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AFOS-ERA VERIFICATION OF GUIDANCE AND LOCAL AVIATION/PUBLIC WEATHER FORECASTS--NO. 6 (APRIL 1986-SEPTEMBER 1986)

Valery J. Dagostaro, Gary M. Carter, J. Paul Dallavalle,
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1. INTRODUCTION

This is the latest supplement 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). All of the forecasts (both local and guidance) and the 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, and archived centrally by TDL. The national AFOS-era verification data processing system is described in detail by Dagostaro (1985). The local collection system is described by Ruth et al. (1985), while guidelines for the public/aviation forecast verification program are given in National Weather Service (1983).

Verification statistics are presented for the warm season months of April through September 1986 for probability of precipitation (PoP), surface wind, cloud amount, ceiling height, visibility, and maximum/minimum (max/min) temperature. Verification summaries are provided for both the 0000 and 1200 GMT forecast cycles. The scores are those recommended in the NWS National Verification Plan (National Weather Service, 1982).

The local public weather PoP and max/min forecasts used for verification were official forecasts obtained from the Coded City Forecast (FPUS4) bulletin. All of the local aviation weather forecasts except for cloud amount were obtained from NWS official terminal forecasts (FT's). The local cloud amount forecasts were manually entered by the forecasters at the WSFO's. The local 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 from variables forecast by the Limited-area Fine Mesh (LFM) model (Gerrity, 1977; Newell and Deaven, 1981) and from archived surface observations. The surface observations were taken at least 9 hours before the valid time of the first MOS forecast.

As noted in the sections which follow, implementation of the new AFOS-era verification system has 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 now being 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. Many other changes are associated with obtaining the local forecasts from the FT's. Hence, we will not compare the AFOS-era verification with statistics based on the pre-AFOS system (e.g., Maglaras et al., 1984).

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 GMT. The predictors for the equation development were forecast fields from the LFM model and weather elements observed at the forecast site at 0300 or 1500 GMT. However, in day-to-day operations, surface observations at 0200 or 1400 GMT (and occasionally even 0100 or 1300 GMT) 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 GMT 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 should be encouraged to depart from the guidance if they have reason to believe it is incorrect, the number of times local forecasters deviated from the guidance by at least 20% and the percent of the deviations which were in the correct direction also were tabulated.

Tables 2.2 and 2.7 present the 1986 warm season results for all 93 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.

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, 1984b). 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 the 12-, 18-, and 24-h forecasts from both 0000 and 1200 GMT. The local forecasts were obtained from the FT's. Since the FT's do not mention wind if the speed is expected to be less than 10 kt, the wind forecasts were verified in two ways. First, for those cases in which the speed forecasts from

both the FT and MOS were $\geq$10 kt, the mean absolute error (MAE) and the mean algebraic error of the speed 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 both the FT's and the MOS forecasts were available, skill score,[1] percent correct, bias by category,[2] and the 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 speeds (forecasts or corresponding observations) were at least 10 kt, the skill score for the wind direction forecasts was computed from contingency tables. The 91 (92) stations used in the verification for the 0000 (1200) GMT cycle are listed in Table 2.1.

In addition, 42-h forecasts of winds $\geq$22 knots were collected as part of the AFOS-era verification system. The local forecasts were manually entered by forecasters at the WSFO's. However, for the warm season, the sample of 42-h forecasts was insufficient to provide a meaningful comparative verification.

It is important to note that several fundamental differences exist between the objective MOS forecasts and the local forecasts obtained from the FT's. In particular, the FT's are not as precise in regard to valid time as are the objective forecasts. Another point to consider is the nature of the wind forecast in the FT. It is unclear whether aviation forecasters tend to concentrate on a specific extreme wind or on an average wind over the forecast period. Only the results based on the observation at the specific verification time are presented here. Due to these and other possible differences between the MOS forecasts and local forecasts as obtained from the FT's, only conclusions of a general nature should be drawn from the verification statistics.

The results for all 91 (92) stations combined for the 0000 (1200) GMT cycles are presented in Table 3.2 (Table 3.7). Tables 3.3-3.6 and 3.8-3.11 show scores for the NWS Eastern, Southern, Central, and Western Regions, for 0000 and 1200 GMT, respectively.

4. CLOUD AMOUNT

During the 1986 warm season, the objective cloud amount forecasts were produced by the prediction equations described in Technical Procedures Bulletin No. 303 (National Weather Service, 1981b). These regionalized equations used LFM model output and 0200 (1400) GMT (or even 0100 and 1300 GMT)

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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.

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.

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 GMT. The local forecasts and surface observations used for verification were converted to the cloud amount 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. 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 being taken do not record total opaque sky cover as part of the observation; in fact, thin clouds are included as part of the total sky cover. 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. This change has 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 GMT 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 GMT cycles, respectively.

5. CEILING AND VISIBILITY

During the 1986 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 0200 (1400) GMT (or 0100 and 1300 GMT) surface observations.

Verification scores were computed for the local and guidance forecasts for 91 (92) of the 94 stations listed in Table 2.1 for the 0000 (1200) GMT cycle. The local forecasts were obtained from the FT's. Persistence based on an observation taken at 0900 (2100) GMT for the 0000 (1200) GMT forecast cycle was used as a standard of comparison. The objective forecasts were verified for both cycles for 12-, 18-, and 24-h projections. The local and persistence forecasts were verified for 12-, 15-, 18-, and 24-h projections from 0000 and 1200 GMT. On station, the guidance and persistence observations usually were available in time for preparation of the local forecasts. As was the case for surface wind, the local ceiling and visibility forecasts from the FT's are not given for a specific valid time. Hence, any comparisons with the results for the objective forecasts must be of a general nature.

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] We have summarized the results in Tables 5.2-5.5. It should be noted that the persistence and local forecasts for the 12-, 15-, 18-, and 24-h projections are actually 3-, 6-, 9-, and 15-h forecasts, respectively, from the latest available surface observation, and in this sense, the guidance for the 12-, 18-, and 24-h projections are at least 10-, 16-, and 22-h forecasts.

