. Correct	Threat Score (>27 kt)	1 No. Obs	2 No. Obs	3 No. Obs	4 No. Obs	5 No. Obs	6 No. Obs
3	LOCAL	31	0.393	2245	3.1	1.6	2263	0.351	80.4	0.25	1.02 3178	0.95 611	0.68 111	0.25 16	2.00 1	0.00 2
9	LOCAL	40	0.259	1152	4.2	3.5	1180	0.203	89.8	0.00	0.97 3699	1.61 175	0.89 37	0.25 4	* 0	* 0
15	LOCAL	40	0.318	731	4.5	3.7	767	0.214	93.6	0.25	0.98 3635	1.61 101	2.08 13	0.50 4	0.33 3	0.00 1

* This category was neither forecast nor observed.

Table 3.20. Same as Table 3.17 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)	Skill Score	No. of Cases	Mean Abs. Error (kt)	Mean Alg. Error (kt)	No. of Cases	Skill Score	Percent Fcst. Correct	Threat Score (>27 kt)	1 No. Obs	2 No. Obs	3 No. Obs	4 No. Obs	5 No. Obs	6 No. Obs
3	LOCAL	28	0.444	3594	3.0	0.8	3604	0.388	67.9	0.08	0.97 2999	1.18 1292	0.78 374	0.37 94	0.43 14	0.40 5
9	LOCAL	39	0.336	2272	4.2	3.0	2309	0.267	79.8	0.00	0.92 4194	1.79 454	0.86 112	0.67 18	0.40 5	0.00 1
15	LOCAL	37	0.350	1786	4.1	3.0	1851	0.260	85.2	0.00	0.96 4331	1.54 363	0.63 73	0.30 10	0.50 2	* 0

* This category was neither forecast nor observed.

Table 3.21. Same as Table 3.17 except for 18 stations in the Western Region.

Fcst Proj (h)	Type of Fcst.	Direction			Speed											
								Contingency Table								
											Bias by Category					
		Mean Abs. Error (deg)	Skill Score	No. of Cases	Mean Abs. Error (kt)	Mean Alg. Error (kt)	No. of Cases	Skill Score	Percent Fcst. Correct	Threat Score (>27 kt)	1 No. Obs	2 No. Obs	3 No. Obs	4 No. Obs	5 No. Obs	6 No. Obs
3	LOCAL	35	0.328	1924	3.2	1.1	1933	0.385	76.7	0.00	1.05 2392	0.94 517	0.83 205	0.29 51	0.30 10	0.00 2
9	LOCAL	44	0.293	1257	4.1	2.6	1279	0.204	82.0	0.00	1.01 2758	0.93 333	1.08 65	0.45 11	0.00 6	* 0
15	LOCAL	46	0.270	664	4.5	3.4	692	0.213	91.4	0.00	1.00 2889	1.08 143	0.53 34	0.50 2	0.00 1	* 0

* This category was neither forecast nor observed.

Table 4.1. Definitions of the total cloud amount categories used for the local forecasts and observations. The MOS guidance was defined for these same categories, but for opaque amounts only.

Category	Cloud Amount
1	CLR, -SCT, -BKN, -OVC, -X
2	SCT
3	BKN
4	OVC, X

Table 4.2. Comparative verification of MOS guidance and local forecasts of four categories of cloud amount (clear, scattered, broken, and overcast) for 94 stations, 0000 UTC cycle.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	Percent Correct	Skill Score
12	MOS	0.82	1.66	1.17	0.74	54.0	0.358
	LOCAL	0.79	1.40	1.49	0.82	61.0	0.459
	No. Obs.	7283	3019	2010	3846		
18	MOS	0.74	1.43	1.27	0.65	54.0	0.372
	LOCAL	0.61	1.41	1.73	0.57	49.2	0.318
	No. Obs.	5838	4523	2510	3284		
24	MOS	0.79	1.47	1.18	0.65	51.1	0.333
	LOCAL	0.67	1.42	1.64	0.57	46.2	0.277
	No. Obs.	6018	4158	2609	3347		