6. MAXIMUM/MINIMUM TEMPERATURE

Throughout the 1986 warm season, the max/min temperature guidance was generated by a new set of LFM-based regression equations. These equations, described more completely in Technical Procedures Bulletin No. 356 (National Weather Service, 1985), predict 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 GMT 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 GMT 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 GMT (1200 GMT) 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.

Note that prior to November 25, 1985, the MOS max/min temperature guidance was valid for calendar day, rather than daytime/nighttime, periods. The calendar day guidance was not completely acceptable to the forecaster and so was replaced.

In this publication, we present results for both guidance and local forecasts which were verified by using observations that approximate the daytime high or nighttime low. In the local AFOS-era verification software (Ruth et al., 1985), 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 reported 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 GMT cycles. The mean algebraic error (forecast minus observed

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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.

temperature), mean absolute error, percent of absolute errors >10°F, probability of detection[5] of min temperatures ≤32°F, and false alarm ratio[6] for min temperatures ≤32°F were computed for 93 stations in the conterminous United States (Table 2.1). At 0000 (1200) GMT, the local max temperature forecasts are valid for daytime periods ending approximately 24 (36) and 48 (60) hours after 0000 (1200) GMT. Similarly, at 0000 (1200) GMT, the local min temperature forecasts are valid for nighttime periods ending approximately 36 (24) and 60 (48) hours after 0000 (1200) GMT.

For all stations combined, the results for 0000 and 1200 GMT are shown in Tables 6.1 and 6.6, respectively. A matched sample of approximately 16,000 cases per forecast projection was available. Similarly, Tables 6.2-6.5 give the 0000 GMT 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 GMT cycle.

7. SUMMARY

Highlights of the 1986 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 GMT. The NWS Brier scores for all stations and both forecast cycles show that the local forecasts were 3.0% better than the guidance for the first period, 0.9% better for the second period, and 0.5% 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, while these changes were in the correct direction from 46% to 53% of the time. The percent improvement over climate scores for all three periods and both forecast cycles indicate that most of the local and guidance scores were about the same as those for the previous warm season (Carter et al., 1985).

- Surface Wind - The AFOS-era wind verification involved the comparison of surface wind speed and direction forecasts for 91 (92) stations for projections of 12, 18, and 24 hours from 0000 (1200) GMT. For purposes of verification, the local forecasts were obtained from NWS official terminal forecasts (FT's). Several fundamental differences exist between the MOS wind forecasts and those in the FT's. For example, the FT's are not as precise in regard to valid time as are the objective forecasts. Due to these differences, only conclusions of a general nature can be drawn from the results. The statistics for all stations combined for wind direction and speed indicate the locals were able to improve upon MOS for the 12-h forecast projection from both 0000 and 1200 GMT, while MOS was better than the locals for

[5]Here, the probability of detection is defined to be the fraction of time the min temperature was correctly forecast to be ≤32°F when the previous day's min was ≥40°F.

[6]Here, the false alarm ratio is defined to be the fraction of forecasts of ≤32°F that failed to verify when the previous day's min was ≥40°F.

the 18- and 24-h projections. The overall results are quite similar to those for the previous warm season.

- Cloud Amount - The verification for cloud amount involved 94 stations and forecasts for projections of 12, 18, and 24 hours from 0000 and 1200 GMT. The skill scores and percents correct for all stations combined indicate both the 0000 and 1200 GMT 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 results varied by category, cycle, and forecast projection, but usually, the guidance was better than the local forecasts except for the prediction of scattered. These results indicate that both types of forecasts generally were about as accurate as those for the previous warm season.

- Ceiling and Visibility - The verification involved the comparison of local forecasts, MOS guidance, and persistence for 91 (92) stations for projections of 12, 15, 18, and 24 hours from 0000 (1200) GMT. Direct comparison of local, MOS, and persistence forecasts was possible for the 12-, 18-, and 24-h projections. These are actually 3-, 9-, and 15-h forecasts from the latest available surface observations for the locals and persistence, and in this sense, they are at least 10-, 16-, and 22-h forecasts for the guidance. For both forecast cycles combined, the log scores, percents correct, and skill scores show that the local forecasts of ceiling were about as good as, or slightly more accurate than, persistence for the 12-h projection, while the local forecasts were much better than persistence for all other projections. Also, the local forecasts usually were better than the guidance for the 12-, 18-, and 24-h projections. The bias by category scores varied greatly from projection to projection and cycle to cycle indicating no clear trends. For visibility, the log scores, percents correct, and skill scores for both cycles combined show that persistence usually was better than either the local or guidance forecasts for the 12- and 15-h projections. Overall, the local forecasts were generally better than both persistence and the guidance for the 18- and 24-h projections from 1200 GMT, while the guidance was better than persistence and the locals for the 18- and 24-h projections from 0000 GMT.

- Maximum/Minimum Temperature - Objective and local forecasts were verified for 93 stations for both the 0000 and 1200 GMT cycles. At 0000 (1200) GMT, the local maximum temperature forecasts were valid for daytime periods approximately 24 (36) and 48 (60) hours in advance, while the minimum temperature forecasts were valid for nighttime periods ending approximately 36 (24) and 60 (48) hours after initial model time. As stated earlier, a new MOS system to forecast max/min temperatures for the same projections as the local forecaster was in operation during the entire 1986 warm season. 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 error of the local max temperature forecasts averaged 0.2°F less than

that for the MOS guidance. In contrast, for the first time ever, the locals were unable to improve over the MOS min temperature guidance in regard to mean absolute error. Note, too, that the mean absolute error of the local forecasts improved by about 3% and 9% respectively, for all max and min temperature forecast projections combined when compared to the 1985 warm season. Similarly, the mean absolute error of the MOS guidance decreased by approximately 9% and 15%, respectively, for the max and min. We do not know how much of the improvement in the local and MOS forecasts is due to natural climatic variability. We think, however, that some of the increase in forecast accuracy comes from the new guidance system. It's also interesting to note that the mean absolute errors of both the locals and guidance for the 1986 warm season appear to be the lowest recorded since 1966 (Carter and Polger, 1986).

8. ACKNOWLEDGMENTS

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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. ELP and LBB were not included in the surface wind, ceiling height, and visibility verifications. TCC was not available during the 0000 GMT cycle for surface wind, ceiling height, and visibility.