Table 4.3. Same as Table 4.1 except for 24 stations in the Eastern Region.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	Percent Correct	Skill Score
12	MOS	0.73	1.74	1.40	0.77	50.7	0.335
	LOCAL	0.67	1.59	1.72	0.80	53.4	0.375
	No. Obs.	1521	701	505	1346		
18	MOS	0.44	1.48	1.34	0.73	49.1	0.314
	LOCAL	0.39	1.38	1.69	0.64	45.8	0.275
	No. Obs.	974	1204	790	1110		
24	MOS	0.67	1.64	1.32	0.72	46.4	0.286
	LOCAL	0.58	1.50	1.83	0.67	42.6	0.246
	No. Obs.	1376	923	614	1162		

Table 4.4. Same as Table 4.1 except for 24 stations in the Southern Region.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	Percent Correct	Skill Score
12	MOS	0.80	1.60	1.02	0.72	50.3	0.316
	LOCAL	0.76	1.38	1.41	0.75	58.2	0.430
	No. Obs.	1744	959	657	861		
18	MOS	0.75	1.29	1.23	0.56	54.7	0.368
	LOCAL	0.60	1.26	1.60	0.46	48.0	0.280
	No. Obs.	1179	1494	810	740		
24	MOS	0.80	1.38	1.04	0.68	51.4	0.336
	LOCAL	0.61	1.42	1.49	0.43	43.2	0.229
	No. Obs.	1288	1273	867	785		

Table 4.5. Same as Table 4.1 except for 28 stations in the Central Region.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	Percent Correct	Skill Score
12	MOS	0.81	1.73	1.20	0.69	55.5	0.358
	LOCAL	0.81	1.40	1.54	0.82	61.7	0.450
	No. Obs.	2397	894	509	980		
18	MOS	0.77	1.52	1.30	0.60	54.1	0.355
	LOCAL	0.55	1.62	1.99	0.54	47.2	0.285
	No. Obs.	2074	1243	569	884		
24	MOS	0.78	1.56	1.26	0.56	52.0	0.333
	LOCAL	0.59	1.55	1.80	0.59	46.1	0.274
	No. Obs.	1992	1198	660	916		

Table 4.6. Same as Table 4.1 except for 18 stations in the Western Region.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	Percent Correct	Skill Score
12	MOS	0.91	1.55	1.09	0.77	61.2	0.416
	LOCAL	0.93	1.18	1.21	0.94	74.0	0.606
	No. Obs.	1621	465	339	659		
18	MOS	0.88	1.52	1.18	0.69	59.4	0.393
	LOCAL	0.84	1.43	1.68	0.61	58.6	0.393
	No. Obs.	1611	582	341	550		
24	MOS	0.93	1.26	1.16	0.61	55.8	0.365
	LOCAL	0.94	1.13	1.47	0.50	54.9	0.355
	No. Obs.	1362	764	468	484		

Table 4.7. Comparative verification of MOS guidance and local forecasts of four categories of cloud amount (clear, scattered, broken, and overcast) for 94 stations, 1200 UTC cycle.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	Percent Correct	Skill Score
12	MOS	0.88	1.46	1.06	0.60	53.0	0.353
	LOCAL	0.81	1.21	1.46	0.72	56.6	0.412
	No. Obs.	6001	4170	2580	3401		
18	MOS	0.93	1.63	1.07	0.70	59.3	0.374
	LOCAL	0.69	1.96	2.07	0.65	50.9	0.306
	No. Obs.	8544	2333	1542	3449		
24	MOS	0.83	1.71	1.09	0.72	53.1	0.343
	LOCAL	0.75	1.59	1.66	0.66	48.5	0.292
	No. Obs.	7274	3002	2014	3841		

Table 4.8. Same as Table 4.7 except for 24 stations in the Eastern Region.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	Percent Correct	Skill Score
12	MOS	0.76	1.69	1.24	0.61	48.0	0.305
	LOCAL	0.66	1.38	1.71	0.73	51.2	0.355
	No. Obs.	1362	922	606	1190		
18	MOS	0.93	1.71	1.21	0.71	53.7	0.345
	LOCAL	0.64	2.10	2.02	0.65	47.5	0.299
	No. Obs.	1703	563	428	1280		
24	MOS	0.73	1.98	1.32	0.67	48.2	0.307
	LOCAL	0.67	1.79	1.81	0.65	45.2	0.275
	No. Obs.	1489	705	518	1362		