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 guidance and local PoP forecasts for 93 stations, 0000 GMT cycle. Only local deviations from guidance of at least 20% are included in the changes to guidance.

Projection (h)	Type of Forecast	Brier Score	% Imp. Over Guid.	% Imp. Over Clim.	No. of Cases	No. of Changes to Guid.	% Changes Correct Direction
12-24	MOS	0.1132		28.8			
(1st period)	LOCAL	0.1102	2.6	30.7	16167	1994	52.5
24-36	MOS	0.1144		24.5			
(2nd period)	LOCAL	0.1129	1.3	25.5	16028	1659	50.6
36-48	MOS	0.1290		18.9			
(3rd period)	LOCAL	0.1281	0.7	19.5	16155	1634	48.0

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

Projection (h)	Type of Forecast	Brier Score	% Imp. Over Guid.	% Imp. Over Clim.	No. of Cases	No. of Changes to Guid.	% Changes Correct Direction
12-24	MOS	0.1216		31.6			
(1st period)	LOCAL	0.1210	0.5	31.9	4118	632	50.0
24-36	MOS	0.1248		29.5			
(2nd period)	LOCAL	0.1256	-0.6	29.0	4124	502	51.8
36-48	MOS	0.1411		20.8			
(3rd period)	LOCAL	0.1397	0.9	21.5	4109	547	53.6

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

Projection (h)	Type of Forecast	Brier Score	% Imp. Over Guid.	% Imp. Over Clim.	No. of Cases	No. of Changes to Guid.	% Changes Correct Direction
12-24	MOS	0.1305		19.1			
(1st period)	LOCAL	0.1273	2.5	21.1	4195	549	48.3
24-36	MOS	0.1064		17.2			
(2nd period)	LOCAL	0.1078	-1.2	16.2	4043	398	40.2
36-48	MOS	0.1413		13.2			
(3rd period)	LOCAL	0.1425	-0.9	12.4	4195	470	41.7

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

Projection (h)	Type of Forecast	Brier Score	% Imp. Over Guid.	% Imp. Over Clim.	No. of Cases	No. of Changes to Guid.	% Changes Correct Direction
12-24	MOS	0.1175		33.8			
(1st period)	LOCAL	0.1136	3.3	36.0	4879	612	58.5
24-36	MOS	0.1345		25.0			
(2nd period)	LOCAL	0.1303	3.2	27.4	4885	576	57.5
36-48	MOS	0.1394		21.8			
(3rd period)	LOCAL	0.1368	1.8	23.2	4877	451	48.6

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

Projection (h)	Type of Forecast	Brier Score	% Imp. Over Guid.	% Imp. Over Clim.	No. of Cases	No. of Changes to Guid.	% Changes Correct Direction
12-24	MOS	0.0701		29.4			
(1st period)	LOCAL	0.0655	6.5	34.0	2975	201	53.2
24-36	MOS	0.0776		23.4			
(2nd period)	LOCAL	0.0738	4.9	27.2	2976	183	48.1
36-48	MOS	0.0781		19.4			
(3rd period)	LOCAL	0.0771	1.3	20.4	2974	166	45.8

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

Projection (h)	Type of Forecast	Brier Score	% Imp. Over Guid.	% Imp. Over Clim.	No. of Cases	No. of Changes to Guid.	% Changes Correct Direction
12-24	MOS	0.1064		29.5			
(1st period)	LOCAL	0.1026	3.5	32.0	15967	2043	51.8
24-36	MOS	0.1204		24.3			
(2nd period)	LOCAL	0.1198	0.5	24.7	16113	1566	45.6
36-48	MOS	0.1230		19.0			
(3rd period)	LOCAL	0.1227	0.3	19.2	15963	1401	50.9

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

Projection (h)	Type of Forecast	Brier Score	% Imp. Over Guid.	% Imp. Over Clim.	No. of Cases	No. of Changes to Guid.	% Changes Correct Direction
12-24	MOS	0.1132		34.8			
(1st period)	LOCAL	0.1115	1.5	35.8	4115	597	50.6
24-36	MOS	0.1272		28.0			
(2nd period)	LOCAL	0.1295	-1.8	26.7	4111	473	48.0
36-48	MOS	0.1314		25.0			
(3rd period)	LOCAL	0.1317	-0.2	24.9	4112	422	54.3

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

Projection (h)	Type of Forecast	Brier Score	% Imp. Over Guid.	% Imp. Over Clim.	No. of Cases	No. of Changes to Guid.	% Changes Correct Direction
12-24	MOS	0.1030		20.2			
(1st period)	LOCAL	0.1019	1.0	21.0	4034	559	42.0
24-36	MOS	0.1360		16.4			
(2nd period)	LOCAL	0.1347	0.9	17.2	4190	482	43.6
36-48	MOS	0.1167		11.3			
(3rd period)	LOCAL	0.1178	-1.0	10.4	4035	359	46.0

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

Projection (h)	Type of Forecast	Brier Score	% Imp. Over Guid.	% Imp. Over Clim.	No. of Cases	No. of Changes to Guid.	% Changes Correct Direction
12-24	MOS	0.1247		31.0			
(1st period)	LOCAL	0.1187	4.8	34.3	4841	682	57.8
24-36	MOS	0.1311		27.0			
(2nd period)	LOCAL	0.1287	1.9	28.4	4829	433	45.7
36-48	MOS	0.1472		18.5			
(3rd period)	LOCAL	0.1451	1.4	19.7	4837	446	56.1

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

Projection (h)	Type of Forecast	Brier Score	% Imp. Over Guid.	% Imp. Over Clim.	No. of Cases	No. of Changes to Guid.	% Changes Correct Direction
12-24	MOS	0.0718		28.9			
(1st period)	LOCAL	0.0651	9.3	35.5	2977	205	62.0
24-36	MOS	0.0719		25.7			
(2nd period)	LOCAL	0.0714	0.7	26.2	2983	178	44.4
36-48	MOS	0.0807		19.7			
(3rd period)	LOCAL	0.0804	0.5	20.1	2979	174	39.7

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	$\leq$ 12
2	30-60	13-17
3	70-110	18-22
4	120-150	23-27
5	160-200	28-32
6	210-240	$\geq$ 33
7	250-290	---
8	300-330	---