Table 4.9. Same as Table 4.7 except for 24 stations in the Southern Region.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	Percent Correct	Skill Score
12	MOS	0.90	1.43	0.84	0.66	53.0	0.355
	LOCAL	0.79	1.20	1.35	0.66	57.0	0.418
	No. Obs.	1284	1267	852	798		
18	MOS	0.92	1.71	0.80	0.71	58.6	0.356
	LOCAL	0.58	2.09	2.01	0.63	46.2	0.255
	No. Obs.	2232	658	464	685		
24	MOS	0.82	1.67	0.87	0.73	50.5	0.316
	LOCAL	0.67	1.66	1.46	0.59	43.7	0.240
	No. Obs.	1739	932	657	866		

Table 4.10. Same as Table 4.7 except for 28 stations in the Central Region.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	Percent Correct	Skill Score
12	MOS	0.90	1.47	1.04	0.58	54.4	0.357
	LOCAL	0.80	1.24	1.50	0.76	57.2	0.410
	No. Obs.	1994	1202	663	919		
18	MOS	0.92	1.79	1.14	0.70	63.1	0.384
	LOCAL	0.68	2.26	2.37	0.66	52.5	0.295
	No. Obs.	2901	588	355	916		
24	MOS	0.82	1.70	1.18	0.72	54.0	0.334
	LOCAL	0.77	1.52	1.89	0.62	48.8	0.272
	No. Obs.	2407	895	505	966		

Table 4.11. Same as Table 4.7 except for 18 stations in the Western Region.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	Percent Correct	Skill Score
12	MOS	0.95	1.25	1.22	0.55	57.2	0.385
	LOCAL	1.02	0.96	1.29	0.73	62.1	0.454
	No. Obs.	1361	779	459	494		
18	MOS	0.98	1.28	1.20	0.69	61.6	0.389
	LOCAL	0.87	1.31	1.87	0.64	58.7	0.372
	No. Obs.	1708	524	295	568		
24	MOS	0.97	1.38	1.01	0.81	61.8	0.411
	LOCAL	0.88	1.26	1.46	0.87	58.7	0.382
	No. Obs.	1639	470	334	647		

Table 5.1. Definitions of the categories used for verification of persistence, local, and guidance forecasts of ceiling height and visibility.

Category	Ceiling (ft)	Visibility (mi)
1	≤400	<1
2	500-900	1-2 3/4
3	1000-2900	3-6
4	≥3000	>6

Table 5.2. Comparative verification of MOS and persistence ceiling height forecasts for 91 stations, 0000 GMT cycle.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	Log Score	Percent Correct	Skill Score
12	MOS	1.19	0.81	0.96	1.01	1.908	85.5	0.362
	PERSISTENCE	0.82	0.71	0.86	1.03	1.169	90.3	0.541
	No. Obs.	340	506	1042	12962			
18	MOS	0.95	0.96	1.03	1.00	0.975	88.3	0.366
	PERSISTENCE	4.59	1.61	0.75	1.00	1.388	87.3	0.327
	No. Obs.	63	225	1198	13333			
24	MOS	0.94	1.05	0.97	1.00	0.703	92.7	0.288
	PERSISTENCE	4.52	2.18	1.56	0.95	1.446	87.8	0.181
	No. Obs.	62	163	557	13722			

Table 5.3. Same as Table 5.2 except for 92 stations, 1200 GMT cycle.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	Log Score	Percent Correct	Skill Score
12	MOS	1.19	0.69	1.02	1.00	0.661	93.1	0.315
	PERSISTENCE	0.73	0.95	1.32	0.99	0.472	94.3	0.490
	No. Obs.	62	162	567	14055			
18	MOS	1.41	0.92	0.97	1.00	1.213	89.7	0.320
	PERSISTENCE	0.27	0.59	1.02	1.02	0.950	90.6	0.308
	No. Obs.	169	264	738	13627			
24	MOS	1.79	0.85	0.93	0.99	2.360	83.4	0.320
	PERSISTENCE	0.13	0.30	0.70	1.08	1.740	85.2	0.186
	No. Obs.	355	522	1093	13141			