Table 3.2. Comparative verification of MOS guidance and local surface wind forecasts for 91 stations, 0000 GMT 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 (Kts)	Mean Alg. Error (Kts)	No. of Cases	Skill Score	Percent Fcst. Correct	Threat Score (>27 Kts)	1 No. Obs	2 No. Obs	3 No. Obs	4 No. Obs	5 No. Obs	6 No. Obs
12	MOS	21	0.555	1957	3.2	1.1	1968	0.368	92.6	0.00	1.01	0.85	0.84	0.35	1.00	0.00
	LOCAL	19	0.607		3.0	1.2		0.409	92.2	0.33	0.99	1.17	0.82	0.14	1.75	0.25
											14733	876	142	37	4	4
18	MOS	26	0.459	4807	3.1	0.5	4821	0.365	80.3	0.07	1.06	0.77	0.76	0.56	0.50	0.14
	LOCAL	28	0.411		3.1	0.5		0.349	78.7	0.07	1.03	1.00	0.58	0.18	0.71	0.00
											12530	2552	600	84	14	7
24	MOS	29	0.431	4062	3.4	0.8	4077	0.326	81.7	0.07	1.06	0.78	0.67	0.54	0.37	0.00
	LOCAL	32	0.396		3.5	1.0		0.294	78.7	0.04	1.00	1.10	0.70	0.15	0.21	0.00
											12977	2151	544	102	19	6

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 (Kts)	Mean Alg. Error (Kts)	No. of Cases	Skill Score	Percent Fcst. Correct	Threat Score (>27 Kts)	1 No. Obs	2 No. Obs	3 No. Obs	4 No. Obs	5 No. Obs	6 No. Obs
12	MOS	20	0.512	568	3.0	0.4	568	0.334	91.2	0.00	1.04	0.61	0.80	0.10	*	*
	LOCAL	18	0.582		2.7	0.5		0.409	91.3	0.00	1.02	0.87	0.74	0.00	*	*
											3766	313	35	10	0	0
18	MOS	26	0.414	1395	2.7	0.2	1396	0.369	79.3	0.00	1.09	0.70	0.61	0.67	*	0.00
	LOCAL	29	0.368		2.9	0.2		0.286	75.7	0.00	1.06	0.86	0.46	0.11	**	0.00
											3175	809	140	9	0	1
24	MOS	28	0.395	659	3.0	0.9	659	0.253	88.6	0.00	1.06	0.52	0.46	0.00	0.00	*
	LOCAL	32	0.351		3.4	1.8		0.220	83.7	0.00	0.98	1.16	1.30	0.00	2.00	*
											3688	404	37	2	1	0

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

Table 3.4. Same as Table 3.2 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 (Kts)	Mean Alg. Error (Kts)	No. of Cases	Skill Score	Percent Fcst. Correct	Threat Score (>27 Kts)	1 No. Obs	2 No. Obs	3 No. Obs	4 No. Obs	5 No. Obs	6 No. Obs
12	MOS	21	0.532	285	3.0	1.6	286	0.440	95.8	0.00	1.00	1.05	0.94	**	0.00	*
	LOCAL	18	0.577		2.9	1.5		0.465	95.8	0.00	0.99	1.29	0.39	*	0.00	*
											3540	120	18	0	1	0
18	MOS	25	0.403	1002	3.0	1.4	1007	0.361	84.4	0.00	1.01	0.95	1.04	0.80	*	*
	LOCAL	27	0.351		2.9	1.2		0.368	84.9	0.00	1.01	1.04	0.47	0.20	***	*
											3167	417	93	5	0	0
24	MOS	25	0.431	754	3.2	1.5	754	0.345	86.6	0.00	1.01	0.96	0.75	0.46	1.00	*
	LOCAL	29	0.366		3.3	1.2		0.305	86.1	0.00	1.02	1.03	0.39	0.08	0.50	*
											3251	340	79	13	2	0

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

Table 3.5. 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)	Skill Score	No. of Cases	Mean Abs. Error (Kts)	Mean Alg. Error (Kts)	No. of Cases	Skill Score	Percent Fcst. Correct	Threat Score (>27 Kts)	1 No. Obs	2 No. Obs	3 No. Obs	4 No. Obs	5 No. Obs	6 No. Obs
12	MOS	20	0.575	781	3.3	1.1	784	0.379	90.9	0.00	1.01	0.88	0.89	0.56	1.33	0.00
	LOCAL	19	0.626		3.1	1.6		0.409	89.3	0.44	0.97	1.47	1.03	0.28	2.33	0.50
											4451	319	65	18	3	2
18	MOS	23	0.521	1847	3.1	0.1	1850	0.345	74.8	0.11	1.11	0.73	0.71	0.52	0.75	0.17
	LOCAL	26	0.458		3.1	0.4		0.349	72.4	0.11	1.00	1.13	0.65	0.23	0.75	0.00
											3507	1004	272	48	8	6
24	MOS	31	0.435	1427	3.4	0.3	1436	0.306	78.7	0.07	1.10	0.69	0.57	0.38	0.33	0.00
	LOCAL	35	0.392		3.7	0.9		0.280	73.5	0.08	0.97	1.28	0.63	0.20	0.11	0.00
											3797	794	205	40	9	3

Table 3.6. Same as Table 3.2 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 (Kts)	Mean Alg. Error (Kts)	No. of Cases	Skill Score	Percent Fcst. Correct	Threat Score (>27 Kts)	1 No. Obs	2 No. Obs	3 No. Obs	4 No. Obs	5 No. Obs	6 No. Obs
12	MOS	26	0.451	323	3.8	1.8	330	0.328	93.4	0.00	1.00	1.19	0.67	0.11	*	0.00
	LOCAL	23	0.504		3.6	1.3		0.327	93.7	0.00	1.00	1.04	0.67	0.00	*	0.00
											2976	124	24	9	0	2
18	MOS	33	0.328	563	3.9	1.1	568	0.375	85.3	0.00	1.03	0.85	0.88	0.55	0.17	*
	LOCAL	36	0.321		3.9	0.5		0.362	85.3	0.00	1.03	0.91	0.67	0.09	0.00	*
											2681	322	95	22	6	0
24	MOS	30	0.323	1222	3.6	1.0	1228	0.322	71.2	0.09	1.05	0.95	0.78	0.72	0.29	0.00
	LOCAL	32	0.332		3.4	0.5		0.305	71.4	0.00	1.08	0.88	0.78	0.13	0.00	0.00
											2241	613	223	47	7	3

* This category was neither forecast nor observed.

Table 3.7. Comparative verification of MOS guidance and local surface wind forecasts for 92 stations, 1200 GMT 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 (Kts)	Mean Alg. Error (Kts)	No. of Cases	Skill Score	Percent Fcst. Correct	Threat Score (>27 Kts)	1 No. Obs	2 No. Obs	3 No. Obs	4 No. Obs	5 No. Obs	6 No. Obs
12	MOS	25	0.462	4254	3.2	0.5	4265	0.348	82.0	0.06	1.05	0.80	0.65	0.59	0.45	0.17
	LOCAL	24	0.492		2.9	0.8		0.400	81.4	0.13	0.99	1.14	0.73	0.57	0.50	0.00
											13044	2168	567	104	20	6
18	MOS	27	0.440	1898	3.6	1.3	1918	0.310	91.4	0.13	1.02	0.84	0.60	0.14	0.40	0.00
	LOCAL	28	0.447		3.7	1.5		0.282	89.6	0.00	0.99	1.28	0.44	0.30	0.60	0.00
											14568	935	177	44	5	2
24	MOS	26	0.506	1594	3.5	1.1	1609	0.282	92.4	0.00	1.02	0.74	0.46	0.23	0.33	0.00
	LOCAL	28	0.458		3.6	1.4		0.268	90.7	0.13	1.00	1.17	0.56	0.20	0.67	0.00
											14804	865	142	35	3	4

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 (Kts)	Mean Alg. Error (Kts)	No. of Cases	Skill Score	Percent Fcst. Correct	Threat Score (>27 Kts)	1 No. Obs	2 No. Obs	3 No. Obs	4 No. Obs	5 No. Obs	6 No. Obs
12	MOS	27	0.418	733	2.7	0.6	733	0.297	89.3	0.00	1.05	0.58	0.43	0.00	0.00	*
	LOCAL	24	0.484		3.0	1.6		0.350	86.4	0.00	0.97	1.28	0.89	1.00	0.00	*
											3693	391	35	2	1	0
18	MOS	25	0.396	386	3.3	0.8	392	0.233	93.7	0.00	1.03	0.58	0.13	0.00	*	*
	LOCAL	28	0.398		3.6	1.5		0.249	91.4	0.00	0.99	1.28	0.25	0.33	**	*
											3883	198	32	3	0	0
24	MOS	25	0.459	457	3.1	0.3	459	0.243	91.0	0.00	1.05	0.48	0.37	0.00	*	*
	LOCAL	28	0.386		3.3	0.5		0.206	89.1	0.00	1.03	0.76	0.49	0.00	*	*
											3744	309	35	8	0	0

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

Table 3.9. Same as Table 3.7 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 (Kts)	Mean Alg. Error (Kts)	No. of Cases	Skill Score	Percent Fcst. Correct	Threat Score (>27 Kts)	1 No. Obs	2 No. Obs	3 No. Obs	4 No. Obs	5 No. Obs	6 No. Obs
12	MOS	22	0.464	810	3.1	1.1	814	0.364	86.1	0.00	1.02	0.91	0.75	0.71	0.00	*
	LOCAL	23	0.459		2.9	0.9		0.391	86.9	0.00	1.02	0.91	0.67	0.29	0.00	*
											3345	382	102	14	2	0
18	MOS	24	0.350	401	3.7	2.4	403	0.371	93.1	0.00	0.98	1.56	0.92	0.00	0.00	*
	LOCAL	23	0.426		3.6	1.6		0.378	94.3	0.00	1.00	1.19	0:38	0.50	0.00	*
											3494	135	37	4	2	0
24	MOS	26	0.491	320	3.6	2.2	321	0.348	94.8	0.00	0.99	1.22	0.71	*	0.00	*
	LOCAL	27	0.433		3.5	2.1		0.375	95.0	0.00	0.99	1.23	0.67	**	0.00	*
											3672	126	21	0	1	0

* This category was neither forecast nor observed.
** This category was forecast twice 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 (Kts)	Mean Alg. Error (Kts)	No. of Cases	Skill Score	Percent Fcst. Correct	Threat Score (>27 Kts)	1 No. Obs	2 No. Obs	3 No. Obs	4 No. Obs	5 No. Obs	6 No. Obs
12	MOS	26	0.469	1450	3.4	0.1	1455	0.327	78.7	0.06	1.08	0.76	0.55	0.40	0.67	0.00
	LOCAL	24	0.489		3.2	0.9		0.383	76.2	0.19	0.94 3757	1.35 788	0.84 206	0.52 40	0.78 9	0.00 3
18	MOS	28	0.462	757	3.6	1.0	763	0.324	89.0	0.25	1.04	0.73	0.73	0.16	0.33	0.00
	LOCAL	28	0.465		3.7	1.3		0.273	84.6	0.00	0.97 4309	1.46 399	0.63 70	0.20 25	0.33 3	0.00 1
24	MOS	24	0.516	592	3.5	0.8	595	0.300	90.9	0.00	1.03	0.72	0.45	0.44	0.50	0.00
	LOCAL	27	0.472		3.6	1.3		0.268	87.0	0.20	0.97 4404	1.56 312	0.61 62	0.17 18	1.00 2	0.00 2