Table 5.4. Comparative verification of local and persistence ceiling height forecasts for 91 stations for the FT issuance time of approximately 0900 UTC.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	Log Score	Percent Correct	Skill Score
3	LOCAL	0.71	0.70	1.03	1.02	1.215	89.7	0.526
	PERSISTENCE	0.70	0.77	0.82	1.03	1.105	90.8	0.556
	No. Obs.	377	496	1117	13806			
6	LOCAL	0.37	0.50	0.88	1.04	1.359	86.6	0.391
	PERSISTENCE	1.19	0.69	0.63	1.05	1.445	87.0	0.405
	No. Obs.	225	553	1437	13564			
9	LOCAL	0.31	0.33	0.72	1.04	0.874	89.0	0.337
	PERSISTENCE	4.51	1.38	0.66	1.01	1.377	86.7	0.307
	No. Obs.	59	276	1385	14038			
15	LOCAL	0.26	0.38	1.11	1.01	0.617	92.8	0.286
	PERSISTENCE	3.98	2.23	1.42	0.95	1.373	88.3	0.198
	No. Obs.	66	170	638	14817			

Table 5.5. Same as Table 5.4 except for 92 stations for the FT issuance time of approximately 1800 UTC.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	Log Score	Percent Correct	Skill Score
3	LOCAL	0.50	0.81	1.17	0.99	0.518	93.4	0.509
	PERSISTENCE	1.26	1.79	1.55	0.96	0.645	91.9	0.508
	No. Obs.	50	158	901	14953			
6	LOCAL	0.28	0.64	1.46	0.99	0.596	92.7	0.370
	PERSISTENCE	0.94	1.70	2.15	0.94	0.853	89.7	0.330
	No. Obs.	67	166	650	15182			
9	LOCAL	0.37	0.67	1.43	0.99	0.705	92.0	0.342
	PERSISTENCE	0.70	1.38	2.13	0.95	1.003	88.4	0.265
	No. Obs.	90	204	659	15095			
15	LOCAL	0.35	0.72	1.49	0.99	1.279	87.9	0.361
	PERSISTENCE	0.24	0.75	1.54	0.99	1.480	85.4	0.236
	No. Obs.	254	376	899	14157			

Table 5.6. Comparative verification of MOS and persistence visibility forecasts for 91 stations, 0000 UTC cycle.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	Log Score	Percent Correct	Skill Score
12	MOS	1.30	1.20	0.94	0.99	2.340	76.5	0.369
	PERSISTENCE	0.72	0.40	0.74	1.10	1.412	84.4	0.506
	No. Obs.	264	729	2330	11682			
18	MOS	0.52	0.98	1.20	0.98	1.008	86.7	0.368
	PERSISTENCE	7.60	1.42	1.23	0.96	1.452	84.1	0.301
	No. Obs.	25	206	1396	13357			
24	MOS	0.77	0.89	1.20	0.98	0.975	87.5	0.359
	PERSISTENCE	7.31	1.29	1.38	0.95	1.567	83.2	0.243
	No. Obs.	26	228	1239	13451			

Table 5.7. Same as Table 5.6 except for 92 stations, 1200 UTC cycle.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	Log Score	Percent Correct	Skill Score
12	MOS	1.89	0.89	1.08	0.99	0.957	88.4	0.375
	PERSISTENCE	0.54	0.78	0.98	1.01	0.543	93.2	0.612
	No. Obs.	28	224	1245	13721			
18	MOS	2.42	1.30	1.01	0.98	1.299	86.5	0.362
	PERSISTENCE	0.19	0.74	0.91	1.02	0.952	88.7	0.391
	No. Obs.	84	234	1327	13326			
24	MOS	2.43	1.28	1.04	0.94	2.816	74.5	0.360
	PERSISTENCE	0.06	0.24	0.53	1.16	2.125	78.2	0.220
	No. Obs.	272	742	2324	11853			