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 (Kts)	Mean Alg. Error (Kts)	No. of Cases	Skill Score	Percent Fcst. Correct	Threat Score (>27 Kts)	1 No. Obs	2 No. Obs	3 No. Obs	4 No. Obs	5 No. Obs	6 No. Obs
12	MOS	26	0.358	1261	3.2	0.4	1263	0.338	72.2	0.07	1.05	0.93	0.72	0.73	0.38	0.33
	LOCAL	23	0.426		2.7	0.2		0.420	76.1	0.08	1.08 2249	0.90 607	0.63 224	0.67 48	0.38 8	0.00 3
18	MOS	31	0.380	354	3.9	1.6	360	0.278	90.3	0.00	1.02	0.86	0.45	0.17	**	0.00
	LOCAL	34	0.341		4.1	1.6		0.232	89.1	0.00	1.01 2882	1.00 203	0.32 38	0.42 12	** 0	0.00 1
24	MOS	29	0.406	225	3.9	1.8	234	0.236	93.5	0.00	1.01	0.96	0.42	0.00	*	0.00
	LOCAL	30	0.397		4.2	2.1		0.247	93.1	0.00	1.00 2984	1.14 118	0.42 24	0.22 9	* 0	0.00 2

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

Table 4.1. Definitions of the cloud amount categories used for the local forecasts and observations. The MOS guidance was based on these same categories 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 GMT cycle.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	Percent Correct	Skill Score
12	MOS	0.68	1.71	1.31	0.77	49.9	0.331
	LOCAL	0.77	1.33	1.53	0.83	60.6	0.470
	No. Obs.	5830	3191	2211	4897		
18	MOS	0.68	1.43	1.16	0.73	51.8	0.352
	LOCAL	0.59	1.28	1.64	0.61	48.6	0.316
	No. Obs.	4342	4624	3162	4003		
24	MOS	0.75	1.42	1.19	0.70	47.2	0.292
	LOCAL	0.64	1.28	1.72	0.60	43.6	0.253
	No. Obs.	4717	4431	2874	4117		

Table 4.3. Same as Table 4.2 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	0.58	1.73	1.51	0.84	49.2	0.316
	LOCAL	0.70	1.57	1.62	0.77	56.9	0.419
	No. Obs.	1255	669	559	1566		
18	MOS	0.53	1.31	1.24	0.82	52.2	0.348
	LOCAL	0.52	1.18	1.61	0.68	49.1	0.313
	No. Obs.	730	1180	874	1267		
24	MOS	0.64	1.46	1.24	0.85	47.6	0.299
	LOCAL	0.60	1.23	1.84	0.74	43.2	0.251
	No. Obs.	1118	953	667	1306		

Table 4.4. Same as Table 4.2 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	0.57	1.77	1.18	0.66	44.2	0.254
	LOCAL	0.64	1.34	1.46	0.81	54.5	0.395
	No. Obs.	1449	1060	734	941		
18	MOS	0.62	1.36	1.08	0.57	51.3	0.311
	LOCAL	0.50	1.22	1.44	0.47	47.6	0.259
	No. Obs.	844	1508	1106	738		
24	MOS	0.67	1.45	1.13	0.52	45.7	0.250
	LOCAL	0.54	1.34	1.57	0.37	41.1	0.191
	No. Obs.	1007	1397	926	872		

Table 4.5. Same as Table 4.2 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	0.60	1.81	1.44	0.78	50.1	0.333
	LOCAL	0.78	1.31	1.59	0.84	61.3	0.476
	No. Obs.	1671	940	591	1645		
18	MOS	0.53	1.64	1.24	0.73	49.2	0.321
	LOCAL	0.44	1.48	1.87	0.61	45.3	0.280
	No. Obs.	1359	1280	796	1405		
24	MOS	0.65	1.50	1.28	0.71	45.4	0.268
	LOCAL	0.52	1.30	1.97	0.64	42.4	0.241
	No. Obs.	1391	1329	773	1352		

Table 4.6. Same as Table 4.2 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	0.99	1.38	1.03	0.75	58.6	0.390
	LOCAL	0.93	1.02	1.41	0.94	72.8	0.604
	No. Obs.	1455	522	327	745		
18	MOS	0.93	1.39	1.03	0.70	55.9	0.362
	LOCAL	0.82	1.24	1.80	0.64	54.8	0.367
	No. Obs.	1409	656	386	593		
24	MOS	1.04	1.19	1.08	0.60	51.7	0.323
	LOCAL	0.90	1.18	1.49	0.55	49.7	0.308
	No. Obs.	1201	752	508	587		

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 GMT cycle.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	Percent Correct	Skill Score
12	MOS	0.81	1.37	1.17	0.70	48.7	0.310
	LOCAL	0.79	1.12	1.50	0.76	55.0	0.400
	No. Obs.	4732	4461	2852	4072		
18	MOS	0.85	1.60	1.02	0.88	54.0	0.342
	LOCAL	0.64	1.74	2.10	0.73	47.5	0.291
	No. Obs.	7531	2582	1777	4072		
24	MOS	0.82	1.58	1.04	0.82	49.9	0.319
	LOCAL	0.73	1.46	1.74	0.69	45.9	0.281
	No. Obs.	5810	3190	2206	4882		

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	0.71	1.38	1.32	0.81	48.5	0.312
	LOCAL	0.75	1.09	1.61	0.84	53.3	0.379
	No. Obs.	1132	964	656	1288		
18	MOS	0.80	1.58	1.13	0.97	54.5	0.358
	LOCAL	0.62	1.76	2.14	0.78	48.8	0.313
	No. Obs.	1661	561	445	1373		
24	MOS	0.74	1.54	1.09	0.95	50.9	0.323
	LOCAL	0.68	1.54	1.88	0.72	45.9	0.280
	No. Obs.	1252	676	550	1551		

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	0.81	1.38	1.01	0.60	47.8	0.280
	LOCAL	0.72	1.17	1.42	0.60	53.8	0.370
	No. Obs.	1009	1407	921	864		
18	MOS	0.77	1.89	0.90	0.80	51.6	0.302
	LOCAL	0.52	1.94	2.14	0.62	42.5	0.228
	No. Obs.	2067	751	494	722		
24	MOS	0.65	1.74	0.96	0.76	45.0	0.260
	LOCAL	0.65	1.45	1.58	0.59	41.6	0.223
	No. Obs.	1447	1054	727	960		

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	0.78	1.37	1.26	0.70	47.3	0.293
	LOCAL	0.70	1.14	1.63	0.81	53.9	0.387
	No. Obs.	1352	1321	762	1337		
18	MOS	0.89	1.61	1.06	0.83	55.0	0.352
	LOCAL	0.61	1.79	2.42	0.72	46.4	0.281
	No. Obs.	2217	724	477	1364		
24	MOS	0.81	1.68	1.20	0.72	47.8	0.295
	LOCAL	0.74	1.49	1.93	0.64	44.5	0.264
	No. Obs.	1626	943	589	1610		

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	0.94	1.33	1.12	0.58	52.3	0.334
	LOCAL	0.98	1.03	1.31	0.73	60.3	0.448
	No. Obs.	1239	769	513	583		
18	MOS	0.96	1.21	0.98	0.92	55.1	0.322
	LOCAL	0.84	1.36	1.59	0.73	54.2	0.334
	No. Obs.	1586	546	361	613		
24	MOS	1.06	1.14	0.87	0.84	58.3	0.371
	LOCAL	0.85	1.31	1.54	0.84	54.0	0.343
	No. Obs.	1485	517	340	761		

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 guidance, persistence, and local 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	0.83	0.73	0.91	1.03	2.446	81.3	0.355
	LOCAL	0.73	0.76	1.09	1.02	1.736	86.0	0.532
	PERSISTENCE	0.76	0.75	0.89	1.04	1.652	86.8	0.540
	No. Obs.	623	744	1423	13006			
15	LOCAL	0.42	0.47	0.82	1.08	1.730	82.1	0.402
	PERSISTENCE	1.58	0.79	0.58	1.07	2.003	81.7	0.400
	No. Obs.	302	712	2205	12670			
18	MOS	0.79	0.61	0.90	1.03	1.320	84.2	0.354
	LOCAL	0.29	0.36	0.70	1.07	1.190	85.4	0.332
	PERSISTENCE	3.97	1.63	0.66	1.00	2.039	81.5	0.294
	No. Obs.	120	344	1890	13421			
24	MOS	0.83	0.74	0.83	1.02	0.917	90.8	0.289
	LOCAL	0.23	0.51	1.11	1.01	0.822	90.7	0.308
	PERSISTENCE	3.91	2.62	1.49	0.92	2.043	83.5	0.192
	No. Obs.	121	214	847	14593			

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

Projection (h)	Type of Forecast	Bias by Category				Log Score	Percent Correct	Skill Score
		1	2	3	4			
12	MOS	1.12	1.02	0.99	0.99	2.838	72.5	0.365
	LOCAL	0.64	0.44	1.24	1.00	1.939	78.6	0.494
	PERSISTENCE	0.60	0.42	0.78	1.12	1.874	80.1	0.471
	No. Obs.	433	1020	2805	11526			
15	LOCAL	0.46	0.24	0.97	1.05	1.506	81.5	0.373
	PERSISTENCE	2.63	0.72	0.94	1.01	1.822	80.4	0.383
	No. Obs.	99	605	2342	12829			
18	MOS	0.46	0.76	1.28	0.97	1.227	84.2	0.343
	LOCAL	0.23	0.13	0.83	1.04	1.049	86.3	0.292
	PERSISTENCE	5.42	1.43	1.34	0.94	1.805	80.9	0.292
	No. Obs.	48	303	1624	13794			
24	MOS	0.60	0.96	1.33	0.97	1.131	85.6	0.330
	LOCAL	0.17	0.18	0.85	1.03	0.934	87.9	0.282
	PERSISTENCE	4.89	1.83	1.57	0.92	1.885	80.3	0.229
	No. Obs.	53	236	1383	14098			

Table 5.4. Same as Table 5.2 except for ceiling height for 92 stations, 1200 GMT cycle. Data for TCC were not available for the 18-h projection.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	Log Score	Percent Correct	Skill Score
12	MOS	1.44	0.87	0.91	1.00	0.958	90.7	0.324
	LOCAL	0.50	0.82	1.24	0.99	0.590	93.0	0.518
	PERSISTENCE	0.74	1.12	1.34	0.98	0.645	92.4	0.509
	No. Obs.	123	215	843	14728			
15	LOCAL	0.51	0.75	1.32	0.99	0.788	91.5	0.449
	PERSISTENCE	0.56	0.82	1.41	0.99	0.890	90.3	0.393
	No. Obs.	164	295	809	14729			
18	MOS	1.74	0.84	0.95	0.99	1.738	86.8	0.335
	LOCAL	0.41	0.80	1.36	0.99	1.255	87.8	0.386
	PERSISTENCE	0.34	0.60	1.16	1.01	1.281	87.3	0.306
	No. Obs.	271	403	974	14102			
24	MOS	1.68	0.85	0.90	0.99	3.177	78.6	0.330
	LOCAL	0.37	0.82	1.47	0.99	2.440	79.3	0.344
	PERSISTENCE	0.15	0.32	0.79	1.10	2.398	80.4	0.200
	No. Obs.	624	752	1425	13068			

Table 5.5. Same as Table 5.2 except for visibility for 92 stations, 1200 GMT cycle. Data for TCC were not available for the 18-h projection.

Projection (h)	Type of Forecast	Bias by Category				Log Score	Percent Correct	Skill Score
		1	2	3	4			
12	MOS	2.31	1.35	1.24	0.97	1.260	85.7	0.339
	LOCAL	0.51	0.43	1.14	1.00	0.687	91.0	0.530
	PERSISTENCE	0.78	1.02	1.02	1.00	0.654	92.2	0.591
	No. Obs.	59	223	1386	14239			
15	LOCAL	0.74	0.54	1.30	0.98	0.878	88.4	0.437
	PERSISTENCE	0.70	1.04	1.01	1.00	0.859	89.6	0.458
	No. Obs.	66	222	1403	14299			
18	MOS	3.38	1.45	1.10	0.96	1.811	82.6	0.334
	LOCAL	0.63	0.68	1.35	0.97	1.224	84.9	0.401
	PERSISTENCE	0.39	0.78	0.87	1.03	1.145	86.9	0.383
	No. Obs.	118	294	1624	13716			
24	MOS	2.39	1.25	1.09	0.90	3.579	70.0	0.365
	LOCAL	0.37	0.62	1.21	1.01	2.557	73.9	0.377
	PERSISTENCE	0.11	0.22	0.51	1.22	2.673	74.2	0.212
	No. Obs.	428	1018	2776	11642			