Table 5.8. Comparative verification of local and persistence visibility forecasts for 91 stations for the FT issuance time of approximately 0900 UTC.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	Log Score	Percent Correct	Skill Score
3	LOCAL	0.58	0.56	1.25	0.99	1.481	83.0	0.511
	PERSISTENCE	0.56	0.48	0.71	1.09	1.253	86.2	0.528
	No. Obs.	302	607	2299	12583			
6	LOCAL	0.34	0.32	1.02	1.03	1.417	82.6	0.395
	PERSISTENCE	1.67	0.54	0.74	1.06	1.472	83.4	0.396
	No. Obs.	102	548	2205	12918			
9	LOCAL	0.17	0.18	0.77	1.04	0.830	88.7	0.352
	PERSISTENCE	7.08	1.26	1.07	0.98	1.322	85.3	0.333
	No. Obs.	24	232	1520	13967			
15	LOCAL	0.10	0.16	0.79	1.03	0.733	90.3	0.328
	PERSISTENCE	5.45	1.43	1.35	0.95	1.436	84.5	0.242
	No. Obs.	31	204	1204	14243			

Table 5.9. Same as Table 5.8 except for 92 stations for the FT issuance time of approximately 1800 UTC.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	Log Score	Percent Correct	Skill Score
3	LOCAL	0.50	0.33	1.14	1.00	0.633	91.4	0.492
	PERSISTENCE	1.13	1.35	1.23	0.98	0.575	92.8	0.612
	No. Obs.	24	174	1265	14575			
6	LOCAL	0.21	0.26	1.10	1.00	0.699	90.7	0.434
	PERSISTENCE	0.82	1.16	1.26	0.98	0.796	90.1	0.468
	No. Obs.	33	202	1234	14574			
9	LOCAL	0.88	0.40	1.08	1.00	0.766	89.6	0.404
	PERSISTENCE	1.08	1.36	1.15	0.98	0.860	89.1	0.425
	No. Obs.	25	173	1340	14492			
15	LOCAL	0.35	0.76	1.24	0.98	1.357	84.0	0.356
	PERSISTENCE	0.16	0.80	0.92	1.02	1.301	85.4	0.345
	No. Obs.	162	291	1650	13564			

Table 6.1. Verification of MOS and local max/min temperature forecasts for 93 stations, 0000 UTC cycle.

Forecast Projection	Forecast Type	Number of Cases	Mean Algebraic Error (°F)	Mean Absolute Error (°F)	Percent of Absolute Errors >10°F	Probability of Detection (32°F)	False Alarm Ratio (32°F)	Improvement Over Climate
Today's Max	MOS	15858	-0.5	3.0	1.8	--	--	77.0
	LOCAL		0.0	2.7	1.4	--	--	80.4
Tonight's Min	MOS	15791	0.2	2.9	1.0	0.45	0.21	71.8
	LOCAL		0.2	2.8	0.9	0.38	0.19	73.0
Tomorrow's Max	MOS	15850	-0.7	3.8	4.2	--	--	64.3
	LOCAL		-0.2	3.5	3.7	--	--	68.1
Tomorrow Night's Min	MOS	15755	0.3	3.4	2.8	0.24	0.33	59.8
	LOCAL		0.2	3.3	2.6	0.27	0.36	60.7

Table 6.2. Same as Table 6.1 except for 24 stations in the Eastern Region.

Forecast Projection	Forecast Type	Number of Cases	Mean Algebraic Error (°F)	Mean Absolute Error (°F)	Percent of Absolute Errors >10°F	Probability of Detection (32°F)	False Alarm Ratio (32°F)	Improvement Over Climate
Today's Max	MOS	4159	-0.6	3.1	1.8	--	--	76.2
	LOCAL		-0.1	2.9	1.9	--	--	78.1
Tonight's Min	MOS	4129	0.1	2.7	0.5	0.50	0.23	77.7
	LOCAL		0.2	2.7	0.6	0.45	0.18	77.6
Tomorrow's Max	MOS	4159	-0.6	3.8	3.8	--	--	66.2
	LOCAL		-0.2	3.6	3.5	--	--	68.3
Tomorrow Night's Min	MOS	4126	-0.1	3.2	1.9	0.30	0.50	68.3
	LOCAL		-0.1	3.3	2.1	0.25	0.50	66.8