Table 6.1. Verification of MOS guidance and local max/min temperature forecasts for 93 stations, 0000 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)
Today's Max	MOS		0.2	2.8	1.7	--	--
	LOCAL	16041	0.2	2.6	1.2	--	--
Tonight's Min	MOS		0.0	2.7	0.6	0.42	0.44
	LOCAL	15976	0.1	2.7	0.7	0.41	0.37
Tomorrow's Max	MOS		0.5	3.6	3.9	--	--
	LOCAL	16026	0.4	3.4	3.4	--	--
Tomorrow Night's Min	MOS		0.0	3.3	2.2	0.23	0.53
	LOCAL	15941	-0.1	3.3	2.5	0.24	0.54

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)
Today's Max	MOS	4141	-0.1	2.9	1.9	--	--
	LOCAL		-0.1	2.9	1.6	--	--
Tonight's Min	MOS	4104	0.0	2.7	0.4	0.39	0.56
	LOCAL		0.0	2.7	0.5	0.50	0.40
Tomorrow's Max	MOS	4134	-0.2	3.6	3.7	--	--
	LOCAL		-0.3	3.5	3.4	--	--
Tomorrow Night's Min	MOS	4091	-0.7	3.3	2.0	0.53	0.43
	LOCAL		-0.7	3.4	2.3	0.47	0.30

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)
Today's Max	MOS	4043	0.2	2.4	1.0	--	--
	LOCAL		0.2	2.2	0.7	--	--
Tonight's Min	MOS	4059	0.3	2.3	0.4	0.00	*
	LOCAL		0.3	2.3	0.4	0.00	*
Tomorrow's Max	MOS	4040	0.6	3.0	2.5	--	--
	LOCAL		0.6	2.7	1.9	--	--
Tomorrow Night's Min	MOS	4049	0.4	2.7	1.6	0.00	*
	LOCAL		0.3	2.8	1.6	0.00	*

* 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)
Today's Max	MOS	4886	0.4	3.1	2.3	--	--
	LOCAL		0.3	3.0	1.7	--	--
Tonight's Min	MOS	4865	-0.1	3.0	0.8	0.57	0.41
	LOCAL		0.1	3.0	0.9	0.54	0.37
Tomorrow's Max	MOS	4882	1.0	4.0	5.5	--	--
	LOCAL		0.7	3.8	5.1	--	--
Tomorrow Night's Min	MOS	4863	0.2	3.7	3.1	0.26	0.50
	LOCAL		0.1	3.7	3.6	0.29	0.55

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)
Today's Max	MOS	2971	0.1	2.7	1.1	--	--
	LOCAL		0.2	2.5	0.8	--	--
Tonight's Min	MOS	2948	-0.4	3.0	1.1	0.29	0.36
	LOCAL		-0.2	2.7	0.9	0.21	0.29
Tomorrow's Max	MOS	2970	0.7	3.6	3.4	--	--
	LOCAL		0.3	3.3	2.6	--	--
Tomorrow Night's Min	MOS	2938	-0.1	3.4	2.1	0.00	1.00
	LOCAL		-0.2	3.1	2.0	0.05	0.86

Table 6.6. Verification of MOS guidance 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)
Tonight's Min	MOS	15907	-0.2	2.5	0.6	0.56	0.44
	LOCAL		-0.2	2.5	0.6	0.49	0.40
Tomorrow's Max	MOS	15960	0.6	3.3	3.2	--	--
	LOCAL		0.2	3.1	2.4	--	--
Tomorrow Night's Min	MOS	15896	-0.1	3.0	1.2	0.32	0.57
	LOCAL		0.0	3.0	1.3	0.32	0.48
Day After Tomorrow's Max	MOS	15947	0.6	4.0	5.6	--	--
	LOCAL		0.5	3.9	5.3	--	--

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)
Tonight's Min	MOS	4092	-0.3	2.5	0.3	0.59	0.68
	LOCAL		-0.4	2.4	0.5	0.47	0.62
Tomorrow's Max	MOS	4130	0.0	3.4	3.5	--	--
	LOCAL		-0.1	3.2	2.8	--	--
Tomorrow Night's Min	MOS	4087	-0.4	2.9	1.1	0.53	0.68
	LOCAL		-0.4	3.0	0.9	0.47	0.59
Day After Tomorrow's Max	MOS	4126	0.0	4.0	5.3	--	--
	LOCAL		0.1	4.0	5.2	--	--

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)
Tonight's Min	MOS	4051	0.2	2.2	0.3	0.00	*
	LOCAL		0.0	2.1	0.5	0.00	*
Tomorrow's Max	MOS	4030	0.5	2.8	2.0	--	--
	LOCAL		0.3	2.5	1.5	--	--
Tomorrow Night's Min	MOS	4046	0.3	2.5	0.8	0.33	0.00
	LOCAL		0.3	2.5	1.1	0.00	*
Day After Tomorrow's Max	MOS	4022	0.6	3.2	3.3	--	--
	LOCAL		0.7	3.1	3.2	--	--

* 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)
Tonight's Min	MOS	4815	-0.2	2.8	0.8	0.70	0.34
	LOCAL		-0.1	2.8	0.8	0.55	0.40
Tomorrow's Max	MOS	4831	1.1	3.8	4.3	--	--
	LOCAL		0.6	3.5	3.5	--	--
Tomorrow Night's Min	MOS	4816	0.2	3.3	1.5	0.40	0.48
	LOCAL		0.2	3.3	1.8	0.37	0.42
Day After Tomorrow's Max	MOS	4834	1.2	4.5	8.3	--	--
	LOCAL		0.9	4.5	8.1	--	--

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)
Tonight's Min	MOS	2949	-0.7	2.7	0.8	0.42	0.08
	LOCAL		-0.5	2.6	0.8	0.46	0.00
Tomorrow's Max	MOS	2969	0.5	3.3	2.4	--	--
	LOCAL		0.0	2.9	1.4	--	--
Tomorrow Night's Min	MOS	2947	-0.4	3.1	1.4	0.08	0.50
	LOCAL		-0.4	2.9	1.3	0.20	0.38
Day After Tomorrow's Max	MOS	2965	0.7	4.0	4.7	--	--
	LOCAL		0.1	3.6	3.8	--	--