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

Forecast Projection	Forecast Type	Number of Cases	Mean Algebraic Error (°F)	Mean Absolute Error (°F)	Percent of Absolute Errors >10°F	Probability of Detection (32°F)	False Alarm Ratio (32°F)	Improvement Over Climate
Today's Max	MOS	4024	-0.3	2.6	1.3	--	--	64.1
	LOCAL		0.1	2.4	1.1	--	--	68.8
Tonight's Min	MOS	4032	0.7	2.5	0.4	0.00	*	66.6
	LOCAL		0.5	2.4	0.5	0.00	*	66.8
Tomorrow's Max	MOS	4023	-0.4	3.3	2.5	--	--	46.4
	LOCAL		0.3	3.0	2.5	--	--	50.8
Tomorrow Night's Min	MOS	4028	0.9	2.9	2.1	0.00	*	52.4
	LOCAL		0.8	2.9	1.7	0.00	*	51.9

* No forecasts of ≤32°F were made.

Table 6.4. Same as Table 6.1 except for 28 stations in the Central Region.

Forecast Projection	Forecast Type	Number of Cases	Mean Algebraic Error (°F)	Mean Absolute Error (°F)	Percent of Absolute Errors >10°F	Probability of Detection (32°F)	False Alarm Ratio (32°F)	Improvement Over Climate
Today's Max	MOS		-0.8	3.3	2.0	--	--	79.9
	LOCAL	4755	-0.1	2.9	1.3	--	--	83.8
Tonight's Min	MOS		0.0	3.2	1.5	0.49	0.24	73.9
	LOCAL	4746	0.3	3.1	1.3	0.42	0.24	74.5
Tomorrow's Max	MOS		-1.5	4.3	6.0	--	--	66.5
	LOCAL	4752	-0.6	3.9	4.8	--	--	71.4
Tomorrow Night's Min	MOS		0.3	3.9	4.1	0.27	0.29	60.5
	LOCAL	4736	0.3	3.8	3.9	0.30	0.32	62.2

Table 6.5. Same as Table 6.1 except for 17 stations in the Western Region.

Forecast Projection	Forecast Type	Number of Cases	Mean Algebraic Error (°F)	Mean Absolute Error (°F)	Percent of Absolute Errors >10°F	Probability of Detection (32°F)	False Alarm Ratio (32°F)	Improvement Over Climate
Today's Max	MOS		-0.3	2.9	2.2	--	--	80.2
	LOCAL	2920	-0.2	2.6	1.5	--	--	83.7
Tonight's Min	MOS		-0.2	3.1	1.7	0.36	0.10	61.7
	LOCAL	2884	-0.1	2.8	1.2	0.28	0.00	67.4
Tomorrow's Max	MOS		0.0	3.8	4.3	--	--	68.6
	LOCAL	2916	0.1	3.4	3.8	--	--	72.2
Tomorrow Night's Min	MOS		0.1	3.6	2.8	0.15	0.00	49.7
	LOCAL	2865	-0.1	3.3	2.7	0.27	0.30	54.3

Table 6.6. Verification of MOS and local max/min temperature forecasts for 93 stations, 1200 GMT cycle.

Forecast Projection	Forecast Type	Number of Cases	Mean Algebraic Error (°F)	Mean Absolute Error (°F)	Percent of Absolute Errors >10°F	Probability of Detection (32°F)	False Alarm Ratio (32°F)	Improvement Over Climate
Tonight's Min	MOS		-0.2	2.7	0.6	0.53	0.25	75.5
	LOCAL	15804	-0.2	2.6	0.7	0.52	0.28	76.2
Tomorrow's Max	MOS		-0.8	3.6	3.2	--	--	68.7
	LOCAL	15847	-0.3	3.2	2.5	--	--	73.6
Tomorrow Night's Min	MOS		-0.2	3.1	1.5	0.38	0.35	67.6
	LOCAL	15780	-0.1	3.1	1.5	0.38	0.34	67.6
Day After Tomorrow's Max	MOS		-1.0	4.2	5.7	--	--	56.4
	LOCAL	15832	-0.4	4.0	5.3	--	--	59.3

Table 6.7. Same as Table 6.6 except for 24 stations in the Eastern Region.

Forecast Projection	Forecast Type	Number of Cases	Mean Algebraic Error (°F)	Mean Absolute Error (°F)	Percent of Absolute Errors >10°F	Probability of Detection (32°F)	False Alarm Ratio (32°F)	Improvement Over Climate
Tonight's Min	MOS	4129	0.0	2.5	0.2	0.53	0.17	80.6
	LOCAL		-0.2	2.6	0.3	0.63	0.20	79.9
Tomorrow's Max	MOS	4153	-0.5	3.6	3.1	--	--	68.7
	LOCAL		-0.3	3.4	2.6	--	--	71.9
Tomorrow Night's Min	MOS	4124	-0.3	3.0	0.9	0.50	0.50	73.9
	LOCAL		-0.3	3.0	1.2	0.45	0.36	73.1
Day After Tomorrow's Max	MOS	4155	-0.9	4.3	5.0	--	--	57.6
	LOCAL		-0.5	4.1	4.8	--	--	59.4

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

Forecast Projection	Forecast Type	Number of Cases	Mean Algebraic Error (°F)	Mean Absolute Error (°F)	Percent of Absolute Errors >10°F	Probability of Detection (32°F)	False Alarm Ratio (32°F)	Improvement Over Climate
Tonight's Min	MOS	4035	0.3	2.3	0.2	0.00	*	71.7
	LOCAL		0.1	2.3	0.4	0.00	*	71.7
Tomorrow's Max	MOS	4026	-0.6	3.2	2.2	--	--	48.6
	LOCAL		-0.1	2.8	1.9	--	--	57.6
Tomorrow Night's Min	MOS	4035	0.4	2.6	0.8	0.00	*	62.5
	LOCAL		0.3	2.7	1.1	0.00	*	61.4
Day After Tomorrow's Max	MOS	4026	-0.7	3.5	3.0	--	--	39.3
	LOCAL		0.0	3.3	3.1	--	--	43.1

* No forecasts of ≤32°F were made.

Table 6.9. Same as Table 6.6 except for 28 stations in the Central Region.

Forecast Projection	Forecast Type	Number of Cases	Mean Algebraic Error (°F)	Mean Absolute Error (°F)	Percent of Absolute Errors >10°F	Probability of Detection (32°F)	False Alarm Ratio (32°F)	Improvement Over Climate
Tonight's Min	MOS		-0.4	3.0	0.9	0.67	0.29	76.8
	LOCAL	4743	-0.3	2.9	1.0	0.58	0.31	78.1
Tomorrow's Max	MOS		-1.5	3.9	4.3	--	--	72.4
	LOCAL	4747	-0.6	3.5	3.2	--	--	76.9
Tomorrow Night's Min	MOS		-0.3	3.5	2.2	0.42	0.33	69.3
	LOCAL	4736	0.0	3.5	2.1	0.40	0.41	69.2
Day After Tomorrow's Max	MOS		-1.8	4.7	8.3	--	--	59.3
	LOCAL	4737	-0.9	4.4	7.3	--	--	62.1

Table 6.10. Same as Table 6.6 except for 17 stations in the Western Region.

Forecast Projection	Forecast Type	Number of Cases	Mean Algebraic Error (°F)	Mean Absolute Error (°F)	Percent of Absolute Errors >10°F	Probability of Detection (32°F)	False Alarm Ratio (32°F)	Improvement Over Climate
Tonight's Min	MOS		-0.7	2.9	1.1	0.33	0.18	67.0
	LOCAL	2897	-0.5	2.7	1.1	0.37	0.29	69.8
Tomorrow's Max	MOS		-0.4	3.5	3.1	--	--	73.8
	LOCAL	2921	0.0	3.0	2.2	--	--	79.1
Tomorrow Night's Min	MOS		-0.5	3.3	1.9	0.26	0.00	57.0
	LOCAL	2885	-0.4	3.1	1.7	0.33	0.10	60.2
Day After Tomorrow's Max	MOS		-0.4	4.4	6.4	--	--	60.1
	LOCAL	2914	-0.2	4.0	6.1	--	--	64.0